Bright - Bright Soliton

Case 1

In[42]:=
$$\text{Solve}\left[2\,\alpha\,P_i\,P_r - P_r^2 + \alpha^2\,P_r^2 - 4\,\alpha\,P_r\,P'_i + 2\,\beta\,P_r\,P'_i + 2\,\alpha\,P_i\,P'_r - 4\,\beta\,P_i\,P'_r + 2\,P_r\,P'_r - 2\,\alpha\,\beta\,P_r\,P'_r + 2\,\beta\,P'_i\,P'_r - \left(P'\right)_r^2 + \beta^2\left(P'\right)_r^2 == 0,\ \beta\right]$$

Out[42]=
$$\left\{\left\{\beta \to \frac{1}{2\left(P'\right)_r^2}\left(-2\,P_r\,P'_i + 4\,P_i\,P'_r + 2\,\alpha\,P_r\,P'_r - 2\,P'_i\,P'_r - \sqrt{\left(\left(2\,P_r\,P'_i - 4\,P_i\,P'_r - 2\,\alpha\,P_r\,P'_r + 2\,P'_i\,P'_r\right)^2 - 4\left(P'\right)_r^2\left(2\,\alpha\,P_i\,P_r - P_r^2 + \alpha^2\,P_r^2 - 4\,\alpha\,P_r\,P'_i + 2\,\alpha\,P_i\,P'_r + 2\,P_r\,P'_r - \left(P'\right)_r^2\right)\right)}\right)\right\},\ \left\{\beta \to \frac{1}{2\left(P'\right)_r^2}\left(-2\,P_r\,P'_i + 4\,P_i\,P'_r + 2\,\alpha\,P_r\,P'_r - 2\,P'_i\,P'_r + \sqrt{\left(\left(2\,P_r\,P'_i - 4\,P_i\,P'_r - 2\,\alpha\,P_r\,P'_r + 2\,P'_i\,P'_r\right)^2 - 4\left(P'\right)_r^2\left(2\,\alpha\,P_i\,P_r - P_r^2 + \alpha^2\,P_r^2 - 4\,\alpha\,P_r\,P'_i + 2\,\alpha\,P_i\,P'_r + 2\,P_r\,P'_r - \left(P'\right)_r^2\right)\right)}\right)\right\}\right\}$$

In[*]:=
$$\text{ReplaceAll}[\%, \{p_{1r} \to P_r,\ p_{1i} \to P_i,\ p_{2r} \to P'_r,\ p_{2i} \to P'_i,\ q_{1r} \to Q_{1r},\ q_{1i} \to Q_{1i},\ R_{1r} \to Q_{2r},\ R_{1i} \to Q_{2i},\ R_{2r} \to Q'_{1r},\ R_{2i} \to Q'_{1i},\ q_{2r} \to Q'_{2r},\ q_{2i} \to Q'_{2i},\ \gamma_{2r} \to \gamma'_r,\ \gamma_{2i} \to \gamma'_i\ \}]$$

In[43]:=
$$\text{Solve}\left[-3\,\alpha\,P_i\,Q_i + 2\,P_r\,Q_i - \alpha^2\,P_r\,Q_i - 2\,P_i\,Q_r + \alpha^2\,P_i\,Q_r - 3\,\alpha\,P_r\,Q_r == 0,\ \alpha\right]$$

Out[43]=
$$\left\{\left\{\alpha \to \frac{3\,P_i\,Q_i + 3\,P_r\,Q_r - \sqrt{-4\left(2\,P_r\,Q_i - 2\,P_i\,Q_r\right)\left(-P_r\,Q_i + P_i\,Q_r\right) + \left(-3\,P_i\,Q_i - 3\,P_r\,Q_r\right)^2}}{2\left(-P_r\,Q_i + P_i\,Q_r\right)}\right\},\ \left\{\alpha \to \frac{3\,P_i\,Q_i + 3\,P_r\,Q_r + \sqrt{-4\left(2\,P_r\,Q_i - 2\,P_i\,Q_r\right)\left(-P_r\,Q_i + P_i\,Q_r\right) + \left(-3\,P_i\,Q_i - 3\,P_r\,Q_r\right)^2}}{2\left(-P_r\,Q_i + P_i\,Q_r\right)}\right\}\right\}$$

$$\left\{\left\{I\,A^{(0,1)}[x,t] + P\,A^{(2,0)}[x,t] + \left(Q_1\,A[x,t]\,A^*[x,t] + Q_2\,B[x,t]\,B^*[x,t]\right)A[x,t] - I\,\gamma\,A[x,t]\right\},\ \left\{I\,B^{(0,1)}[x,t] + P'\,B^{(2,0)}[x,t] + \left(Q'_1\,A[x,t]\,A^*[x,t] + Q'_2\,B[x,t]\,B^*[x,t]\right)B[x,t] - I\,\gamma'\,B[x,t]\right\}\right\}$$

$$\text{ReplaceAll}\left[\%, \left\{A[x,t] \to \frac{G[x,t]}{f[x,t]^m}\,\text{Exp}\left[I\left(K_1\,x - \Omega_1\,t\right)\right],\ B[x,t] \to \frac{H[x,t]}{f[x,t]^n}\,\text{Exp}\left[I\left(K_2\,x - \Omega_2\,t\right)\right],\ A^*[x,t] \to \frac{G^*[x,t]}{f[x,t]^{m^*}}\,\text{Exp}\left[-I\left(K_1\,x - \Omega_1\,t\right)\right],\ B^*[x,t] \to \frac{H^*[x,t]}{f[x,t]^{n^*}}\,\text{Exp}\left[-I\left(K_2\,x - \Omega_2\,t\right)\right]\right\}\right]$$

$$\text{ReplaceAll}[\%, \{P \to P_r + I\,P_i,\ P' \to P'_r + I\,P'_i,\ Q_1 \to Q_{1r} + I\,Q_{1i},\ Q_2 \to Q_{2r} + I\,Q_{2i},\ Q'_1 \to Q'_{1r} + I\,Q'_{1i},\ Q'_2 \to Q'_{2r} + I\,Q'_{2i},\ \gamma \to \gamma_r + I\,\gamma_i,\ \gamma' \to \gamma'_r + I\,\gamma'_i,\ k^* \to k_r - I\,k_i,\ k \to k_r + I\,k_i,\ \omega^* \to \omega_r - I\,\omega_i,\ \omega \to \omega_r + I\,\omega_i\}]$$

$$\Big\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to k_i^2\,P_i - k_r^2\,P_i - 2\,k_i\,k_r\,P_r + \gamma_r,$$

$$\omega_i \to -2\,k_i\,k_r\,P_i - k_i^2\,P_r + k_r^2\,P_r + \gamma_i,\ k_i \to \alpha\,k_r - \frac{\gamma_i}{2\,k_r\,P_i},$$

$$\eta^* \to \frac{4\,k_r^2\left(-P_r\left(\left(-2+\alpha^2\right)Q_{2\,i} + 3\,\alpha\,Q_{2\,r}\right) + P_i\left(-3\,\alpha\,Q_{2\,i} + \left(-2+\alpha^2\right)Q_{2\,r}\right)\right)}{\eta\left(Q_{2\,i}\,Q_r - Q_i\,Q_{2\,r}\right)},$$

$$\mu^* \to \frac{4\,k_r^2\left(P_r\left(\left(-2+\alpha^2\right)Q_i + 3\,\alpha\,Q_r\right) + P_i\left(3\,\alpha\,Q_i - \left(-2+\alpha^2\right)Q_r\right)\right)}{\mu\left(Q_{2\,i}\,Q_r - Q_i\,Q_{2\,r}\right)},$$

$$Q_{2\,r} \to \Big(Q_{2\,i}\,Q_r\left(3\,\beta\,P'_i + \left(-2+\beta^2\right)P'_r\right) + P_r\left(-\left(-2+\alpha^2\right)Q_{2\,i}\,Q'_r + \left(-2+\alpha^2\right)Q_i\,Q'_{2\,r} + 3\,\alpha\,Q_r\,Q'_{2\,r}\right) +$$
$$P_i\left(-3\,\alpha\,Q_{2\,i}\,Q'_r + 3\,\alpha\,Q_i\,Q'_{2\,r} - \left(-2+\alpha^2\right)Q_r\,Q'_{2\,r}\right)\Big) \Big/$$
$$\left(3\,\beta\,Q_i\,P'_i + \left(-2+\beta^2\right)Q_i\,P'_r + \left(\left(2-\alpha^2\right)P_i + 3\,\alpha\,P_r\right)Q'_r\right),\ k_r \to \frac{\sqrt{\frac{\gamma_i\,P'_i - P_i\,\gamma'_i}{(\alpha-\beta)\,P_i\,P'_i}}}{\sqrt{2}},$$

$$\gamma_r \to \Big(-2\,\alpha\,P_r\,\gamma_i^2\left(P'\right)_i^2 + \left(-1+\alpha^2\right)P_i^3\left(\gamma'\right)_i^2 - 2\,P_i^2\,\gamma'_i\left(\left(-1+\alpha\,\beta\right)\gamma_i\,P'_i + \alpha\,P_r\,\gamma'_i\right) +$$
$$P_i\,\gamma_i\,P'_i\left(\left(-1+\beta^2\right)\gamma_i\,P'_i + 4\,\alpha\,P_r\,\gamma'_i\right)\Big) \Big/ \left(2\,(\alpha-\beta)\,P_i\,P'_i\left(-\gamma_i\,P'_i + P_i\,\gamma'_i\right)\right),$$

$$\gamma'_r \to \Big(\left(-1+\beta^2\right)\gamma_i^2\left(P'\right)_i^3 - 2\,\beta\,P_i^2\,P'_r\left(\gamma'\right)_i^2 + P_i\,P'_i\,\gamma'_i\left(4\,\beta\,\gamma_i\,P'_r + \left(-1+\alpha^2\right)P_i\,\gamma'_i\right) -$$
$$2\,\gamma_i\left(P'\right)_i^2\left(\beta\,\gamma_i\,P'_r + \left(-1+\alpha\,\beta\right)P_i\,\gamma'_i\right)\Big) \Big/ \left(2\,(\alpha-\beta)\,P_i\,P'_i\left(-\gamma_i\,P'_i + P_i\,\gamma'_i\right)\right),$$

$$\gamma'_i \to \frac{P_r\,\gamma_i\,P'_i}{P_i\,P'_r},\ \left(-3\,\alpha\,P_i\,Q_i + 2\,P_r\,Q_i - \alpha^2\,P_r\,Q_i - 2\,P_i\,Q_r + \alpha^2\,P_i\,Q_r - 3\,\alpha\,P_r\,Q_r\right)$$
$$\Big(3\,\beta\,Q_{2\,i}\,P'_i\,Q'_i - 2\,Q_{2\,i}\,P'_r\,Q'_i + \beta^2\,Q_{2\,i}\,P'_r\,Q'_i - 3\,\beta\,Q_i\,P'_i\,Q'_{2\,i} + 2\,Q_i\,P'_r\,Q'_{2\,i} - \beta^2\,Q_i\,P'_r\,Q'_{2\,i} +$$
$$2\,Q_{2\,i}\,P'_i\,Q'_r - \beta^2\,Q_{2\,i}\,P'_i\,Q'_r + 3\,\beta\,Q_{2\,i}\,P'_r\,Q'_r - 2\,P_i\,Q'_{2\,i}\,Q'_r + \alpha^2\,P_i\,Q'_{2\,i}\,Q'_r - 3\,\alpha\,P_r\,Q'_{2\,i}\,Q'_r -$$
$$2\,Q_i\,P'_i\,Q'_{2\,r} + \beta^2\,Q_i\,P'_i\,Q'_{2\,r} - 3\,\beta\,Q_i\,P'_r\,Q'_{2\,r} + 2\,P_i\,Q'_i\,Q'_{2\,r} - \alpha^2\,P_i\,Q'_i\,Q'_{2\,r} + 3\,\alpha\,P_r\,Q'_i\,Q'_{2\,r}\Big) \to 0,$$

$$2\,\alpha\,P_i\,P_r - P_r^2 + \alpha^2\,P_r^2 - 4\,\alpha\,P_r\,P'_i + 2\,\beta\,P_r\,P'_i + 2\,\alpha\,P_i\,P'_r - 4\,\beta\,P_i\,P'_r + 2\,P_r\,P'_r -$$
$$2\,\alpha\,\beta\,P_r\,P'_r + 2\,\beta\,P'_i\,P'_r - \left(P'\right)_r^2 + \beta^2\left(P'\right)_r^2 \to 0,\ \Big\{\beta \to \frac{1}{2\left(P'\right)_r^2}$$
$$\Big(-2\,P_r\,P'_i + 4\,P_i\,P'_r + 2\,\alpha\,P_r\,P'_r - 2\,P'_i\,P'_r - \sqrt{\left(\left(2\,P_r\,P'_i - 4\,P_i\,P'_r - 2\,\alpha\,P_r\,P'_r + 2\,P'_i\,P'_r\right)^2 -$$
$$4\left(P'\right)_r^2\left(2\,\alpha\,P_i\,P_r - P_r^2 + \alpha^2\,P_r^2 - 4\,\alpha\,P_r\,P'_i + 2\,\alpha\,P_i\,P'_r + 2\,P_r\,P'_r - \left(P'\right)_r^2\right)\right)}\Big)\Big\},\ \Big\{\beta \to \frac{1}{2\left(P'\right)_r^2}$$
$$\Big(-2\,P_r\,P'_i + 4\,P_i\,P'_r + 2\,\alpha\,P_r\,P'_r - 2\,P'_i\,P'_r + \sqrt{\left(\left(2\,P_r\,P'_i - 4\,P_i\,P'_r - 2\,\alpha\,P_r\,P'_r + 2\,P'_i\,P'_r\right)^2 -$$
$$4\left(P'\right)_r^2\left(2\,\alpha\,P_i\,P_r - P_r^2 + \alpha^2\,P_r^2 - 4\,\alpha\,P_r\,P'_i + 2\,\alpha\,P_i\,P'_r + 2\,P_r\,P'_r - \left(P'\right)_r^2\right)\right)}\Big)\Big\},$$

$$\Big\{\alpha \to \frac{3\,P_i\,Q_i + 3\,P_r\,Q_r - \sqrt{-4\left(2\,P_r\,Q_i - 2\,P_i\,Q_r\right)\left(-P_r\,Q_i + P_i\,Q_r\right) + \left(-3\,P_i\,Q_i - 3\,P_r\,Q_r\right)^2}}{2\left(-P_r\,Q_i + P_i\,Q_r\right)}\Big\},$$

$$\Big\{\alpha \to \frac{3\,P_i\,Q_i + 3\,P_r\,Q_r + \sqrt{-4\left(2\,P_r\,Q_i - 2\,P_i\,Q_r\right)\left(-P_r\,Q_i + P_i\,Q_r\right) + \left(-3\,P_i\,Q_i - 3\,P_r\,Q_r\right)^2}}{2\left(-P_r\,Q_i + P_i\,Q_r\right)}\Big\}\Big\}$$

Out[•]=

$$\Big\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to k_i^2\, P_i - k_r^2\, P_i - 2\, k_i\, k_r\, P_r + \gamma_r,$$

$$\omega_i \to -2\, k_i\, k_r\, P_i - k_i^2\, P_r + k_r^2\, P_r + \gamma_i,\ k_i \to \alpha\, k_r - \frac{\gamma_i}{2\, k_r\, P_i},$$

$$\eta^* \to \frac{4\, k_r^2\, \left(-P_r\, \left(\left(-2+\alpha^2\right)\, Q_{2\,i} + 3\,\alpha\, Q_{2\,r}\right) + P_i\, \left(-3\,\alpha\, Q_{2\,i} + \left(-2+\alpha^2\right)\, Q_{2\,r}\right)\right)}{\eta\, \left(Q_{2\,i}\, Q_r - Q_i\, Q_{2\,r}\right)},$$

$$\mu^* \to \frac{4\, k_r^2\, \left(P_r\, \left(\left(-2+\alpha^2\right)\, Q_i + 3\,\alpha\, Q_r\right) + P_i\, \left(3\,\alpha\, Q_i - \left(-2+\alpha^2\right)\, Q_r\right)\right)}{\mu\, \left(Q_{2\,i}\, Q_r - Q_i\, Q_{2\,r}\right)},$$

$$Q_{2\,r} \to \left(Q_{2\,i}\, Q_r\, \left(3\,\beta\, P'_i + \left(-2+\beta^2\right)\, P'_r\right) + P_r\, \left(\left(2-\alpha^2\right)\, Q_{2\,i}\, Q'_r + \left(-2+\alpha^2\right)\, Q_i\, Q'_{2\,r} + 3\,\alpha\, Q_r\, Q'_{2\,r}\right) + P_i\, \left(-3\,\alpha\, Q_{2\,i}\, Q'_r + 3\,\alpha\, Q_i\, Q'_{2\,r} - \left(-2+\alpha^2\right)\, Q_r\, Q'_{2\,r}\right)\right) \Big/ \left(3\,\beta\, Q_i\, P'_i + \left(-2+\beta^2\right)\, Q_i\, P'_r + \left(\left(2-\alpha^2\right)\, P_i + 3\,\alpha\, P_r\right)\, Q'_r\right),\ k_r \to \frac{\sqrt{\frac{\gamma_i\, P'_i - P_i\, \gamma'_i}{(\alpha-\beta)\, P_i\, P'_i}}}{\sqrt{2}},$$

$$\gamma_r \to \left(-2\,\alpha\, P_r\, \gamma_i^2\, \left(P'\right)_i^2 + \left(-1+\alpha^2\right)\, P_i^3\, \left(\gamma'\right)_i^2 - 2\, P_i^2\, \gamma'_i\, \left(\left(-1+\alpha\,\beta\right)\, \gamma_i\, P'_i + \alpha\, P_r\, \gamma'_i\right) + P_i\, \gamma_i\, P'_i\, \left(\left(-1+\beta^2\right)\, \gamma_i\, P'_i + 4\,\alpha\, P_r\, \gamma'_i\right)\right) \Big/ \left(2\, (\alpha-\beta)\, P_i\, P'_i\, \left(-\gamma_i\, P'_i + P_i\, \gamma'_i\right)\right),$$

$$\gamma'_r \to \left(\left(-1+\beta^2\right)\, \gamma_i^2\, \left(P'\right)_i^3 - 2\,\beta\, P_i^2\, P'_r\, \left(\gamma'\right)_i^2 + P_i\, P'_i\, \gamma'_i\, \left(4\,\beta\, \gamma_i\, P'_r + \left(-1+\alpha^2\right)\, P_i\, \gamma'_i\right) - 2\, \gamma_i\, \left(P'\right)_i^2\, \left(\beta\, \gamma_i\, P'_r + (-1+\alpha\,\beta)\, P_i\, \gamma'_i\right)\right) \Big/ \left(2\, (\alpha-\beta)\, P_i\, P'_i\, \left(-\gamma_i\, P'_i + P_i\, \gamma'_i\right)\right),$$

$$\gamma'_i \to \frac{P_r\, \gamma_i\, P'_i}{P_i\, P'_r},\ \left(-3\,\alpha\, P_i\, Q_i + 2\, P_r\, Q_i - \alpha^2\, P_r\, Q_i - 2\, P_i\, Q_r + \alpha^2\, P_i\, Q_r - 3\,\alpha\, P_r\, Q_r\right)$$

$$\left(3\,\beta\, Q_{2\,i}\, P'_i\, Q'_i - 2\, Q_{2\,i}\, P'_r\, Q'_i + \beta^2\, Q_{2\,i}\, P'_r\, Q'_i - 3\,\beta\, Q_i\, P'_i\, Q'_{2\,i} + 2\, Q_i\, P'_r\, Q'_{2\,i} - \beta^2\, Q_i\, P'_r\, Q'_{2\,i} + 2\, Q_{2\,i}\, P'_i\, Q'_r - \beta^2\, Q_{2\,i}\, P'_i\, Q'_r + 3\,\beta\, Q_{2\,i}\, P'_r\, Q'_r - 2\, P_i\, Q'_{2\,i}\, Q'_r + \alpha^2\, P_i\, Q'_{2\,i}\, Q'_r - 3\,\alpha\, P_r\, Q'_{2\,i}\, Q'_r - 2\, Q_i\, P'_i\, Q'_{2\,r} + \beta^2\, Q_i\, P'_i\, Q'_{2\,r} - 3\,\beta\, Q_i\, P'_r\, Q'_{2\,r} + 2\, P_i\, Q'_i\, Q'_{2\,r} - \alpha^2\, P_i\, Q'_i\, Q'_{2\,r} + 3\,\alpha\, P_r\, Q'_i\, Q'_{2\,r}\right) \to 0,$$

$$2\,\alpha\, P_i\, P_r - P_r^2 + \alpha^2\, P_r^2 - 4\,\alpha\, P_r\, P'_i + 2\,\beta\, P_r\, P'_i + 2\,\alpha\, P_i\, P'_r - 4\,\beta\, P_i\, P'_r + 2\, P_r\, P'_r - 2\,\alpha\,\beta\, P_r\, P'_r + 2\,\beta\, P'_i\, P'_r - \left(P'\right)_r^2 + \beta^2\, \left(P'\right)_r^2 \to 0,\ \Big\{\beta \to \frac{1}{2\, \left(P'\right)_r^2}$$

$$\left(-2\, P_r\, P'_i + 4\, P_i\, P'_r + 2\,\alpha\, P_r\, P'_r - 2\, P'_i\, P'_r - \sqrt{\left(\left(2\, P_r\, P'_i - 4\, P_i\, P'_r - 2\,\alpha\, P_r\, P'_r + 2\, P'_i\, P'_r\right)^2 - 4\, \left(P'\right)_r^2\, \left(2\,\alpha\, P_i\, P_r - P_r^2 + \alpha^2\, P_r^2 - 4\,\alpha\, P_r\, P'_i + 2\,\alpha\, P_i\, P'_r + 2\, P_r\, P'_r - \left(P'\right)_r^2\right)\right)}\right)\Big\},\ \Big\{\beta \to \frac{1}{2\, \left(P'\right)_r^2}$$

$$\left(-2\, P_r\, P'_i + 4\, P_i\, P'_r + 2\,\alpha\, P_r\, P'_r - 2\, P'_i\, P'_r + \sqrt{\left(\left(2\, P_r\, P'_i - 4\, P_i\, P'_r - 2\,\alpha\, P_r\, P'_r + 2\, P'_i\, P'_r\right)^2 - 4\, \left(P'\right)_r^2\, \left(2\,\alpha\, P_i\, P_r - P_r^2 + \alpha^2\, P_r^2 - 4\,\alpha\, P_r\, P'_i + 2\,\alpha\, P_i\, P'_r + 2\, P_r\, P'_r - \left(P'\right)_r^2\right)\right)}\right)\Big\},$$

$$\Big\{\alpha \to \frac{3\, P_i\, Q_i + 3\, P_r\, Q_r - \sqrt{-4\, \left(2\, P_r\, Q_i - 2\, P_i\, Q_r\right)\, \left(-P_r\, Q_i + P_i\, Q_r\right) + \left(-3\, P_i\, Q_i - 3\, P_r\, Q_r\right)^2}}{2\, \left(-P_r\, Q_i + P_i\, Q_r\right)}\Big\},$$

$$\Big\{\alpha \to \frac{3\, P_i\, Q_i + 3\, P_r\, Q_r + \sqrt{-4\, \left(2\, P_r\, Q_i - 2\, P_i\, Q_r\right)\, \left(-P_r\, Q_i + P_i\, Q_r\right) + \left(-3\, P_i\, Q_i - 3\, P_r\, Q_r\right)^2}}{2\, \left(-P_r\, Q_i + P_i\, Q_r\right)}\Big\}\Big\}$$

In[•]:=
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ReplaceAll[%, {P_r → 2, P'_r → 3`, P'_i → -2.5, P_i → 1, Q_1r → 1, Q_1i → -2.4`,
  Q'_1r → 0.6`, Q'_1i → -3, Q'_2r → -0.5, Q'_2i → 2.25, γ_i → 1.75, Q_2i → 1.75}]
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Out[•]=

$$\left\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to k_i^2 - 4\,k_i\,k_r - k_r^2 + \gamma_r,\ \omega_i \to 1.75 - 2\,k_i^2 - 2\,k_i\,k_r + 2\,k_r^2,\right.$$

$$k_i \to -\frac{0.875}{k_r} + \alpha\,k_r,\ \eta^* \to \frac{4\,k_r^2\left(-5.25\,\alpha + \left(-2+\alpha^2\right)Q_{2r} - 2\left(1.75\left(-2+\alpha^2\right) + 3\,\alpha\,Q_{2r}\right)\right)}{\eta\left(1.75 + 2.4\,Q_{2r}\right)},$$

$$\mu^* \to \frac{4\left(2 - 7.2\,\alpha - \alpha^2 + 2\left(3\,\alpha - 2.4\left(-2+\alpha^2\right)\right)\right)k_r^2}{\mu\left(1.75 + 2.4\,Q_{2r}\right)},$$

$$Q_{2r} \to \left(0.45\,\alpha + 0.5\left(-2+\alpha^2\right) + 2\left(-1.5\,\alpha + 1.05\left(2-\alpha^2\right) + 1.2\left(-2+\alpha^2\right)\right) + 1.75\left(-7.5\,\beta + 3.\left(-2+\beta^2\right)\right)\right) \Big/ \left(0.6\left(2 + 6\,\alpha - \alpha^2\right) + 18.\,\beta - 7.2\left(-2+\beta^2\right)\right),$$

$$k_r \to 0.447214\sqrt{-\frac{-4.375 - \gamma'_i}{\alpha - \beta}},\ \gamma_r \to -\frac{1}{(\alpha-\beta)\left(4.375 + \gamma'_i\right)}0.2\left(-76.5625\,\alpha + \left(-1+\alpha^2\right)(\gamma')_i^2 - 2\,\gamma'_i\left(-4.375\,(-1+\alpha\,\beta) + 2\,\alpha\,\gamma'_i\right) - 4.375\left(-4.375\left(-1+\beta^2\right) + 8\,\alpha\,\gamma'_i\right)\right),$$

$$\gamma'_r \to -\frac{1}{(\alpha-\beta)\left(4.375 + \gamma'_i\right)}0.2\left(-47.8516\left(-1+\beta^2\right) - 6.\,\beta\,(\gamma')_i^2 - 2.5\,\gamma'_i\left(21.\,\beta + \left(-1+\alpha^2\right)\gamma'_i\right) - 21.875\left(5.25\,\beta + (-1+\alpha\,\beta)\,\gamma'_i\right)\right),\ \gamma'_i \to -2.91667,$$

$$\left(-11.6 + 1.2\,\alpha + 5.8\,\alpha^2\right)\left(0.15 + 0.9\,\alpha - 0.15\,\alpha^2 - 2.475\,\beta + 0.075\,\beta^2\right) \to 0,$$

$$-1. + 30.\,\alpha + 4\,\alpha^2 - 37.\,\beta - 12.\,\alpha\,\beta + 9.\,\beta^2 \to 0,$$

$$\left\{\beta \to 0.0555556\left(37. + 12.\,\alpha - \sqrt{\left(-37. - 12.\,\alpha\right)^2 - 36.\left(-1. + 30.\,\alpha + 4\,\alpha^2\right)}\right)\right\},$$

$$\left\{\beta \to 0.0555556\left(37. + 12.\,\alpha + \sqrt{\left(-37. - 12.\,\alpha\right)^2 - 36.\left(-1. + 30.\,\alpha + 4\,\alpha^2\right)}\right)\right\},$$

$$\left.\{\alpha \to -1.52144\},\ \{\alpha \to 1.31454\}\right\}$$

In[•]:=
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ReplaceAll[%, γ'_i → -2.9166666666666665`]
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In[•]:=
$$\left\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to k_i^2 - 4\,k_i\,k_r - k_r^2 + \gamma_r,\ \omega_i \to 1.75` - 2\,k_i^2 - 2\,k_i\,k_r + 2\,k_r^2,\right.$$
$$k_i \to -\frac{0.875`}{k_r} + \alpha\,k_r,\ \eta^* \to \frac{4\,k_r^2\left(-5.25`\,\alpha + \left(-2+\alpha^2\right)Q_{2r} - 2\left(1.75`\left(-2+\alpha^2\right) + 3\,\alpha\,Q_{2r}\right)\right)}{\eta\left(1.75` + 2.4`\,Q_{2r}\right)},$$
$$\mu^* \to \frac{4\left(2 - 7.199999999999999`\,\alpha - \alpha^2 + 2\left(3\,\alpha - 2.4`\left(-2+\alpha^2\right)\right)\right)k_r^2}{\mu\left(1.75` + 2.4`\,Q_{2r}\right)},$$
$$Q_{2r} \to \left(0.44999999999999973`\,\alpha + 0.5`\left(-2+\alpha^2\right) + 2\left(-1.5`\,\alpha + 1.05`\left(2-\alpha^2\right) + 1.2`\left(-2+\alpha^2\right)\right) + 1.75`\left(-7.5`\,\beta + 3.`\left(-2+\beta^2\right)\right)\right) \Big/ \left(0.6`\left(2 + 6\,\alpha - \alpha^2\right) + 18.`\,\beta - 7.199999999999999`\left(-2+\beta^2\right)\right),$$
$$k_r \to 0.5400617248673217`\sqrt{\frac{1}{\alpha-\beta}},$$
$$\gamma_r \to -\frac{1}{\alpha-\beta}0.13714285714285712`\left(-76.5625`\,\alpha + 8.506944444444443`\left(-1+\alpha^2\right) + 5.833333333333333`\left(-5.833333333333333`\,\alpha - 4.375`\left(-1+\alpha\,\beta\right)\right) - 4.375`\left(-23.333333333333332`\,\alpha - 4.375`\left(-1+\beta^2\right)\right)\right),$$
$$\gamma'_r \to -\frac{1}{\alpha-\beta}0.13714285714285712`\left(-51.04166666666666`\,\beta + 7.291666666666666`\left(-2.9166666666666665`\left(-1+\alpha^2\right) + 21.`\,\beta\right) - 47.8515625`\left(-1+\beta^2\right) - 21.875`\left(5.25`\,\beta - 2.9166666666666665`\left(-1+\alpha\,\beta\right)\right)\right),$$
$$-2.9166666666666665` \to -2.9166666666666665`,$$
$$\left(-11.6` + 1.1999999999999993`\,\alpha + 5.8`\,\alpha^2\right)\left(0.15000000000000213` + 0.9000000000000004`\,\alpha - 0.15000000000000013`\,\alpha^2 - 2.4749999999999943`\,\beta + 0.07499999999999929`\,\beta^2\right) \to 0,$$
$$-1.` + 30.`\,\alpha + 4\,\alpha^2 - 37.`\,\beta - 12.`\,\alpha\,\beta + 9.`\,\beta^2 \to 0,$$
$$\left\{\beta \to 0.05555555555555555`\left(37.` + 12.`\,\alpha - \sqrt{\left(-37.` - 12.`\,\alpha\right)^2 - 36.`\left(-1.` + 30.`\,\alpha + 4\,\alpha^2\right)}\right)\right\},\ \left\{\beta \to 0.05555555555555555`\left(37.` + 12.`\,\alpha + \sqrt{\left(-37.` - 12.`\,\alpha\right)^2 - 36.`\left(-1.` + 30.`\,\alpha + 4\,\alpha^2\right)}\right)\right\},$$
$$\left.\{\alpha \to -1.521440358272558`\},\ \{\alpha \to 1.31454380654842`\}\right\}$$

Out[•]= $\Big\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to k_i^2 - 4\,k_i\,k_r - k_r^2 + \gamma_r,\ \omega_i \to 1.75 - 2\,k_i^2 - 2\,k_i\,k_r + 2\,k_r^2,$

$k_i \to -\frac{0.875}{k_r} + \alpha\,k_r,\ \eta^* \to \frac{4\,k_r^2\left(-5.25\,\alpha + \left(-2+\alpha^2\right)Q_{2r} - 2\left(1.75\left(-2+\alpha^2\right) + 3\,\alpha\,Q_{2r}\right)\right)}{\eta\left(1.75 + 2.4\,Q_{2r}\right)},$

$\mu^* \to \frac{4\left(2 - 7.2\,\alpha - \alpha^2 + 2\left(3\,\alpha - 2.4\left(-2+\alpha^2\right)\right)\right)k_r^2}{\mu\left(1.75 + 2.4\,Q_{2r}\right)},$

$Q_{2r} \to \left(0.45\,\alpha + 0.5\left(-2+\alpha^2\right) + 2\left(-1.5\,\alpha + 1.05\left(2-\alpha^2\right) + 1.2\left(-2+\alpha^2\right)\right) +$
$1.75\left(-7.5\,\beta + 3.\left(-2+\beta^2\right)\right)\right) \Big/ \left(0.6\left(2 + 6\,\alpha - \alpha^2\right) + 18.\,\beta - 7.2\left(-2+\beta^2\right)\right),$

$k_r \to 0.540062\sqrt{\frac{1}{\alpha-\beta}},\ \gamma_r \to -\frac{1}{\alpha-\beta}0.137143\left(-76.5625\,\alpha + 8.50694\left(-1+\alpha^2\right) +$
$5.83333\left(-5.83333\,\alpha - 4.375\,(-1+\alpha\,\beta)\right) - 4.375\left(-23.3333\,\alpha - 4.375\left(-1+\beta^2\right)\right)\right),$

$\gamma'_r \to -\frac{1}{\alpha-\beta}0.137143\left(-51.0417\,\beta + 7.29167\left(-2.91667\left(-1+\alpha^2\right) + 21.\,\beta\right) -$
$47.8516\left(-1+\beta^2\right) - 21.875\left(5.25\,\beta - 2.91667\,(-1+\alpha\,\beta)\right)\right),\ -2.91667 \to -2.91667,$

$\left(-11.6 + 1.2\,\alpha + 5.8\,\alpha^2\right)\left(0.15 + 0.9\,\alpha - 0.15\,\alpha^2 - 2.475\,\beta + 0.075\,\beta^2\right) \to 0,$

$-1. + 30.\,\alpha + 4\,\alpha^2 - 37.\,\beta - 12.\,\alpha\,\beta + 9.\,\beta^2 \to 0,$

$\left\{\beta \to 0.0555556\left(37. + 12.\,\alpha - \sqrt{\left(-37. - 12.\,\alpha\right)^2 - 36.\left(-1. + 30.\,\alpha + 4\,\alpha^2\right)}\right)\right\},$

$\left\{\beta \to 0.0555556\left(37. + 12.\,\alpha + \sqrt{\left(-37. - 12.\,\alpha\right)^2 - 36.\left(-1. + 30.\,\alpha + 4\,\alpha^2\right)}\right)\right\},$

$\{\alpha \to -1.52144\},\ \{\alpha \to 1.31454\}\Big\}$

In[•]:= **ReplaceAll[%, {α → 1.31454380654842`}]**

Out[•]= $\Big\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to k_i^2 - 4\,k_i\,k_r - k_r^2 + \gamma_r,$

$\omega_i \to 1.75 - 2\,k_i^2 - 2\,k_i\,k_r + 2\,k_r^2,\ k_i \to -\frac{0.875}{k_r} + 1.31454\,k_r,$

$\eta^* \to \frac{4\,k_r^2\left(-6.90135 - 0.271975\,Q_{2r} - 2\left(-0.475956 + 3.94363\,Q_{2r}\right)\right)}{\eta\left(1.75 + 2.4\,Q_{2r}\right)},$

$\mu^* \to -\frac{1.06581\times10^{-14}\,k_r^2}{\mu\left(1.75 + 2.4\,Q_{2r}\right)},\ Q_{2r} \to \frac{-3.56967 + 1.75\left(-7.5\,\beta + 3.\left(-2+\beta^2\right)\right)}{4.89554 + 18.\,\beta - 7.2\left(-2+\beta^2\right)},$

$k_r \to 0.540062\sqrt{\frac{1}{1.31454-\beta}},\ \gamma_r \to -\frac{1}{1.31454-\beta}0.137143\left(-94.4515 +$
$5.83333\left(-7.66817 - 4.375\left(-1+1.31454\,\beta\right)\right) - 4.375\left(-30.6727 - 4.375\left(-1+\beta^2\right)\right)\right),$

$\gamma'_r \to -\frac{1}{1.31454-\beta}0.137143\left(-51.0417\,\beta + 7.29167\left(-2.12341 + 21.\,\beta\right) -$
$47.8516\left(-1+\beta^2\right) - 21.875\left(5.25\,\beta - 2.91667\left(-1+1.31454\,\beta\right)\right)\right),$

$-2.91667 \to -2.91667,\ 1.77636\times10^{-15}\left(1.07389 - 2.475\,\beta + 0.075\,\beta^2\right) \to 0,$

$45.3484 - 52.7745\,\beta + 9.\,\beta^2 \to 0,\ \{\beta \to 1.0458\},$

$\{\beta \to 4.81803\},\ \{1.31454 \to -1.52144\},\ \{1.31454 \to 1.31454\}\Big\}$

In[•]:=
```
ReplaceAll[%, {β → 1.0458028182282497`}]
```

Out[•]=
$$\Big\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to k_i^2 - 4\,k_i\,k_r - k_r^2 + \gamma_r,$$
$$\omega_i \to 1.75 - 2\,k_i^2 - 2\,k_i\,k_r + 2\,k_r^2,\ k_i \to -\frac{0.875}{k_r} + 1.31454\,k_r,$$
$$\eta^* \to \frac{4\,k_r^2\,\left(-6.90135 - 0.271975\,Q_{2\,r} - 2\,\left(-0.475956 + 3.94363\,Q_{2\,r}\right)\right)}{\eta\,\left(1.75 + 2.4\,Q_{2\,r}\right)},$$
$$\mu^* \to -\frac{1.06581 \times 10^{-14}\,k_r^2}{\mu\,\left(1.75 + 2.4\,Q_{2\,r}\right)},\ Q_{2\,r} \to -0.729167,\ k_r \to 1.04178,\ \gamma_r \to 6.51161,$$
$$\gamma'_r \to 4.79792,\ -2.91667 \to -2.91667,\ -2.54454 \times 10^{-15} \to 0,\ -3.55271 \times 10^{-15} \to 0,$$
$$\{1.0458 \to 1.0458\},\ \{1.0458 \to 4.81803\},\ \{1.31454 \to -1.52144\},\ \{1.31454 \to 1.31454\}\Big\}$$

In[•]:=
```
ReplaceAll[%, {Q2 r → -0.7291666666666667`,
  kr → 1.0417810279445396`, γr → 6.511613080797135`, γ'r → 4.797919755978034`}]
```

Out[•]=
$$\Big\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to 5.42631 - 4.16712\,k_i + k_i^2,$$
$$\omega_i \to 3.92062 - 2.08356\,k_i - 2\,k_i^2,\ k_i \to 0.529559,\ \eta^* \to \frac{17.3649}{\eta},\ \mu^* \to \frac{52.0948}{\mu},$$
$$-0.729167 \to -0.729167,\ 1.04178 \to 1.04178,\ 6.51161 \to 6.51161,\ 4.79792 \to 4.79792,$$
$$-2.91667 \to -2.91667,\ -2.54454 \times 10^{-15} \to 0,\ -3.55271 \times 10^{-15} \to 0,\ \{1.0458 \to 1.0458\},$$
$$\{1.0458 \to 4.81803\},\ \{1.31454 \to -1.52144\},\ \{1.31454 \to 1.31454\}\Big\}$$

In[•]:=
```
ReplaceAll[%,
  {ki → 0.5295590088750854`, η* → 17.364923362962905`/η, μ* → 52.094770088888716`/μ}]
```

Out[•]=
$$\Big\{\Omega_1 \to 0,\ K_1 \to 0,\ \Omega_2 \to 0,\ K_2 \to 0,\ \omega_r \to 3.5,\ \omega_i \to 2.25638,\ 0.529559 \to 0.529559,$$
$$\frac{17.3649}{\eta} \to \frac{17.3649}{\eta},\ \frac{52.0948}{\mu} \to \frac{52.0948}{\mu},\ -0.729167 \to -0.729167,$$
$$1.04178 \to 1.04178,\ 6.51161 \to 6.51161,\ 4.79792 \to 4.79792,\ -2.91667 \to -2.91667,$$
$$-2.54454 \times 10^{-15} \to 0,\ -3.55271 \times 10^{-15} \to 0,\ \{1.0458 \to 1.0458\},$$
$$\{1.0458 \to 4.81803\},\ \{1.31454 \to -1.52144\},\ \{1.31454 \to 1.31454\}\Big\}$$

```
ReplaceAll[%,
 {{G[x, t] → η Exp[k x + ω t], G*[x, t] → η* Exp[k* x + ω* t], H[x, t] → μ Exp[k x + ω t],
   H*[x, t] → μ* Exp[k* x + ω* t], f[x, t] → 1 + Exp[(k + k*) x + (ω + ω*) t]}}]
```

```
ReplaceAll[%, {γ'i → -2.9166666666666665`, α → 1.31454380654842`,
  β → 1.0458028182282497`, Q2 r → -0.7291666666666667`, kr → 1.0417810279445396`,
  γr → 6.511613080797135`, γ'r → 4.797919755978034`, ki → 0.5295590088750854`,
  η* → 17.364923362962905`/η, μ* → 52.094770088888716`/μ, Ω1 → 0, K1 → 0,
  Ω2 → 0, K2 → 0, ωr → 3.5000000000000036`, ωi → 2.2563808753624817`}]
```

In[1]:=
$$\left\{A[x,t]\,A^*[x,t] \to e^{i\,(x\,K_1 - t\,\Omega_1)}\,f[x,t]^{-1-i\,\alpha}\,G[x,t]\;e^{-i\,(x\,K_1 - t\,\Omega_1)}\,f[x,t]^{-1+i\,\alpha}\,G^*[x,t],\right.$$
$$\left. B[x,t]\,B^*[x,t] \to e^{i\,(x\,K_2 - t\,\Omega_2)}\,f[x,t]^{-1-i\,\beta}\,H[x,t]\;e^{-i\,(x\,K_2 - t\,\Omega_2)}\,f[x,t]^{-1+i\,\beta}\,H^*[x,t]\right\}$$

Out[1]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{G[x,t]\,G^*[x,t]}{f[x,t]^2},\; B[x,t]\,B^*[x,t] \to \frac{H[x,t]\,H^*[x,t]}{f[x,t]^2}\right\}$$

In[2]:=
$$\texttt{ReplaceAll}\left[\%,\; \left\{\left\{G[x,t] \to \eta\,\texttt{Exp}[k\,x + \omega\,t],\; G^*[x,t] \to \eta^*\,\texttt{Exp}[k^*\,x + \omega^*\,t],\; H[x,t] \to \mu\,\texttt{Exp}[k\,x + \omega\,t],\right.\right.\right.$$
$$\left.\left.\left. H^*[x,t] \to \mu^*\,\texttt{Exp}[k^*\,x + \omega^*\,t],\; f[x,t] \to 1 + \texttt{Exp}\left[\left(k + k^*\right)x + \left(\omega + \omega^*\right)t\right]\right\}\right\}\right]$$

Out[2]=
$$\left\{\left\{A[x,t]\,A^*[x,t] \to \frac{e^{k\,x + t\,\omega + x\,k^* + t\,\omega^*}\,\eta\,\eta^*}{\left(1 + e^{x\,(k+k^*) + t\,(\omega+\omega^*)}\right)^2},\; B[x,t]\,B^*[x,t] \to \frac{e^{k\,x + t\,\omega + x\,k^* + t\,\omega^*}\,\mu\,\mu^*}{\left(1 + e^{x\,(k+k^*) + t\,(\omega+\omega^*)}\right)^2}\right\}\right\}$$

In[3]:=
$$\texttt{ReplaceAll}[\%,\; \{k \to k_r + I\,k_i,\; k^* \to k_r - I\,k_i,\; \omega \to \omega_r + I\,\omega_i,\; \omega^* \to \omega_r - I\,\omega_i\}]$$

Out[3]=
$$\left\{\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i + k_r) + x\,(i\,k_i + k_r) + t\,(-i\,\omega_i + \omega_r) + t\,(i\,\omega_i + \omega_r)}\,\eta\,\eta^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2},\right.\right.$$
$$\left.\left. B[x,t]\,B^*[x,t] \to \frac{e^{x\,(-i\,k_i + k_r) + x\,(i\,k_i + k_r) + t\,(-i\,\omega_i + \omega_r) + t\,(i\,\omega_i + \omega_r)}\,\mu\,\mu^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2}\right\}\right\}$$

In[4]:=
$$\texttt{Simplify}[\%]$$

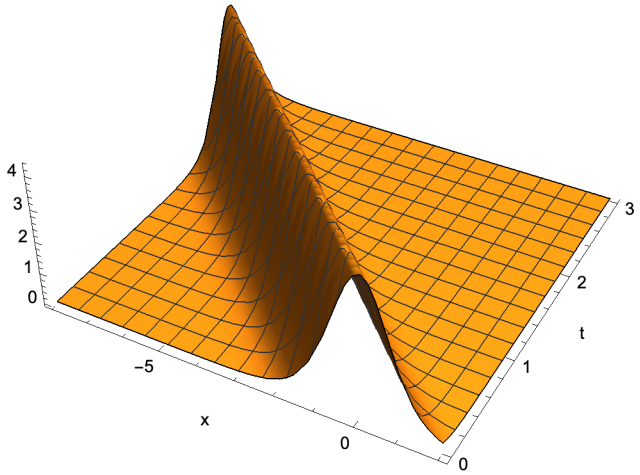
Out[4]=
$$\left\{\left\{A[x,t]\,A^*[x,t] \to \frac{e^{2\,x\,k_r + 2\,t\,\omega_r}\,\eta\,\eta^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2},\; B[x,t]\,B^*[x,t] \to \frac{e^{2\,x\,k_r + 2\,t\,\omega_r}\,\mu\,\mu^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2}\right\}\right\}$$

In[5]:=
$$\texttt{ReplaceAll}\left[\%,\; \left\{\gamma'_i \to -2.9166666666666665`,\; \alpha \to 1.31454380654842`,\right.\right.$$
$$\beta \to 1.0458028182282497`,\; Q_{2\,r} \to -0.7291666666666667`,\; k_r \to 1.0417810279445396`,$$
$$\gamma_r \to 6.511613080797135`,\; \gamma'_r \to 4.797919755978034`,\; k_i \to 0.5295590088750854`,$$
$$\eta^* \to \frac{17.364923362962905`}{\eta},\; \mu^* \to \frac{52.094770088888716`}{\mu},\; \Omega_1 \to 0,\; K_1 \to 0,$$
$$\left.\left.\Omega_2 \to 0,\; K_2 \to 0,\; \omega_r \to 3.5000000000000036`,\; \omega_i \to 2.2563808753624817`\right\}\right]$$

Out[5]=
$$\left\{\left\{A[x,t]\,A^*[x,t] \to \frac{17.3649\,e^{7.\,t + 2.08356\,x}}{\left(1 + e^{7.\,t + 2.08356\,x}\right)^2},\; B[x,t]\,B^*[x,t] \to \frac{52.0948\,e^{7.\,t + 2.08356\,x}}{\left(1 + e^{7.\,t + 2.08356\,x}\right)^2}\right\}\right\}$$

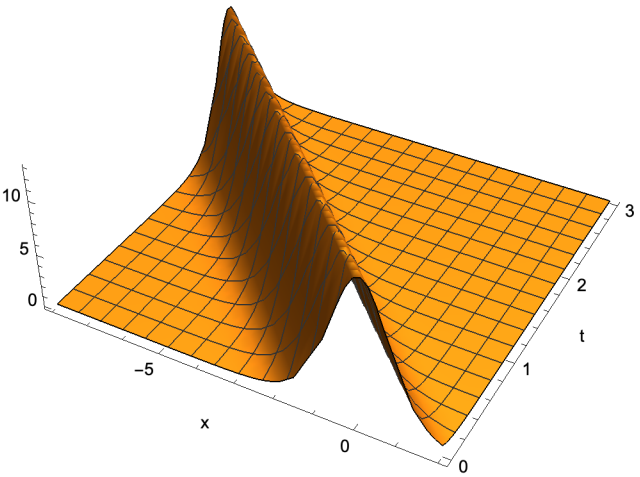
In[6]:=
$$\text{Plot3D}\left[\frac{17.364923362962905` \, e^{7.000000000000007` \, t+2.0835620558890793` \, x}}{\left(1+e^{7.000000000000007` \, t+2.0835620558890793` \, x}\right)^2}, \{x, -8, 2\}, \{t, 0, 3\}, \{\text{PlotRange} \to \text{All}\}, \text{Boxed} \to \text{False}, \text{AxesLabel} \to \{\text{"x"}, \text{"t"}, \text{"}|A|^2 \text{ "}\}\right]$$

Out[6]=



In[7]:=
$$\text{Plot3D}\left[\frac{52.094770088888716` \, e^{7.000000000000007` \, t+2.0835620558890793` \, x}}{\left(1+e^{7.000000000000007` \, t+2.0835620558890793` \, x}\right)^2}, \{x, -8, 2\}, \{t, 0, 3\}, \{\text{PlotRange} \to \text{All}\}, \text{Boxed} \to \text{False}, \text{AxesLabel} \to \{\text{"x"}, \text{"t"}, \text{"}|B|^2 \text{ "}\}\right]$$

Out[7]=



Case 2

In[•]:=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to -2\,k_i\,k_r\,P_i - k_i^2\,P_r + k_r^2\,P_r,\ k_i \to \alpha\,k_r,\ \beta \to \alpha,\right.$$
$$\eta^* \to \frac{4\,k_r^2\left(-P_r\left(\left(-2+\alpha^2\right)Q_{2i} + 3\,\alpha\,Q_{2r}\right) + P_i\left(-3\,\alpha\,Q_{2i} + \left(-2+\alpha^2\right)Q_{2r}\right)\right)}{\eta\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)},$$
$$\mu^* \to \frac{4\,k_r^2\left(P_r\left(\left(-2+\alpha^2\right)Q_i + 3\,\alpha\,Q_r\right) + P_i\left(3\,\alpha\,Q_i - \left(-2+\alpha^2\right)Q_r\right)\right)}{\mu\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)},$$
$$k_r^2 \to \frac{\gamma_r}{P_i - \alpha^2\,P_i + 2\,\alpha\,P_r},\ \gamma'_r \to \frac{\gamma_r\left(\left(-1+\alpha^2\right)P'_i - 2\,\alpha\,P'_r\right)}{\left(-1+\alpha^2\right)P_i - 2\,\alpha\,P_r},$$
$$Q_{2r} \to \left(Q_{2i}\,Q_r\left(3\,\alpha\,P'_i + \left(-2+\alpha^2\right)P'_r\right) + P_r\left(-\left(-2+\alpha^2\right)Q_{2i}\,Q'_r + \left(-2+\alpha^2\right)Q_i\,Q'_{2r} + 3\,\alpha\,Q_r\,Q'_{2r}\right) + \right.$$
$$\left.P_i\left(-3\,\alpha\,Q_{2i}\,Q'_r + 3\,\alpha\,Q_i\,Q'_{2r} - \left(-2+\alpha^2\right)Q_r\,Q'_{2r}\right)\right) /$$
$$\left(3\,\alpha\,Q_i\,P'_i + \left(-2+\alpha^2\right)Q_i\,P'_r + \left(\left(2-\alpha^2\right)P_i + 3\,\alpha\,P_r\right)Q'_r\right),\ P'_i \to P_i + \frac{\left(-1+\alpha^2\right)\left(P_r - P'_r\right)}{2\,\alpha},$$
$$2\left(P_r - P'_r\right)\left(-Q_{2i}\,Q'_r + Q_i\,Q'_{2r}\right) + \alpha^4\left(P_r - P'_r\right)\left(-Q_{2i}\,Q'_r + Q_i\,Q'_{2r}\right) - \alpha^3\left(-3\,P_r\,Q_{2i}\,Q'_i + \right.$$
$$\left.Q_{2i}\,P'_r\,Q'_i + 3\,P_r\,Q_i\,Q'_{2i} - Q_i\,P'_r\,Q'_{2i} + 2\,P_i\,Q_{2i}\,Q'_r - 2\,P_i\,Q'_{2i}\,Q'_r - 2\,P_i\,Q_i\,Q'_{2r} + 2\,P_i\,Q'_i\,Q'_{2r}\right) +$$
$$\alpha\left(-3\,P_r\,Q_{2i}\,Q'_i - Q_{2i}\,P'_r\,Q'_i + 3\,P_r\,Q_i\,Q'_{2i} + Q_i\,P'_r\,Q'_{2i} + 4\,P_i\,Q_{2i}\,Q'_r - 4\,P_i\,Q'_{2i}\,Q'_r - \right.$$
$$\left.4\,P_i\,Q_i\,Q'_{2r} + 4\,P_i\,Q'_i\,Q'_{2r}\right) - 3\,\alpha^2\left(-2\,P_i\,Q_{2i}\,Q'_i + 2\,P_i\,Q_i\,Q'_{2i} - P_r\,Q_{2i}\,Q'_r - \right.$$
$$\left.\left.Q_{2i}\,P'_r\,Q'_r + 2\,P_r\,Q'_{2i}\,Q'_r + P_r\,Q_i\,Q'_{2r} + Q_i\,P'_r\,Q'_{2r} - 2\,P_r\,Q'_i\,Q'_{2r}\right)\right\}$$

Out[•]=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to -2\,k_i\,k_r\,P_i - k_i^2\,P_r + k_r^2\,P_r,\ k_i \to \alpha\,k_r,\ \beta \to \alpha,\right.$$
$$\eta^* \to \frac{4\,k_r^2\left(-P_r\left(\left(-2+\alpha^2\right)Q_{2i} + 3\,\alpha\,Q_{2r}\right) + P_i\left(-3\,\alpha\,Q_{2i} + \left(-2+\alpha^2\right)Q_{2r}\right)\right)}{\eta\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)},$$
$$\mu^* \to \frac{4\,k_r^2\left(P_r\left(\left(-2+\alpha^2\right)Q_i + 3\,\alpha\,Q_r\right) + P_i\left(3\,\alpha\,Q_i - \left(-2+\alpha^2\right)Q_r\right)\right)}{\mu\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)},$$
$$k_r^2 \to \frac{\gamma_r}{P_i - \alpha^2\,P_i + 2\,\alpha\,P_r},\ \gamma'_r \to \frac{\gamma_r\left(\left(-1+\alpha^2\right)P'_i - 2\,\alpha\,P'_r\right)}{\left(-1+\alpha^2\right)P_i - 2\,\alpha\,P_r},$$
$$Q_{2r} \to \left(Q_{2i}\,Q_r\left(3\,\alpha\,P'_i + \left(-2+\alpha^2\right)P'_r\right) + P_r\left(\left(2-\alpha^2\right)Q_{2i}\,Q'_r + \left(-2+\alpha^2\right)Q_i\,Q'_{2r} + 3\,\alpha\,Q_r\,Q'_{2r}\right) + \right.$$
$$\left.P_i\left(-3\,\alpha\,Q_{2i}\,Q'_r + 3\,\alpha\,Q_i\,Q'_{2r} - \left(-2+\alpha^2\right)Q_r\,Q'_{2r}\right)\right) /$$
$$\left(3\,\alpha\,Q_i\,P'_i + \left(-2+\alpha^2\right)Q_i\,P'_r + \left(\left(2-\alpha^2\right)P_i + 3\,\alpha\,P_r\right)Q'_r\right),\ P'_i \to P_i + \frac{\left(-1+\alpha^2\right)\left(P_r - P'_r\right)}{2\,\alpha},$$
$$2\left(P_r - P'_r\right)\left(-Q_{2i}\,Q'_r + Q_i\,Q'_{2r}\right) + \alpha^4\left(P_r - P'_r\right)\left(-Q_{2i}\,Q'_r + Q_i\,Q'_{2r}\right) - \alpha^3\left(-3\,P_r\,Q_{2i}\,Q'_i + \right.$$
$$\left.Q_{2i}\,P'_r\,Q'_i + 3\,P_r\,Q_i\,Q'_{2i} - Q_i\,P'_r\,Q'_{2i} + 2\,P_i\,Q_{2i}\,Q'_r - 2\,P_i\,Q'_{2i}\,Q'_r - 2\,P_i\,Q_i\,Q'_{2r} + 2\,P_i\,Q'_i\,Q'_{2r}\right) +$$
$$\alpha\left(-3\,P_r\,Q_{2i}\,Q'_i - Q_{2i}\,P'_r\,Q'_i + 3\,P_r\,Q_i\,Q'_{2i} + Q_i\,P'_r\,Q'_{2i} + 4\,P_i\,Q_{2i}\,Q'_r - 4\,P_i\,Q'_{2i}\,Q'_r - \right.$$
$$\left.4\,P_i\,Q_i\,Q'_{2r} + 4\,P_i\,Q'_i\,Q'_{2r}\right) - 3\,\alpha^2\left(-2\,P_i\,Q_{2i}\,Q'_i + 2\,P_i\,Q_i\,Q'_{2i} - P_r\,Q_{2i}\,Q'_r - \right.$$
$$\left.\left.Q_{2i}\,P'_r\,Q'_r + 2\,P_r\,Q'_{2i}\,Q'_r + P_r\,Q_i\,Q'_{2r} + Q_i\,P'_r\,Q'_{2r} - 2\,P_r\,Q'_i\,Q'_{2r}\right)\right\}$$

In[•]:=
```
ReplaceAll[%, {P_r → 3, P'_r → 2, P_i → 2.5, Q_1r → -1, Q_1i → 2.4`,
  Q'_1r → 0.6`, Q'_1i → -3, Q'_2r → -0.5, γ_r → -1.75, Q_2i → -1.75, Q'_2i → 2.065}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to -3\,k_i^2 - 5.\,k_i\,k_r + 3\,k_r^2,\ k_i \to \alpha\,k_r,\ \beta \to \alpha,\right.$$
$$\eta^* \to \frac{4\,k_r^2\left(-3\left(-1.75\left(-2+\alpha^2\right)+3\,\alpha\,Q_{2r}\right)+2.5\left(5.25\,\alpha+\left(-2+\alpha^2\right)Q_{2r}\right)\right)}{\eta\left(1.75-2.4\,Q_{2r}\right)},$$
$$\mu^* \to \frac{4\left(2.5\left(-2+7.2\,\alpha+\alpha^2\right)+3\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\right)k_r^2}{\mu\left(1.75-2.4\,Q_{2r}\right)},$$
$$k_r^2 \to -\frac{1.75}{2.5+6\,\alpha-2.5\,\alpha^2},\ \gamma'_r \to -\frac{1.75\left(-4\,\alpha+\left(-1+\alpha^2\right)P'_i\right)}{-6\,\alpha+2.5\left(-1+\alpha^2\right)},$$
$$Q_{2r} \to \left(3\left(1.5\,\alpha-1.05\left(2-\alpha^2\right)-1.2\left(-2+\alpha^2\right)\right)+2.5\left(-0.45\,\alpha-0.5\left(-2+\alpha^2\right)\right)+\right.$$
$$\left.1.75\left(2\left(-2+\alpha^2\right)+3\,\alpha\,P'_i\right)\right)\Big/\left(4.8\left(-2+\alpha^2\right)+0.6\left(9\,\alpha+2.5\left(2-\alpha^2\right)\right)+7.2\,\alpha\,P'_i\right),$$
$$\left.P'_i \to 2.5+\frac{-1+\alpha^2}{2\,\alpha},\ -0.3+0.876\,\alpha+11.358\,\alpha^2+0.003\,\alpha^3-0.15\,\alpha^4\right\}$$

In[•]:=
```
Solve[-0.2999999999999998` + 0.8759999999999977` α + 11.35800000000001` α^2 +
  0.0030000000000001137` α^3 - 0.1499999999999999` α^4 == 0, α]
```

Out[•]= {{α → -8.65131}, {α → -0.205674}, {α → 0.12848}, {α → 8.74851}}

Out[•]= {{α → -8.65722}, {α → -0.206022}, {α → 0.128375}, {α → 8.73487}}

Only α → -8.657221966458971` works

In[•]:=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to -3\,k_i^2 - 5.`\,k_i\,k_r + 3\,k_r^2,\ k_i \to \alpha\,k_r,\ \beta \to \alpha,\right.$$
$$\eta^* \to \frac{4\,k_r^2\left(-3\left(-1.75`\left(-2+\alpha^2\right)+3\,\alpha\,Q_{2r}\right)+2.5`\left(5.25`\,\alpha+\left(-2+\alpha^2\right)Q_{2r}\right)\right)}{\eta\left(1.75`-2.4`\,Q_{2r}\right)},$$
$$\mu^* \to \frac{4\left(2.5`\left(-2+7.199999999999999`\,\alpha+\alpha^2\right)+3\left(-3\,\alpha+2.4`\left(-2+\alpha^2\right)\right)\right)k_r^2}{\mu\left(1.75`-2.4`\,Q_{2r}\right)},$$
$$k_r^2 \to -\frac{1.75`}{2.5`+6\,\alpha-2.5`\,\alpha^2},\ \gamma'_r \to -\frac{1.75`\left(-4\,\alpha+\left(-1+\alpha^2\right)P'_i\right)}{-6\,\alpha+2.5`\left(-1+\alpha^2\right)},$$
$$Q_{2r} \to \left(3\left(1.5`\,\alpha-1.05`\left(2-\alpha^2\right)-1.2`\left(-2+\alpha^2\right)\right)+\right.$$
$$\left.2.5`\left(-0.44999999999999973`\,\alpha-0.5`\left(-2+\alpha^2\right)\right)+1.75`\left(2\left(-2+\alpha^2\right)+3\,\alpha\,P'_i\right)\right)/$$
$$\left(4.8`\left(-2+\alpha^2\right)+0.6`\left(9\,\alpha+2.5`\left(2-\alpha^2\right)\right)+7.199999999999999`\,\alpha\,P'_i\right),$$
$$P'_i \to 2.5`+\frac{-1+\alpha^2}{2\,\alpha},\ -0.2999999999999998`+0.8759999999999977`\,\alpha+$$
$$\left.11.35800000000001`\,\alpha^2+0.0030000000000001137`\,\alpha^3-0.1499999999999999`\,\alpha^4\right\}$$

Out[•]=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to -3\,k_i^2 - 5.\,k_i\,k_r + 3\,k_r^2,\ k_i \to \alpha\,k_r,\ \beta \to \alpha,\right.$$
$$\eta^* \to \frac{4\,k_r^2\left(-3\left(-1.75\left(-2+\alpha^2\right)+3\,\alpha\,Q_{2r}\right)+2.5\left(5.25\,\alpha+\left(-2+\alpha^2\right)Q_{2r}\right)\right)}{\eta\left(1.75-2.4\,Q_{2r}\right)},$$
$$\mu^* \to \frac{4\left(2.5\left(-2+7.2\,\alpha+\alpha^2\right)+3\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\right)k_r^2}{\mu\left(1.75-2.4\,Q_{2r}\right)},$$
$$k_r^2 \to -\frac{1.75}{2.5+6\,\alpha-2.5\,\alpha^2},\ \gamma'_r \to -\frac{1.75\left(-4\,\alpha+\left(-1+\alpha^2\right)P'_i\right)}{-6\,\alpha+2.5\left(-1+\alpha^2\right)},$$
$$Q_{2r} \to \left(3\left(1.5\,\alpha-1.05\left(2-\alpha^2\right)-1.2\left(-2+\alpha^2\right)\right)+2.5\left(-0.45\,\alpha-0.5\left(-2+\alpha^2\right)\right)+\right.$$
$$\left.1.75\left(2\left(-2+\alpha^2\right)+3\,\alpha\,P'_i\right)\right)/\left(4.8\left(-2+\alpha^2\right)+0.6\left(9\,\alpha+2.5\left(2-\alpha^2\right)\right)+7.2\,\alpha\,P'_i\right),$$
$$P'_i \to 2.5+\frac{-1+\alpha^2}{2\,\alpha},\ -0.3+0.876\,\alpha+11.358\,\alpha^2+0.003\,\alpha^3-0.15\,\alpha^4\Big\}$$

In[•]:=
```
ReplaceAll[%, {α → 8.748507371478683`}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to -3\,k_i^2 - 5.\,k_i\,k_r + 3\,k_r^2,\ k_i \to 8.74851\,k_r,\ \beta \to 8.74851,\right.$$
$$\eta^* \to \frac{4\,k_r^2\left(-3\left(-130.439+26.2455\,Q_{2r}\right)+2.5\left(45.9297+74.5364\,Q_{2r}\right)\right)}{\eta\left(1.75-2.4\,Q_{2r}\right)},$$
$$\mu^* \to \frac{3206.96\,k_r^2}{\mu\left(1.75-2.4\,Q_{2r}\right)},\ k_r^2 \to 0.0128346,\ \gamma'_r \to -0.0128346\left(-34.994+75.5364\,P'_i\right),$$
$$\left.Q_{2r} \to \frac{-97.1856+1.75\left(149.073+26.2455\,P'_i\right)}{293.212+62.9893\,P'_i},\ P'_i \to 6.8171,\ -1.13687\times10^{-13}\right\}$$

In[•]:=
```
ReplaceAll[%, P'i → 6.817101079155266`]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to -3\,k_i^2 - 5.\,k_i\,k_r + 3\,k_r^2,\ k_i \to 8.74851\,k_r,\ \beta \to 8.74851,\right.$$
$$\eta^* \to \frac{4\,k_r^2\left(-3\left(-130.439 + 26.2455\,Q_{2\,r}\right) + 2.5\left(45.9297 + 74.5364\,Q_{2\,r}\right)\right)}{\eta\left(1.75 - 2.4\,Q_{2\,r}\right)},$$
$$\mu^* \to \frac{3206.96\,k_r^2}{\mu\left(1.75 - 2.4\,Q_{2\,r}\right)},\ k_r^2 \to 0.0128346,\ \gamma'_r \to -6.15992,$$
$$\left.Q_{2\,r} \to 0.659823,\ 6.8171 \to 6.8171,\ -1.13687\times 10^{-13}\right\}$$

In[•]:=
```
ReplaceAll[%, {kr → Sqrt[0.01283462537560516`],
  γ'r → -6.1599157711868955`, Q2r → 0.6598231849612674`}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to 0.0385039 - 0.56645\,k_i - 3\,k_i^2,\ k_i \to 0.991118,\right.$$
$$\beta \to 8.74851,\ \eta^* \to \frac{178.036}{\eta},\ \mu^* \to \frac{247.32}{\mu},\ 0.0128346 \to 0.0128346,$$
$$\left.-6.15992 \to -6.15992,\ 0.659823 \to 0.659823,\ 6.8171 \to 6.8171,\ -1.13687\times 10^{-13}\right\}$$

In[•]:=
```
ReplaceAll[%, {ki → 0.9911184493673615`, β → 8.748507371478683`,
  η* → 178.03586557962788`/η, μ* → 247.320185920484`/μ}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ \gamma'_i \to 0,\ \omega_r \to 0,\ \omega_i \to -3.46986,\ 0.991118 \to 0.991118,\ 8.74851 \to 8.74851,\right.$$
$$\frac{178.036}{\eta} \to \frac{178.036}{\eta},\ \frac{247.32}{\mu} \to \frac{247.32}{\mu},\ 0.0128346 \to 0.0128346,$$
$$\left.-6.15992 \to -6.15992,\ 0.659823 \to 0.659823,\ 6.8171 \to 6.8171,\ -1.13687\times 10^{-13}\right\}$$

In[8]:=
$$\left\{\left\{A[x,t]\,A^*[x,t] \to \frac{e^{2\,x\,k_r+2\,t\,\omega_r}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{e^{2\,x\,k_r+2\,t\,\omega_r}\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}\right\}$$

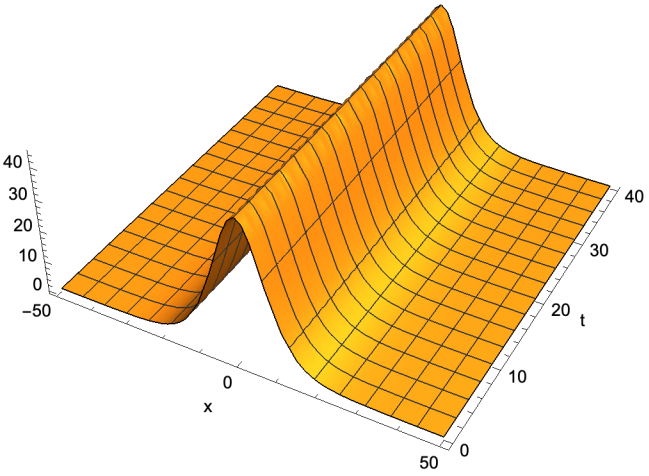
Out[8]=
$$\left\{\left\{A[x,t]\,A^*[x,t] \to \frac{e^{2\,x\,k_r+2\,t\,\omega_r}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{e^{2\,x\,k_r+2\,t\,\omega_r}\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}\right\}$$

In[9]:=
```
ReplaceAll[%, {α → 8.748507371478683`, P'i → 6.817101079155266`,
  kr → Sqrt[0.01283462537560516`], γ'r → -6.1599157711868955`,
  Q2r → 0.6598231849612674`, ki → 0.9911184493673615`, β → 8.748507371478683`,
  η* → 178.03586557962788`/η, μ* → 247.320185920484`/μ, γi → 0, γ'i → 0,
  ωr → 0, ωi → -3.4698625394455194`, Ω1 → 0, K1 → 0, Ω2 → 0, K2 → 0}]
```

Out[9]=
$$\left\{\left\{A[x,t]\,A^*[x,t] \to \frac{178.036\,e^{0.22658\,x}}{\left(1+e^{0.22658\,x}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{247.32\,e^{0.22658\,x}}{\left(1+e^{0.22658\,x}\right)^2}\right\}\right\}$$

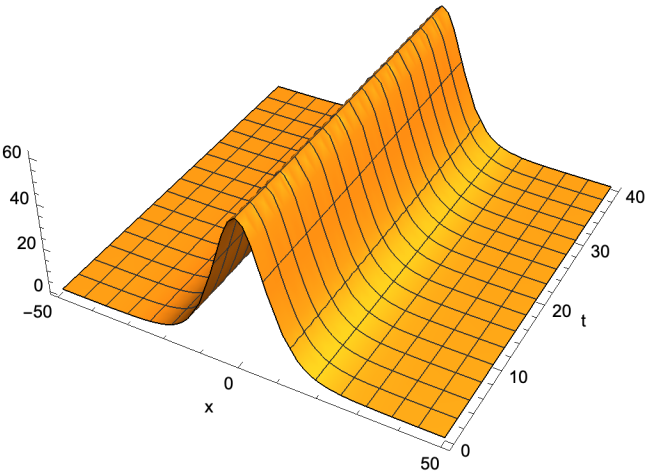
In[11]:=
```
Plot3D[178.03586557962788` e^(0.22658001125964453` x) / (1 + e^(0.22658001125964453` x))^2, {x, -50, 50}, {t, 0, 40},
 {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[11]=



In[12]:=
```
Plot3D[247.320185920484` e^(0.22658001125964453` x) / (1 + e^(0.22658001125964453` x))^2, {x, -50, 50}, {t, 0, 40},
 {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[12]=



Solution Dark – Dark

Case 1

$$\{\Omega_1 \to K_1^2 P_r - \gamma_i - \eta Q_{1r} \eta^* - \mu Q_{2r} \mu^*,\ \Omega_2 \to K_2^2 P'_r - \gamma'_i - \eta Q'_{1r} \eta^* - \mu Q'_{2r} \mu^*,\ \omega \to 2k(k\alpha - K_1) P_r,$$
$$\Gamma_r \to \gamma_i + \eta Q_{1r} \eta^* + \mu Q_{2r} \mu^*,\ \Gamma_i \to -\gamma_r + \eta Q_{1i} \eta^* + \mu Q_{2i} \mu^*,\ \Gamma_{2r} \to \gamma'_i + \eta Q'_{1r} \eta^* + \mu Q'_{2r} \mu^*,$$
$$\Gamma_{2i} \to -\gamma'_r + \eta Q'_{1i} \eta^* + \mu Q'_{2i} \mu^*,\ \eta^* \to \frac{k^2 P_r \left(\left(-2+\alpha^2\right) Q_{2i} + 3\alpha Q_{2r}\right)}{\eta \left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right)},$$
$$\mu^* \to -\frac{k^2 P_r \left(\left(-2+\alpha^2\right) Q_{1i} + 3\alpha Q_{1r}\right)}{\mu \left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right)},\ k^2 \to -\frac{\gamma_r}{3\alpha P_r},\ K_2 \to k\beta + \frac{(-k\alpha + K_1) P_r}{P'_r},\ P_i \to 0,$$
$$P'_i \to 0,\ \gamma'_r \to \frac{\gamma_r \left(-\left(\left(-2+\alpha^2\right) Q_{2i} + 3\alpha Q_{2r}\right) Q'_{1i} + \left(-2+\alpha^2\right) Q_{1i} Q'_{2i} + 3\alpha Q_r Q'_{2i}\right)}{3\alpha \left(Q_{2i} Q_r - Q_i Q_{2r}\right)},$$
$$\alpha^2 \left(Q_{1i} Q'_{2r} - Q_{2i} Q'_{1r}\right) P_r + 3\alpha \left(Q_{1r} Q'_{2r} - Q_{2r} Q'_{1r}\right) P_r + \beta^2 \left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right) P'_r +$$
$$2 \left(Q_{1i} Q_{2r} - Q_{2i} Q_{1r}\right) P'_r + 2 \left(Q_{2i} Q'_{1r} - Q_{1i} Q'_{2r}\right) P_r \to 0,\ \alpha^2 P_r \left(Q_{2i} Q'_{1i} - Q_{1i} Q'_{2i}\right) +$$
$$3\alpha P_r \left(Q_{2r} Q'_{1i} - Q_{1r} Q'_{2i}\right) + 3\beta \left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right) P'_r + 2 P_r \left(Q_{1i} Q'_{2i} - Q_{2i} Q'_{1i}\right) \to 0\}$$

In[•]:=
```
Solve[{α^2 ( Q1i Q'2r - Q2i Q'1r) Pr + 3 α ( Q1r Q'2r - Q2r Q'1r) Pr +
    β^2 ( Q2i Q1r - Q1i Q2r) P'r + 2 (Q1i Q2r - Q2i Q1r) P'r + 2 (Q2i Q'1r - Q1i Q'2r) Pr == 0,
  α^2 Pr (Q2i Q'1i - Q1i Q'2i) + 3 α Pr ( Q2r Q'1i - Q1r Q'2i) +
    3 β (Q2i Q1r - Q1i Q2r) P'r + 2 Pr ( Q1i Q'2i - Q2i Q'1i) == 0}, {α, β}]
```

Out[•]=

$$\left\{\left\{\alpha \to -\frac{3\left(Q_{2r} Q'_i - Q_r Q'_{2i}\right)}{2\left(Q_{2i} Q'_i - Q_i Q'_{2i}\right)} - \frac{1}{2}\sqrt{\cdots 1 \cdots} - \frac{1}{2}\sqrt{\frac{18\left(Q_{2r} Q'_i - Q_r Q'_{2i}\right)^2}{\left(Q_{2i} Q'_i - Q_i Q'_{2i}\right)^2} - \frac{\cdots 1 \cdots}{P_r \cdots 1 \cdots^2} - \cdots 1 \cdots - \cdots 1 \cdots - \frac{\cdots 1 \cdots}{\cdots 1 \cdots} - \frac{-\frac{216\left(Q \cdots 1 \cdots - \cdots 1 \cdots\right)^3}{\left(Q_2 \cdots 1 \cdots - \cdots 1 \cdots\right)^3} + \frac{24\left(\cdots 1 \cdots\right)\left(\cdots 1 \cdots + \cdots 13 \cdots\right)}{P_r \left(\cdots 1 \cdots\right)^3} + \frac{24\left(\cdots 1 \cdots\right)}{P_r \left(\cdots 1 \cdots\right)^2}}{4\sqrt{\frac{9\left(Q \cdots 1 \cdots - \cdots 1 \cdots\right)^2}{\left(Q \cdots 1 \cdots - \cdots 1 \cdots\right)^2} - \frac{\cdots 1 \cdots}{P_r \left(\cdots 1 \cdots\right)^2} + \cdots 1 \cdots + \frac{2 \cdots 1 \cdots}{3\left(\cdots 1 \cdots\right) \cdots 1 \cdots} + \frac{\left(\cdots 1 \cdots\right)^{1/3}}{3 \cdot 2^{1/3} \left(\cdots 1 \cdots\right)}}}\right\},\ \beta \to \cdots 1 \cdots\right\},\ \cdots 2 \cdots,\ \left\{\cdots 1 \cdots\right\}\right\}$$

large output | show less | show more | show all | set size limit...

In[•]:=
```
ReplaceAll[%, {Pr → 2, P'r → 3`, Q1r → 1, Q1i → 2.4`, Q'1r → 0.6`, Q'1i → -3, Q'2r → -0.5,
  Q'2i → 2.25, γr → 1.5, γi → 1.75, γ'i → 1.25, Q2r → -1.25, Q2i → 1.75}]
```

Out[•]=
```
{{α → 0.201528 - 0.481815 i, β → -1.13435 + 0.00467606 i},
 {α → 0.201528 + 0.481815 i, β → -1.13435 - 0.00467606 i},
 {α → -2.14401, β → 1.7452}, {α → 2.58602, β → 1.7911}}
```

```
Only {α → -2.144007467651334`, β → 1.7451982704913325`}
```

In[•]:=
$$\left\{\Omega_1 \to K_1^2 P_r - \gamma_i - \eta Q_{1r} \eta^* - \mu Q_{2r} \mu^*,\ \Omega_2 \to K_2^2 P'_r - \gamma'_i - \eta Q'_{1r} \eta^* - \mu Q'_{2r} \mu^*,\ \omega \to 2k\left(k\alpha - K_1\right) P_r,\right.$$
$$\Gamma_r \to \gamma_i + \eta Q_{1r} \eta^* + \mu Q_{2r} \mu^*,\ \Gamma_i \to -\gamma_r + \eta Q_{1i} \eta^* + \mu Q_{2i} \mu^*,\ \Gamma_{2r} \to \gamma'_i + \eta Q'_{1r} \eta^* + \mu Q'_{2r} \mu^*,$$
$$\Gamma_{2i} \to -\gamma'_r + \eta Q'_{1i} \eta^* + \mu Q'_{2i} \mu^*,\ \eta^* \to \frac{k^2 P_r\left(\left(-2+\alpha^2\right) Q_{2i} + 3\alpha Q_{2r}\right)}{\eta\left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right)},$$
$$\mu^* \to -\frac{k^2 P_r\left(\left(-2+\alpha^2\right) Q_{1i} + 3\alpha Q_{1r}\right)}{\mu\left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right)},\ k^2 \to -\frac{\gamma_r}{3\alpha P_r},\ K_2 \to k\beta + \frac{\left(-k\alpha + K_1\right) P_r}{P'_r},\ P_i \to 0,$$
$$P'_i \to 0,\ \gamma'_r \to \frac{\gamma_r\left(-\left(\left(-2+\alpha^2\right) Q_{2i} + 3\alpha Q_{2r}\right) Q'_{1i} + \left(-2+\alpha^2\right) Q_{1i} Q'_{2i} + 3\alpha Q_r Q'_{2i}\right)}{3\alpha\left(Q_{2i} Q_r - Q_i Q_{2r}\right)},$$
$$\alpha^2\left(Q_{1i} Q'_{2r} - Q_{2i} Q'_{1r}\right) P_r + 3\alpha\left(Q_{1r} Q'_{2r} - Q_{2r} Q'_{1r}\right) P_r + \beta^2\left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right) P'_r +$$
$$2\left(Q_{1i} Q_{2r} - Q_{2i} Q_{1r}\right) P'_r + 2\left(Q_{2i} Q'_{1r} - Q_{1i} Q'_{2r}\right) P_r \to 0,\ \alpha^2 P_r\left(Q_{2i} Q'_{1i} - Q_{1i} Q'_{2i}\right) +$$
$$\left.3\alpha P_r\left(Q_{2r} Q'_{1i} - Q_{1r} Q'_{2i}\right) + 3\beta\left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right) P'_r + 2 P_r\left(Q_{1i} Q'_{2i} - Q_{2i} Q'_{1i}\right) \to 0\right\}$$

Out[•]=
$$\left\{\Omega_1 \to K_1^2 P_r - \gamma_i - \eta Q_r \eta^* - \mu Q_{2r} \mu^*,\ \Omega_2 \to K_2^2 P'_r - \gamma'_i - \eta Q'_r \eta^* - \mu Q'_{2r} \mu^*,\ \omega \to 2k\left(k\alpha - K_1\right) P_r,\right.$$
$$\Gamma_r \to \gamma_i + \eta Q_r \eta^* + \mu Q_{2r} \mu^*,\ \Gamma_i \to -\gamma_r + \eta Q_i \eta^* + \mu Q_{2i} \mu^*,\ \Gamma_{2r} \to \gamma'_i + \eta Q'_r \eta^* + \mu Q'_{2r} \mu^*,$$
$$\Gamma_{2i} \to -\gamma'_r + \eta Q'_i \eta^* + \mu Q'_{2i} \mu^*,\ \eta^* \to \frac{k^2 P_r\left(\left(-2+\alpha^2\right) Q_{2i} + 3\alpha Q_{2r}\right)}{\eta\left(Q_{2i} Q_r - Q_i Q_{2r}\right)},$$
$$\mu^* \to -\frac{k^2 P_r\left(\left(-2+\alpha^2\right) Q_i + 3\alpha Q_r\right)}{\mu\left(Q_{2i} Q_r - Q_i Q_{2r}\right)},\ k^2 \to -\frac{\gamma_r}{3\alpha P_r},\ K_2 \to k\beta + \frac{\left(-k\alpha + K_1\right) P_r}{P'_r},\ P_i \to 0,$$
$$P'_i \to 0,\ \gamma'_r \to \frac{\gamma_r\left(\left(-\left(-2+\alpha^2\right) Q_{2i} - 3\alpha Q_{2r}\right) Q'_i + \left(-2+\alpha^2\right) Q_i Q'_{2i} + 3\alpha Q_r Q'_{2i}\right)}{3\alpha\left(Q_{2i} Q_r - Q_i Q_{2r}\right)},$$
$$\beta^2\left(Q_{2i} Q_r - Q_i Q_{2r}\right) P'_r + 2\left(-Q_{2i} Q_r + Q_i Q_{2r}\right) P'_r + 2 P_r\left(Q_{2i} Q'_r - Q_i Q'_{2r}\right) +$$
$$\alpha^2 P_r\left(-Q_{2i} Q'_r + Q_i Q'_{2r}\right) + 3\alpha P_r\left(-Q_{2r} Q'_r + Q_r Q'_{2r}\right) \to 0,\ 3\beta\left(Q_{2i} Q_r - Q_i Q_{2r}\right) P'_r +$$
$$\left.\alpha^2 P_r\left(Q_{2i} Q'_i - Q_i Q'_{2i}\right) + 2 P_r\left(-Q_{2i} Q'_i + Q_i Q'_{2i}\right) + 3\alpha P_r\left(Q_{2r} Q'_i - Q_r Q'_{2i}\right) \to 0\right\}$$

In[•]:=
```
ReplaceAll[%, {P_r → 2, P'_r → 3`, Q_1r → 1, Q_1i → 2.4`, Q'_1r → 0.6`, Q'_1i → -3, Q'_2r → -0.5,
  Q'_2i → 2.25, γ_r → 1.5, γ_i → 1.75, γ'_i → 1.25, Q_2r → -1.25, Q_2i → 1.75}]
```

Out[•]=
$$\left\{\Omega_1 \to -1.75 + 2 K_1^2 - \eta \eta^* + 1.25 \mu \mu^*,\ \Omega_2 \to -1.25 + 3. K_2^2 - 0.6 \eta \eta^* + 0.5 \mu \mu^*,\ \omega \to 4k\left(k\alpha - K_1\right),\right.$$
$$\Gamma_r \to 1.75 + \eta \eta^* - 1.25 \mu \mu^*,\ \Gamma_i \to -1.5 + 2.4 \eta \eta^* + 1.75 \mu \mu^*,\ \Gamma_{2r} \to 1.25 + 0.6 \eta \eta^* - 0.5 \mu \mu^*,$$
$$\Gamma_{2i} \to -\gamma'_r - 3 \eta \eta^* + 2.25 \mu \mu^*,\ \eta^* \to \frac{0.421053 k^2\left(-3.75\alpha + 1.75\left(-2+\alpha^2\right)\right)}{\eta},$$
$$\mu^* \to -\frac{0.421053 k^2\left(3\alpha + 2.4\left(-2+\alpha^2\right)\right)}{\mu},\ k^2 \to -\frac{0.25}{\alpha},\ K_2 \to k\beta + 0.666667\left(-k\alpha + K_1\right),$$
$$P_i \to 0,\ P'_i \to 0,\ \gamma'_r \to \frac{0.105263\left(6.75\alpha + 5.4\left(-2+\alpha^2\right) - 3\left(3.75\alpha - 1.75\left(-2+\alpha^2\right)\right)\right)}{\alpha},$$
$$\left.-19.5 + 1.5\alpha - 4.5\alpha^2 + 14.25\beta^2 \to 0,\ 42.6 + 9.\alpha - 21.3\alpha^2 + 42.75\beta \to 0\right\}$$

In[•]:= **ReplaceAll[%, {α → -2.144007467651334`, β → 1.7451982704913325`}]**

Out[•]= $\{\Omega_1 \to -1.75 + 2\,K_1^2 - \eta\,\eta^* + 1.25\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 - 0.6\,\eta\,\eta^* + 0.5\,\mu\,\mu^*,$
$\omega \to 4\,k\,\left(-2.14401\,k - K_1\right),\ \Gamma_r \to 1.75 + \eta\,\eta^* - 1.25\,\mu\,\mu^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^* + 1.75\,\mu\,\mu^*,$
$\Gamma_{2\,r} \to 1.25 + 0.6\,\eta\,\eta^* - 0.5\,\mu\,\mu^*,\ \Gamma_{2\,i} \to -\gamma'_r - 3\,\eta\,\eta^* + 2.25\,\mu\,\mu^*,\ \eta^* \to \frac{5.29868\,k^2}{\eta},$
$\mu^* \to \frac{0.0841175\,k^2}{\mu},\ k^2 \to 0.116604,\ K_2 \to 1.7452\,k + 0.666667\,\left(2.14401\,k + K_1\right),$
$P_i \to 0,\ P'_i \to 0,\ \gamma'_r \to -1.83148,\ -1.33468 \times 10^{-10} \to 0,\ 6.75016 \times 10^{-13} \to 0\}$

In[•]:= **ReplaceAll[%, k → Sqrt[0.11660407147455695`]]**

In[•]:= $\{\Omega_1 \to -1.75` + 2\,K_1^2 - \eta\,\eta^* + 1.25`\,\mu\,\mu^*,\ \Omega_2 \to -1.25` + 3.`\,K_2^2 - 0.6`\,\eta\,\eta^* + 0.5`\,\mu\,\mu^*,$
$\omega \to 1.3658935330372244`\,\left(-0.7321214837121183` - K_1\right),\ \Gamma_r \to 1.75` + \eta\,\eta^* - 1.25`\,\mu\,\mu^*,$
$\Gamma_i \to -1.5` + 2.4`\,\eta\,\eta^* + 1.75`\,\mu\,\mu^*,\ \Gamma_{2\,r} \to 1.25` + 0.6`\,\eta\,\eta^* - 0.5`\,\mu\,\mu^*,$
$\Gamma_{2\,i} \to -\gamma'_r - 3\,\eta\,\eta^* + 2.25`\,\mu\,\mu^*,\ \eta^* \to \frac{0.6178480071311616`}{\eta},$
$\mu^* \to \frac{0.009808447362978197`}{\mu},\ 0.11660407147455695` \to 0.11660407147455695`,$
$K_2 \to 0.5959387578829649` + 0.6666666666666666`\,\left(0.7321214837121183` + K_1\right),$
$P_i \to 0,\ P'_i \to 0,\ \gamma'_r \to -1.8314750148267838`,$
$-1.3346834748517722`*^-10 \to 0,\ 6.750155989720952`*^-13 \to 0\}$

Out[•]= $\{\Omega_1 \to -1.75 + 2\,K_1^2 - \eta\,\eta^* + 1.25\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 - 0.6\,\eta\,\eta^* + 0.5\,\mu\,\mu^*,$
$\omega \to 1.36589\,\left(-0.732121 - K_1\right),\ \Gamma_r \to 1.75 + \eta\,\eta^* - 1.25\,\mu\,\mu^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^* + 1.75\,\mu\,\mu^*,$
$\Gamma_{2\,r} \to 1.25 + 0.6\,\eta\,\eta^* - 0.5\,\mu\,\mu^*,\ \Gamma_{2\,i} \to -\gamma'_r - 3\,\eta\,\eta^* + 2.25\,\mu\,\mu^*,\ \eta^* \to \frac{0.617848}{\eta},$
$\mu^* \to \frac{0.00980845}{\mu},\ 0.116604 \to 0.116604,\ K_2 \to 0.595939 + 0.666667\,\left(0.732121 + K_1\right),$
$P_i \to 0,\ P'_i \to 0,\ \gamma'_r \to -1.83148,\ -1.33468 \times 10^{-10} \to 0,\ 6.75016 \times 10^{-13} \to 0\}$

In[•]:= **ReplaceAll[%, K₁ → 2.5]**

Out[•]= $\{\Omega_1 \to 10.75 - \eta\,\eta^* + 1.25\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 - 0.6\,\eta\,\eta^* + 0.5\,\mu\,\mu^*,\ \omega \to -4.41473,$
$\Gamma_r \to 1.75 + \eta\,\eta^* - 1.25\,\mu\,\mu^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^* + 1.75\,\mu\,\mu^*,\ \Gamma_{2\,r} \to 1.25 + 0.6\,\eta\,\eta^* - 0.5\,\mu\,\mu^*,$
$\Gamma_{2\,i} \to -\gamma'_r - 3\,\eta\,\eta^* + 2.25\,\mu\,\mu^*,\ \eta^* \to \frac{0.617848}{\eta},\ \mu^* \to \frac{0.00980845}{\mu},\ 0.116604 \to 0.116604,$
$K_2 \to 2.75069,\ P_i \to 0,\ P'_i \to 0,\ \gamma'_r \to -1.83148,\ -1.33468 \times 10^{-10} \to 0,\ 6.75016 \times 10^{-13} \to 0\}$

In[•]:=
$$\text{ReplaceAll}\left[\%, \left\{K_2 \to 2.750686413691043`, \eta^* \to \frac{0.6178480071311616`}{\eta}, \mu^* \to \frac{0.009808447362978197`}{\mu}, \gamma'_r \to -1.8314750148267838`\right\}\right]$$

Out[•]=
$$\left\{\Omega_1 \to 10.1444, \Omega_2 \to 21.083, \omega \to -4.41473, \Gamma_r \to 2.35559, \Gamma_i \to -3.26128 \times 10^{-16}, \Gamma_{2r} \to 1.6158, \Gamma_{2i} \to -1.31839 \times 10^{-16}, \frac{0.617848}{\eta} \to \frac{0.617848}{\eta}, \frac{0.00980845}{\mu} \to \frac{0.00980845}{\mu}, 0.116604 \to 0.116604, 2.75069 \to 2.75069, P_i \to 0, P'_i \to 0, -1.83148 \to -1.83148, -1.33468 \times 10^{-10} \to 0, 6.75016 \times 10^{-13} \to 0\right\}$$

$$\text{ReplaceAll}\left[\%, \left\{\Omega_1 \to 10.144412552072561`, \Omega_2 \to 21.083022658796274`, \omega \to -4.414733832593061`, \Gamma_r \to 2.355587447927439`, \Gamma_i \to -3.2612801348363973`*^-16, \Gamma_{2r} \to 1.6158045805972079`, \Gamma_{2i} \to -1.3183898417423734`*^-16, \alpha \to -2.144007467651334`, \beta \to 1.7451982704913325`, k \to \text{Sqrt}[0.11660407147455695`], K_1 \to 2.5, K_2 \to 2.750686413691043`, \eta^* \to \frac{0.6178480071311616`}{\eta}, \mu^* \to \frac{0.009808447362978197`}{\mu}, \gamma'_r \to -1.8314750148267838`, P_i \to 0, P'_i \to 0\right\}\right]$$

In[13]:=
$$\left\{A[x, t]\, A^*[x, t] \to \frac{\left(1 - e^{2(k x + t \omega)}\right)^2 \eta\, \eta^*}{\left(1 + e^{2(k x + t \omega)}\right)^2}, B[x, t]\, B^*[x, t] \to \frac{\left(1 - e^{2(k x + t \omega)}\right)^2 \mu\, \mu^*}{\left(1 + e^{2(k x + t \omega)}\right)^2}\right\}$$

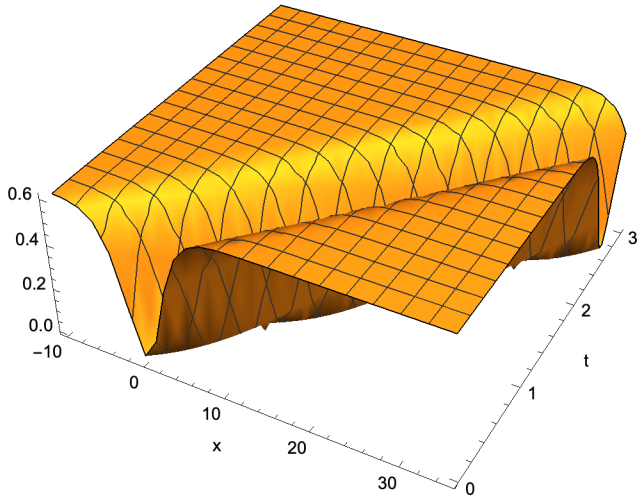
Out[13]=
$$\left\{A[x, t]\, A^*[x, t] \to \frac{\left(1 - e^{2(k x + t \omega)}\right)^2 \eta\, \eta^*}{\left(1 + e^{2(k x + t \omega)}\right)^2}, B[x, t]\, B^*[x, t] \to \frac{\left(1 - e^{2(k x + t \omega)}\right)^2 \mu\, \mu^*}{\left(1 + e^{2(k x + t \omega)}\right)^2}\right\}$$

In[14]:=
$$\text{ReplaceAll}\left[\%, \left\{\Omega_1 \to 10.144412552072561`, \Omega_2 \to 21.083022658796274`, \omega \to -4.414733832593061`, \Gamma_r \to 2.355587447927439`, \Gamma_i \to -3.2612801348363973`*^-16, \Gamma_{2r} \to 1.6158045805972079`, \Gamma_{2i} \to -1.3183898417423734`*^-16, \alpha \to -2.144007467651334`, \beta \to 1.7451982704913325`, k \to \text{Sqrt}[0.11660407147455695`], K_1 \to 2.5, K_2 \to 2.750686413691043`, \eta^* \to \frac{0.6178480071311616`}{\eta}, \mu^* \to \frac{0.009808447362978197`}{\mu}, \gamma'_r \to -1.8314750148267838`, P_i \to 0, P'_i \to 0\right\}\right]$$

Out[14]=
$$\left\{A[x, t]\, A^*[x, t] \to \frac{0.617848 \left(1 - e^{2(-4.41473 t + 0.341473 x)}\right)^2}{\left(1 + e^{2(-4.41473 t + 0.341473 x)}\right)^2}, B[x, t]\, B^*[x, t] \to \frac{0.00980845 \left(1 - e^{2(-4.41473 t + 0.341473 x)}\right)^2}{\left(1 + e^{2(-4.41473 t + 0.341473 x)}\right)^2}\right\}$$

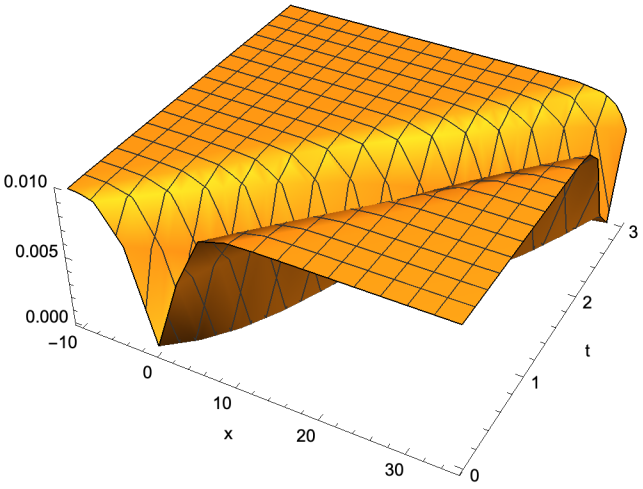
In[15]:=
```
Plot3D[0.6178480071311616` (1 - E^(2 (-4.414733832593061` t+0.3414733832593061` x)))^2 / (1 + E^(2 (-4.414733832593061` t+0.3414733832593061` x)))^2, {x, -10, 35},
 {t, 0, 3}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[15]=



In[16]:=
```
Plot3D[0.009808447362978197` (1 - E^(2 (-4.414733832593061` t+0.3414733832593061` x)))^2 / (1 + E^(2 (-4.414733832593061` t+0.3414733832593061` x)))^2, {x, -10, 35},
 {t, 0, 3}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[16]=



Subcase

In[•]:=
$$\left\{\Omega_1 \to K_1^2 P_r - \gamma_i - \eta Q_{1r} \eta^* - \mu Q_{2r} \mu^*,\ \Omega_2 \to K_2^2 P'_r - \gamma'_i - \eta Q'_{1r} \eta^* - \mu Q'_{2r} \mu^*,\ \omega \to 2k\left(k\alpha - K_1\right) P_r,\right.$$
$$\Gamma_r \to \gamma_i + \eta Q_{1r} \eta^* + \mu Q_{2r} \mu^*,\ \Gamma_i \to -\gamma_r + \eta Q_{1i} \eta^* + \mu Q_{2i} \mu^*,\ \Gamma_{2r} \to \gamma'_i + \eta Q'_{1r} \eta^* + \mu Q'_{2r} \mu^*,$$
$$\Gamma_{2i} \to -\gamma'_r + \eta Q'_{1i} \eta^* + \mu Q'_{2i} \mu^*,\ \eta^* \to \frac{k^2 P_r\left(\left(-2+\alpha^2\right) Q_{2i} + 3\alpha Q_{2r}\right)}{\eta\left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right)},$$
$$\mu^* \to -\frac{k^2 P_r\left(\left(-2+\alpha^2\right) Q_{1i} + 3\alpha Q_{1r}\right)}{\mu\left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right)},\ k^2 \to -\frac{\gamma_r}{3\alpha P_r},\ K_2 \to k\beta + \frac{\left(-k\alpha + K_1\right) P_r}{P'_r},\ P_i \to 0,$$
$$P'_i \to 0,\ \gamma'_r \to \frac{\gamma_r\left(-\left(\left(-2+\alpha^2\right) Q_{2i} + 3\alpha Q_{2r}\right) Q'_{1i} + \left(-2+\alpha^2\right) Q_{1i} Q'_{2i} + 3\alpha Q_r Q'_{2i}\right)}{3\alpha\left(Q_{2i} Q_r - Q_i Q_{2r}\right)},$$
$$\alpha^2\left(Q_{1i} Q'_{2r} - Q_{2i} Q'_{1r}\right) P_r + 3\alpha\left(Q_{1r} Q'_{2r} - Q_{2r} Q'_{1r}\right) P_r + \beta^2\left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right) P'_r +$$
$$2\left(Q_{1i} Q_{2r} - Q_{2i} Q_{1r}\right) P'_r + 2\left(Q_{2i} Q'_{1r} - Q_{1i} Q'_{2r}\right) P_r \to 0,\ \alpha^2 P_r\left(Q_{2i} Q'_{1i} - Q_{1i} Q'_{2i}\right) +$$
$$\left.3\alpha P_r\left(Q_{2r} Q'_{1i} - Q_{1r} Q'_{2i}\right) + 3\beta\left(Q_{2i} Q_{1r} - Q_{1i} Q_{2r}\right) P'_r + 2 P_r\left(Q_{1i} Q'_{2i} - Q_{2i} Q'_{1i}\right) \to 0\right\}$$

Out[•]=
$$\left\{\Omega_1 \to K_1^2 P_r - \gamma_i - \eta Q_r \eta^* - \mu Q_{2r} \mu^*,\ \Omega_2 \to K_2^2 P'_r - \gamma'_i - \eta Q'_r \eta^* - \mu Q'_{2r} \mu^*,\ \omega \to 2k\left(k\alpha - K_1\right) P_r,\right.$$
$$\Gamma_r \to \gamma_i + \eta Q_r \eta^* + \mu Q_{2r} \mu^*,\ \Gamma_i \to -\gamma_r + \eta Q_i \eta^* + \mu Q_{2i} \mu^*,\ \Gamma_{2r} \to \gamma'_i + \eta Q'_r \eta^* + \mu Q'_{2r} \mu^*,$$
$$\Gamma_{2i} \to -\gamma'_r + \eta Q'_i \eta^* + \mu Q'_{2i} \mu^*,\ \eta^* \to \frac{k^2 P_r\left(\left(-2+\alpha^2\right) Q_{2i} + 3\alpha Q_{2r}\right)}{\eta\left(Q_{2i} Q_r - Q_i Q_{2r}\right)},$$
$$\mu^* \to -\frac{k^2 P_r\left(\left(-2+\alpha^2\right) Q_i + 3\alpha Q_r\right)}{\mu\left(Q_{2i} Q_r - Q_i Q_{2r}\right)},\ k^2 \to -\frac{\gamma_r}{3\alpha P_r},\ K_2 \to k\beta + \frac{\left(-k\alpha + K_1\right) P_r}{P'_r},\ P_i \to 0,$$
$$P'_i \to 0,\ \gamma'_r \to \frac{\gamma_r\left(\left(-\left(-2+\alpha^2\right) Q_{2i} - 3\alpha Q_{2r}\right) Q'_i + \left(-2+\alpha^2\right) Q_i Q'_{2i} + 3\alpha Q_r Q'_{2i}\right)}{3\alpha\left(Q_{2i} Q_r - Q_i Q_{2r}\right)},$$
$$\beta^2\left(Q_{2i} Q_r - Q_i Q_{2r}\right) P'_r + 2\left(-Q_{2i} Q_r + Q_i Q_{2r}\right) P'_r + 2 P_r\left(Q_{2i} Q'_r - Q_i Q'_{2r}\right) +$$
$$\alpha^2 P_r\left(-Q_{2i} Q'_r + Q_i Q'_{2r}\right) + 3\alpha P_r\left(-Q_{2r} Q'_r + Q_r Q'_{2r}\right) \to 0,\ 3\beta\left(Q_{2i} Q_r - Q_i Q_{2r}\right) P'_r +$$
$$\left.\alpha^2 P_r\left(Q_{2i} Q'_i - Q_i Q'_{2i}\right) + 2 P_r\left(-Q_{2i} Q'_i + Q_i Q'_{2i}\right) + 3\alpha P_r\left(Q_{2r} Q'_i - Q_r Q'_{2i}\right) \to 0\right\}$$

In[•]:=
```
ReplaceAll[%, {P_r → 2, P'_r → 3`, Q_1r → 1, Q_1i → 2.4`, Q'_1r → 0.6`, Q'_1i → -3, γ_r → 1.5,
  γ_i → 1.75, γ'_i → 1.25, Q_2r → -1.25, Q_2i → 1.75, Q'_2i → 3.75`, Q'_2r → -0.75`}]
```

Out[•]=
$$\left\{\Omega_1 \to -1.75 + 2 K_1^2 - \eta \eta^* + 1.25 \mu \mu^*,\ \Omega_2 \to -1.25 + 3. K_2^2 - 0.6 \eta \eta^* + 0.75 \mu \mu^*,\ \omega \to 4k\left(k\alpha - K_1\right),\right.$$
$$\Gamma_r \to 1.75 + \eta \eta^* - 1.25 \mu \mu^*,\ \Gamma_i \to -1.5 + 2.4 \eta \eta^* + 1.75 \mu \mu^*,\ \Gamma_{2r} \to 1.25 + 0.6 \eta \eta^* - 0.75 \mu \mu^*,$$
$$\Gamma_{2i} \to -\gamma'_r - 3 \eta \eta^* + 3.75 \mu \mu^*,\ \eta^* \to \frac{0.421053 k^2\left(-3.75\alpha + 1.75\left(-2+\alpha^2\right)\right)}{\eta},$$
$$\mu^* \to -\frac{0.421053 k^2\left(3\alpha + 2.4\left(-2+\alpha^2\right)\right)}{\mu},\ k^2 \to -\frac{0.25}{\alpha},\ K_2 \to k\beta + 0.666667\left(-k\alpha + K_1\right),$$
$$P_i \to 0,\ P'_i \to 0,\ \gamma'_r \to \frac{0.105263\left(11.25\alpha + 9.\left(-2+\alpha^2\right) - 3\left(3.75\alpha - 1.75\left(-2+\alpha^2\right)\right)\right)}{\alpha},$$
$$\left.-17.1 - 5.7\alpha^2 + 14.25\beta^2 \to 0,\ 57. - 28.5\alpha^2 + 42.75\beta \to 0\right\}$$

In[•]:= **ReplaceAll[%, {α → -2.1490753463338934`, β → 1.7456832294800957`}]**

Out[•]= $\{\Omega_1 \to -1.75 + 2\,K_1^2 - \eta\,\eta^* + 1.25\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 - 0.6\,\eta\,\eta^* + 0.75\,\mu\,\mu^*,$
$\omega \to 4\,k\,\left(-2.14908\,k - K_1\right),\ \Gamma_r \to 1.75 + \eta\,\eta^* - 1.25\,\mu\,\mu^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^* + 1.75\,\mu\,\mu^*,$
$\Gamma_{2\,r} \to 1.25 + 0.6\,\eta\,\eta^* - 0.75\,\mu\,\mu^*,\ \Gamma_{2\,i} \to -\gamma'_r - 3\,\eta\,\eta^* + 3.75\,\mu\,\mu^*,\ \eta^* \to \frac{5.32272\,k^2}{\eta},$
$\mu^* \to \frac{0.0685332\,k^2}{\mu},\ k^2 \to 0.116329,\ K_2 \to 1.74568\,k + 0.666667\,\left(2.14908\,k + K_1\right),$
$P_i \to 0,\ P'_i \to 0,\ \gamma'_r \to -1.82766,\ -7.10543 \times 10^{-15} \to 0,\ -2.84217 \times 10^{-14} \to 0\}$

In[•]:= **ReplaceAll[%, {k → Sqrt[0.11632909959461164`], γ'r → -1.8276638243655008`, K1 → 5}]**

Out[•]= $\{\Omega_1 \to 48.25 - \eta\,\eta^* + 1.25\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 - 0.6\,\eta\,\eta^* + 0.75\,\mu\,\mu^*,$
$\omega \to -7.82141,\ \Gamma_r \to 1.75 + \eta\,\eta^* - 1.25\,\mu\,\mu^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^* + 1.75\,\mu\,\mu^*,$
$\Gamma_{2\,r} \to 1.25 + 0.6\,\eta\,\eta^* - 0.75\,\mu\,\mu^*,\ \Gamma_{2\,i} \to 1.82766 - 3\,\eta\,\eta^* + 3.75\,\mu\,\mu^*,$
$\eta^* \to \frac{0.619187}{\eta},\ \mu^* \to \frac{0.00797241}{\mu},\ 0.116329 \to 0.116329,\ K_2 \to 4.41739,\ P_i \to 0,$
$P'_i \to 0,\ -1.82766 \to -1.82766,\ -7.10543 \times 10^{-15} \to 0,\ -2.84217 \times 10^{-14} \to 0\}$

In[•]:= **ReplaceAll[%, {η* → 0.6191867854483949` / η, μ* → 0.00797240852791569` / μ}]**

Out[•]= $\{\Omega_1 \to 47.6408,\ \Omega_2 \to -1.61553 + 3.\,K_2^2,\ \omega \to -7.82141,\ \Gamma_r \to 2.35922,$
$\Gamma_i \to 7.11237 \times 10^{-17},\ \Gamma_{2\,r} \to 1.61553,\ \Gamma_{2\,i} \to -1.66533 \times 10^{-16},\ \frac{0.619187}{\eta} \to \frac{0.619187}{\eta},$
$\frac{0.00797241}{\mu} \to \frac{0.00797241}{\mu},\ 0.116329 \to 0.116329,\ K_2 \to 4.41739,\ P_i \to 0,$
$P'_i \to 0,\ -1.82766 \to -1.82766,\ -7.10543 \times 10^{-15} \to 0,\ -2.84217 \times 10^{-14} \to 0\}$

In[•]:= **ReplaceAll[%, {K2 → 4.4173919173435685`}]**

Out[•]= $\{\Omega_1 \to 47.6408,\ \Omega_2 \to 56.9245,\ \omega \to -7.82141,\ \Gamma_r \to 2.35922,$
$\Gamma_i \to 7.11237 \times 10^{-17},\ \Gamma_{2\,r} \to 1.61553,\ \Gamma_{2\,i} \to -1.66533 \times 10^{-16},\ \frac{0.619187}{\eta} \to \frac{0.619187}{\eta},$
$\frac{0.00797241}{\mu} \to \frac{0.00797241}{\mu},\ 0.116329 \to 0.116329,\ 4.41739 \to 4.41739,\ P_i \to 0,$
$P'_i \to 0,\ -1.82766 \to -1.82766,\ -7.10543 \times 10^{-15} \to 0,\ -2.84217 \times 10^{-14} \to 0\}$

ReplaceAll[%,
{α → -2.1490753463338934`, β → 1.7456832294800957`, k → Sqrt[153.26683828438394`],
η* → 0.0016483143240671406` / η, μ* → 0.0016639194761265542` / μ,
K1 → 5, K2 → 21.6248760069397`, γ'r → -4.598004125481732`*^-7,
Pi → 0, P'i → 0, Ω1 → 47.640778725211504`, Ω2 → 56.92452128936377`,
ω → -7.821410399458799`, Γr → 2.3592212747885`, Γi → 7.112366251504909`*^-17,
Γ2r → 1.6155327648731002`, Γ2i → -1.6653345369377348`*^-16}]

In[17]:=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{\left(1-e^{2\,(k\,x+t\,\omega)}\right)^2 \eta\,\eta^*}{\left(1+e^{2\,(k\,x+t\,\omega)}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,(k\,x+t\,\omega)}\right)^2 \mu\,\mu^*}{\left(1+e^{2\,(k\,x+t\,\omega)}\right)^2}\right\}$$

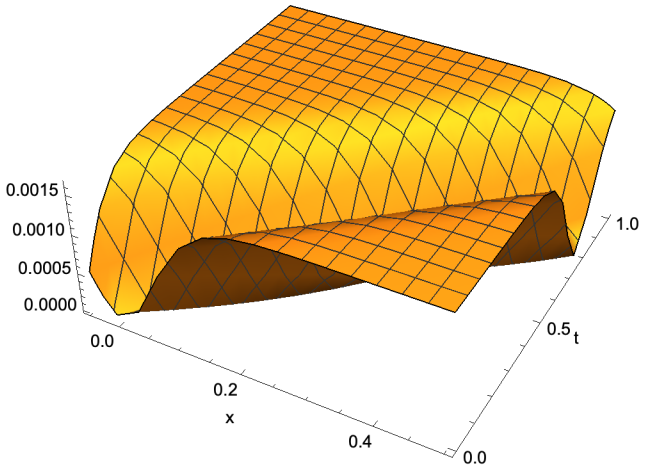
Out[17]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{\left(1-e^{2\,(k\,x+t\,\omega)}\right)^2 \eta\,\eta^*}{\left(1+e^{2\,(k\,x+t\,\omega)}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,(k\,x+t\,\omega)}\right)^2 \mu\,\mu^*}{\left(1+e^{2\,(k\,x+t\,\omega)}\right)^2}\right\}$$

In[18]:=
```
ReplaceAll[%,
 {α → -2.1490753463338934`, β → 1.7456832294800957`, k → Sqrt[153.26683828438394`],
  η* → 0.0016483143240671406`/η, μ* → 0.0016639194761265542`/μ,
  K1 → 5, K2 → 21.6248760069397`, γ'r → -4.598004125481732`*^-7,
  Pi → 0, P'i → 0, Ω1 → 47.640778725211504`, Ω2 → 56.92452128936377`,
  ω → -7.821410399458799`, Γr → 2.3592212747885`, Γi → 7.112366251504909`*^-17,
  Γ2r → 1.6155327648731002`, Γ2i → -1.6653345369377348`*^-16}]
```

Out[18]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{0.00164831\left(1-e^{2\,(-7.82141\,t+12.3801\,x)}\right)^2}{\left(1+e^{2\,(-7.82141\,t+12.3801\,x)}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.00166392\left(1-e^{2\,(-7.82141\,t+12.3801\,x)}\right)^2}{\left(1+e^{2\,(-7.82141\,t+12.3801\,x)}\right)^2}\right\}$$

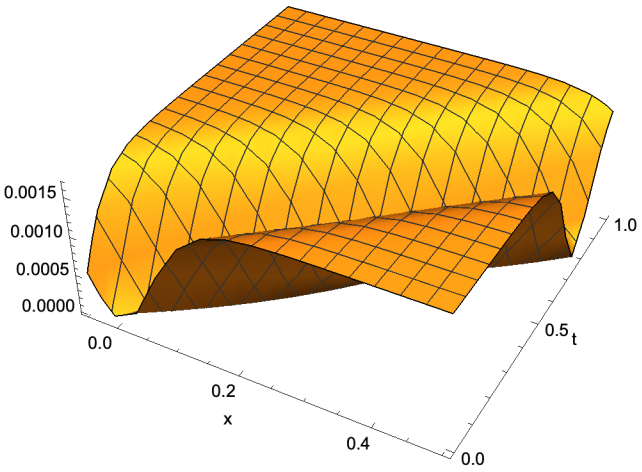
In[19]:=
```
Plot3D[0.0016483143240671406` (1 - e^(2 (-7.821410399458799` t+12.380098476360514` x)))^2/
  (1 + e^(2 (-7.821410399458799` t+12.380098476360514` x)))^2,
 {x, -0.05, 0.5}, {t, 0, 1}, {PlotRange → All},
 Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[19]=



In[20]:=
```
Plot3D[0.0016639194761265542` (1 - E^(2 (-7.821410399458799` t+12.380098476360514` x)))^2 /
  (1 + E^(2 (-7.821410399458799` t+12.380098476360514` x)))^2,
 {x, -0.05, 0.5}, {t, 0, 1}, {PlotRange → All},
 Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[20]=



Case 2

Solution Kink - Kink or Front - Front

```
ReplaceAll[%, {A[x, t] → G[x, t]/f[x, t]^m Exp[I (K1 x - Ω1 t)],
  B[x, t] → H[x, t]/f[x, t]^n Exp[I (K2 x - Ω2 t)], A*[x, t] → G*[x, t]/f[x, t]^{m*} Exp[-I (K1 x - Ω1 t)],
  B*[x, t] → H*[x, t]/f[x, t]^{n*} Exp[-I (K2 x - Ω2 t)]}]
```

```
ReplaceAll[%, {G[x, t] → η , G*[x, t] → η*, H[x, t] → μ Exp[k x + ω t],
  H*[x, t] → μ* Exp[k x + ω t], f[x, t] → 1 + Exp[k x + ω t]}]
```

Solution

$$\left\{\left\{\Gamma_r \to \gamma_i + \eta\, Q_r\, \eta^*,\ \Gamma_i \to -\gamma_r + \eta\, Q_i\, \eta^*,\ \Gamma_{2\,i} \to -\gamma'_r + \eta\, Q'_i\, \eta^*,\ \Gamma_{2\,r} \to \gamma'_i + \eta\, Q'_r\, \eta^*,\right.\right.$$
$$\Omega_1 \to K_1^2\, P_r - \gamma_i - \eta\, Q_r\, \eta^*,\ \Omega_2 \to 2\, k\, K_2\, P'_i - k^2\, P'_r + K_2^2\, P'_r - \gamma'_i - \eta\, Q'_r\, \eta^*,$$
$$\omega \to k\left(k\, P_i + \left(k\,\alpha - 2\, K_1\right) P_r\right),\ \mu^* \to \frac{\eta\, Q_r\, \eta^*}{\mu\, Q_{2\,r}},\ Q_{2\,i} \to \frac{Q_i\, Q_{2\,r}}{Q_r},\ Q'_r \to \frac{Q_r\, Q'_{2\,r}}{Q_{2\,r}},$$
$$Q'_i \to \frac{Q_r\, Q'_{2\,i}}{Q_{2\,r}},\ K_1 \to \frac{1}{2}\, k\left(\alpha - \frac{P_r}{P_i}\right),\ K_2 \to \frac{1}{2}\, k\left(\beta + \frac{P'_r}{P'_i}\right),\ \eta^* \to \frac{k^2\left(3\,\alpha\, P_i + \left(-2 + \alpha^2\right) P_r\right)}{2\,\eta\, Q_r},$$
$$k^2 \to -\frac{4\, P_i\, Q_r\, \gamma_r}{P_r^2\, Q_r + \alpha\, P_i^2\left(-6\, Q_i + \alpha\, Q_r\right) - 2\, P_i\, P_r\left(\left(-2 + \alpha^2\right) Q_i + \alpha\, Q_r\right)},$$
$$\gamma'_r \to -\left(\left(Q_r\,\gamma_r\left(4\, P_r^2\, Q_{2\,r}\, P'_i + 2\, P_i^2\, P'_i\left(2\, Q_{2\,r} + 3\,\alpha\, Q'_{2\,i}\right) + \right.\right.\right.$$
$$\left.\left.\left. P_i\left(\left(4 - \beta^2\right) Q_{2\,r}\left(P'\right)_i^2 + 3\, Q_{2\,r}\left(P'\right)_r^2 + 2\, P'_i\left(\beta\, Q_{2\,r}\, P'_r + \left(-2 + \alpha^2\right) P_r\, Q'_{2\,i}\right)\right)\right)\right) \Big/$$
$$\left.\left.\left(P_r^2\, Q_r + \alpha\, P_i^2\left(-6\, Q_i + \alpha\, Q_r\right) - 2\, P_i\, P_r\left(\left(-2 + \alpha^2\right) Q_i + \alpha\, Q_r\right)\right) Q_{2\,r}\, P'_i\right)\right),$$
$$Q_{2\,r} \to \frac{\left(3\,\alpha\, P_i + \left(-2 + \alpha^2\right) P_r\right) Q'_{2\,i}}{\left(-2 + \beta^2\right) P'_i - 3\,\beta\, P'_r},\ -3\,\alpha\, P_i\, Q_i + 2\, P_r\, Q_i - \alpha^2\, P_r\, Q_i - 2\, P_i\, Q_r + \alpha^2\, P_i\, Q_r - 3\,\alpha\, P_r\, Q_r \to$$
$$0,\ P_i^2\, P'_i + P_r^2\, P'_i + P_i\left(P'\right)_i^2 + P_i\left(P'\right)_r^2 \to 0,$$
$$-3\,\beta\, P'_i\, Q'_{2\,i} + 2\, P'_r\, Q'_{2\,i} - \beta^2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r} + \beta^2\, P'_i\, Q'_{2\,r} - 3\,\beta\, P'_r\, Q'_{2\,r} \to 0,$$
$$\left\{\alpha \to \frac{3\, P_i\, Q_i + 3\, P_r\, Q_r - \sqrt{-4\left(2\, P_r\, Q_i - 2\, P_i\, Q_r\right)\left(-P_r\, Q_i + P_i\, Q_r\right) + \left(-3\, P_i\, Q_i - 3\, P_r\, Q_r\right)^2}}{2\left(-P_r\, Q_i + P_i\, Q_r\right)}\right\},$$
$$\left\{\alpha \to \frac{3\, P_i\, Q_i + 3\, P_r\, Q_r + \sqrt{-4\left(2\, P_r\, Q_i - 2\, P_i\, Q_r\right)\left(-P_r\, Q_i + P_i\, Q_r\right) + \left(-3\, P_i\, Q_i - 3\, P_r\, Q_r\right)^2}}{2\left(-P_r\, Q_i + P_i\, Q_r\right)}\right\},$$
$$\left\{\beta \to \frac{1}{2\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right)}\left(3\, P'_i\, Q'_{2\,i} + 3\, P'_r\, Q'_{2\,r} - \right.$$
$$\left.\sqrt{-4\left(2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r}\right)\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right) + \left(-3\, P'_i\, Q'_{2\,i} - 3\, P'_r\, Q'_{2\,r}\right)^2}\right)\Big\},$$
$$\left\{\beta \to \frac{1}{2\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right)}\left(3\, P'_i\, Q'_{2\,i} + 3\, P'_r\, Q'_{2\,r} + \right.\right.$$
$$\left.\left.\sqrt{-4\left(2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r}\right)\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right) + \left(-3\, P'_i\, Q'_{2\,i} - 3\, P'_r\, Q'_{2\,r}\right)^2}\right)\right\},$$
$$\left\{P_i \to \frac{-\left(P'\right)_i^2 - \left(P'\right)_r^2 - \sqrt{-4\, P_r^2\left(P'\right)_i^2 + \left(\left(P'\right)_i^2 + \left(P'\right)_r^2\right)^2}}{2\, P'_i}\right\},$$
$$\left.\left\{P_i \to \frac{-\left(P'\right)_i^2 - \left(P'\right)_r^2 + \sqrt{-4\, P_r^2\left(P'\right)_i^2 + \left(\left(P'\right)_i^2 + \left(P'\right)_r^2\right)^2}}{2\, P'_i}\right\}\right\}$$

In[•]:=
```
ReplaceAll[%, {P_r → 2, P'_r → 3`, P'_i → 0.6`, Q_1r → -1,
  Q_1i → 2.4`, γ_r → 1.5, γ_i → 1.75, γ'_i → 1.25, Q'_2i → 3.75`, Q'_2r → -0.75`}]
```

In[•]:=
$$\left\{\left\{\Gamma_r \to 1.75` - \eta\,\eta^*,\ \Gamma_i \to -1.5` + 2.4`\,\eta\,\eta^*,\ \Gamma_{2\,i} \to -\gamma'_r + \eta\,Q'_i\,\eta^*,\ \Gamma_{2\,r} \to 1.25` + \eta\,Q'_r\,\eta^*,\right.\right.$$
$$\Omega_1 \to -1.75` + 2\,K_1^2 + \eta\,\eta^*,\ \Omega_2 \to -1.25` - 3.`\,k^2 + 1.2`\,k\,K_2 + 3.`\,K_2^2 - \eta\,Q'_r\,\eta^*,$$
$$\omega \to k\left(2\left(k\,\alpha - 2\,K_1\right) + k\,P_i\right),\ \mu^* \to -\frac{\eta\,\eta^*}{\mu\,Q_{2\,r}},\ Q_{2\,i} \to -2.4`\,Q_{2\,r},\ Q'_r \to \frac{0.75`}{Q_{2\,r}},$$
$$Q'_i \to -\frac{3.75`}{Q_{2\,r}},\ K_1 \to \frac{1}{2}k\left(\alpha - \frac{2}{P_i}\right),\ K_2 \to \frac{1}{2}k\left(5.` + \beta\right),\ \eta^* \to -\frac{k^2\left(2\left(-2+\alpha^2\right) + 3\,\alpha\,P_i\right)}{2\,\eta},$$
$$k^2 \to \frac{6.`\,P_i}{-4 - 4\left(-\alpha + 2.4`\left(-2+\alpha^2\right)\right)P_i + \left(-14.399999999999999` - \alpha\right)\alpha\,P_i^2},$$
$$\gamma'_r \to \left(2.5`\left(9.6`\,Q_{2\,r} + 1.2`\,P_i^2\left(11.25`\,\alpha + 2\,Q_{2\,r}\right) + \right.\right.$$
$$\left.\left.P_i\left(27.`\,Q_{2\,r} + 0.36`\left(4-\beta^2\right)Q_{2\,r} + 1.2`\left(7.5`\left(-2+\alpha^2\right) + 3.`\,\beta\,Q_{2\,r}\right)\right)\right)\right) /$$
$$\left(\left(-4 - 4\left(-\alpha + 2.4`\left(-2+\alpha^2\right)\right)P_i + \left(-14.399999999999999` - \alpha\right)\alpha\,P_i^2\right)Q_{2\,r}\right),$$
$$Q_{2\,r} \to \frac{3.75`\left(2\left(-2+\alpha^2\right) + 3\,\alpha\,P_i\right)}{-9.`\,\beta + 0.6`\left(-2+\beta^2\right)},$$
$$9.6` + 6\,\alpha - 4.8`\,\alpha^2 + 2\,P_i - 7.199999999999999`\,\alpha\,P_i - \alpha^2\,P_i \to 0,$$
$$2.4` + 9.36`\,P_i + 0.6`\,P_i^2 \to 0,\ 23.4` + 8.881784197001252`*^-16\,\beta - 11.7`\,\beta^2 \to 0,$$
$$\left\{\alpha \to \frac{1}{2\left(-4.8` - P_i\right)}\left(-6 + 7.199999999999999`\,P_i - \right.\right.$$
$$\left.\left.\sqrt{\left(6 - 7.199999999999999`\,P_i\right)^2 - 4\left(-4.8` - P_i\right)\left(9.6` + 2\,P_i\right)}\right)\right\},$$
$$\left\{\alpha \to \frac{1}{2\left(-4.8` - P_i\right)}\left(-6 + 7.199999999999999`\,P_i + \right.\right.$$
$$\left.\left.\sqrt{\left(6 - 7.199999999999999`\,P_i\right)^2 - 4\left(-4.8` - P_i\right)\left(9.6` + 2\,P_i\right)}\right)\right\},$$
$$\{\beta \to 1.414213562373095`\},\ \{\beta \to -1.414213562373095`\},$$
$$\left.\left.\{P_i \to -15.339230729988305`\},\ \{P_i \to -0.2607692700116952`\}\right\}\right\}$$

Out[•]=

$$\Big\{\Big\{\Gamma_r \to 1.75 - \eta\,\eta^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^*,\ \Gamma_{2i} \to -\gamma'_r + \eta\,Q'_i\,\eta^*,\ \Gamma_{2r} \to 1.25 + \eta\,Q'_r\,\eta^*,$$
$$\Omega_1 \to -1.75 + 2\,K_1^2 + \eta\,\eta^*,\ \Omega_2 \to -1.25 - 3.\,k^2 + 1.2\,k\,K_2 + 3.\,K_2^2 - \eta\,Q'_r\,\eta^*,$$
$$\omega \to k\left(2\left(k\,\alpha - 2\,K_1\right) + k\,P_i\right),\ \mu^* \to -\frac{\eta\,\eta^*}{\mu\,Q_{2r}},\ Q_{2i} \to -2.4\,Q_{2r},$$
$$Q'_r \to \frac{0.75}{Q_{2r}},\ Q'_i \to -\frac{3.75}{Q_{2r}},\ K_1 \to \frac{1}{2}k\left(\alpha - \frac{2}{P_i}\right),\ K_2 \to \frac{1}{2}k\,(5. + \beta),$$
$$\eta^* \to -\frac{k^2\left(2\left(-2+\alpha^2\right) + 3\,\alpha\,P_i\right)}{2\,\eta},\ k^2 \to \frac{6.\,P_i}{-4 - 4\left(-\alpha + 2.4\left(-2+\alpha^2\right)\right)P_i + (-14.4-\alpha)\,\alpha\,P_i^2},$$
$$\gamma'_r \to \Big(2.5\Big(9.6\,Q_{2r} + 1.2\,P_i^2\left(11.25\,\alpha + 2\,Q_{2r}\right) +$$
$$P_i\left(27.\,Q_{2r} + 0.36\left(4-\beta^2\right)Q_{2r} + 1.2\left(7.5\left(-2+\alpha^2\right) + 3.\,\beta\,Q_{2r}\right)\right)\Big)\Big) \Big/$$
$$\left(\left(-4 - 4\left(-\alpha + 2.4\left(-2+\alpha^2\right)\right)P_i + (-14.4-\alpha)\,\alpha\,P_i^2\right)Q_{2r}\right),\ Q_{2r} \to \frac{3.75\left(2\left(-2+\alpha^2\right) + 3\,\alpha\,P_i\right)}{-9.\,\beta + 0.6\left(-2+\beta^2\right)},$$
$$9.6 + 6\,\alpha - 4.8\,\alpha^2 + 2\,P_i - 7.2\,\alpha\,P_i - \alpha^2\,P_i \to 0,\ 2.4 + 9.36\,P_i + 0.6\,P_i^2 \to 0,$$
$$23.4 + 8.88178 \times 10^{-16}\,\beta - 11.7\,\beta^2 \to 0,$$
$$\left\{\alpha \to \frac{-6 + 7.2\,P_i - \sqrt{\left(6 - 7.2\,P_i\right)^2 - 4\left(-4.8 - P_i\right)\left(9.6 + 2\,P_i\right)}}{2\left(-4.8 - P_i\right)}\right\},$$
$$\left\{\alpha \to \frac{-6 + 7.2\,P_i + \sqrt{\left(6 - 7.2\,P_i\right)^2 - 4\left(-4.8 - P_i\right)\left(9.6 + 2\,P_i\right)}}{2\left(-4.8 - P_i\right)}\right\},$$
$$\{\beta \to 1.41421\},\ \{\beta \to -1.41421\},\ \{P_i \to -15.3392\},\ \{P_i \to -0.260769\}\Big\}\Big\}$$

In[•]:=
```
ReplaceAll[%, {Pi → -15.339230729988305`}]
```

In[•]:=
```
{{Γr → 1.75` - η η*, Γi → -1.5` + 2.4` η η*, Γ2i → -γ'r + η Q'i η*, Γ2r → 1.25` + η Q'r η*,
  Ω1 → -1.75` + 2 K1^2 + η η*, Ω2 → -1.25` - 3.` k^2 + 1.2` k K2 + 3.` K2^2 - η Q'r η*,
  ω → k (-15.339230729988305` k + 2 (k α - 2 K1)), μ* → -η η*/(μ Q2r), Q2i → -2.4` Q2r,
  Q'r → 0.75`/Q2r, Q'i → -3.75`/Q2r, K1 → 1/2 k (0.13038463500584718` + α),
  K2 → 1/2 k (5.` + β), η* → -(k^2 (-46.01769218996492` α + 2 (-2 + α^2)))/(2 η),
  k^2 → -(92.03538437992984` / (-4 + 235.29199938781755` (-14.399999999999999` - α) α +
       61.35692291995322` (-α + 2.4` (-2 + α^2)))),
  γ'r → (2.5` (9.6` Q2r + 282.35039926538104` (11.25` α + 2 Q2r) - 15.339230729988305`
       (27.` Q2r + 0.36` (4 - β^2) Q2r + 1.2` (7.5` (-2 + α^2) + 3.` β Q2r)))) /
    ((-4 + 235.29199938781755` (-14.399999999999999` - α) α +
       61.35692291995322` (-α + 2.4` (-2 + α^2))) Q2r),
  Q2r → (3.75` (-46.01769218996492` α + 2 (-2 + α^2)))/(-9.` β + 0.6` (-2 + β^2)),
  -21.07846145997661` + 116.44246125591579` α + 10.539230729988304` α^2 → 0,
  0.` → 0, 23.4` + 8.881784197001252`*^-16 β - 11.7` β^2 → 0,
  {α → -11.226626139110028`}, {α → 0.1781479115112448`},
  {β → 1.414213562373095`}, {β → -1.414213562373095`},
  {-15.339230729988305` → -15.339230729988305`},
  {-15.339230729988305` → -0.2607692700116952`}}}
```

Out[•]=
```
{{Γr → 1.75 - η η*, Γi → -1.5 + 2.4 η η*, Γ2i → -γ'r + η Q'i η*, Γ2r → 1.25 + η Q'r η*,
  Ω1 → -1.75 + 2 K1^2 + η η*, Ω2 → -1.25 - 3. k^2 + 1.2 k K2 + 3. K2^2 - η Q'r η*,
  ω → k (-15.3392 k + 2 (k α - 2 K1)), μ* → -η η*/(μ Q2r), Q2i → -2.4 Q2r, Q'r → 0.75/Q2r, Q'i → -3.75/Q2r,
  K1 → 1/2 k (0.130385 + α), K2 → 1/2 k (5. + β), η* → -(k^2 (-46.0177 α + 2 (-2 + α^2)))/(2 η),
  k^2 → -92.0354/(-4 + 235.292 (-14.4 - α) α + 61.3569 (-α + 2.4 (-2 + α^2))),
  γ'r → (2.5 (9.6 Q2r + 282.35 (11.25 α + 2 Q2r) -
       15.3392 (27. Q2r + 0.36 (4 - β^2) Q2r + 1.2 (7.5 (-2 + α^2) + 3. β Q2r)))) /
    ((-4 + 235.292 (-14.4 - α) α + 61.3569 (-α + 2.4 (-2 + α^2))) Q2r),
  Q2r → (3.75 (-46.0177 α + 2 (-2 + α^2)))/(-9. β + 0.6 (-2 + β^2)), -21.0785 + 116.442 α + 10.5392 α^2 → 0,
  0. → 0, 23.4 + 8.88178 × 10^-16 β - 11.7 β^2 → 0, {α → -11.2266},
  {α → 0.178148}, {β → 1.41421}, {β → -1.41421},
  {-15.3392 → -15.3392}, {-15.3392 → -0.260769}}}
```

In[•]:= **ReplaceAll[%, {α → 0.1781479115112448`, β → -1.414213562373095`}]**

Out[•]= $\left\{\left\{\Gamma_r \to 1.75 - \eta\,\eta^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^*,\ \Gamma_{2i} \to -\gamma'_r + \eta\,Q'_i\,\eta^*,\ \Gamma_{2r} \to 1.25 + \eta\,Q'_r\,\eta^*,\right.\right.$
$\Omega_1 \to -1.75 + 2\,K_1^2 + \eta\,\eta^*,\ \Omega_2 \to -1.25 - 3.\,k^2 + 1.2\,k\,K_2 + 3.\,K_2^2 - \eta\,Q'_r\,\eta^*,$
$\omega \to k\left(-15.3392\,k + 2\left(0.178148\,k - 2\,K_1\right)\right),\ \mu^* \to -\frac{\eta\,\eta^*}{\mu\,Q_{2r}},\ Q_{2i} \to -2.4\,Q_{2r},$
$Q'_r \to \frac{0.75}{Q_{2r}},\ Q'_i \to -\frac{3.75}{Q_{2r}},\ K_1 \to 0.154266\,k,\ K_2 \to 1.79289\,k,\ \eta^* \to \frac{6.06724\,k^2}{\eta},$
$k^2 \to 0.100493,\ \gamma'_r \to -\frac{1}{Q_{2r}}0.00272974\left(9.6\,Q_{2r} + 282.35\left(2.00416 + 2\,Q_{2r}\right) -\right.$
$\left.15.3392\left(1.2\left(-14.762 - 4.24264\,Q_{2r}\right) + 27.72\,Q_{2r}\right)\right),\ Q_{2r} \to -3.57516,$
$5.38458 \times 10^{-15} \to 0,\ 0. \to 0,\ 3.55271 \times 10^{-15} \to 0,\ \{0.178148 \to -11.2266\},$
$\{0.178148 \to 0.178148\},\ \{-1.41421 \to 1.41421\},\ \{-1.41421 \to -1.41421\},$
$\left.\left.\{-15.3392 \to -15.3392\},\ \{-15.3392 \to -0.260769\}\right\}\right\}$

In[•]:= **ReplaceAll[%, Q$_{2r}$ → -3.5751561628522968`]**

Out[•]= $\left\{\left\{\Gamma_r \to 1.75 - \eta\,\eta^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^*,\ \Gamma_{2i} \to -\gamma'_r + \eta\,Q'_i\,\eta^*,\ \Gamma_{2r} \to 1.25 + \eta\,Q'_r\,\eta^*,\right.\right.$
$\Omega_1 \to -1.75 + 2\,K_1^2 + \eta\,\eta^*,\ \Omega_2 \to -1.25 - 3.\,k^2 + 1.2\,k\,K_2 + 3.\,K_2^2 - \eta\,Q'_r\,\eta^*,$
$\omega \to k\left(-15.3392\,k + 2\left(0.178148\,k - 2\,K_1\right)\right),\ \mu^* \to \frac{0.279708\,\eta\,\eta^*}{\mu},$
$Q_{2i} \to 8.58037,\ Q'_r \to -0.209781,\ Q'_i \to 1.04891,\ K_1 \to 0.154266\,k,$
$K_2 \to 1.79289\,k,\ \eta^* \to \frac{6.06724\,k^2}{\eta},\ k^2 \to 0.100493,\ \gamma'_r \to 0.019359,$
$-3.57516 \to -3.57516,\ 5.38458 \times 10^{-15} \to 0,\ 0. \to 0,\ 3.55271 \times 10^{-15} \to 0,$
$\{0.178148 \to -11.2266\},\ \{0.178148 \to 0.178148\},\ \{-1.41421 \to 1.41421\},$
$\left.\left.\{-1.41421 \to -1.41421\},\ \{-15.3392 \to -15.3392\},\ \{-15.3392 \to -0.260769\}\right\}\right\}$

In[•]:= **ReplaceAll[%,**
{Q$_{2i}$ → 8.580374790845513`, Q'$_r$ → -0.209781046152021`, Q'$_i$ → 1.048905230760105`}]

Out[•]= $\left\{\left\{\Gamma_r \to 1.75 - \eta\,\eta^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^*,\ \Gamma_{2i} \to -\gamma'_r + 1.04891\,\eta\,\eta^*,\ \Gamma_{2r} \to 1.25 - 0.209781\,\eta\,\eta^*,\right.\right.$
$\Omega_1 \to -1.75 + 2\,K_1^2 + \eta\,\eta^*,\ \Omega_2 \to -1.25 - 3.\,k^2 + 1.2\,k\,K_2 + 3.\,K_2^2 + 0.209781\,\eta\,\eta^*,$
$\omega \to k\left(-15.3392\,k + 2\left(0.178148\,k - 2\,K_1\right)\right),\ \mu^* \to \frac{0.279708\,\eta\,\eta^*}{\mu},$
$8.58037 \to 8.58037,\ -0.209781 \to -0.209781,\ 1.04891 \to 1.04891,$
$K_1 \to 0.154266\,k,\ K_2 \to 1.79289\,k,\ \eta^* \to \frac{6.06724\,k^2}{\eta},\ k^2 \to 0.100493,\ \gamma'_r \to 0.019359,$
$-3.57516 \to -3.57516,\ 5.38458 \times 10^{-15} \to 0,\ 0. \to 0,\ 3.55271 \times 10^{-15} \to 0,$
$\{0.178148 \to -11.2266\},\ \{0.178148 \to 0.178148\},\ \{-1.41421 \to 1.41421\},$
$\left.\left.\{-1.41421 \to -1.41421\},\ \{-15.3392 \to -15.3392\},\ \{-15.3392 \to -0.260769\}\right\}\right\}$

In[•]:=
```
ReplaceAll[%, {k → Sqrt[0.10049293010631864`], γ'r → 0.019359027106311898`}]
```

Out[•]=
$$\left\{\left\{\Gamma_r \to 1.75 - \eta\,\eta^*,\ \Gamma_i \to -1.5 + 2.4\,\eta\,\eta^*,\right.\right.$$
$$\Gamma_{2i} \to -0.019359 + 1.04891\,\eta\,\eta^*,\ \Gamma_{2r} \to 1.25 - 0.209781\,\eta\,\eta^*,$$
$$\Omega_1 \to -1.75 + 2\,K_1^2 + \eta\,\eta^*,\ \Omega_2 \to -1.55148 + 0.380407\,K_2 + 3.\,K_2^2 + 0.209781\,\eta\,\eta^*,$$
$$\omega \to 0.317006\left(-4.86263 + 2\left(0.056474 - 2\,K_1\right)\right),\ \mu^* \to \frac{0.279708\,\eta\,\eta^*}{\mu},$$
$$8.58037 \to 8.58037,\ -0.209781 \to -0.209781,\ 1.04891 \to 1.04891,\ K_1 \to 0.0489034,$$
$$K_2 \to 0.568358,\ \eta^* \to \frac{0.609715}{\eta},\ 0.100493 \to 0.100493,\ 0.019359 \to 0.019359,$$
$$-3.57516 \to -3.57516,\ 5.38458 \times 10^{-15} \to 0,\ 0. \to 0,\ 3.55271 \times 10^{-15} \to 0,$$
$$\{0.178148 \to -11.2266\},\ \{0.178148 \to 0.178148\},\ \{-1.41421 \to 1.41421\},$$
$$\left.\left.\{-1.41421 \to -1.41421\},\ \{-15.3392 \to -15.3392\},\ \{-15.3392 \to -0.260769\}\right\}\right\}$$

In[•]:=
```
ReplaceAll[%,
  {K1 → 0.04890336489571538`, K2 → 0.5683582642314903`, η* → 0.60971484582254`/η}]
```

Out[•]=
$$\left\{\left\{\Gamma_r \to 1.14029,\ \Gamma_i \to -0.0366844,\ \Gamma_{2i} \to 0.620174,\ \Gamma_{2r} \to 1.12209,\right.\right.$$
$$\Omega_1 \to -1.1355,\ \Omega_2 \to -0.238271,\ \omega \to -1.56769,\ \mu^* \to \frac{0.170542}{\mu},\ 8.58037 \to 8.58037,$$
$$-0.209781 \to -0.209781,\ 1.04891 \to 1.04891,\ 0.0489034 \to 0.0489034,$$
$$0.568358 \to 0.568358,\ \frac{0.609715}{\eta} \to \frac{0.609715}{\eta},\ 0.100493 \to 0.100493,\ 0.019359 \to 0.019359,$$
$$-3.57516 \to -3.57516,\ 5.38458 \times 10^{-15} \to 0,\ 0. \to 0,\ 3.55271 \times 10^{-15} \to 0,$$
$$\{0.178148 \to -11.2266\},\ \{0.178148 \to 0.178148\},\ \{-1.41421 \to 1.41421\},$$
$$\left.\left.\{-1.41421 \to -1.41421\},\ \{-15.3392 \to -15.3392\},\ \{-15.3392 \to -0.260769\}\right\}\right\}$$

In[•]:=
```
ReplaceAll[%, {Γr → 1.1402851541774601`, Γi → -0.03668437002590408`,
  Γ2i → 0.6201740639490413`, Γ2r → 1.1220933817889294`, Ω1 → -1.135502075981213`,
  Ω2 → -0.23827111103561216`, ω → -1.567689709658571`, μ* → 0.17054215761476085`/μ}]
```

Out[•]=
$$\left\{\left\{1.14029 \to 1.14029,\ -0.0366844 \to -0.0366844,\ 0.620174 \to 0.620174,\ 1.12209 \to 1.12209,\right.\right.$$
$$-1.1355 \to -1.1355,\ -0.238271 \to -0.238271,\ -1.56769 \to -1.56769,$$
$$\frac{0.170542}{\mu} \to \frac{0.170542}{\mu},\ 8.58037 \to 8.58037,\ -0.209781 \to -0.209781,$$
$$1.04891 \to 1.04891,\ 0.0489034 \to 0.0489034,\ 0.568358 \to 0.568358,$$
$$\frac{0.609715}{\eta} \to \frac{0.609715}{\eta},\ 0.100493 \to 0.100493,\ 0.019359 \to 0.019359,$$
$$-3.57516 \to -3.57516,\ 5.38458 \times 10^{-15} \to 0,\ 0. \to 0,\ 3.55271 \times 10^{-15} \to 0,$$
$$\{0.178148 \to -11.2266\},\ \{0.178148 \to 0.178148\},\ \{-1.41421 \to 1.41421\},$$
$$\left.\left.\{-1.41421 \to -1.41421\},\ \{-15.3392 \to -15.3392\},\ \{-15.3392 \to -0.260769\}\right\}\right\}$$

```
ReplaceAll[%, {P_i → -15.339230729988305`, α → 0.1781479115112448`,
  β → -1.414213562373095`, Q_2r → -3.5751561628522968`, Q_2i → 8.580374790845513`,
  Q'_r → -0.209781046152021`, Q'_i → 1.048905230760105`, k → Sqrt[0.10049293010631864`],
  γ'_r → 0.019359027106311898`, K_1 → 0.04890336489571538`, K_2 → 0.5683582642314903`,
  η* → 0.60971484582254`/η, Γ_r → 1.1402851541774601`, Γ_i → -0.03668437002590408`,
  Γ_2i → 0.6201740639490413`, Γ_2r → 1.1220933817889294`, Ω_1 → -1.135502075981213`,
  Ω_2 → -0.23827111103561216`, ω → -1.567689709658571`, μ* → 0.17054215761476085`/μ}]
```

```
{Q_2i → 1.75, Q'_1r → 0.6`, Q'_1i → -3, P_i → 1.75}
```

In[53]:=
```
{A[x, t] A*[x, t] → e^(i (x K_1 - t Ω_1)) f[x, t]^(-1-i α) G[x, t] e^(-i (x K_1 - t Ω_1)) f[x, t]^(-1+i α) G*[x, t],
 B[x, t] B*[x, t] → e^(i (x K_2 - t Ω_2)) f[x, t]^(-1-i β) H[x, t] e^(-i (x K_2 - t Ω_2)) f[x, t]^(-1+i β) H*[x, t]}
```

Out[53]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{G[x,t]\,G^*[x,t]}{f[x,t]^2},\ B[x,t]\,B^*[x,t] \to \frac{H[x,t]\,H^*[x,t]}{f[x,t]^2}\right\}$$

In[54]:=
```
ReplaceAll[%, {G[x, t] → η , G*[x, t] → η*, H[x, t] → μ Exp[k x + ω t],
  H*[x, t] → μ* Exp[k x + ω t], f[x, t] → 1 + Exp[k x + ω t]}]
```

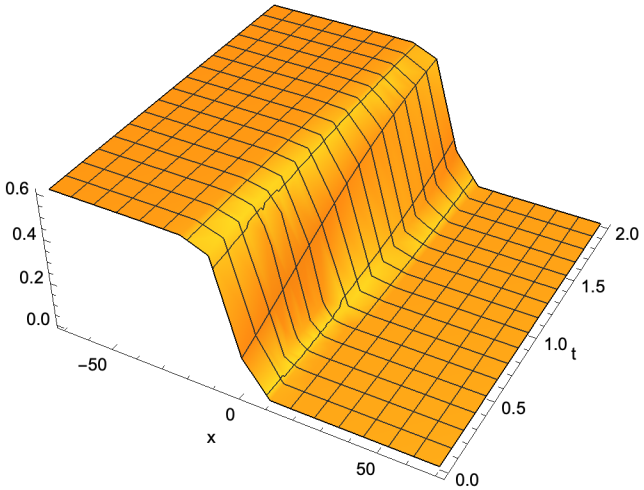
Out[54]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{\eta\,\eta^*}{\left(1+e^{k\,x+t\,\omega}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{e^{2\,k\,x+2\,t\,\omega}\,\mu\,\mu^*}{\left(1+e^{k\,x+t\,\omega}\right)^2}\right\}$$

In[55]:=
```
ReplaceAll[%, {P_i → -15.339230729988305`, α → 0.1781479115112448`,
  β → -1.414213562373095`, Q_2r → -3.5751561628522968`, Q_2i → 8.580374790845513`,
  Q'_r → -0.209781046152021`, Q'_i → 1.048905230760105`, k → Sqrt[0.10049293010631864`],
  γ'_r → 0.019359027106311898`, K_1 → 0.04890336489571538`, K_2 → 0.5683582642314903`,
  η* → 0.60971484582254`/η, Γ_r → 1.1402851541774601`, Γ_i → -0.03668437002590408`,
  Γ_2i → 0.6201740639490413`, Γ_2r → 1.1220933817889294`, Ω_1 → -1.135502075981213`,
  Ω_2 → -0.23827111103561216`, ω → -1.567689709658571`, μ* → 0.17054215761476085`/μ}]
```

Out[55]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{0.609715}{\left(1+e^{-1.56769\,t+0.317006\,x}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{0.170542\,e^{-3.13538\,t+0.634012\,x}}{\left(1+e^{-1.56769\,t+0.317006\,x}\right)^2}\right\}$$

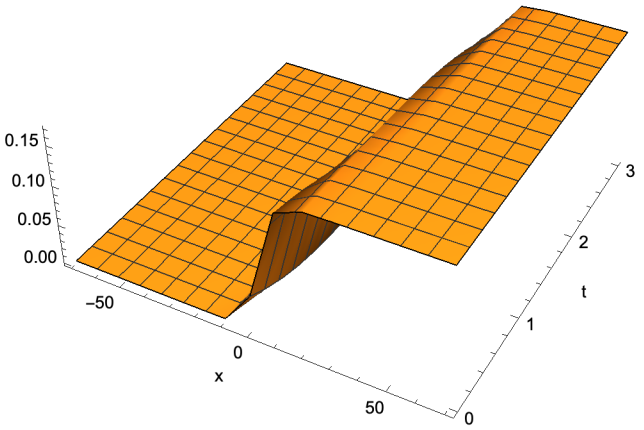
In[56]:=
```
Plot3D[0.60971484582254` / (1 + E^(-1.567689709658571` t + 0.31700619884525705` x))^2, {x, -70, 70}, {t, 0, 2},
 {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[56]=



In[57]:=
```
Plot3D[0.17054215761476085` E^(-3.135379419317142` t + 0.6340123976905141` x) / (1 + E^(-1.567689709658571` t + 0.31700619884525705` x))^2, {x, -70, 70},
 {t, 0, 3}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[57]=



Other Situation

In[•]:=

$$\Big\{\Big\{\Gamma_r \to \gamma_i + \eta\, Q_r\, \eta^*,\ \Gamma_i \to -\gamma_r + \eta\, Q_i\, \eta^*,\ \Gamma_{2\,i} \to -\gamma'_r + \eta\, Q'_i\, \eta^*,\ \Gamma_{2\,r} \to \gamma'_i + \eta\, Q'_r\, \eta^*,$$

$$\Omega_1 \to K_1^2\, P_r - \gamma_i - \eta\, Q_r\, \eta^*,\ \Omega_2 \to 2\, k\, K_2\, P'_i - k^2\, P'_r + K_2^2\, P'_r - \gamma'_i - \eta\, Q'_r\, \eta^*,$$

$$\omega \to k\left(k\, P_i + \left(k\,\alpha - 2\, K_1\right) P_r\right),\ \mu^* \to \frac{\eta\, Q_r\, \eta^*}{\mu\, Q_{2\,r}},\ Q_{2\,i} \to \frac{Q_i\, Q_{2\,r}}{Q_r},\ Q'_r \to \frac{Q_r\, Q'_{2\,r}}{Q_{2\,r}},$$

$$Q'_i \to \frac{Q_r\, Q'_{2\,i}}{Q_{2\,r}},\ K_1 \to \frac{1}{2}\, k\left(\alpha - \frac{P_r}{P_i}\right),\ K_2 \to \frac{1}{2}\, k\left(\beta + \frac{P'_r}{P'_i}\right),\ \eta^* \to \frac{k^2\left(3\,\alpha\, P_i + \left(-2 + \alpha^2\right) P_r\right)}{2\,\eta\, Q_r},$$

$$k^2 \to -\frac{4\, P_i\, Q_r\, \gamma_r}{P_r^2\, Q_r + \alpha\, P_i^2\left(-6\, Q_i + \alpha\, Q_r\right) - 2\, P_i\, P_r\left(\left(-2 + \alpha^2\right) Q_i + \alpha\, Q_r\right)},$$

$$\gamma'_r \to -\Big(\Big(Q_r\,\gamma_r\left(4\, P_r^2\, Q_{2\,r}\, P'_i + 2\, P_i^2\, P'_i\left(2\, Q_{2\,r} + 3\,\alpha\, Q'_{2\,i}\right) + P_i\left(\left(4 - \beta^2\right) Q_{2\,r}\left(P'\right)_i^2 + 3\, Q_{2\,r}\left(P'\right)_r^2 + 2\, P'_i\left(\beta\, Q_{2\,r}\, P'_r + \left(-2 + \alpha^2\right) P_r\, Q'_{2\,i}\right)\right)\right)\Big)\Big/$$

$$\left(\left(P_r^2\, Q_r + \alpha\, P_i^2\left(-6\, Q_i + \alpha\, Q_r\right) - 2\, P_i\, P_r\left(\left(-2 + \alpha^2\right) Q_i + \alpha\, Q_r\right)\right) Q_{2\,r}\, P'_i\right)\Big),$$

$$Q_{2\,r} \to \frac{\left(3\,\alpha\, P_i + \left(-2 + \alpha^2\right) P_r\right) Q'_{2\,i}}{\left(-2 + \beta^2\right) P'_i - 3\,\beta\, P'_r},\ -3\,\alpha\, P_i\, Q_i + 2\, P_r\, Q_i - \alpha^2\, P_r\, Q_i - 2\, P_i\, Q_r + \alpha^2\, P_i\, Q_r - 3\,\alpha\, P_r\, Q_r \to$$

$$0,\ P_i^2\, P'_i + P_r^2\, P'_i + P_i\left(P'\right)_i^2 + P_i\left(P'\right)_r^2 \to 0,$$

$$-3\,\beta\, P'_i\, Q'_{2\,i} + 2\, P'_r\, Q'_{2\,i} - \beta^2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r} + \beta^2\, P'_i\, Q'_{2\,r} - 3\,\beta\, P'_r\, Q'_{2\,r} \to 0,$$

$$\left\{\alpha \to \frac{3\, P_i\, Q_i + 3\, P_r\, Q_r - \sqrt{-4\left(2\, P_r\, Q_i - 2\, P_i\, Q_r\right)\left(-P_r\, Q_i + P_i\, Q_r\right) + \left(-3\, P_i\, Q_i - 3\, P_r\, Q_r\right)^2}}{2\left(-P_r\, Q_i + P_i\, Q_r\right)}\right\},$$

$$\left\{\alpha \to \frac{3\, P_i\, Q_i + 3\, P_r\, Q_r + \sqrt{-4\left(2\, P_r\, Q_i - 2\, P_i\, Q_r\right)\left(-P_r\, Q_i + P_i\, Q_r\right) + \left(-3\, P_i\, Q_i - 3\, P_r\, Q_r\right)^2}}{2\left(-P_r\, Q_i + P_i\, Q_r\right)}\right\},$$

$$\left\{\beta \to \frac{1}{2\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right)}\left(3\, P'_i\, Q'_{2\,i} + 3\, P'_r\, Q'_{2\,r} - \sqrt{-4\left(2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r}\right)\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right) + \left(-3\, P'_i\, Q'_{2\,i} - 3\, P'_r\, Q'_{2\,r}\right)^2}\right)\right\},$$

$$\left\{\beta \to \frac{1}{2\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right)}\left(3\, P'_i\, Q'_{2\,i} + 3\, P'_r\, Q'_{2\,r} + \sqrt{-4\left(2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r}\right)\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right) + \left(-3\, P'_i\, Q'_{2\,i} - 3\, P'_r\, Q'_{2\,r}\right)^2}\right)\right\},$$

$$\left\{P_i \to \frac{-\left(P'\right)_i^2 - \left(P'\right)_r^2 - \sqrt{-4\, P_r^2\left(P'\right)_i^2 + \left(\left(P'\right)_i^2 + \left(P'\right)_r^2\right)^2}}{2\, P'_i}\right\},$$

$$\left\{P_i \to \frac{-\left(P'\right)_i^2 - \left(P'\right)_r^2 + \sqrt{-4\, P_r^2\left(P'\right)_i^2 + \left(\left(P'\right)_i^2 + \left(P'\right)_r^2\right)^2}}{2\, P'_i}\right\}\Big\}\Big\}$$

Out[•]=

$$\Big\{\Big\{\Gamma_r \to \gamma_i + \eta\, Q_r\, \eta^*,\ \Gamma_i \to -\gamma_r + \eta\, Q_i\, \eta^*,\ \Gamma_{2\,i} \to -\gamma'_r + \eta\, Q'_i\, \eta^*,\ \Gamma_{2\,r} \to \gamma'_i + \eta\, Q'_r\, \eta^*,$$

$$\Omega_1 \to K_1^2\, P_r - \gamma_i - \eta\, Q_r\, \eta^*,\ \Omega_2 \to 2\, k\, K_2\, P'_i - k^2\, P'_r + K_2^2\, P'_r - \gamma'_i - \eta\, Q'_r\, \eta^*,$$

$$\omega \to k\,\left(k\, P_i + \left(k\,\alpha - 2\, K_1\right)\, P_r\right),\ \mu^* \to \frac{\eta\, Q_r\, \eta^*}{\mu\, Q_{2\,r}},\ Q_{2\,i} \to \frac{Q_i\, Q_{2\,r}}{Q_r},\ Q'_r \to \frac{Q_r\, Q'_{2\,r}}{Q_{2\,r}},$$

$$Q'_i \to \frac{Q_r\, Q'_{2\,i}}{Q_{2\,r}},\ K_1 \to \frac{1}{2}\, k\,\left(\alpha - \frac{P_r}{P_i}\right),\ K_2 \to \frac{1}{2}\, k\,\left(\beta + \frac{P'_r}{P'_i}\right),\ \eta^* \to \frac{k^2\,\left(3\,\alpha\, P_i + \left(-2+\alpha^2\right)\, P_r\right)}{2\,\eta\, Q_r},$$

$$k^2 \to -\frac{4\, P_i\, Q_r\, \gamma_r}{P_r^2\, Q_r + \alpha\, P_i^2\,\left(-6\, Q_i + \alpha\, Q_r\right) - 2\, P_i\, P_r\,\left(\left(-2+\alpha^2\right)\, Q_i + \alpha\, Q_r\right)},$$

$$\gamma'_r \to -\Big(\Big(Q_r\,\gamma_r\,\Big(4\, P_r^2\, Q_{2\,r}\, P'_i + 2\, P_i^2\, P'_i\,\left(2\, Q_{2\,r} + 3\,\alpha\, Q'_{2\,i}\right) +$$

$$P_i\,\Big(\left(4-\beta^2\right)\, Q_{2\,r}\,\left(P'\right)_i^2 + 3\, Q_{2\,r}\,\left(P'\right)_r^2 + 2\, P'_i\,\left(\beta\, Q_{2\,r}\, P'_r + \left(-2+\alpha^2\right)\, P_r\, Q'_{2\,i}\right)\Big)\Big)\Big) \Big/$$

$$\left(\left(P_r^2\, Q_r + \alpha\, P_i^2\,\left(-6\, Q_i + \alpha\, Q_r\right) - 2\, P_i\, P_r\,\left(\left(-2+\alpha^2\right)\, Q_i + \alpha\, Q_r\right)\right)\, Q_{2\,r}\, P'_i\right)\Big),$$

$$Q_{2\,r} \to \frac{\left(3\,\alpha\, P_i + \left(-2+\alpha^2\right)\, P_r\right)\, Q'_{2\,i}}{\left(-2+\beta^2\right)\, P'_i - 3\,\beta\, P'_r},\ -3\,\alpha\, P_i\, Q_i + 2\, P_r\, Q_i - \alpha^2\, P_r\, Q_i - 2\, P_i\, Q_r + \alpha^2\, P_i\, Q_r - 3\,\alpha\, P_r\, Q_r \to 0,$$

$$P_i^2\, P'_i + P_r^2\, P'_i + P_i\,\left(P'\right)_i^2 + P_i\,\left(P'\right)_r^2 \to 0,$$

$$-3\,\beta\, P'_i\, Q'_{2\,i} + 2\, P'_r\, Q'_{2\,i} - \beta^2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r} + \beta^2\, P'_i\, Q'_{2\,r} - 3\,\beta\, P'_r\, Q'_{2\,r} \to 0,$$

$$\left\{\alpha \to \frac{3\, P_i\, Q_i + 3\, P_r\, Q_r - \sqrt{-4\,\left(2\, P_r\, Q_i - 2\, P_i\, Q_r\right)\,\left(-P_r\, Q_i + P_i\, Q_r\right) + \left(-3\, P_i\, Q_i - 3\, P_r\, Q_r\right)^2}}{2\,\left(-P_r\, Q_i + P_i\, Q_r\right)}\right\},$$

$$\left\{\alpha \to \frac{3\, P_i\, Q_i + 3\, P_r\, Q_r + \sqrt{-4\,\left(2\, P_r\, Q_i - 2\, P_i\, Q_r\right)\,\left(-P_r\, Q_i + P_i\, Q_r\right) + \left(-3\, P_i\, Q_i - 3\, P_r\, Q_r\right)^2}}{2\,\left(-P_r\, Q_i + P_i\, Q_r\right)}\right\},$$

$$\left\{\beta \to \frac{1}{2\,\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right)}\left(3\, P'_i\, Q'_{2\,i} + 3\, P'_r\, Q'_{2\,r} -\right.$$

$$\left.\sqrt{-4\,\left(2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r}\right)\,\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right) + \left(-3\, P'_i\, Q'_{2\,i} - 3\, P'_r\, Q'_{2\,r}\right)^2}\right)\Big\},$$

$$\left\{\beta \to \frac{1}{2\,\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right)}\left(3\, P'_i\, Q'_{2\,i} + 3\, P'_r\, Q'_{2\,r} +\right.\right.$$

$$\left.\left.\sqrt{-4\,\left(2\, P'_r\, Q'_{2\,i} - 2\, P'_i\, Q'_{2\,r}\right)\,\left(-P'_r\, Q'_{2\,i} + P'_i\, Q'_{2\,r}\right) + \left(-3\, P'_i\, Q'_{2\,i} - 3\, P'_r\, Q'_{2\,r}\right)^2}\right)\Big\},$$

$$\left\{P_i \to \frac{-\left(P'\right)_i^2 - \left(P'\right)_r^2 - \sqrt{-4\, P_r^2\,\left(P'\right)_i^2 + \left(\left(P'\right)_i^2 + \left(P'\right)_r^2\right)^2}}{2\, P'_i}\right\},$$

$$\left\{P_i \to \frac{-\left(P'\right)_i^2 - \left(P'\right)_r^2 + \sqrt{-4\, P_r^2\,\left(P'\right)_i^2 + \left(\left(P'\right)_i^2 + \left(P'\right)_r^2\right)^2}}{2\, P'_i}\right\}\Big\}\Big\}$$

In[•]:=
```
ReplaceAll[%, {P_r → 0.0000011, P'_r → 0.0000013, P'_i → 0.0000023`, Q_1r → -0.7,
  Q_1i → 1.2`, γ_r → 1.5, γ_i → 1.75, γ'_i → 1.25, Q'_2i → 0.6`, Q'_2r → -0.5`}]
```

Out[•]=

$$\left\{\left\{\Gamma_r \to 1.75 - 0.7\,\eta\,\eta^*,\ \Gamma_i \to -1.5 + 1.2\,\eta\,\eta^*,\right.\right.$$
$$\Gamma_{2i} \to -\gamma'_r + \eta\,Q'_i\,\eta^*,\ \Gamma_{2r} \to 1.25 + \eta\,Q'_r\,\eta^*,\ \Omega_1 \to -1.75 + 1.1\times 10^{-6}\,K_1^2 + 0.7\,\eta\,\eta^*,$$
$$\Omega_2 \to -1.25 - 1.3\times 10^{-6}\,k^2 + 4.6\times 10^{-6}\,k\,K_2 + 1.3\times 10^{-6}\,K_2^2 - \eta\,Q'_r\,\eta^*,$$
$$\omega \to k\left(1.1\times 10^{-6}\left(k\,\alpha - 2\,K_1\right) + k\,P_i\right),\ \mu^* \to -\frac{0.7\,\eta\,\eta^*}{\mu\,Q_{2r}},$$
$$Q_{2i} \to -1.71429\,Q_{2r},\ Q'_r \to \frac{0.35}{Q_{2r}},\ Q'_i \to -\frac{0.42}{Q_{2r}},\ K_1 \to \frac{1}{2}k\left(\alpha - \frac{1.1\times 10^{-6}}{P_i}\right),$$
$$K_2 \to \frac{1}{2}k\left(0.565217 + \beta\right),\ \eta^* \to -\frac{0.714286\,k^2\left(1.1\times 10^{-6}\left(-2+\alpha^2\right) + 3\,\alpha\,P_i\right)}{\eta},$$
$$k^2 \to \frac{4.2\,P_i}{-8.47\times 10^{-13} - 2.2\times 10^{-6}\left(-0.7\,\alpha + 1.2\left(-2+\alpha^2\right)\right)P_i + \left(-7.2 - 0.7\,\alpha\right)\alpha\,P_i^2},$$
$$\gamma'_r \to \left(456\,522.\left(1.1132\times 10^{-17}\,Q_{2r} + 4.6\times 10^{-6}\,P_i^2\left(1.8\,\alpha + 2\,Q_{2r}\right) + P_i\left(5.07\times 10^{-12}\,Q_{2r} + \right.\right.\right.$$
$$\left.\left.\left.5.29\times 10^{-12}\left(4-\beta^2\right)Q_{2r} + 4.6\times 10^{-6}\left(6.6\times 10^{-7}\left(-2+\alpha^2\right) + 1.3\times 10^{-6}\,\beta\,Q_{2r}\right)\right)\right)\right) /$$
$$\left(\left(-8.47\times 10^{-13} - 2.2\times 10^{-6}\left(-0.7\,\alpha + 1.2\left(-2+\alpha^2\right)\right)P_i + \left(-7.2 - 0.7\,\alpha\right)\alpha\,P_i^2\right)Q_{2r}\right),$$
$$Q_{2r} \to \frac{0.6\left(1.1\times 10^{-6}\left(-2+\alpha^2\right) + 3\,\alpha\,P_i\right)}{-3.9\times 10^{-6}\,\beta + 2.3\times 10^{-6}\left(-2+\beta^2\right)},$$
$$2.64\times 10^{-6} + 2.31\times 10^{-6}\,\alpha - 1.32\times 10^{-6}\,\alpha^2 + 1.4\,P_i - 3.6\,\alpha\,P_i - 0.7\,\alpha^2\,P_i \to 0,$$
$$2.783\times 10^{-18} + 6.98\times 10^{-12}\,P_i + 2.3\times 10^{-6}\,P_i^2 \to 0,$$
$$3.86\times 10^{-6} - 2.19\times 10^{-6}\,\beta - 1.93\times 10^{-6}\,\beta^2 \to 0,\ \left\{\alpha \to \left(-2.31\times 10^{-6} + 3.6\,P_i - \right.\right.$$
$$\left.\sqrt{\left(2.31\times 10^{-6} - 3.6\,P_i\right)^2 - 4\left(-1.32\times 10^{-6} - 0.7\,P_i\right)\left(2.64\times 10^{-6} + 1.4\,P_i\right)}\right) /$$
$$\left(2\left(-1.32\times 10^{-6} - 0.7\,P_i\right)\right)\},\ \left\{\alpha \to \left(-2.31\times 10^{-6} + 3.6\,P_i + \right.\right.$$
$$\left.\sqrt{\left(2.31\times 10^{-6} - 3.6\,P_i\right)^2 - 4\left(-1.32\times 10^{-6} - 0.7\,P_i\right)\left(2.64\times 10^{-6} + 1.4\,P_i\right)}\right) /$$
$$\left(2\left(-1.32\times 10^{-6} - 0.7\,P_i\right)\right)\},\ \{\beta \to 0.956419\},\ \{\beta \to -2.09113\},$$
$$\left.\left.\left\{P_i \to -2.56261\times 10^{-6}\right\},\ \left\{P_i \to -4.72175\times 10^{-7}\right\}\right\}\right\}$$

In[•]:= **ReplaceAll[%, {Pi → -2.56260724878725`*^-6}]**

Out[•]=
$$\Big\{\Big\{\Gamma_r \to 1.75 - 0.7\,\eta\,\eta^*,\ \Gamma_i \to -1.5 + 1.2\,\eta\,\eta^*,$$
$$\Gamma_{2i} \to -\gamma'_r + \eta\,Q'_i\,\eta^*,\ \Gamma_{2r} \to 1.25 + \eta\,Q'_r\,\eta^*,\ \Omega_1 \to -1.75 + 1.1\times10^{-6}\,K_1^2 + 0.7\,\eta\,\eta^*,$$
$$\Omega_2 \to -1.25 - 1.3\times10^{-6}\,k^2 + 4.6\times10^{-6}\,k\,K_2 + 1.3\times10^{-6}\,K_2^2 - \eta\,Q'_r\,\eta^*,$$
$$\omega \to k\left(-2.56261\times10^{-6}\,k + 1.1\times10^{-6}\left(k\,\alpha - 2\,K_1\right)\right),\ \mu^* \to -\frac{0.7\,\eta\,\eta^*}{\mu\,Q_{2r}},\ Q_{2i} \to -1.71429\,Q_{2r},$$
$$Q'_r \to \frac{0.35}{Q_{2r}},\ Q'_i \to -\frac{0.42}{Q_{2r}},\ K_1 \to \frac{1}{2}k\left(0.42925 + \alpha\right),\ K_2 \to \frac{1}{2}k\left(0.565217 + \beta\right),$$
$$\eta^* \to -\frac{0.714286\,k^2\left(-7.68782\times10^{-6}\,\alpha + 1.1\times10^{-6}\left(-2+\alpha^2\right)\right)}{\eta},\ k^2 \to$$
$$-\frac{0.000010763}{-8.47\times10^{-13} + 6.56696\times10^{-12}\left(-7.2 - 0.7\,\alpha\right)\alpha + 5.63774\times10^{-12}\left(-0.7\,\alpha + 1.2\left(-2+\alpha^2\right)\right)},$$
$$\gamma'_r \to \Big(456\,522.\Big(1.1132\times10^{-17}\,Q_{2r} + 3.0208\times10^{-17}\left(1.8\,\alpha + 2\,Q_{2r}\right) -$$
$$2.56261\times10^{-6}\left(5.07\times10^{-12}\,Q_{2r} + 5.29\times10^{-12}\left(4-\beta^2\right)Q_{2r} +$$
$$4.6\times10^{-6}\left(6.6\times10^{-7}\left(-2+\alpha^2\right) + 1.3\times10^{-6}\,\beta\,Q_{2r}\right)\right)\Big)\Big/\Big(\Big(-8.47\times10^{-13} +$$
$$6.56696\times10^{-12}\left(-7.2 - 0.7\,\alpha\right)\alpha + 5.63774\times10^{-12}\left(-0.7\,\alpha + 1.2\left(-2+\alpha^2\right)\right)\Big)\,Q_{2r}\Big),$$
$$Q_{2r} \to \frac{0.6\left(-7.68782\times10^{-6}\,\alpha + 1.1\times10^{-6}\left(-2+\alpha^2\right)\right)}{-3.9\times10^{-6}\,\beta + 2.3\times10^{-6}\left(-2+\beta^2\right)},$$
$$-9.4765\times10^{-7} + 0.0000115354\,\alpha + 4.73825\times10^{-7}\,\alpha^2 \to 0,$$
$$0. \to 0,\ 3.86\times10^{-6} - 2.19\times10^{-6}\,\beta - 1.93\times10^{-6}\,\beta^2 \to 0,$$
$$\{\alpha \to -24.4271\},\ \{\alpha \to 0.0818762\},$$
$$\{\beta \to 0.956419\},\ \{\beta \to -2.09113\},$$
$$\left\{-2.56261\times10^{-6} \to -2.56261\times10^{-6}\right\},$$
$$\left\{-2.56261\times10^{-6} \to -4.72175\times10^{-7}\right\}\Big\}\Big\}$$

In[•]:= **ReplaceAll[%, {α → 0.08187621570341645`, β → -2.091133922898288`}]**

Out[•]=
$$\Big\{\Big\{\Gamma_r \to 1.75 - 0.7\,\eta\,\eta^*,\ \Gamma_i \to -1.5 + 1.2\,\eta\,\eta^*,$$
$$\Gamma_{2i} \to -\gamma'_r + \eta\,Q'_i\,\eta^*,\ \Gamma_{2r} \to 1.25 + \eta\,Q'_r\,\eta^*,\ \Omega_1 \to -1.75 + 1.1\times10^{-6}\,K_1^2 + 0.7\,\eta\,\eta^*,$$
$$\Omega_2 \to -1.25 - 1.3\times10^{-6}\,k^2 + 4.6\times10^{-6}\,k\,K_2 + 1.3\times10^{-6}\,K_2^2 - \eta\,Q'_r\,\eta^*,$$
$$\omega \to k\left(-2.56261\times10^{-6}\,k + 1.1\times10^{-6}\left(0.0818762\,k - 2\,K_1\right)\right),$$
$$\mu^* \to -\frac{0.7\,\eta\,\eta^*}{\mu\,Q_{2r}},\ Q_{2i} \to -1.71429\,Q_{2r},\ Q'_r \to \frac{0.35}{Q_{2r}},\ Q'_i \to -\frac{0.42}{Q_{2r}},$$
$$K_1 \to 0.255563\,k,\ K_2 \to -0.762958\,k,\ \eta^* \to \frac{2.01577\times10^{-6}\,k^2}{\eta},\ k^2 \to 579\,981.,$$
$$\gamma'_r \to -\frac{1}{Q_{2r}}2.46005\times10^{16}\Big(-2.56261\times10^{-6}\Big(4.6\times10^{-6}\left(-1.31558\times10^{-6} - 2.71847\times10^{-6}\,Q_{2r}\right) +$$
$$3.09767\times10^{-12}\,Q_{2r}\Big) + 1.1132\times10^{-17}\,Q_{2r} + 3.0208\times10^{-17}\left(0.147377 + 2\,Q_{2r}\right)\Big),$$
$$Q_{2r} \to -0.124385,\ 4.73354\times10^{-21} \to 0,\ 0. \to 0,\ 3.38813\times10^{-21} \to 0,$$
$$\{0.0818762 \to -24.4271\},\ \{0.0818762 \to 0.0818762\},$$
$$\{-2.09113 \to 0.956419\},\ \{-2.09113 \to -2.09113\},$$
$$\left\{-2.56261\times10^{-6} \to -2.56261\times10^{-6}\right\},\ \left\{-2.56261\times10^{-6} \to -4.72175\times10^{-7}\right\}\Big\}\Big\}$$

In[•]:=
```
ReplaceAll[%, Q2r → -0.12438483609473883`]
```

Out[•]=
$$\left\{\left\{\Gamma_r \to 1.75 - 0.7\,\eta\,\eta^*,\ \Gamma_i \to -1.5 + 1.2\,\eta\,\eta^*,\right.\right.$$
$$\Gamma_{2i} \to -\gamma'_r + \eta\,Q'_i\,\eta^*,\ \Gamma_{2r} \to 1.25 + \eta\,Q'_r\,\eta^*,\ \Omega_1 \to -1.75 + 1.1\times10^{-6}\,K_1^2 + 0.7\,\eta\,\eta^*,$$
$$\Omega_2 \to -1.25 - 1.3\times10^{-6}\,k^2 + 4.6\times10^{-6}\,k\,K_2 + 1.3\times10^{-6}\,K_2^2 - \eta\,Q'_r\,\eta^*,$$
$$\omega \to k\left(-2.56261\times10^{-6}\,k + 1.1\times10^{-6}\left(0.0818762\,k - 2\,K_1\right)\right),\ \mu^* \to \frac{5.6277\,\eta\,\eta^*}{\mu},$$
$$Q_{2i} \to 0.213231,\ Q'_r \to -2.81385,\ Q'_i \to 3.37662,\ K_1 \to 0.255563\,k,\ K_2 \to -0.762958\,k,$$
$$\eta^* \to \frac{2.01577\times10^{-6}\,k^2}{\eta},\ k^2 \to 579\,981.,\ \gamma'_r \to 1.59446,\ -0.124385 \to -0.124385,$$
$$4.73354\times10^{-21} \to 0,\ 0. \to 0,\ 3.38813\times10^{-21} \to 0,\ \{0.0818762 \to -24.4271\},$$
$$\{0.0818762 \to 0.0818762\},\ \{-2.09113 \to 0.956419\},\ \{-2.09113 \to -2.09113\},$$
$$\left.\left\{-2.56261\times10^{-6} \to -2.56261\times10^{-6}\right\},\ \left\{-2.56261\times10^{-6} \to -4.72175\times10^{-7}\right\}\right\}\right\}$$

In[•]:=
```
ReplaceAll[%,
 {Q2i → 0.21323114759098083`, Q'r → -2.813847820914596`, Q'i → 3.376617385097515`}]
```

Out[•]=
$$\left\{\left\{\Gamma_r \to 1.75 - 0.7\,\eta\,\eta^*,\ \Gamma_i \to -1.5 + 1.2\,\eta\,\eta^*,\ \Gamma_{2i} \to -\gamma'_r + 3.37662\,\eta\,\eta^*,\right.\right.$$
$$\Gamma_{2r} \to 1.25 - 2.81385\,\eta\,\eta^*,\ \Omega_1 \to -1.75 + 1.1\times10^{-6}\,K_1^2 + 0.7\,\eta\,\eta^*,$$
$$\Omega_2 \to -1.25 - 1.3\times10^{-6}\,k^2 + 4.6\times10^{-6}\,k\,K_2 + 1.3\times10^{-6}\,K_2^2 + 2.81385\,\eta\,\eta^*,$$
$$\omega \to k\left(-2.56261\times10^{-6}\,k + 1.1\times10^{-6}\left(0.0818762\,k - 2\,K_1\right)\right),\ \mu^* \to \frac{5.6277\,\eta\,\eta^*}{\mu},$$
$$0.213231 \to 0.213231,\ -2.81385 \to -2.81385,\ 3.37662 \to 3.37662,$$
$$K_1 \to 0.255563\,k,\ K_2 \to -0.762958\,k,\ \eta^* \to \frac{2.01577\times10^{-6}\,k^2}{\eta},\ k^2 \to 579\,981.,$$
$$\gamma'_r \to 1.59446,\ -0.124385 \to -0.124385,\ 4.73354\times10^{-21} \to 0,$$
$$0. \to 0,\ 3.38813\times10^{-21} \to 0,\ \{0.0818762 \to -24.4271\},$$
$$\{0.0818762 \to 0.0818762\},\ \{-2.09113 \to 0.956419\},\ \{-2.09113 \to -2.09113\},$$
$$\left.\left\{-2.56261\times10^{-6} \to -2.56261\times10^{-6}\right\},\ \left\{-2.56261\times10^{-6} \to -4.72175\times10^{-7}\right\}\right\}\right\}$$

In[•]:=
```
ReplaceAll[%, {k → Sqrt[579980.8016216066`], γ'r → 1.5944612214966543`}]
```

Out[•]=
$$\left\{\left\{\Gamma_r \to 1.75 - 0.7\,\eta\,\eta^*,\ \Gamma_i \to -1.5 + 1.2\,\eta\,\eta^*,\ \Gamma_{2i} \to -1.59446 + 3.37662\,\eta\,\eta^*,\right.\right.$$
$$\Gamma_{2r} \to 1.25 - 2.81385\,\eta\,\eta^*,\ \Omega_1 \to -1.75 + 1.1\times10^{-6}\,K_1^2 + 0.7\,\eta\,\eta^*,$$
$$\Omega_2 \to -2.00398 + 0.0035032\,K_2 + 1.3\times10^{-6}\,K_2^2 + 2.81385\,\eta\,\eta^*,$$
$$\omega \to 761.565\left(-0.00195159 + 1.1\times10^{-6}\left(62.354 - 2\,K_1\right)\right),$$
$$\mu^* \to \frac{5.6277\,\eta\,\eta^*}{\mu},\ 0.213231 \to 0.213231,\ -2.81385 \to -2.81385,$$
$$3.37662 \to 3.37662,\ K_1 \to 194.628,\ K_2 \to -581.042,\ \eta^* \to \frac{1.16911}{\eta},$$
$$579\,981. \to 579\,981.,\ 1.59446 \to 1.59446,\ -0.124385 \to -0.124385,$$
$$4.73354\times10^{-21} \to 0,\ 0. \to 0,\ 3.38813\times10^{-21} \to 0,\ \{0.0818762 \to -24.4271\},$$
$$\{0.0818762 \to 0.0818762\},\ \{-2.09113 \to 0.956419\},\ \{-2.09113 \to -2.09113\},$$
$$\left.\left\{-2.56261\times10^{-6} \to -2.56261\times10^{-6}\right\},\ \left\{-2.56261\times10^{-6} \to -4.72175\times10^{-7}\right\}\right\}\right\}$$

In[•]:=
```
ReplaceAll[%,
 {K1 → 194.6279677165143`, K2 → -581.0420874804896`, η* → 1.1691069333364856`/η}]
```

Out[•]=
```
{{Γr → 0.931625, Γi → -0.0970717, Γ2i → 2.35317, Γ2r → -2.03969, Ω1 → -0.889957,
  Ω2 → -0.310898, ω → -1.76012, μ* → 6.57938/μ, 0.213231 → 0.213231,
  -2.81385 → -2.81385, 3.37662 → 3.37662, 194.628 → 194.628, -581.042 → -581.042,
  1.16911/η → 1.16911/η, 579981. → 579981., 1.59446 → 1.59446, -0.124385 → -0.124385,
  4.73354×10^-21 → 0, 0. → 0, 3.38813×10^-21 → 0, {0.0818762 → -24.4271},
  {0.0818762 → 0.0818762}, {-2.09113 → 0.956419}, {-2.09113 → -2.09113},
  {-2.56261×10^-6 → -2.56261×10^-6}, {-2.56261×10^-6 → -4.72175×10^-7}}}
```

In[•]:=
```
ReplaceAll[%, {Γr → 0.9316251466644601`, Γi → -0.09707167999621724`,
  Γ2i → 2.353165574645365`, Γ2r → -2.039688996785016`, Ω1 → -0.8899570962652534`,
  Ω2 → -0.3108984400357673`, ω → -1.7601156501386148`, μ* → 6.579377993570032`/μ}]
```

Out[•]=
```
{{0.931625 → 0.931625, -0.0970717 → -0.0970717, 2.35317 → 2.35317,
  -2.03969 → -2.03969, -0.889957 → -0.889957, -0.310898 → -0.310898,
  -1.76012 → -1.76012, 6.57938/μ → 6.57938/μ, 0.213231 → 0.213231,
  -2.81385 → -2.81385, 3.37662 → 3.37662, 194.628 → 194.628, -581.042 → -581.042,
  1.16911/η → 1.16911/η, 579981. → 579981., 1.59446 → 1.59446, -0.124385 → -0.124385,
  4.73354×10^-21 → 0, 0. → 0, 3.38813×10^-21 → 0, {0.0818762 → -24.4271},
  {0.0818762 → 0.0818762}, {-2.09113 → 0.956419}, {-2.09113 → -2.09113},
  {-2.56261×10^-6 → -2.56261×10^-6}, {-2.56261×10^-6 → -4.72175×10^-7}}}
```

```
ReplaceAll[%, {Pi → -2.56260724878725`*^-6, α → 0.08187621570341645`,
  β → -2.091133922898288`, Q2r → -0.12438483609473883`, Q2i → 0.21323114759098083`,
  Q'r → -2.813847820914596`, Q'i → 3.376617385097515`, k → Sqrt[579980.8016216066`],
  γ'r → 1.5944612214966543`, K1 → 194.6279677165143`, K2 → -581.0420874804896`,
  η* → 1.1691069333364856`/η, Γr → 0.9316251466644601`, Γi → -0.09707167999621724`,
  Γ2i → 2.353165574645365`, Γ2r → -2.039688996785016`, Ω1 → -0.8899570962652534`,
  Ω2 → -0.3108984400357673`, ω → -1.7601156501386148`, μ* → 6.579377993570032`/μ}]
```

```
{Q2i → 1.75, Q'1r → 0.6`, Q'1i → -3, Pi → 1.75}
```

In[58]:=
```
{A[x, t] A*[x, t] → e^(i (x K1 - t Ω1)) f[x, t]^(-1-i α) G[x, t] e^(-i (x K1 - t Ω1)) f[x, t]^(-1+i α) G*[x, t],
 B[x, t] B*[x, t] → e^(i (x K2 - t Ω2)) f[x, t]^(-1-i β) H[x, t] e^(-i (x K2 - t Ω2)) f[x, t]^(-1+i β) H*[x, t]}
```

Out[58]=
```
{A[x, t] A*[x, t] → G[x, t] G*[x, t]/f[x, t]^2, B[x, t] B*[x, t] → H[x, t] H*[x, t]/f[x, t]^2}
```

$$\left\{A[x,t]\,A^*[x,t] \to \frac{G[x,t]\,G^*[x,t]}{f[x,t]^2},\ B[x,t]\,B^*[x,t] \to \frac{H[x,t]\,H^*[x,t]}{f[x,t]^2}\right\}$$

In[59]:=
```
ReplaceAll[%, {G[x, t] → η , G*[x, t] → η*, H[x, t] → μ Exp[k x + ω t],
  H*[x, t] → μ* Exp[k x + ω t], f[x, t] → 1 + Exp[k x + ω t]}]
```

Out[59]= $\left\{A[x,t]\,A^*[x,t] \to \frac{\eta\,\eta^*}{\left(1+e^{k\,x+t\,\omega}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{e^{2\,k\,x+2\,t\,\omega}\,\mu\,\mu^*}{\left(1+e^{k\,x+t\,\omega}\right)^2}\right\}$

In[•]:=
```
ReplaceAll[%, {P_i → -2.56260724878725`*^-6, α → 0.08187621570341645`,
  β → -2.091133922898288`, Q2r → -0.12438483609473883`, Q2i → 0.21323114759098083`,
  Q'r → -2.813847820914596`, Q'i → 3.376617385097515`, k → Sqrt[579980.8016216066`],
  γ'r → 1.5944612214966543`, K1 → 194.6279677165143`, K2 → -581.0420874804896`,
  η* → 1.1691069333364856`/η, Γr → 0.9316251466644601`, Γi → -0.09707167999621724`,
  Γ2i → 2.353165574645365`, Γ2r → -2.039688996785016`, Ω1 → -0.8899570962652534`,
  Ω2 → -0.3108984400357673`, ω → -1.7601156501386148`, μ* → 6.579377993570032`/μ}]
```

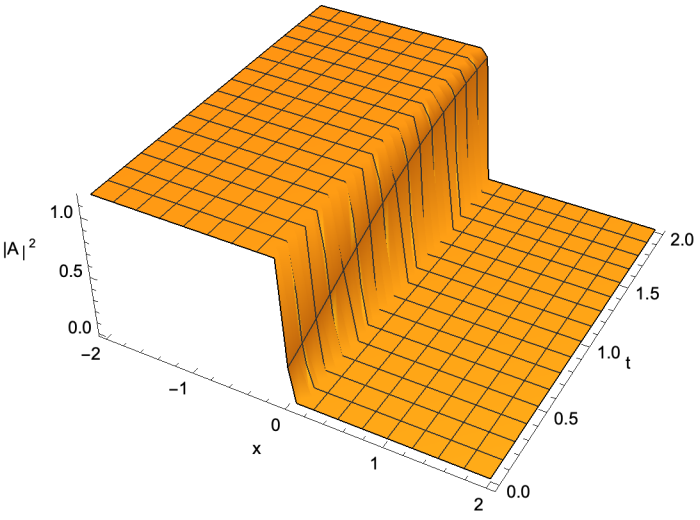
Out[•]= $\left\{\Phi[x,t]\,\Phi^*[x,t] \to \frac{1.16911}{\left(1+e^{-1.76012\,t+761.565\,x}\right)^2},\ \Psi[x,t]\,\Psi^*[x,t] \to \frac{6.57938\,e^{-3.52023\,t+1523.13\,x}}{\left(1+e^{-1.76012\,t+761.565\,x}\right)^2}\right\}$

In[60]:=
```
Plot3D[1.1691069333364856` / (1 + E^(-1.7601156501386148` t + 761.5647061291684` x))^2,
  {x, -2, 2}, {t, 0, 2}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

... General: Exp[−1522.91] is too small to represent as a normalized machine number; precision may be lost.

... General: Exp[−1305.79] is too small to represent as a normalized machine number; precision may be lost.

Out[60]=



In[61]:=
```
Plot3D[6.579377993570032` e^(-3.5202313002772296` t+1523.1294122583367` x) / (1 + e^(-1.7601156501386148` t+761.5647061291684` x))^2, {x, -2, 2},
 {t, 0, 3}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

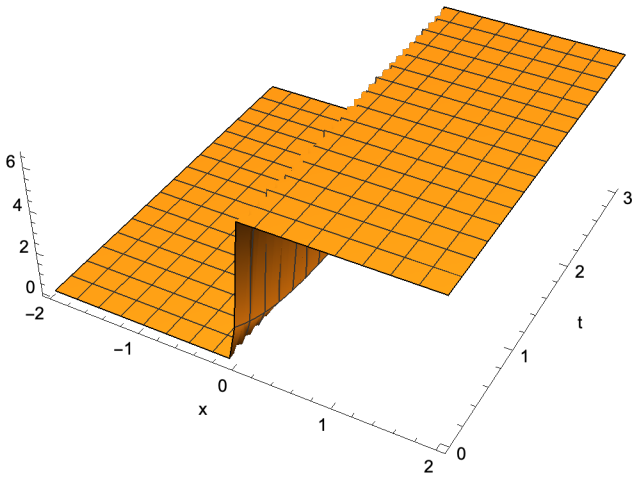
General: Exp[−3045.82] is too small to represent as a normalized machine number; precision may be lost.

General: Exp[−1522.91] is too small to represent as a normalized machine number; precision may be lost.

General: Exp[−1305.92] is too small to represent as a normalized machine number; precision may be lost.

General: Further output of General::munfl will be suppressed during this calculation.

Out[61]=



Other Solutions

Bright - Kink

Solution

$$\Big\{\gamma_i \to 0,\ p_i \to 0,\ \omega_r \to -2\,k_i\,k_r\,p_r + \gamma_r - \mu\,R_i\,\mu^*,\ \omega_i \to -k_i^2\,p_r + k_r^2\,p_r + \mu\,R_r\,\mu^*,$$

$$\Omega_2 \to K_2^2\,p_{2r} - \gamma_{2i} - \mu\,q_{2r}\,\mu^*,\ K_2 \to \frac{4\,k_r^2\left(5\,\beta\,p_{2i} + \left(-2+\beta^2\right)p_{2r}\right) + \eta\,R_{2r}\,\eta^* - 4\,\mu\,q_{2r}\,\mu^*}{8\,k_r\,p_{2i}},$$

$$k_i \to \frac{1}{8\,k_r\,p_{2i}\,p_r}\Big(4\,k_r^2\left(\left(-2+\beta^2\right)p_{2i}^2 + 2\,\alpha\,p_{2i}\,p_r + \left(-2+\beta^2\right)p_{2r}^2\right) + p_{2i}\left(\eta\,R_{2i}\,\eta^* - 4\,\mu\,q_{2i}\,\mu^*\right) +$$
$$p_{2r}\left(\eta\,R_{2r}\,\eta^* - 4\,\mu\,q_{2r}\,\mu^*\right)\Big),\ \eta^* \to -\frac{4\,k_r^2\,p_r\left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\,R_r\right)}{\eta\left(q_r\,R_i - q_i\,R_r\right)},$$

$$\mu^* \to -\frac{k_r^2\,p_r\left(\left(-2+\alpha^2\right)q_i + 3\,\alpha\,q_r\right)}{\mu\left(q_r\,R_i - q_i\,R_r\right)},\ k_r \to \sqrt{-\frac{\left(q_r\,R_i - q_i\,R_r\right)\gamma_r}{p_r\left(\alpha\,q_r\,R_i + q_i\left(\left(-2+\alpha^2\right)R_i + 2\,\alpha\,R_r\right)\right)}},$$

$$\gamma_{2r} \to \Big(\Big(\left(5\,\beta\,p_{2i} + \left(-2+\beta^2\right)p_{2r}\right)^2\left(q_r\,R_i - q_i\,R_r\right)^2 +$$
$$p_r^2\left(\left(-2+\alpha^2\right)q_i\,q_{2r} + 3\,\alpha\,q_r\,q_{2r} - \left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\,R_r\right)R_{2r}\right)^2 - 2\,p_r\left(-q_r\,R_i + q_i\,R_r\right)$$
$$\left(\left(-2+\beta^2\right)p_{2r}\left(\left(-2+\alpha^2\right)q_i\,q_{2r} + 3\,\alpha\,q_r\,q_{2r} - \left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\,R_r\right)R_{2r}\right) +\right.$$
$$p_{2i}\left(6\,\alpha\,q_{2i}\,q_r + 15\,\alpha\,\beta\,q_r\,q_{2r} + \left(-2+\alpha^2\right)q_i\left(2\,q_{2i} + 5\,\beta\,q_{2r}\right) -\right.$$
$$\left.\left.\left.5\,\beta\left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\,R_r\right)R_{2r}\right)\right)\Big)\gamma_r\Big)\Big/$$
$$\left(4\,p_{2i}\,p_r\left(q_r\,R_i - q_i\,R_r\right)\left(\alpha\,q_r\,R_i + q_i\left(\left(-2+\alpha^2\right)R_i + 2\,\alpha\,R_r\right)\right)\right),$$
$$\left(-2\,p_r\,q_i\,q_{2r} + \alpha^2\,p_r\,q_i\,q_{2r} + 3\,\alpha\,p_r\,q_r\,q_{2r} + 3\,\beta\,p_{2i}\,q_r\,R_i - 2\,p_{2r}\,q_r\,R_i + \beta^2\,p_{2r}\,q_r\,R_i -\right.$$
$$\left.3\,\beta\,p_{2i}\,q_i\,R_r + 2\,p_{2r}\,q_i\,R_r - \beta^2\,p_{2r}\,q_i\,R_r + 2\,p_r\,R_i\,R_{2r} - \alpha^2\,p_r\,R_i\,R_{2r} - 3\,\alpha\,p_r\,R_r\,R_{2r}\right) \to 0,$$
$$\left(-2\,p_r\,q_i\,q_{2i} + \alpha^2\,p_r\,q_i\,q_{2i} + 3\,\alpha\,p_r\,q_{2i}\,q_r - 2\,p_{2i}\,q_r\,R_i + \beta^2\,p_{2i}\,q_r\,R_i - 3\,\beta\,p_{2r}\,q_r\,R_i +\right.$$
$$\left.2\,p_r\,R_i\,R_{2i} - \alpha^2\,p_r\,R_i\,R_{2i} + 2\,p_{2i}\,q_i\,R_r - \beta^2\,p_{2i}\,q_i\,R_r + 3\,\beta\,p_{2r}\,q_i\,R_r - 3\,\alpha\,p_r\,R_{2i}\,R_r\right) \to 0\Big\}$$

$$\Big\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to k_r^2\left(\left(-1+\alpha^2\right)p_i - 2\,\alpha\, p_r\right) + \gamma_r - \mu\, R_i\, \mu^*,$$
$$\omega_i \to k_r^2\left(-2\,\alpha\, p_i - \left(-1+\alpha^2\right)p_r\right) + \mu\, R_r\, \mu^*,\ \Omega_2 \to K_2^2\, p_{2r} - \gamma_{2i} - \mu\, q_{2r}\, \mu^*,$$
$$K_2 \to \frac{4\,k_r^2\left(5\,\beta\, p_{2i} + \left(-2+\beta^2\right)p_{2r}\right) + \eta\, R_{2r}\, \eta^* - 4\,\mu\, q_{2r}\, \mu^*}{8\,k_r\, p_{2i}},$$
$$\mu^* \to \frac{k_r^2\left(-p_r\left(\left(-2+\alpha^2\right)q_i + 3\,\alpha\, q_r\right) + p_i\left(-3\,\alpha\, q_i + \left(-2+\alpha^2\right)q_r\right)\right)}{\mu\left(q_r\, R_i - q_i\, R_r\right)},$$
$$\eta^* \to \frac{4\,k_r^2\left(-p_r\left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\, R_r\right) + p_i\left(-3\,\alpha\, R_i + \left(-2+\alpha^2\right)R_r\right)\right)}{\eta\left(q_r\, R_i - q_i\, R_r\right)},\ k_r \to$$
$$\sqrt{\frac{q_r\, R_i\, \gamma_r - q_i\, R_r\, \gamma_r}{-3\,\alpha\, p_i\, q_i\, R_i + 2\,p_r\, q_i\, R_i - \alpha^2\, p_r\, q_i\, R_i - p_i\, q_r\, R_i - \alpha\, p_r\, q_r\, R_i - p_i\, q_i\, R_r + \alpha^2\, p_i\, q_i\, R_r - 2\,\alpha\, p_r\, q_i\, R_r}}$$
$$, R_i \to \left(\left(3\,\beta\, p_{2i} + \left(-2+\beta^2\right)p_{2r}\right)q_i\, R_r + p_r\left(-\left(-2+\alpha^2\right)q_i\, q_{2r} - 3\,\alpha\, q_r\, q_{2r} + 3\,\alpha\, R_r\, R_{2r}\right) + p_i\left(-3\,\alpha\, q_i\, q_{2r} + \left(-2+\alpha^2\right)\left(q_r\, q_{2r} - R_r\, R_{2r}\right)\right)\right) \Big/ \left(3\,\beta\, p_{2i}\, q_r + \left(-2+\beta^2\right)p_{2r}\, q_r - \left(3\,\alpha\, p_i + \left(-2+\alpha^2\right)p_r\right)R_{2r}\right),$$
$$R_{2i} \to \left(\left(3\,\alpha\, p_i + \left(-2+\alpha^2\right)p_r\right)q_{2i}\, R_{2r} + p_{2r}\left(-\left(-2+\beta^2\right)q_{2i}\, q_r - 3\,\beta\, q_r\, q_{2r} + 3\,\beta\, R_r\, R_{2r}\right) + p_{2i}\left(-3\,\beta\, q_{2i}\, q_r + \left(-2+\beta^2\right)\left(q_r\, q_{2r} - R_r\, R_{2r}\right)\right)\right) \Big/ \left(3\,\alpha\, p_i\, q_{2r} + \left(-2+\alpha^2\right)p_r\, q_{2r} - \left(3\,\beta\, p_{2i} + \left(-2+\beta^2\right)p_{2r}\right)R_r\right),$$
$$\gamma_{2r} \to \left(\left(q_{2i}\left(\left(-2+\beta^2\right)p_{2r}\, q_r - \left(3\,\alpha\, p_i + \left(-2+\alpha^2\right)p_r\right)R_{2r}\right) + \beta\, p_{2i}\left(3\,q_{2i}\, q_r - \beta\, q_r\, q_{2r} + \beta\, R_r\, R_{2r}\right)\right)\gamma_r\right) \Big/ \left(\left(3\,\beta\, p_{2i} + \left(-2+\beta^2\right)p_{2r}\right)q_i\, R_r + p_i\left(-3\,\alpha\, q_i\, q_{2r} - q_r\, q_{2r} + R_r\, R_{2r}\right) + p_r\left(-\left(-2+\alpha^2\right)q_i\, q_{2r} - \alpha\, q_r\, q_{2r} + \alpha\, R_r\, R_{2r}\right)\right),$$
$$R_i \to \left(\left(3\,\beta\, p_{2i} + \left(-2+\beta^2\right)p_{2r}\right)q_i\, R_r + p_r\left(-\left(-2+\alpha^2\right)q_i\, q_{2r} - 3\,\alpha\, q_r\, q_{2r} + 3\,\alpha\, R_r\, R_{2r}\right) + p_i\left(-3\,\alpha\, q_i\, q_{2r} + \left(-2+\alpha^2\right)\left(q_r\, q_{2r} - R_r\, R_{2r}\right)\right)\right) \Big/ \left(3\,\beta\, p_{2i}\, q_r + \left(-2+\beta^2\right)p_{2r}\, q_r - \left(3\,\alpha\, p_i + \left(-2+\alpha^2\right)p_r\right)R_{2r}\right),$$
$$R_{2i} \to \left(\left(3\,\alpha\, p_i + \left(-2+\alpha^2\right)p_r\right)q_{2i}\, R_{2r} + p_{2r}\left(-\left(-2+\beta^2\right)q_{2i}\, q_r - 3\,\beta\, q_r\, q_{2r} + 3\,\beta\, R_r\, R_{2r}\right) + p_{2i}\left(-3\,\beta\, q_{2i}\, q_r + \left(-2+\beta^2\right)\left(q_r\, q_{2r} - R_r\, R_{2r}\right)\right)\right) \Big/ \left(3\,\alpha\, p_i\, q_{2r} + \left(-2+\alpha^2\right)p_r\, q_{2r} - \left(3\,\beta\, p_{2i} + \left(-2+\beta^2\right)p_{2r}\right)R_r\right),$$
$$\gamma_{2r} \to \left(\left(q_{2i}\left(\left(-2+\beta^2\right)p_{2r}\, q_r - \left(3\,\alpha\, p_i + \left(-2+\alpha^2\right)p_r\right)R_{2r}\right) + \beta\, p_{2i}\left(3\,q_{2i}\, q_r - \beta\, q_r\, q_{2r} + \beta\, R_r\, R_{2r}\right)\right)\gamma_r\right) \Big/ \left(\left(3\,\beta\, p_{2i} + \left(-2+\beta^2\right)p_{2r}\right)q_i\, R_r + p_i\left(-3\,\alpha\, q_i\, q_{2r} - q_r\, q_{2r} + R_r\, R_{2r}\right) + p_r\left(-\left(-2+\alpha^2\right)q_i\, q_{2r} - \alpha\, q_r\, q_{2r} + \alpha\, R_r\, R_{2r}\right)\right),$$
$$\left(-3\,\alpha\, p_i\, q_i\, q_{2r} + 2\,p_r\, q_i\, q_{2r} - \alpha^2\, p_r\, q_i\, q_{2r} - 2\,p_i\, q_r\, q_{2r} + \alpha^2\, p_i\, q_r\, q_{2r} - 3\,\alpha\, p_r\, q_r\, q_{2r} - 3\,\beta\, p_{2i}\, q_r\, R_i + 2\,p_{2r}\, q_r\, R_i - \beta^2\, p_{2r}\, q_r\, R_i + 3\,\beta\, p_{2i}\, q_i\, R_r - 2\,p_{2r}\, q_i\, R_r + \beta^2\, p_{2r}\, q_i\, R_r + 3\,\alpha\, p_i\, R_i\, R_{2r} - 2\,p_r\, R_i\, R_{2r} + \alpha^2\, p_r\, R_i\, R_{2r} + 2\,p_i\, R_r\, R_{2r} - \alpha^2\, p_i\, R_r\, R_{2r} + 3\,\alpha\, p_r\, R_r\, R_{2r}\right) \to 0,$$
$$\left(-3\,\alpha\, p_i\, q_i\, q_{2i} + 2\,p_r\, q_i\, q_{2i} - \alpha^2\, p_r\, q_i\, q_{2i} - 2\,p_i\, q_{2i}\, q_r + \alpha^2\, p_i\, q_{2i}\, q_r - 3\,\alpha\, p_r\, q_{2i}\, q_r + 2\,p_{2i}\, q_r\, R_i - \beta^2\, p_{2i}\, q_r\, R_i + 3\,\beta\, p_{2r}\, q_r\, R_i + 3\,\alpha\, p_i\, R_i\, R_{2i} - 2\,p_r\, R_i\, R_{2i} + \alpha^2\, p_r\, R_i\, R_{2i} - 2\,p_{2i}\, q_i\, R_r + \beta^2\, p_{2i}\, q_i\, R_r - 3\,\beta\, p_{2r}\, q_i\, R_r + 2\,p_i\, R_{2i}\, R_r - \alpha^2\, p_i\, R_{2i}\, R_r + 3\,\alpha\, p_r\, R_{2i}\, R_r\right) \to 0\Big\}$$

```
In[•]:= ReplaceAll[%, γi → 0]

In[•]:= ReplaceAll[%, ki → α kr]

In[•]:= ReplaceAll[%, {{ωr → kr^2 ((-1 + α^2) pi - 2 α pr) + γr - μ Ri μ*,
          ωi → kr^2 (-2 α pi - (-1 + α^2) pr) + μ Rr μ*, Ω2 → K2^2 p2r - γ2i - μ q2r μ*}}]
```

In[•]:=
$$\text{ReplaceAll}\left[\%, \left\{\left\{K_2 \to \frac{4 k_r^2 \left(5 \beta p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) + \eta R_{2r} \eta^* - 4 \mu q_{2r} \mu^*}{8 k_r p_{2i}}\right\}\right\}\right]$$

In[•]:=
$$\text{ReplaceAll}\left[\%, \left\{\left\{\mu^* \to \frac{k_r^2 \left(-p_r \left(\left(-2+\alpha^2\right) q_i + 3 \alpha q_r\right) + p_i \left(-3 \alpha q_i + \left(-2+\alpha^2\right) q_r\right)\right)}{\mu \left(q_r R_i - q_i R_r\right)},\right.\right.$$
$$\left.\left.\eta^* \to \frac{4 k_r^2 \left(-p_r \left(\left(-2+\alpha^2\right) R_i + 3 \alpha R_r\right) + p_i \left(-3 \alpha R_i + \left(-2+\alpha^2\right) R_r\right)\right)}{\eta \left(q_r R_i - q_i R_r\right)}\right\}\right]$$

In[•]:=
$$\text{ReplaceAll}\left[\%, \left\{k_r \to \sqrt{\left(\frac{q_r R_i \gamma_r - q_i R_r \gamma_r}{-3 \alpha p_i q_i R_i + 2 p_r q_i R_i - \alpha^2 p_r q_i R_i - p_i q_r R_i - \alpha p_r q_r R_i - p_i q_i R_r + \alpha^2 p_i q_i R_r - 2 \alpha p_r q_i R_r}\right)}\right\}\right]$$

In[•]:=
$$\text{ReplaceAll}\left[\%,\right.$$
$$\left.\left\{\left\{R_i \to \left(\left(3 \beta p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) q_i R_r + p_r \left(-\left(-2+\alpha^2\right) q_i q_{2r} - 3 \alpha q_r q_{2r} + 3 \alpha R_r R_{2r}\right) + p_i \left(-3 \alpha q_i q_{2r} + \left(-2+\alpha^2\right) \left(q_r q_{2r} - R_r R_{2r}\right)\right)\right) \Big/ \left(3 \beta p_{2i} q_r + \left(-2+\beta^2\right) p_{2r} q_r - \left(3 \alpha p_i + \left(-2+\alpha^2\right) p_r\right) R_{2r}\right),\right.\right.$$
$$\left.\left. R_{2i} \to \left(\left(3 \alpha p_i + \left(-2+\alpha^2\right) p_r\right) q_{2i} R_{2r} + p_{2r} \left(-\left(-2+\beta^2\right) q_{2i} q_r - 3 \beta q_r q_{2r} + 3 \beta R_r R_{2r}\right) + p_{2i} \left(-3 \beta q_{2i} q_r + \left(-2+\beta^2\right) \left(q_r q_{2r} - R_r R_{2r}\right)\right)\right) \Big/ \left(3 \alpha p_i q_{2r} + \left(-2+\alpha^2\right) p_r q_{2r} - \left(3 \beta p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) R_r\right)\right\}\right]$$

In[•]:=
$$\text{ReplaceAll}\left[\%, \left\{\left\{\gamma_{2r} \to \left(\left(q_{2i} \left(\left(-2+\beta^2\right) p_{2r} q_r - \left(3 \alpha p_i + \left(-2+\alpha^2\right) p_r\right) R_{2r}\right) + \beta p_{2i} \left(3 q_{2i} q_r - \beta q_r q_{2r} + \beta R_r R_{2r}\right)\right) \gamma_r\right) \Big/ \left(\left(3 \beta p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) q_i R_r + p_i \left(-3 \alpha q_i q_{2r} - q_r q_{2r} + R_r R_{2r}\right) + p_r \left(-\left(-2+\alpha^2\right) q_i q_{2r} - \alpha q_r q_{2r} + \alpha R_r R_{2r}\right)\right)\right\}\right]$$

```
ReplaceAll[%, p_i → 0]
```

Bright - Dark Solitons

```
ReplaceAll[%, {A[x, t] → G[x, t] / f[x, t]^m Exp[I (K_1 x - Ω_1 t)],
  B[x, t] → H[x, t] / f[x, t]^n Exp[I (K_2 x - Ω_2 t)], A*[x, t] → G*[x, t] / f[x, t]^{m*} Exp[-I (K_1 x - Ω_1 t)],
  B*[x, t] → H*[x, t] / f[x, t]^{n*} Exp[-I (K_2 x - Ω_2 t)]}]
```

```
ReplaceAll[%, {G[x, t] → η Exp[k x + ω t],
  G*[x, t] → η* Exp[k* x + ω* t], H[x, t] → μ (1 - Exp[(k + k*) x + (ω + ω*) t]),
  H*[x, t] → μ* (1 - Exp[(k + k*) x + (ω + ω*) t]), f[x, t] → 1 + Exp[(k + k*) x + (ω + ω*) t]}]
```

$$\Big\{\omega_r \to k_i^2\, P_i - k_r^2\, P_i - 2\, k_i\, k_r\, P_r + \gamma_r - \mu\, Q_{2i}\, \mu^*,$$

$$\omega_i \to -2\, k_i\, k_r\, P_i - k_i^2\, P_r + k_r^2\, P_r + \gamma_i + \mu\, Q_{2r}\, \mu^*,\ \Omega_2 \to K_2^2\, P'_r - \gamma'_i - \mu\, Q'_{2r}\, \mu^*,$$

$$k_i \to \alpha\, k_r - \frac{\gamma_i}{2\, k_r\, P_i},\ K_2 \to \frac{-4\,\gamma_i + 4\, k_r^2\, \left(5\,\beta\, P'_i + \left(-2+\beta^2\right) P'_r\right) + \eta\, Q'_r\, \eta^* - 4\,\mu\, Q'_{2r}\, \mu^*}{8\, k_r\, P'_i},$$

$$\eta^* \to -\frac{4\, k_r^2\, \left(Q_{2r}\, \left(\left(2-\beta^2\right) P'_i + 3\,\beta\, P'_r\right) + 3\,\alpha\, P_i\, Q'_{2i} + \left(-2+\alpha^2\right) P_r\, Q'_{2i}\right)}{\eta\, \left(-Q_{2r}\, Q'_i + Q_r\, Q'_{2i}\right)},$$

$$\mu^* \to \frac{k_r^2\, \left(\left(-2+\beta^2\right) Q_r\, P'_i - 3\,\beta\, Q_r\, P'_r - \left(3\,\alpha\, P_i + \left(-2+\alpha^2\right) P_r\right) Q'_i\right)}{\mu\, \left(-Q_{2r}\, Q'_i + Q_r\, Q'_{2i}\right)},$$

$$k_r \to \frac{1}{\sqrt{2}}\Big(\sqrt{\Big(P_i\, \left(Q_{2i}\, Q_r - Q_i\, Q_{2r}\right)\, (\alpha\,\gamma_i - \gamma_r) - \sqrt{\Big(P_i\, \left(Q_{2i}\, Q_r - Q_i\, Q_{2r}\right)\, \Big(-P_r\, \big(\alpha\, Q_{2i}\, Q_r + Q_i\, \left(\left(-2+\alpha^2\right) Q_{2i} + 2\,\alpha\, Q_{2r}\right)\big)\, \gamma_i^2 + P_i\, \left(Q_{2i}\, Q_r\, \left(\left(-1+\alpha^2\right)\gamma_i^2 - 2\,\alpha\,\gamma_i\,\gamma_r + \gamma_r^2\right) - Q_i\, \left(3\,\alpha\, Q_{2i}\,\gamma_i^2 + Q_{2r}\, \left(\gamma_i^2 - 2\,\alpha\,\gamma_i\,\gamma_r + \gamma_r^2\right)\right)\right)\Big)\Big) \Big/ \Big(P_i\, \Big(P_r\, \big(\alpha\, Q_{2i}\, Q_r + Q_i\, \left(\left(-2+\alpha^2\right) Q_{2i} + 2\,\alpha\, Q_{2r}\right)\big) + P_i\, \left(Q_{2i}\, Q_r + Q_i\, \left(3\,\alpha\, Q_{2i} + Q_{2r} - \alpha^2\, Q_{2r}\right)\right)\Big)\Big)\Big)\Big),$$

$$P'_i \to \frac{P_i\, P'_r}{P_r},\ \gamma'_r \to \beta\,\gamma_i - \frac{P_r\,\gamma_i^2}{4\, k_r^2\, P_i\, P'_r} + \frac{1}{P_r\, \left(Q_{2i}\, Q_r - Q_i\, Q_{2r}\right)} k_r^2\, \Big(-P_r^2\, \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right) Q'_{2i} + P_i\, \left(\beta^2\, \left(-Q_{2i}\, Q_r + Q_i\, Q_{2r}\right) P'_r + P_r\, \left(-3\,\alpha\, Q_i + \left(-2+\alpha^2\right) Q_r\right) Q'_{2i}\right)\Big),$$

$$2\, Q_{2i}\, Q_r\, P'_i - \beta^2\, Q_{2i}\, Q_r\, P'_i - 2\, Q_i\, Q_{2r}\, P'_i + \beta^2\, Q_i\, Q_{2r}\, P'_i + 3\,\beta\, Q_{2i}\, Q_r\, P'_r - 3\,\beta\, Q_i\, Q_{2r}\, P'_r + 3\,\alpha\, P_i\, Q_{2i}\, Q'_i - 2\, P_r\, Q_{2i}\, Q'_i + \alpha^2\, P_r\, Q_{2i}\, Q'_i + 2\, P_i\, Q_{2r}\, Q'_i - \alpha^2\, P_i\, Q_{2r}\, Q'_i + 3\,\alpha\, P_r\, Q_{2r}\, Q'_i - 3\,\alpha\, P_i\, Q_i\, Q'_{2i} + 2\, P_r\, Q_i\, Q'_{2i} - \alpha^2\, P_r\, Q_i\, Q'_{2i} - 2\, P_i\, Q_r\, Q'_{2i} + \alpha^2\, P_i\, Q_r\, Q'_{2i} - 3\,\alpha\, P_r\, Q_r\, Q'_{2i} \to 0,$$

$$3\,\beta\, Q_{2r}\, P'_i\, Q'_i - 2\, Q_{2r}\, P'_r\, Q'_i + \beta^2\, Q_{2r}\, P'_r\, Q'_i - 3\,\beta\, Q_r\, P'_i\, Q'_{2i} + 2\, Q_r\, P'_r\, Q'_{2i} - \beta^2\, Q_r\, P'_r\, Q'_{2i} + 2\, Q_{2r}\, P'_i\, Q'_r - \beta^2\, Q_{2r}\, P'_i\, Q'_r + 3\,\beta\, Q_{2r}\, P'_r\, Q'_r + 3\,\alpha\, P_i\, Q'_{2i}\, Q'_r - 2\, P_r\, Q'_{2i}\, Q'_r + \alpha^2\, P_r\, Q'_{2i}\, Q'_r - 2\, Q_r\, P'_i\, Q'_{2r} + \beta^2\, Q_r\, P'_i\, Q'_{2r} - 3\,\beta\, Q_r\, P'_r\, Q'_{2r} - 3\,\alpha\, P_i\, Q'_i\, Q'_{2r} + 2\, P_r\, Q'_i\, Q'_{2r} - \alpha^2\, P_r\, Q'_i\, Q'_{2r} \to 0\Big\}$$

In[•]:=
```
ReplaceAll[%, {P_r → 2, P_i → -3.5, P'_r → 3`, Q_1r → -1, Q_1i → 2.4`, γ_r → 3.5, γ_i → -1.25,
  γ'_i → 1.25, Q'_2i → 3.75`, Q'_2r → -0.75`, Q_2r → -3.5, Q_2i → 4.58, Q'_r → -0.3, Q'_i → 1.10}]
```

Out[•]=

$$\Big\{\omega_r \to 3.5 - 3.5\,k_i^2 - 4\,k_i\,k_r + 3.5\,k_r^2 - 4.58\,\mu\,\mu^*,$$

$$\omega_i \to -1.25 - 2\,k_i^2 + 7.\,k_i\,k_r + 2\,k_r^2 - 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$$

$$k_i \to -\frac{0.178571}{k_r} + \alpha\,k_r,\ K_2 \to \frac{5. + 4\,k_r^2\left(3.\left(-2+\beta^2\right) + 5\,\beta\,P'_i\right) - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*}{8\,k_r\,P'_i},$$

$$\eta^* \to -\frac{40.\,k_r^2\left(-39.375\,\alpha + 7.5\left(-2+\alpha^2\right) - 3.5\left(9.\,\beta + \left(2-\beta^2\right)P'_i\right)\right)}{\eta},$$

$$\mu^* \to \frac{10.\,k_r^2\left(-1.1\left(-10.5\,\alpha + 2\left(-2+\alpha^2\right)\right) + 9.\,\beta - \left(-2+\beta^2\right)P'_i\right)}{\mu},\ k_r \to 0.377964$$

$$\sqrt{\Big(-\Big(\big(-13.37\left(-3.5 - 1.25\,\alpha\right) - 3.6565\sqrt{\big(3.125\left(-4.58\,\alpha + 2.4\left(-7.\,\alpha + 4.58\left(-2+\alpha^2\right)\right)\right) + 3.5\left(-2.4\left(21.4688\,\alpha - 3.5\left(13.8125 + 8.75\,\alpha\right)\right) - 4.58\left(12.25 + 8.75\,\alpha + 1.5625\left(-1+\alpha^2\right)\right)\right)\big)\big/\left(-3.5\left(-4.58 + 2.4\left(-3.5 + 13.74\,\alpha + 3.5\,\alpha^2\right)\right) + 2\left(-4.58\,\alpha + 2.4\left(-7.\,\alpha + 4.58\left(-2+\alpha^2\right)\right)\right)\right)\big)\big)\Big)},$$

$$P'_i \to -5.25,\ \gamma'_r \to -1.25\,\beta + \frac{0.0744048}{k_r^2} + 0.13089\left(-15.\left(-3\,\alpha + 2.4\left(-2+\alpha^2\right)\right) - 3.5\left(7.5\left(2 - 7.2\,\alpha - \alpha^2\right) - 11.46\,\beta^2\right)\right)k_r^2,$$

$$16.548 + 41.001\,\alpha - 8.274\,\alpha^2 + 34.38\,\beta + 7.64\,P'_i - 3.82\,\beta^2\,P'_i \to 0,$$

$$1.8 + 3.15\,\alpha - 0.6\,\alpha^2 + 2.7\,\beta - 0.3\,\beta^2 + 0.6\,P'_i - 0.3\,\beta\,P'_i - 0.3\,\beta^2\,P'_i \to 0\Big\}$$

In[•]:=
```
ReplaceAll[%, {P'i → -5.25`}]
```

Out[•]=
$$\{\omega_r \to 3.5 - 3.5\, k_i^2 - 4\, k_i\, k_r + 3.5\, k_r^2 - 4.58\, \mu\, \mu^*,\ \omega_i \to -1.25 - 2\, k_i^2 + 7.\, k_i\, k_r + 2\, k_r^2 - 3.5\, \mu\, \mu^*,$$
$$\Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,\ k_i \to -\frac{0.178571}{k_r} + \alpha\, k_r,$$
$$K_2 \to -\frac{0.0238095\, \left(5. + 4\, \left(-26.25\, \beta + 3.\, \left(-2 + \beta^2\right)\right)\, k_r^2 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)}{k_r},$$
$$\eta^* \to -\frac{40.\, \left(-39.375\, \alpha + 7.5\, \left(-2 + \alpha^2\right) - 3.5\, \left(9.\, \beta - 5.25\, \left(2 - \beta^2\right)\right)\right)\, k_r^2}{\eta},$$
$$\mu^* \to \frac{10.\, \left(-1.1\, \left(-10.5\, \alpha + 2\, \left(-2 + \alpha^2\right)\right) + 9.\, \beta + 5.25\, \left(-2 + \beta^2\right)\right)\, k_r^2}{\mu},\ k_r \to 0.377964$$
$$\sqrt{\left(-\left(\left(-13.37\, \left(-3.5 - 1.25\, \alpha\right) - 3.6565\, \sqrt{\left(3.125\, \left(-4.58\, \alpha + 2.4\, \left(-7.\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right) + 3.5\, \left(-2.4\, \left(21.4688\, \alpha - 3.5\, \left(13.8125 + 8.75\, \alpha\right)\right) - 4.58\, \left(12.25 + 8.75\, \alpha + 1.5625\, \left(-1 + \alpha^2\right)\right)\right)\right)\right) \Big/ \left(-3.5\, \left(-4.58 + 2.4\, \left(-3.5 + 13.74\, \alpha + 3.5\, \alpha^2\right)\right) + 2\, \left(-4.58\, \alpha + 2.4\, \left(-7.\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right)\right)\right)\right)},$$
$$-5.25 \to -5.25,\ \gamma'_r \to -1.25\, \beta + \frac{0.0744048}{k_r^2} + 0.13089\, \left(-15.\, \left(-3\, \alpha + 2.4\, \left(-2 + \alpha^2\right)\right) - 3.5\, \left(7.5\, \left(2 - 7.2\, \alpha - \alpha^2\right) - 11.46\, \beta^2\right)\right)\, k_r^2,$$
$$-23.562 + 41.001\, \alpha - 8.274\, \alpha^2 + 34.38\, \beta + 20.055\, \beta^2 \to 0,$$
$$-1.35 + 3.15\, \alpha - 0.6\, \alpha^2 + 4.275\, \beta + 1.275\, \beta^2 \to 0\}$$

In[•]:=
```
Solve[{-23.561999999999998` + 41.001000000000005` α -
    8.274000000000001` α^2 + 34.379999999999995` β + 20.055` β^2 == 0,
  -1.3499999999999992` + 3.1499999999999986` α - 0.5999999999999999` α^2 +
    4.275000000000003` β + 1.2749999999999995` β^2 == 0}, {α, β}]
```

... Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

Out[•]=
$$\{\{\alpha \to -12.5361,\ \beta \to 8.75406\},\ \{\alpha \to 0.962941,\ \beta \to -0.288414\},$$
$$\{\alpha \to 3.79772,\ \beta \to -0.54779\},\ \{\alpha \to 22.4649,\ \beta \to 11.9566\}\}$$

In[•]:=

$$\Big\{\omega_r \to 3.5` - 3.5` k_i^2 - 4\, k_i\, k_r + 3.5` k_r^2 - 4.58` \mu\, \mu^*,$$

$$\omega_i \to -1.25` - 2\, k_i^2 + 7.` k_i\, k_r + 2\, k_r^2 - 3.5` \mu\, \mu^*,$$

$$\Omega_2 \to -1.25` + 3.` K_2^2 + 0.75` \mu\, \mu^*,\ k_i \to -\frac{0.17857142857142855`}{k_r} + \alpha\, k_r,$$

$$K_2 \to -\frac{0.023809523809523808` \left(5.` + 4 \left(-26.25` \beta + 3.` \left(-2 + \beta^2\right)\right) k_r^2 - 0.3` \eta\, \eta^* + 3.` \mu\, \mu^*\right)}{k_r},$$

$$\eta^* \to -\frac{39.99999999999979` \left(-39.375` \alpha + 7.5` \left(-2 + \alpha^2\right) - 3.5` \left(9.` \beta - 5.25` \left(2 - \beta^2\right)\right)\right) k_r^2}{\eta},$$

$$\mu^* \to \frac{9.999999999999947` \left(-1.1` \left(-10.5` \alpha + 2 \left(-2 + \alpha^2\right)\right) + 9.` \beta + 5.25` \left(-2 + \beta^2\right)\right) k_r^2}{\mu},$$

$$k_r \to 0.3779644730092272` \sqrt{\Big(-\Big(\big(-13.370000000000001` \left(-3.5` - 1.25` \alpha\right) - 3.6565010597564442` \sqrt{\big(3.125` \left(-4.58` \alpha + 2.4` \left(-7.` \alpha + 4.58` \left(-2 + \alpha^2\right)\right)\right) + 3.5` \left(-2.4` \left(21.46875` \alpha - 3.5` \left(13.8125` + 8.75` \alpha\right)\right) - 4.58` \left(12.25` + 8.75` \alpha + 1.5625` \left(-1 + \alpha^2\right)\right)\right)\big)}\big) \Big/ \left(-3.5` \left(-4.58` + 2.4` \left(-3.5` + 13.74` \alpha + 3.5` \alpha^2\right)\right) + 2 \left(-4.58` \alpha + 2.4` \left(-7.` \alpha + 4.58` \left(-2 + \alpha^2\right)\right)\right)\right)\Big)\Big)},$$

$$-5.25` \to -5.25`,\ \gamma'_r \to -1.25` \beta + \frac{0.07440476190476189`}{k_r^2} + 0.13089005235602094` \left(-15.` \left(-3\, \alpha + 2.4` \left(-2 + \alpha^2\right)\right) - 3.5` \left(7.5` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) - 11.46` \beta^2\right)\right) k_r^2,$$

$$-23.561999999999998` + 41.001000000000005` \alpha - 8.274000000000001` \alpha^2 + 34.379999999999995` \beta + 20.055` \beta^2 \to 0,$$

$$-1.3499999999999992` + 3.1499999999999986` \alpha - 0.5999999999999999` \alpha^2 + 4.275000000000003` \beta + 1.2749999999999995` \beta^2 \to 0\Big\}$$

Out[•]= $\left\{\omega_r \to 3.5 - 3.5\, k_i^2 - 4\, k_i\, k_r + 3.5\, k_r^2 - 4.58\, \mu\, \mu^*,\ \omega_i \to -1.25 - 2\, k_i^2 + 7.\, k_i\, k_r + 2\, k_r^2 - 3.5\, \mu\, \mu^*,\right.$

$\Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,\ k_i \to -\dfrac{0.178571}{k_r} + \alpha\, k_r,$

$K_2 \to -\dfrac{0.0238095\, \left(5. + 4\, \left(-26.25\, \beta + 3.\, \left(-2 + \beta^2\right)\right)\, k_r^2 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)}{k_r},$

$\eta^* \to -\dfrac{40.\, \left(-39.375\, \alpha + 7.5\, \left(-2 + \alpha^2\right) - 3.5\, \left(9.\, \beta - 5.25\, \left(2 - \beta^2\right)\right)\right)\, k_r^2}{\eta},$

$\mu^* \to \dfrac{10.\, \left(-1.1\, \left(-10.5\, \alpha + 2\, \left(-2 + \alpha^2\right)\right) + 9.\, \beta + 5.25\, \left(-2 + \beta^2\right)\right)\, k_r^2}{\mu},\ k_r \to 0.377964$

$\sqrt{\left(-\left(\left(-13.37\, \left(-3.5 - 1.25\, \alpha\right) - 3.6565\, \sqrt{\left(3.125\, \left(-4.58\, \alpha + 2.4\, \left(-7.\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right) + 3.5\, \left(-2.4\, \left(21.4688\, \alpha - 3.5\, \left(13.8125 + 8.75\, \alpha\right)\right) - 4.58\, \left(12.25 + 8.75\, \alpha + 1.5625\, \left(-1 + \alpha^2\right)\right)\right)\right)\right)} \Big/ \left(-3.5\, \left(-4.58 + 2.4\, \left(-3.5 + 13.74\, \alpha + 3.5\, \alpha^2\right)\right) + 2\, \left(-4.58\, \alpha + 2.4\, \left(-7.\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right)\right)\right)\right)},$

$-5.25 \to -5.25,\ \gamma'_r \to -1.25\, \beta + \dfrac{0.0744048}{k_r^2} + 0.13089\, \left(-15.\, \left(-3\, \alpha + 2.4\, \left(-2 + \alpha^2\right)\right) - 3.5\, \left(7.5\, \left(2 - 7.2\, \alpha - \alpha^2\right) - 11.46\, \beta^2\right)\right)\, k_r^2,$

$-23.562 + 41.001\, \alpha - 8.274\, \alpha^2 + 34.38\, \beta + 20.055\, \beta^2 \to 0,$

$\left.-1.35 + 3.15\, \alpha - 0.6\, \alpha^2 + 4.275\, \beta + 1.275\, \beta^2 \to 0\right\}$

In[•]:= **ReplaceAll[%, {α → 0.9629414676998117`, β → -0.2884139636266138`}]**

Out[•]= $\left\{\omega_r \to 3.5 - 3.5\, k_i^2 - 4\, k_i\, k_r + 3.5\, k_r^2 - 4.58\, \mu\, \mu^*,\right.$

$\omega_i \to -1.25 - 2\, k_i^2 + 7.\, k_i\, k_r + 2\, k_r^2 - 3.5\, \mu\, \mu^*,\ \Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,$

$k_i \to -\dfrac{0.178571}{k_r} + 0.962941\, k_r,\ K_2 \to -\dfrac{0.0238095\, \left(5. + 7.28166\, k_r^2 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)}{k_r},$

$\eta^* \to \dfrac{66.1936\, k_r^2}{\eta},\ \mu^* \to \dfrac{8.22993\, k_r^2}{\mu},\ k_r \to 0.183556,\ -5.25 \to -5.25,$

$\left.\gamma'_r \to 0.360517 + \dfrac{0.0744048}{k_r^2} + 31.299\, k_r^2,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\right\}$

In[•]:= **ReplaceAll[%, {k_r → 0.18355597316810585`}]**

Out[•]= $\left\{\omega_r \to 3.61792 - 0.734224\, k_i - 3.5\, k_i^2 - 4.58\, \mu\, \mu^*,\ \omega_i \to -1.18261 + 1.28489\, k_i - 2\, k_i^2 - 3.5\, \mu\, \mu^*,\right.$

$\Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,\ k_i \to -0.796091,\ K_2 \to -0.129713\, \left(5.24534 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right),$

$\eta^* \to \dfrac{2.23025}{\eta},\ \mu^* \to \dfrac{0.277289}{\mu},\ 0.183556 \to 0.183556,\ -5.25 \to -5.25,$

$\left.\gamma'_r \to 3.6234,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\right\}$

$$\left\{P'_i \to -5.25`,\ \alpha \to 0.9629414676998117`,\ \beta \to -0.2884139636266138`,\ k_r \to 0.18355597316810585`,\ k_i \to -0.7960908942706486`,\ \eta^* \to \frac{2.2302459985143397`}{\eta},\ \mu^* \to \frac{0.27728941762760295`}{\mu},\ \gamma'_r \to 3.6233952626657584`,\ K_2 \to -0.7015031407542284`,\ \omega_r \to 0.714285714285718`,\ \omega_i \to -4.443539466803328`,\ \Omega_2 \to 0.4342870326848425`\right\}$$

In[•]:=
```
ReplaceAll[%, {k_i → -0.7960908942706486`, η* → 2.2302459985143397`/η,
  μ* → 0.27728941762760295`/μ, γ'_r → 3.6233952626657584`}]
```

Out[•]=
$$\left\{\omega_r \to 0.714286,\ \omega_i \to -4.44354,\ \Omega_2 \to -1.04203 + 3.\ K_2^2,\ -0.796091 \to -0.796091,\ K_2 \to -0.701503,\ \frac{2.23025}{\eta} \to \frac{2.23025}{\eta},\ \frac{0.277289}{\mu} \to \frac{0.277289}{\mu},\ 0.183556 \to 0.183556,\ -5.25 \to -5.25,\ 3.6234 \to 3.6234,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\right\}$$

In[•]:=
```
ReplaceAll[%, {K_2 → -0.7015031407542284`}]
```

Out[•]=
$$\left\{\omega_r \to 0.714286,\ \omega_i \to -4.44354,\ \Omega_2 \to 0.434287,\ -0.796091 \to -0.796091,\ -0.701503 \to -0.701503,\ \frac{2.23025}{\eta} \to \frac{2.23025}{\eta},\ \frac{0.277289}{\mu} \to \frac{0.277289}{\mu},\ 0.183556 \to 0.183556,\ -5.25 \to -5.25,\ 3.6234 \to 3.6234,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\right\}$$

```
ReplaceAll[%, {}]
```

$$P'_i \to 0.6`,\ \gamma'_r \to -0.5,$$

In[62]:=
```
{A[x, t] A*[x, t] → ℯ^(ⅈ (x K1 - t Ω1)) f[x, t]^(-1-ⅈ α) G[x, t] ℯ^(-ⅈ (x K1 - t Ω1)) f[x, t]^(-1+ⅈ α) G*[x, t],
 B[x, t] B*[x, t] → ℯ^(ⅈ (x K2 - t Ω2)) f[x, t]^(-1-ⅈ β) H[x, t] ℯ^(-ⅈ (x K2 - t Ω2)) f[x, t]^(-1+ⅈ β) H*[x, t]}
```

Out[62]=
$$\left\{A[x, t]\, A^*[x, t] \to \frac{G[x, t]\, G^*[x, t]}{f[x, t]^2},\ B[x, t]\, B^*[x, t] \to \frac{H[x, t]\, H^*[x, t]}{f[x, t]^2}\right\}$$

In[63]:=
```
ReplaceAll[%, {G[x, t] → η Exp[k x + ω t],
  G*[x, t] → η* Exp[k* x + ω* t], H[x, t] → μ (1 - Exp[(k + k*) x + (ω + ω*) t]),
  H*[x, t] → μ* (1 - Exp[(k + k*) x + (ω + ω*) t]), f[x, t] → 1 + Exp[(k + k*) x + (ω + ω*) t]}]
```

Out[63]=
$$\left\{A[x, t]\, A^*[x, t] \to \frac{\mathrm{e}^{k\,x + t\,\omega + x\,k^* + t\,\omega^*}\,\eta\,\eta^*}{\left(1 + \mathrm{e}^{x\,(k+k^*) + t\,(\omega+\omega^*)}\right)^2},\ B[x, t]\, B^*[x, t] \to \frac{\left(1 - \mathrm{e}^{x\,(k+k^*) + t\,(\omega+\omega^*)}\right)^2 \mu\,\mu^*}{\left(1 + \mathrm{e}^{x\,(k+k^*) + t\,(\omega+\omega^*)}\right)^2}\right\}$$

In[64]:=
```
ReplaceAll[%, {k → k_r + I k_i, k* → k_r - I k_i, ω → ω_r + I ω_i, ω* → ω_r - I ω_i}]
```

Out[64]=
$$\left\{A[x, t]\, A^*[x, t] \to \frac{\mathrm{e}^{x\,(-\mathrm{i}\,k_i + k_r) + x\,(\mathrm{i}\,k_i + k_r) + t\,(-\mathrm{i}\,\omega_i + \omega_r) + t\,(\mathrm{i}\,\omega_i + \omega_r)}\,\eta\,\eta^*}{\left(1 + \mathrm{e}^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2},\ B[x, t]\, B^*[x, t] \to \frac{\left(1 - \mathrm{e}^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2 \mu\,\mu^*}{\left(1 + \mathrm{e}^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2}\right\}$$

In[65]:=
```
ReplaceAll[%, {P'ᵢ → -5.25`, α → 0.9629414676998117`, β → -0.2884139636266138`,
  kᵣ → 0.18355597316810585`, kᵢ → -0.7960908942706486`, η* → 2.2302459985143397`/η,
  μ* → 0.27728941762760295`/μ, γ'ᵣ → 3.6233952626657584`, K₂ → -0.7015031407542284`,
  ωᵣ → 0.714285714285718`, ωᵢ → -4.443539466803328`, Ω₂ → 0.4342870326848425`}]
```

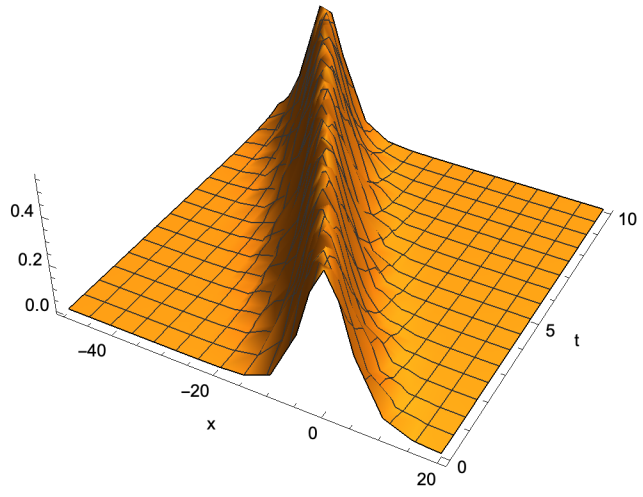
Out[65]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{2.23025\, e^{(1.42857+0.\,i)\,t+(0.367112+0.\,i)\,x}}{\left(1+e^{1.42857\,t+0.367112\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.277289\left(1-e^{1.42857\,t+0.367112\,x}\right)^2}{\left(1+e^{1.42857\,t+0.367112\,x}\right)^2}\right\}$$

In[•]:=
```
Simplify[%]
```

Out[•]=
$$\left\{\Phi[x,t]\,\Phi^*[x,t] \to \frac{2.23025\, e^{1.42857\,t+0.367112\,x}}{\left(1.+e^{1.42857\,t+0.367112\,x}\right)^2},\right.$$
$$\left. \Psi[x,t]\,\Psi^*[x,t] \to \frac{0.277289\left(-1.+e^{1.42857\,t+0.367112\,x}\right)^2}{\left(1.+e^{1.42857\,t+0.367112\,x}\right)^2}\right\}$$

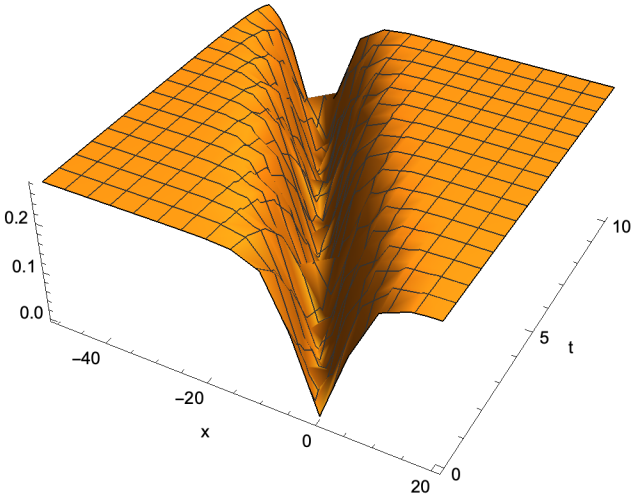
In[66]:=
```
Plot3D[2.2302459985143397` e^(1.428571428571436` t+0.3671119463362117` x)/(1.` + e^(1.428571428571436` t+0.3671119463362117` x))^2,
 {x, -50, 20}, {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[66]=



In[67]:=
```
Plot3D[0.27728941762760295` (1 - e^(1.428571428571436` t+0.3671119463362117` x))^2 / (1 + e^(1.428571428571436` t+0.3671119463362117` x))^2, {x, -50, 20},
 {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[67]=



ok

Out[•]=
```
{{α → -12.5361, β → 8.75406}, {α → 0.962941, β → -0.288414},
 {α → 3.79772, β → -0.54779}, {α → 22.4649, β → 11.9566}}
```

In[•]:=
$$\Big\{\omega_r \to 3.5` - 3.5` k_i^2 - 4\, k_i\, k_r + 3.5` k_r^2 - 4.58` \mu\, \mu^*,$$
$$\omega_i \to -1.25` - 2\, k_i^2 + 7.` k_i\, k_r + 2\, k_r^2 - 3.5` \mu\, \mu^*,$$
$$\Omega_2 \to -1.25` + 3.` K_2^2 + 0.75` \mu\, \mu^*,\ k_i \to -\frac{0.17857142857142855`}{k_r} + \alpha\, k_r,$$
$$K_2 \to -\frac{0.023809523809523808` \left(5.` + 4 \left(-26.25` \beta + 3.` \left(-2 + \beta^2\right)\right) k_r^2 - 0.3` \eta\, \eta^* + 3.` \mu\, \mu^*\right)}{k_r},$$
$$\eta^* \to -\frac{39.99999999999979` \left(-39.375` \alpha + 7.5` \left(-2 + \alpha^2\right) - 3.5` \left(9.` \beta - 5.25` \left(2 - \beta^2\right)\right)\right) k_r^2}{\eta},$$
$$\mu^* \to \frac{9.999999999999947` \left(-1.1` \left(-10.5` \alpha + 2 \left(-2 + \alpha^2\right)\right) + 9.` \beta + 5.25` \left(-2 + \beta^2\right)\right) k_r^2}{\mu},$$
$$k_r \to 0.3779644730092272` \sqrt{\Big(-\Big(\big(-13.370000000000001` \left(-3.5` - 1.25` \alpha\right) - 3.6565010597564442` \sqrt{\big(3.125` \left(-4.58` \alpha + 2.4` \left(-7.` \alpha + 4.58` \left(-2 + \alpha^2\right)\right)\right) + 3.5` \left(-2.4` \left(21.46875` \alpha - 3.5` \left(13.8125` + 8.75` \alpha\right)\right) - 4.58` \left(12.25` + 8.75` \alpha + 1.5625` \left(-1 + \alpha^2\right)\right)\right)\big)}\big) \Big/ \left(-3.5` \left(-4.58` + 2.4` \left(-3.5` + 13.74` \alpha + 3.5` \alpha^2\right)\right) + 2 \left(-4.58` \alpha + 2.4` \left(-7.` \alpha + 4.58` \left(-2 + \alpha^2\right)\right)\right)\right)\Big)\Big)},$$
$$-5.25` \to -5.25`,\ \gamma'_r \to -1.25` \beta + \frac{0.07440476190476189`}{k_r^2} + 0.13089005235602094` \left(-15.` \left(-3\, \alpha + 2.4` \left(-2 + \alpha^2\right)\right) - 3.5` \left(7.5` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) - 11.46` \beta^2\right)\right) k_r^2,$$
$$-23.561999999999998` + 41.001000000000005` \alpha - 8.274000000000001` \alpha^2 + 34.379999999999995` \beta + 20.055` \beta^2 \to 0,$$
$$-1.3499999999999992` + 3.1499999999999986` \alpha - 0.5999999999999999` \alpha^2 + 4.275000000000003` \beta + 1.2749999999999995` \beta^2 \to 0\Big\}$$

Out[•]= $\{\omega_r \to 3.5 - 3.5\, k_i^2 - 4\, k_i\, k_r + 3.5\, k_r^2 - 4.58\, \mu\, \mu^*,\ \omega_i \to -1.25 - 2\, k_i^2 + 7.\, k_i\, k_r + 2\, k_r^2 - 3.5\, \mu\, \mu^*,$

$\Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,\ k_i \to -\dfrac{0.178571}{k_r} + \alpha\, k_r,$

$K_2 \to -\dfrac{0.0238095\, \left(5. + 4\, \left(-26.25\, \beta + 3.\, \left(-2 + \beta^2\right)\right)\, k_r^2 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)}{k_r},$

$\eta^* \to -\dfrac{40.\, \left(-39.375\, \alpha + 7.5\, \left(-2 + \alpha^2\right) - 3.5\, \left(9.\, \beta - 5.25\, \left(2 - \beta^2\right)\right)\right)\, k_r^2}{\eta},$

$\mu^* \to \dfrac{10.\, \left(-1.1\, \left(-10.5\, \alpha + 2\, \left(-2 + \alpha^2\right)\right) + 9.\, \beta + 5.25\, \left(-2 + \beta^2\right)\right)\, k_r^2}{\mu},\ k_r \to 0.377964$

$\sqrt{\left(-\left(\left(-13.37\, \left(-3.5 - 1.25\, \alpha\right) - 3.6565\, \sqrt{\left(3.125\, \left(-4.58\, \alpha + 2.4\, \left(-7.\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right) + 3.5\, \left(-2.4\, \left(21.4688\, \alpha - 3.5\, \left(13.8125 + 8.75\, \alpha\right)\right) - 4.58\, \left(12.25 + 8.75\, \alpha + 1.5625\, \left(-1 + \alpha^2\right)\right)\right)\right)\right)} \Big/ \left(-3.5\, \left(-4.58 + 2.4\, \left(-3.5 + 13.74\, \alpha + 3.5\, \alpha^2\right)\right) + 2\, \left(-4.58\, \alpha + 2.4\, \left(-7.\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right)\right)\right)\right)},$

$-5.25 \to -5.25,\ \gamma'_r \to -1.25\, \beta + \dfrac{0.0744048}{k_r^2} + 0.13089\, \left(-15.\, \left(-3\, \alpha + 2.4\, \left(-2 + \alpha^2\right)\right) - 3.5\, \left(7.5\, \left(2 - 7.2\, \alpha - \alpha^2\right) - 11.46\, \beta^2\right)\right)\, k_r^2,$

$-23.562 + 41.001\, \alpha - 8.274\, \alpha^2 + 34.38\, \beta + 20.055\, \beta^2 \to 0,$

$-1.35 + 3.15\, \alpha - 0.6\, \alpha^2 + 4.275\, \beta + 1.275\, \beta^2 \to 0\}$

In[•]:= **ReplaceAll[%, {α → 22.464873525305386`, β → 11.956575473719793`}]**

Out[•]= $\{\omega_r \to 3.5 - 3.5\, k_i^2 - 4\, k_i\, k_r + 3.5\, k_r^2 - 4.58\, \mu\, \mu^*,$

$\omega_i \to -1.25 - 2\, k_i^2 + 7.\, k_i\, k_r + 2\, k_r^2 - 3.5\, \mu\, \mu^*,\ \Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,$

$k_i \to -\dfrac{0.178571}{k_r} + 22.4649\, k_r,\ K_2 \to -\dfrac{0.0238095\, \left(5. + 436.076\, k_r^2 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)}{k_r},$

$\eta^* \to \dfrac{3251.68\, k_r^2}{\eta},\ \mu^* \to \dfrac{12.4168\, k_r^2}{\mu},\ k_r \to 0.0715369,\ -5.25 \to -5.25,$

$\gamma'_r \to -14.9457 + \dfrac{0.0744048}{k_r^2} + 797.102\, k_r^2,\ 0. \to 0,\ 5.68434 \times 10^{-14} \to 0\}$

In[•]:= **ReplaceAll[%, {k_r → 0.07153694134555033`}]**

Out[•]= $\{\omega_r \to 3.51791 - 0.286148\, k_i - 3.5\, k_i^2 - 4.58\, \mu\, \mu^*,$

$\omega_i \to -1.23976 + 0.500759\, k_i - 2\, k_i^2 - 3.5\, \mu\, \mu^*,\ \Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,\ k_i \to -0.889144,$

$K_2 \to -0.332828\, \left(7.23163 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right),\ \eta^* \to \dfrac{16.6406}{\eta},\ \mu^* \to \dfrac{0.0635436}{\mu},$

$0.0715369 \to 0.0715369,\ -5.25 \to -5.25,\ \gamma'_r \to 3.67266,\ 0. \to 0,\ 5.68434 \times 10^{-14} \to 0\}$

In[•]:=
```
ReplaceAll[%,
 {k_i → -0.8891444590523245`, η* → 16.64055977711836`/η, μ* → 0.06354362728640765`/μ}]
```

Out[•]=
$$\left\{\omega_r \to 0.714286,\ \omega_i \to -3.48857,\ \Omega_2 \to -1.20234 + 3.\ K_2^2,\ -0.889144 \to -0.889144,\ K_2 \to -0.808805,\ \frac{16.6406}{\eta} \to \frac{16.6406}{\eta},\ \frac{0.0635436}{\mu} \to \frac{0.0635436}{\mu},\ 0.0715369 \to 0.0715369,\ -5.25 \to -5.25,\ \gamma'_r \to 3.67266,\ 0. \to 0,\ 5.68434 \times 10^{-14} \to 0\right\}$$

In[•]:=
```
ReplaceAll[%, {K_2 → -0.8088050274877259`}]
```

Out[•]=
$$\left\{\omega_r \to 0.714286,\ \omega_i \to -3.48857,\ \Omega_2 \to 0.760154,\ -0.889144 \to -0.889144,\ -0.808805 \to -0.808805,\ \frac{16.6406}{\eta} \to \frac{16.6406}{\eta},\ \frac{0.0635436}{\mu} \to \frac{0.0635436}{\mu},\ 0.0715369 \to 0.0715369,\ -5.25 \to -5.25,\ \gamma'_r \to 3.67266,\ 0. \to 0,\ 5.68434 \times 10^{-14} \to 0\right\}$$

$$\left\{P'_i \to -5.25`\ \alpha \to 22.464873525305386`,\ \beta \to 11.956575473719793`,\ k_r \to 0.07153694134555033`,\ k_i \to -0.8891444590523245`,\ \eta^* \to \frac{16.64055977711836`}{\eta},\ \mu^* \to \frac{0.06354362728640765`}{\mu},\ \gamma'_r \to 3.6233952626657584`,\ K_2 \to -0.7015031407542284`,\ \gamma'_r \to 3.6726578578935287`,\ \omega_r \to 0.714285714285718`,\ \omega_i \to -4.443539466803328`,\ \Omega_2 \to 0.4342870326848425`\right\}$$

In[•]:=
```
ReplaceAll[%, {k_i → -0.7960908942706486`, η* → 2.2302459985143397`/η,
  μ* → 0.27728941762760295`/μ, γ'_r → 3.6233952626657584`}]
```

Out[•]=
$$\left\{\omega_r \to 0.714286,\ \omega_i \to -4.44354,\ \Omega_2 \to -1.04203 + 3.\ K_2^2,\ -0.796091 \to -0.796091,\ K_2 \to -0.701503,\ \frac{2.23025}{\eta} \to \frac{2.23025}{\eta},\ \frac{0.277289}{\mu} \to \frac{0.277289}{\mu},\ 0.183556 \to 0.183556,\ -5.25 \to -5.25,\ 3.6234 \to 3.6234,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\right\}$$

In[•]:=
```
ReplaceAll[%, {K_2 → -0.7015031407542284`}]
```

Out[•]=
$$\left\{\omega_r \to 0.714286,\ \omega_i \to -4.44354,\ \Omega_2 \to 0.434287,\ -0.796091 \to -0.796091,\ -0.701503 \to -0.701503,\ \frac{2.23025}{\eta} \to \frac{2.23025}{\eta},\ \frac{0.277289}{\mu} \to \frac{0.277289}{\mu},\ 0.183556 \to 0.183556,\ -5.25 \to -5.25,\ 3.6234 \to 3.6234,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\right\}$$

In[68]:=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$$

Out[68]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$$

In[69]:=
```
ReplaceAll[%, {P'i → -5.25` α → 22.464873525305386`,
  β → 11.956575473719793`, kr → 0.07153694134555033`, ki → -0.8891444590523245`,
  η* → 16.64055977711836`/η, μ* → 0.06354362728640765`/μ, γ'r → 3.6233952626657584`,
  K2 → -0.7015031407542284`, γ'r → 3.6726578578935287`,
  ωr → 0.714285714285718`, ωi → -4.443539466803328`, Ω2 → 0.4342870326848425`}]
```

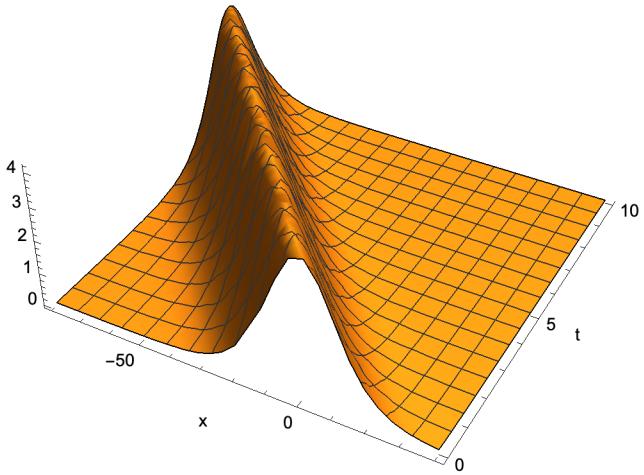
Out[69]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{16.6406\,e^{(1.42857+0.\,i)\,t+(0.143074+0.\,i)\,x}}{\left(1+e^{1.42857\,t+0.143074\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.0635436\,\left(1-e^{1.42857\,t+0.143074\,x}\right)^2}{\left(1+e^{1.42857\,t+0.143074\,x}\right)^2}\right\}$$

In[•]:=
```
Simplify[%]
```

Out[•]=
$$\left\{\Phi[x,t]\,\Phi^*[x,t] \to \frac{16.6406\,e^{1.42857\,t+0.143074\,x}}{\left(1.+e^{1.42857\,t+0.143074\,x}\right)^2},\right.$$
$$\left. \Psi[x,t]\,\Psi^*[x,t] \to \frac{0.0635436\,\left(-1.+e^{1.42857\,t+0.143074\,x}\right)^2}{\left(1.+e^{1.42857\,t+0.143074\,x}\right)^2}\right\}$$

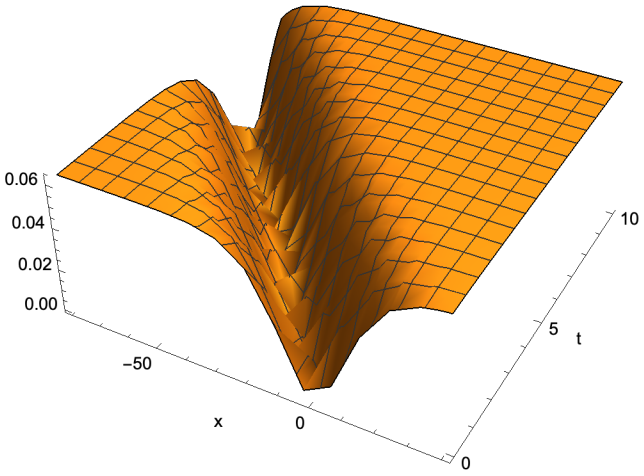
In[70]:=
```
Plot3D[16.64055977711836` e^(1.428571428571436` t+0.14307388269110066` x) / (1.` + e^(1.428571428571436` t+0.14307388269110066` x))^2, {x, -80, 40},
 {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[70]=



In[71]:=
```
Plot3D[0.06354362728640765` (-1.` + e^(1.428571428571436` t+0.14307388269110066` x))^2 / (1.` + e^(1.428571428571436` t+0.14307388269110066` x))^2, {x, -80, 40},
 {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[71]=



ok

Out[•]=
```
{{α → -12.5361, β → 8.75406}, {α → 0.962941, β → -0.288414},
 {α → 3.79772, β → -0.54779}, {α → 22.4649, β → 11.9566}}
```

seulement deux valeurs the alpha et beta marchent ici

In[•]:=
```
ReplaceAll[%, {p1r → Pr, p1i → Pi, p2r → P'r, p2i → P'i, q1r → Q1r, q1i → Q1i, R1r → Q2r,
  R1i → Q2i, R2r → Q'1r, R2i → Q'1i, q2r → Q'2r, q2i → Q'2i, ϒ2r → ϒ'r, ϒ2i → ϒ'i }]
```

In[•]:=
```
ReplaceAll[%, {P_r → 2, P_i → -3.5, P'_r → 3`, Q_1r → -1, Q_1i → 2.4`, γ_r → 3.5, γ_i → -1.25,
  γ'_i → 1.25, Q'_2i → 3.75`, Q'_2r → -0.75`, Q_2r → -3.5, Q_2i → 4.58, Q'_r → -0.3, Q'_i → 1.10}]
```

In[•]:=
```
ReplaceAll[%, {α → 0.9629414676998117`, β → -0.2884139636266138`}]
```

Out[•]=
$$\{\omega_r \to 3.5 - 3.5\, k_i^2 - 4\, k_i\, k_r + 3.5\, k_r^2 - 4.58\, \mu\, \mu^*,\ \omega_i \to -1.25 - 2\, k_i^2 + 7.\, k_i\, k_r + 2\, k_r^2 - 3.5\, \mu\, \mu^*,\ \Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,\ k_i \to -\frac{0.178571}{k_r} + 0.962941\, k_r,\ K_2 \to -\frac{0.0238095\, \left(5. + 7.28166\, k_r^2 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)}{k_r},\ \eta^* \to \frac{66.1936\, k_r^2}{\eta},\ \mu^* \to \frac{8.22993\, k_r^2}{\mu},\ k_r \to 0.183556,\ -5.25 \to -5.25,\ \gamma'_r \to 0.360517 + \frac{0.0744048}{k_r^2} + 31.299\, k_r^2,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\}$$

In[•]:=
```
ReplaceAll[%, {k_r → 0.18355597316810585`}]
```

Out[•]=
$$\{\omega_r \to 3.61792 - 0.734224\, k_i - 3.5\, k_i^2 - 4.58\, \mu\, \mu^*,\ \omega_i \to -1.18261 + 1.28489\, k_i - 2\, k_i^2 - 3.5\, \mu\, \mu^*,\ \Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,\ k_i \to -0.796091,\ K_2 \to -0.129713\, \left(5.24534 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right),\ \eta^* \to \frac{2.23025}{\eta},\ \mu^* \to \frac{0.277289}{\mu},\ 0.183556 \to 0.183556,\ -5.25 \to -5.25,\ \gamma'_r \to 3.6234,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\}$$

$$\{P'_i \to -5.25`,\ \alpha \to 0.9629414676998117`,\ \beta \to -0.2884139636266138`,\ k_r \to 0.18355597316810585`,\ k_i \to -0.7960908942706486`,\ \eta^* \to \frac{2.2302459985143397`}{\eta},\ \mu^* \to \frac{0.27728941762760295`}{\mu},\ \gamma'_r \to 3.6233952626657584`,\ K_2 \to -0.7015031407542284`,\ \omega_r \to 0.714285714285718`,\ \omega_i \to -4.443539466803328`,\ \Omega_2 \to 0.4342870326848425`\}$$

In[•]:=
```
ReplaceAll[%, {k_i → -0.7960908942706486`, η* → 2.2302459985143397`/η,
  μ* → 0.27728941762760295`/μ, γ'_r → 3.6233952626657584`}]
```

Out[•]=
$$\{\omega_r \to 0.714286,\ \omega_i \to -4.44354,\ \Omega_2 \to -1.04203 + 3.\, K_2^2,\ -0.796091 \to -0.796091,\ K_2 \to -0.701503,\ \frac{2.23025}{\eta} \to \frac{2.23025}{\eta},\ \frac{0.277289}{\mu} \to \frac{0.277289}{\mu},\ 0.183556 \to 0.183556,\ -5.25 \to -5.25,\ 3.6234 \to 3.6234,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\}$$

In[•]:=
```
ReplaceAll[%, {K_2 → -0.7015031407542284`}]
```

Out[•]=
$$\{\omega_r \to 0.714286,\ \omega_i \to -4.44354,\ \Omega_2 \to 0.434287,\ -0.796091 \to -0.796091,\ -0.701503 \to -0.701503,\ \frac{2.23025}{\eta} \to \frac{2.23025}{\eta},\ \frac{0.277289}{\mu} \to \frac{0.277289}{\mu},\ 0.183556 \to 0.183556,\ -5.25 \to -5.25,\ 3.6234 \to 3.6234,\ 5.32907 \times 10^{-15} \to 0,\ -1.55431 \times 10^{-15} \to 0\}$$

In[72]:=
$$\left\{A[x,t]\,A^*[x,t] \to e^{i\,(x\,K_1 - t\,\Omega_1)}\,f[x,t]^{-1-i\,\alpha}\,G[x,t]\,e^{-i\,(x\,K_1 - t\,\Omega_1)}\,f[x,t]^{-1+i\,\alpha}\,G^*[x,t],\right.$$
$$\left. B[x,t]\,B^*[x,t] \to e^{i\,(x\,K_2 - t\,\Omega_2)}\,f[x,t]^{-1-i\,\beta}\,H[x,t]\;e^{-i\,(x\,K_2 - t\,\Omega_2)}\,f[x,t]^{-1+i\,\beta}\,H^*[x,t]\right\}$$

Out[72]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{G[x,t]\,G^*[x,t]}{f[x,t]^2},\; B[x,t]\,B^*[x,t] \to \frac{H[x,t]\,H^*[x,t]}{f[x,t]^2}\right\}$$

In[73]:=
$$\text{ReplaceAll}\left[\%,\left\{G[x,t] \to \eta\,\text{Exp}[k\,x + \omega\,t],\right.\right.$$
$$G^*[x,t] \to \eta^*\,\text{Exp}[k^*\,x + \omega^*\,t],\; H[x,t] \to \mu\,\left(1 - \text{Exp}\left[\left(k + k^*\right)x + (\omega + \omega^*)\,t\right]\right),$$
$$\left.\left.H^*[x,t] \to \mu^*\,\left(1 - \text{Exp}\left[\left(k + k^*\right)x + (\omega + \omega^*)\,t\right]\right),\; f[x,t] \to 1 + \text{Exp}\left[\left(k + k^*\right)x + (\omega + \omega^*)\,t\right]\right\}\right]$$

Out[73]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{k\,x + t\,\omega + x\,k^* + t\,\omega^*}\,\eta\,\eta^*}{\left(1 + e^{x\,(k + k^*) + t\,(\omega + \omega^*)}\right)^2},\; B[x,t]\,B^*[x,t] \to \frac{\left(1 - e^{x\,(k + k^*) + t\,(\omega + \omega^*)}\right)^2\,\mu\,\mu^*}{\left(1 + e^{x\,(k + k^*) + t\,(\omega + \omega^*)}\right)^2}\right\}$$

In[74]:=
$$\text{ReplaceAll}[\%,\{k \to k_r + I\,k_i,\; k^* \to k_r - I\,k_i,\; \omega \to \omega_r + I\,\omega_i,\; \omega^* \to \omega_r - I\,\omega_i\}]$$

Out[74]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i + k_r) + x\,(i\,k_i + k_r) + t\,(-i\,\omega_i + \omega_r) + t\,(i\,\omega_i + \omega_r)}\,\eta\,\eta^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{\left(1 - e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2\,\mu\,\mu^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2}\right\}$$

In[75]:=
$$\text{ReplaceAll}\left[\%,\left\{P'_i \to -5.25`,\; \alpha \to 0.9629414676998117`,\; \beta \to -0.2884139636266138`,\right.\right.$$
$$k_r \to 0.18355597316810585`,\; k_i \to -0.7960908942706486`,\; \eta^* \to \frac{2.2302459985143397`}{\eta},$$
$$\mu^* \to \frac{0.27728941762760295`}{\mu},\; \gamma'_r \to 3.6233952626657584`,\; K_2 \to -0.7015031407542284`,$$
$$\left.\left.\omega_r \to 0.714285714285718`,\; \omega_i \to -4.443539466803328`,\; \Omega_2 \to 0.4342870326848425`\right\}\right]$$

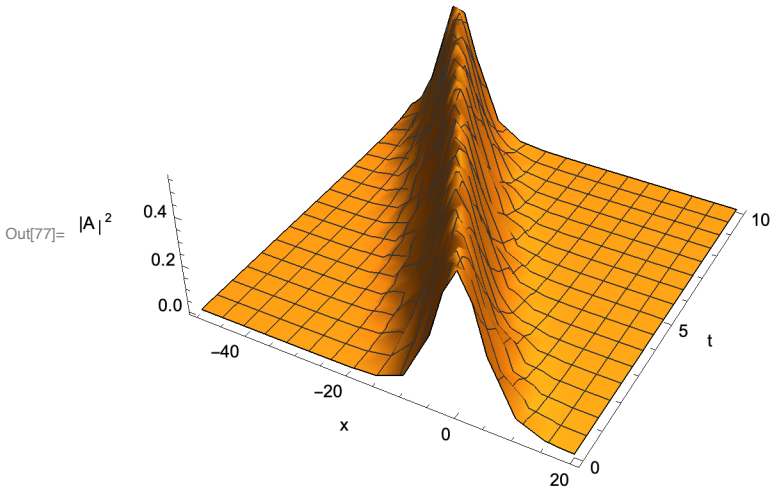
Out[75]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{2.23025\,e^{(1.42857 + 0.\,i)\,t + (0.367112 + 0.\,i)\,x}}{\left(1 + e^{1.42857\,t + 0.367112\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.277289\,\left(1 - e^{1.42857\,t + 0.367112\,x}\right)^2}{\left(1 + e^{1.42857\,t + 0.367112\,x}\right)^2}\right\}$$

In[76]:=
$$\text{Simplify}[\%]$$

Out[76]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{2.23025\,e^{1.42857\,t + 0.367112\,x}}{\left(1. + e^{1.42857\,t + 0.367112\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.277289\,\left(-1. + e^{1.42857\,t + 0.367112\,x}\right)^2}{\left(1. + e^{1.42857\,t + 0.367112\,x}\right)^2}\right\}$$

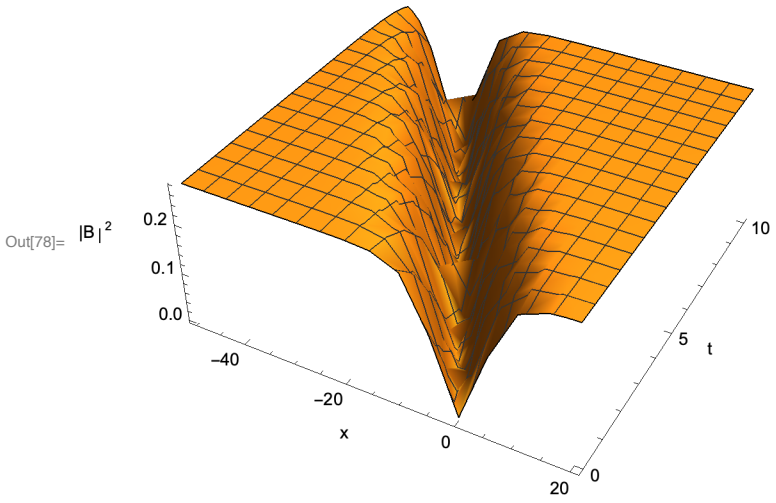
In[77]:=
```
Plot3D[2.2302459985143397` e^(1.428571428571436` t+0.3671119463362117` x) / (1.` + e^(1.428571428571436` t+0.3671119463362117` x))^2, {x, -50, 20},
 {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[77]=



In[78]:=
```
Plot3D[0.27728941762760295` (1 - e^(1.428571428571436` t+0.3671119463362117` x))^2 / (1 + e^(1.428571428571436` t+0.3671119463362117` x))^2, {x, -50, 20},
 {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[78]=



Solution Dark - Bright Case 2

$$R_i \to \left(\left(3\beta p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) q_i R_r + p_r \left(-\left(-2+\alpha^2\right) q_i q_{2r} - 3\alpha q_r q_{2r} + 3\alpha R_r R_{2r}\right) + p_i \left(-3\alpha q_i q_{2r} + \left(-2+\alpha^2\right)\left(q_r q_{2r} - R_r R_{2r}\right)\right)\right) / \left(3\beta p_{2i} q_r + \left(-2+\beta^2\right) p_{2r} q_r - \left(3\alpha p_i + \left(-2+\alpha^2\right) p_r\right) R_{2r}\right),$$

$$R_{2i} \to \left(\left(3\alpha p_i + \left(-2+\alpha^2\right) p_r\right) q_{2i} R_{2r} + p_{2r} \left(-\left(-2+\beta^2\right) q_{2i} q_r - 3\beta q_r q_{2r} + 3\beta R_r R_{2r}\right) + p_{2i} \left(-3\beta q_{2i} q_r + \left(-2+\beta^2\right)\left(q_r q_{2r} - R_r R_{2r}\right)\right)\right) / \left(3\alpha p_i q_{2r} + \left(-2+\alpha^2\right) p_r q_{2r} - \left(3\beta p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) R_r\right),$$

In[•]:=
$$\left\{\gamma_i \to 0,\ p_i \to 0,\ \omega_r \to -2\,k_i\,k_r\,p_r + \gamma_r - \mu\,R_i\,\mu^*,\ \omega_i \to -k_i^2\,p_r + k_r^2\,p_r + \mu\,R_r\,\mu^*,\right.$$
$$\Omega_2 \to K_2^2\,p_{2r} - \gamma_{2i} - \mu\,q_{2r}\,\mu^*,\ K_2 \to \frac{4\,k_r^2\left(5\,\beta\,p_{2i} + \left(-2+\beta^2\right)p_{2r}\right) + \eta\,R_{2r}\,\eta^* - 4\,\mu\,q_{2r}\,\mu^*}{8\,k_r\,p_{2i}},$$
$$k_i \to \frac{1}{8\,k_r\,p_{2i}\,p_r}\left(4\,k_r^2\left(\left(-2+\beta^2\right)p_{2i}^2 + 2\,\alpha\,p_{2i}\,p_r + \left(-2+\beta^2\right)p_{2r}^2\right) + p_{2i}\left(\eta\,R_{2i}\,\eta^* - 4\,\mu\,q_{2i}\,\mu^*\right) +\right.$$
$$\left.p_{2r}\left(\eta\,R_{2r}\,\eta^* - 4\,\mu\,q_{2r}\,\mu^*\right)\right),\ \eta^* \to -\frac{4\,k_r^2\,p_r\left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\,R_r\right)}{\eta\left(q_r\,R_i - q_i\,R_r\right)},$$
$$\mu^* \to -\frac{k_r^2\,p_r\left(\left(-2+\alpha^2\right)q_i + 3\,\alpha\,q_r\right)}{\mu\left(q_r\,R_i - q_i\,R_r\right)},\ k_r \to \sqrt{-\frac{\left(q_r\,R_i - q_i\,R_r\right)\gamma_r}{p_r\left(\alpha\,q_r\,R_i + q_i\left(\left(-2+\alpha^2\right)R_i + 2\,\alpha\,R_r\right)\right)}},$$
$$\gamma_{2r} \to \left(\left(\left(5\,\beta\,p_{2i} + \left(-2+\beta^2\right)p_{2r}\right)^2\left(q_r\,R_i - q_i\,R_r\right)^2 +\right.\right.$$
$$p_r^2\left(\left(-2+\alpha^2\right)q_i\,q_{2r} + 3\,\alpha\,q_r\,q_{2r} - \left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\,R_r\right)R_{2r}\right)^2 - 2\,p_r\left(-q_r\,R_i + q_i\,R_r\right)$$
$$\left(\left(-2+\beta^2\right)p_{2r}\left(\left(-2+\alpha^2\right)q_i\,q_{2r} + 3\,\alpha\,q_r\,q_{2r} - \left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\,R_r\right)R_{2r}\right) +\right.$$
$$p_{2i}\left(6\,\alpha\,q_{2i}\,q_r + 15\,\alpha\,\beta\,q_r\,q_{2r} + \left(-2+\alpha^2\right)q_i\left(2\,q_{2i} + 5\,\beta\,q_{2r}\right) -\right.$$
$$\left.\left.\left.5\,\beta\left(\left(-2+\alpha^2\right)R_i + 3\,\alpha\,R_r\right)R_{2r}\right)\right)\gamma_r\right)\Big/$$
$$\left(4\,p_{2i}\,p_r\left(q_r\,R_i - q_i\,R_r\right)\left(\alpha\,q_r\,R_i + q_i\left(\left(-2+\alpha^2\right)R_i + 2\,\alpha\,R_r\right)\right)\right),$$
$$\left(-2\,p_r\,q_i\,q_{2r} + \alpha^2\,p_r\,q_i\,q_{2r} + 3\,\alpha\,p_r\,q_r\,q_{2r} + 3\,\beta\,p_{2i}\,q_r\,R_i - 2\,p_{2r}\,q_r\,R_i + \beta^2\,p_{2r}\,q_r\,R_i -\right.$$
$$3\,\beta\,p_{2i}\,q_i\,R_r + 2\,p_{2r}\,q_i\,R_r - \beta^2\,p_{2r}\,q_i\,R_r + 2\,p_r\,R_i\,R_{2r} - \alpha^2\,p_r\,R_i\,R_{2r} - 3\,\alpha\,p_r\,R_r\,R_{2r}\Big) \to 0,$$
$$\left(-2\,p_r\,q_i\,q_{2i} + \alpha^2\,p_r\,q_i\,q_{2i} + 3\,\alpha\,p_r\,q_{2i}\,q_r - 2\,p_{2i}\,q_r\,R_i + \beta^2\,p_{2i}\,q_r\,R_i - 3\,\beta\,p_{2r}\,q_r\,R_i +\right.$$
$$\left.\left.2\,p_r\,R_i\,R_{2i} - \alpha^2\,p_r\,R_i\,R_{2i} + 2\,p_{2i}\,q_i\,R_r - \beta^2\,p_{2i}\,q_i\,R_r + 3\,\beta\,p_{2r}\,q_i\,R_r - 3\,\alpha\,p_r\,R_{2i}\,R_r\right) \to 0\right\}$$

Out[•]=

$$\Big\{\gamma_i \to 0,\ p_i \to 0,\ \omega_r \to -2\,k_i\,k_r\,p_r + \gamma_r - \mu\,R_i\,\mu^*,\ \omega_i \to -k_i^2\,p_r + k_r^2\,p_r + \mu\,R_r\,\mu^*,$$

$$\Omega_2 \to k_2^2\,p_{2r} - \gamma_{2i} - \mu\,q_{2r}\,\mu^*,\ K_2 \to \frac{4\,k_r^2\,\left(5\,\beta\,p_{2i} + \left(-2+\beta^2\right)\,p_{2r}\right) + \eta\,R_{2r}\,\eta^* - 4\,\mu\,q_{2r}\,\mu^*}{8\,k_r\,p_{2i}},$$

$$k_i \to \frac{1}{8\,k_r\,p_{2i}\,p_r}\Big(4\,k_r^2\,\left(\left(-2+\beta^2\right)\,p_{2i}^2 + 2\,\alpha\,p_{2i}\,p_r + \left(-2+\beta^2\right)\,p_{2r}^2\right) +$$
$$p_{2i}\,\left(\eta\,R_{2i}\,\eta^* - 4\,\mu\,q_{2i}\,\mu^*\right) + p_{2r}\,\left(\eta\,R_{2r}\,\eta^* - 4\,\mu\,q_{2r}\,\mu^*\right)\Big),$$

$$\eta^* \to -\frac{4\,k_r^2\,p_r\,\left(\left(-2+\alpha^2\right)\,R_i + 3\,\alpha\,R_r\right)}{\eta\,\left(q_r\,R_i - q_i\,R_r\right)},\ \mu^* \to -\frac{k_r^2\,p_r\,\left(\left(-2+\alpha^2\right)\,q_i + 3\,\alpha\,q_r\right)}{\mu\,\left(q_r\,R_i - q_i\,R_r\right)},$$

$$k_r \to \sqrt{-\frac{\left(q_r\,R_i - q_i\,R_r\right)\,\gamma_r}{p_r\,\left(\alpha\,q_r\,R_i + q_i\,\left(\left(-2+\alpha^2\right)\,R_i + 2\,\alpha\,R_r\right)\right)}},$$

$$\gamma_{2r} \to \Big(\Big(\left(5\,\beta\,p_{2i} + \left(-2+\beta^2\right)\,p_{2r}\right)^2\,\left(q_r\,R_i - q_i\,R_r\right)^2 +$$
$$p_r^2\,\left(\left(-2+\alpha^2\right)\,q_i\,q_{2r} + 3\,\alpha\,q_r\,q_{2r} - \left(\left(-2+\alpha^2\right)\,R_i + 3\,\alpha\,R_r\right)\,R_{2r}\right)^2 - 2\,p_r\,\left(-q_r\,R_i + q_i\,R_r\right)$$
$$\left(\left(-2+\beta^2\right)\,p_{2r}\,\left(\left(-2+\alpha^2\right)\,q_i\,q_{2r} + 3\,\alpha\,q_r\,q_{2r} - \left(\left(-2+\alpha^2\right)\,R_i + 3\,\alpha\,R_r\right)\,R_{2r}\right) +$$
$$p_{2i}\,\left(6\,\alpha\,q_{2i}\,q_r + 15\,\alpha\,\beta\,q_r\,q_{2r} + \left(-2+\alpha^2\right)\,q_i\,\left(2\,q_{2i} + 5\,\beta\,q_{2r}\right) -$$
$$5\,\beta\,\left(\left(-2+\alpha^2\right)\,R_i + 3\,\alpha\,R_r\right)\,R_{2r}\right)\Big)\,\gamma_r\Big)\Big/$$
$$\left(4\,p_{2i}\,p_r\,\left(q_r\,R_i - q_i\,R_r\right)\,\left(\alpha\,q_r\,R_i + q_i\,\left(\left(-2+\alpha^2\right)\,R_i + 2\,\alpha\,R_r\right)\right)\right),$$

$$-2\,p_r\,q_i\,q_{2r} + \alpha^2\,p_r\,q_i\,q_{2r} + 3\,\alpha\,p_r\,q_r\,q_{2r} + 3\,\beta\,p_{2i}\,q_r\,R_i - 2\,p_{2r}\,q_r\,R_i +$$
$$\beta^2\,p_{2r}\,q_r\,R_i - 3\,\beta\,p_{2i}\,q_i\,R_r + 2\,p_{2r}\,q_i\,R_r - \beta^2\,p_{2r}\,q_i\,R_r +$$
$$2\,p_r\,R_i\,R_{2r} - \alpha^2\,p_r\,R_i\,R_{2r} - 3\,\alpha\,p_r\,R_r\,R_{2r} \to 0,$$

$$-2\,p_r\,q_i\,q_{2i} + \alpha^2\,p_r\,q_i\,q_{2i} + 3\,\alpha\,p_r\,q_{2i}\,q_r - 2\,p_{2i}\,q_r\,R_i + \beta^2\,p_{2i}\,q_r\,R_i -$$
$$3\,\beta\,p_{2r}\,q_r\,R_i + 2\,p_r\,R_i\,R_{2i} - \alpha^2\,p_r\,R_i\,R_{2i} + 2\,p_{2i}\,q_i\,R_r -$$
$$\beta^2\,p_{2i}\,q_i\,R_r + 3\,\beta\,p_{2r}\,q_i\,R_r - 3\,\alpha\,p_r\,R_{2i}\,R_r \to 0\Big\}$$

In[•]:=
```
ReplaceAll[%, {p1r → Pr, p1i → Pi, p2r → P'r, p2i → P'i, q1r → Q1r, q1i → Q1i, R1r → Q2r,
  R1i → Q2i, R2r → Q'1r, R2i → Q'1i, q2r → Q'2r, q2i → Q'2i, γ2r → γ'r, γ2i → γ'i }]
```

Out[•]=

$$\Big\{\gamma_i \to 0,\ P_i \to 0,\ \omega_r \to -2\,k_i\,k_r\,P_r + \gamma_r - \mu\,Q_{2i}\,\mu^*,\ \omega_i \to -k_i^2\,P_r + k_r^2\,P_r + \mu\,Q_{2r}\,\mu^*,$$

$$\Omega_2 \to K_2^2\,P'_r - \gamma'_i - \mu\,Q'_{2r}\,\mu^*,\ K_2 \to \frac{4\,k_r^2\left(5\,\beta\,P'_i + \left(-2+\beta^2\right)\,P'_r\right) + \eta\,Q'_r\,\eta^* - 4\,\mu\,Q'_{2r}\,\mu^*}{8\,k_r\,P'_i},$$

$$k_i \to \frac{1}{8\,k_r\,P_r\,P'_i}\Big(4\,k_r^2\left(2\,\alpha\,P_r\,P'_i + \left(-2+\beta^2\right)\,\left(P'\right)_i^2 + \left(-2+\beta^2\right)\,\left(P'\right)_r^2\right) +$$
$$P'_i\left(\eta\,Q'_i\,\eta^* - 4\,\mu\,Q'_{2i}\,\mu^*\right) + P'_r\left(\eta\,Q'_r\,\eta^* - 4\,\mu\,Q'_{2r}\,\mu^*\right)\Big),$$

$$\eta^* \to -\frac{4\,k_r^2\,P_r\left(\left(-2+\alpha^2\right)\,Q_{2i} + 3\,\alpha\,Q_{2r}\right)}{\eta\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)},\ \mu^* \to -\frac{k_r^2\,P_r\left(\left(-2+\alpha^2\right)\,Q_i + 3\,\alpha\,Q_r\right)}{\mu\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)},$$

$$k_r \to \sqrt{-\frac{\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)\,\gamma_r}{P_r\left(\alpha\,Q_{2i}\,Q_r + Q_i\left(\left(-2+\alpha^2\right)\,Q_{2i} + 2\,\alpha\,Q_{2r}\right)\right)}},$$

$$\gamma'_r \to \Big(\gamma_r\Big(\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)^2\left(5\,\beta\,P'_i + \left(-2+\beta^2\right)\,P'_r\right)^2 + P_r^2$$
$$\left(-\left(\left(-2+\alpha^2\right)\,Q_{2i} + 3\,\alpha\,Q_{2r}\right)\,Q'_r + \left(-2+\alpha^2\right)\,Q_i\,Q'_{2r} + 3\,\alpha\,Q_r\,Q'_{2r}\right)^2 - 2\,P_r\left(-Q_{2i}\,Q_r + Q_i\,Q_{2r}\right)$$
$$\left(\left(-2+\beta^2\right)\,P'_r\left(-\left(\left(-2+\alpha^2\right)\,Q_{2i} + 3\,\alpha\,Q_{2r}\right)\,Q'_r + \left(-2+\alpha^2\right)\,Q_i\,Q'_{2r} + 3\,\alpha\,Q_r\,Q'_{2r}\right) +\right.$$
$$P'_i\left(6\,\alpha\,Q_r\,Q'_{2i} - 5\,\beta\left(\left(-2+\alpha^2\right)\,Q_{2i} + 3\,\alpha\,Q_{2r}\right)\,Q'_r +\right.$$
$$\left.\left.\left.15\,\alpha\,\beta\,Q_r\,Q'_{2r} + \left(-2+\alpha^2\right)\,Q_i\left(2\,Q'_{2i} + 5\,\beta\,Q'_{2r}\right)\right)\right)\Big)\Big/$$
$$\left(4\,P_r\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)\left(\alpha\,Q_{2i}\,Q_r + Q_i\left(\left(-2+\alpha^2\right)\,Q_{2i} + 2\,\alpha\,Q_{2r}\right)\right)\,P'_i\right),$$

$$3\,\beta\,Q_{2i}\,Q_r\,P'_i - 3\,\beta\,Q_i\,Q_{2r}\,P'_i - 2\,Q_{2i}\,Q_r\,P'_r + \beta^2\,Q_{2i}\,Q_r\,P'_r + 2\,Q_i\,Q_{2r}\,P'_r -$$
$$\beta^2\,Q_i\,Q_{2r}\,P'_r + 2\,P_r\,Q_{2i}\,Q'_r - \alpha^2\,P_r\,Q_{2i}\,Q'_r - 3\,\alpha\,P_r\,Q_{2r}\,Q'_r -$$
$$2\,P_r\,Q_i\,Q'_{2r} + \alpha^2\,P_r\,Q_i\,Q'_{2r} + 3\,\alpha\,P_r\,Q_r\,Q'_{2r} \to 0,$$

$$-2\,Q_{2i}\,Q_r\,P'_i + \beta^2\,Q_{2i}\,Q_r\,P'_i + 2\,Q_i\,Q_{2r}\,P'_i - \beta^2\,Q_i\,Q_{2r}\,P'_i - 3\,\beta\,Q_{2i}\,Q_r\,P'_r +$$
$$3\,\beta\,Q_i\,Q_{2r}\,P'_r + 2\,P_r\,Q_{2i}\,Q'_i - \alpha^2\,P_r\,Q_{2i}\,Q'_i - 3\,\alpha\,P_r\,Q_{2r}\,Q'_i -$$
$$2\,P_r\,Q_i\,Q'_{2i} + \alpha^2\,P_r\,Q_i\,Q'_{2i} + 3\,\alpha\,P_r\,Q_r\,Q'_{2i} \to 0\Big\}$$

In[•]:=
```
ReplaceAll[%, {Pr → 2, P'r → 3`, P'i → -3.5, Q1r → -1, Q1i → 2.4`, γr → 3.5, γ'i → 1.25,
  Q'2i → 3.75`, Q'2r → -0.75`, Q2r → 3.5, Q2i → 4.58, Q'r → -0.3, Q'i → 1.10}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ P_i \to 0,\ \omega_r \to 3.5 - 4\, k_i\, k_r - 4.58\, \mu\, \mu^*,\right.$$
$$\omega_i \to -2\, k_i^2 + 2\, k_r^2 + 3.5\, \mu\, \mu^*,\ \Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,$$
$$K_2 \to -\frac{0.0357143\, \left(4\, \left(-17.5\, \beta + 3.\, \left(-2 + \beta^2\right)\right)\, k_r^2 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)}{k_r},\ k_i \to -\frac{1}{k_r} 0.0178571$$
$$\left(4\, \left(-14.\, \alpha + 21.25\, \left(-2 + \beta^2\right)\right)\, k_r^2 - 3.5\, \left(1.1\, \eta\, \eta^* - 15.\, \mu\, \mu^*\right) + 3.\, \left(-0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)\right),$$
$$\eta^* \to \frac{0.616333\, \left(10.5\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\, k_r^2}{\eta},\ \mu^* \to \frac{0.154083\, \left(-3\, \alpha + 2.4\, \left(-2 + \alpha^2\right)\right)\, k_r^2}{\mu},$$
$$k_r \to 4.76603\, \sqrt{\frac{1}{-4.58\, \alpha + 2.4\, \left(7.\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)}},$$
$$\gamma'_r \to \frac{1}{-4.58\, \alpha + 2.4\, \left(7.\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)}\, 0.0096302$$
$$\left(4\, \left(2.25\, \alpha - 1.8\, \left(-2 + \alpha^2\right) + 0.3\, \left(10.5\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right)^2 + \right.$$
$$168.48\, \left(-17.5\, \beta + 3.\, \left(-2 + \beta^2\right)\right)^2 - 51.92$$
$$\left(-3.5\, \left(-22.5\, \alpha + 2.4\, \left(-2 + \alpha^2\right)\, \left(7.5 - 3.75\, \beta\right) + 11.25\, \alpha\, \beta + 1.5\, \left(10.5\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right.\right.$$
$$\left.\left.\beta\right) + 3.\, \left(2.25\, \alpha - 1.8\, \left(-2 + \alpha^2\right) + 0.3\, \left(10.5\, \alpha + 4.58\, \left(-2 + \alpha^2\right)\right)\right)\, \left(-2 + \beta^2\right)\right)\Big),$$
$$79.584 + 10.8\, \alpha - 0.852\, \alpha^2 + 136.29\, \beta - 38.94\, \beta^2 \to 0,\ -106.708 - 45.6\, \alpha +$$
$$\left.7.924\, \alpha^2 + 116.82\, \beta + 45.43\, \beta^2 \to 0\right\}$$

In[•]:=
```
Solve[{79.58399999999999` + 10.8` α - 0.8519999999999999` α^2 + 136.29` β - 38.94` β^2 == 0,
  -106.708` - 45.6` α + 7.923999999999999` α^2 + 116.82` β + 45.43` β^2 == 0}, {α, β}]
```

... Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

Out[•]=
$$\{\{\alpha \to -2.23344,\ \beta \to -0.342289\},\ \{\alpha \to 1.74195 - 13.6764\, i,\ \beta \to 4.88182 - 0.439143\, i\},$$
$$\{\alpha \to 1.74195 + 13.6764\, i,\ \beta \to 4.88182 + 0.439143\, i\},\ \{\alpha \to 8.27335,\ \beta \to -0.679657\}\}$$

In[•]:=
$$\Big\{\gamma_i \to 0,\ P_i \to 0,\ \omega_r \to 3.5` - 4\,k_i\,k_r - 4.58`\,\mu\,\mu^*,$$
$$\omega_i \to -2\,k_i^2 + 2\,k_r^2 + 3.5`\,\mu\,\mu^*,\ \Omega_2 \to -1.25` + 3.`\,K_2^2 + 0.75`\,\mu\,\mu^*,$$
$$K_2 \to -\frac{0.03571428571428571`\,\left(4\,\left(-17.5`\,\beta + 3.`\,\left(-2+\beta^2\right)\right)\,k_r^2 - 0.3`\,\eta\,\eta^* + 3.`\,\mu\,\mu^*\right)}{k_r},$$
$$k_i \to -\frac{1}{k_r}0.017857142857142856`\,\left(4\,\left(-14.`\,\alpha + 21.25`\,\left(-2+\beta^2\right)\right)\,k_r^2 - \right.$$
$$\left. 3.5`\,\left(1.1`\,\eta\,\eta^* - 15.`\,\mu\,\mu^*\right) + 3.`\,\left(-0.3`\,\eta\,\eta^* + 3.`\,\mu\,\mu^*\right)\right),$$
$$\eta^* \to \frac{0.6163328197226502`\,\left(10.5`\,\alpha + 4.58`\,\left(-2+\alpha^2\right)\right)\,k_r^2}{\eta},$$
$$\mu^* \to \frac{0.15408320493066255`\,\left(-3\,\alpha + 2.4`\,\left(-2+\alpha^2\right)\right)\,k_r^2}{\mu},$$
$$k_r \to 4.76602559791699`\,\sqrt{\frac{1}{-4.58`\,\alpha + 2.4`\,\left(7.`\,\alpha + 4.58`\,\left(-2+\alpha^2\right)\right)}},$$
$$\gamma'_r \to \frac{1}{-4.58`\,\alpha + 2.4`\,\left(7.`\,\alpha + 4.58`\,\left(-2+\alpha^2\right)\right)}\,0.00963020030816641`$$
$$\left(4\,\left(2.25`\,\alpha - 1.7999999999999998`\,\left(-2+\alpha^2\right) + 0.3`\,\left(10.5`\,\alpha + 4.58`\,\left(-2+\alpha^2\right)\right)\right)^2 + \right.$$
$$168.4804`\,\left(-17.5`\,\beta + 3.`\,\left(-2+\beta^2\right)\right)^2 -$$
$$51.92`\,\left(-3.5`\,\left(-22.5`\,\alpha + 2.4`\,\left(-2+\alpha^2\right)\,\left(7.5` - 3.75`\,\beta\right) + \right.\right.$$
$$\left.\left. 11.25`\,\alpha\,\beta + 1.5`\,\left(10.5`\,\alpha + 4.58`\,\left(-2+\alpha^2\right)\right)\,\beta\right) + 3.`\,\left(2.25`\,\alpha - \right.\right.$$
$$\left.\left.\left. 1.7999999999999998`\,\left(-2+\alpha^2\right) + 0.3`\,\left(10.5`\,\alpha + 4.58`\,\left(-2+\alpha^2\right)\right)\right)\,\left(-2+\beta^2\right)\right)\right),$$
$$79.58399999999999` + 10.8`\,\alpha - 0.8519999999999999`\,\alpha^2 + 136.29`\,\beta - 38.94`\,\beta^2 \to 0,$$
$$-106.708` - 45.6`\,\alpha + 7.9239999999999995`\,\alpha^2 + 116.82`\,\beta + 45.43`\,\beta^2 \to 0\Big\}$$

Out[•]= $\{\gamma_i \to 0,\ P_i \to 0,\ \omega_r \to 3.5 - 4\,k_i\,k_r - 4.58\,\mu\,\mu^*,$
$\omega_i \to -2\,k_i^2 + 2\,k_r^2 + 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$
$K_2 \to -\dfrac{0.0357143\,\left(4\,\left(-17.5\,\beta + 3.\,\left(-2+\beta^2\right)\right)\,k_r^2 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)}{k_r},\ k_i \to -\dfrac{1}{k_r}0.0178571$
$\left(4\,\left(-14.\,\alpha + 21.25\,\left(-2+\beta^2\right)\right)\,k_r^2 - 3.5\,(1.1\,\eta\,\eta^* - 15.\,\mu\,\mu^*) + 3.\,\left(-0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)\right),$
$\eta^* \to \dfrac{0.616333\,\left(10.5\,\alpha + 4.58\,\left(-2+\alpha^2\right)\right)\,k_r^2}{\eta},\ \mu^* \to \dfrac{0.154083\,\left(-3\,\alpha + 2.4\,\left(-2+\alpha^2\right)\right)\,k_r^2}{\mu},$
$k_r \to 4.76603\,\sqrt{\dfrac{1}{-4.58\,\alpha + 2.4\,\left(7.\,\alpha + 4.58\,\left(-2+\alpha^2\right)\right)}},$
$\gamma'_r \to \dfrac{1}{-4.58\,\alpha + 2.4\,\left(7.\,\alpha + 4.58\,\left(-2+\alpha^2\right)\right)}\,0.0096302$
$\Big(4\,\left(2.25\,\alpha - 1.8\,\left(-2+\alpha^2\right) + 0.3\,\left(10.5\,\alpha + 4.58\,\left(-2+\alpha^2\right)\right)\right)^2 +$
$168.48\,\left(-17.5\,\beta + 3.\,\left(-2+\beta^2\right)\right)^2 - 51.92$
$\left(-3.5\,\left(-22.5\,\alpha + 2.4\,\left(-2+\alpha^2\right)\,\left(7.5 - 3.75\,\beta\right) + 11.25\,\alpha\,\beta + 1.5\,\left(10.5\,\alpha + 4.58\,\left(-2+\alpha^2\right)\right)\right.\right.$
$\left.\left.\beta\right) + 3.\,\left(2.25\,\alpha - 1.8\,\left(-2+\alpha^2\right) + 0.3\,\left(10.5\,\alpha + 4.58\,\left(-2+\alpha^2\right)\right)\right)\,\left(-2+\beta^2\right)\right)\Big),$
$79.584 + 10.8\,\alpha - 0.852\,\alpha^2 + 136.29\,\beta - 38.94\,\beta^2 \to 0,\ -106.708 - 45.6\,\alpha +$
$7.924\,\alpha^2 + 116.82\,\beta + 45.43\,\beta^2 \to 0\}$

In[•]:= **ReplaceAll[%, {α → 8.273352016882313`, β → -0.6796572966843853`}]**

Out[•]= $\{\gamma_i \to 0,\ P_i \to 0,\ \omega_r \to 3.5 - 4\,k_i\,k_r - 4.58\,\mu\,\mu^*,\ \omega_i \to -2\,k_i^2 + 2\,k_r^2 + 3.5\,\mu\,\mu^*,$
$\Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,\ K_2 \to -\dfrac{0.0357143\,\left(29.1192\,k_r^2 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)}{k_r},$
$k_i \to -\dfrac{0.0178571\,\left(-594.043\,k_r^2 - 3.5\,(1.1\,\eta\,\eta^* - 15.\,\mu\,\mu^*) + 3.\,\left(-0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)\right)}{k_r},$
$\eta^* \to \dfrac{241.112\,k_r^2}{\eta},\ \mu^* \to \dfrac{20.7482\,k_r^2}{\mu},\ k_r \to 0.165282,$
$\gamma'_r \to 2.16967,\ 1.42109 \times 10^{-14} \to 0,\ -1.06581 \times 10^{-13} \to 0\}$

In[•]:= **ReplaceAll[%, {k_r → 0.16528181385912982`, γ'_r → 2.1696733279850027`}]**

Out[•]= $\{\gamma_i \to 0,\ P_i \to 0,\ \omega_r \to 3.5 - 0.661127\,k_i - 4.58\,\mu\,\mu^*,\ \omega_i \to 0.0546362 - 2\,k_i^2 + 3.5\,\mu\,\mu^*,$
$\Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,\ K_2 \to -0.216081\,\left(0.795481 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right),$
$k_i \to -0.108041\,\left(-16.2281 - 3.5\,(1.1\,\eta\,\eta^* - 15.\,\mu\,\mu^*) + 3.\,\left(-0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)\right),$
$\eta^* \to \dfrac{6.58671}{\eta},\ \mu^* \to \dfrac{0.566802}{\mu},\ 0.165282 \to 0.165282,$
$2.16967 \to 2.16967,\ 1.42109 \times 10^{-14} \to 0,\ -1.06581 \times 10^{-13} \to 0\}$

In[•]:=
```
ReplaceAll[%, {η* → 6.58670691885709` / η, μ* → 0.5668016806487961` / μ}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ P_i \to 0,\ \omega_r \to 0.904048 - 0.661127\, k_i,\ \omega_i \to 2.03844 - 2\, k_i^2,\ \Omega_2 \to -0.824899 + 3.\, K_2^2,\right.$$
$$K_2 \to -0.112335,\ k_i \to 1.36743,\ \frac{6.58671}{\eta} \to \frac{6.58671}{\eta},\ \frac{0.566802}{\mu} \to \frac{0.566802}{\mu},$$
$$\left.0.165282 \to 0.165282,\ 2.16967 \to 2.16967,\ 1.42109 \times 10^{-14} \to 0,\ -1.06581 \times 10^{-13} \to 0\right\}$$

$$\{\alpha \to 8.273352016882313`,\ \beta \to -0.6796572966843853`,\ k_r \to 0.16528181385912982`,$$
$$\gamma'_r \to 2.1696733279850027`,\ \eta^* \to \frac{6.58670691885709`}{\eta},\ \mu^* \to \frac{0.5668016806487961`}{\mu},$$
$$K_2 \to -0.11233499079858794`,\ k_i \to 1.3674346280453993`,\ \gamma_i \to 0,\ P_i \to 0,$$
$$\omega_r \to 1.3322676295501878`*^-15,\ \omega_i \to -1.7013128856994042`,\ \Omega_2 \to -0.7870412890402464`\}$$

In[•]:=
```
ReplaceAll[%, {K₂ → -0.11233499079858794`, kᵢ → 1.3674346280453993`}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ P_i \to 0,\ \omega_r \to 1.33227 \times 10^{-15},\ \omega_i \to -1.70131,\ \Omega_2 \to -0.787041,\right.$$
$$-0.112335 \to -0.112335,\ 1.36743 \to 1.36743,\ \frac{6.58671}{\eta} \to \frac{6.58671}{\eta},\ \frac{0.566802}{\mu} \to \frac{0.566802}{\mu},$$
$$\left.0.165282 \to 0.165282,\ 2.16967 \to 2.16967,\ 1.42109 \times 10^{-14} \to 0,\ -1.06581 \times 10^{-13} \to 0\right\}$$

In[•]:=
```
{Φ[x, t] Φ*[x, t] → ℯ^(x (-i kᵢ+kᵣ)+x (i kᵢ+kᵣ)+t (-i ωᵢ+ωᵣ)+t (i ωᵢ+ωᵣ)) η η* / (1 + ℯ^(2 x kᵣ+2 t ωᵣ))^2,
 Ψ[x, t] Ψ*[x, t] → (1 - ℯ^(2 x kᵣ+2 t ωᵣ))^2 μ μ* / (1 + ℯ^(2 x kᵣ+2 t ωᵣ))^2}
```

Out[•]=
$$\left\{\Phi[x, t]\,\Phi^*[x, t] \to \frac{e^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\ \eta\ \eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$$
$$\left.\Psi[x, t]\,\Psi^*[x, t] \to \frac{\left(1-e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2\ \mu\ \mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$$

In[•]:=
```
ReplaceAll[%, {α → 8.273352016882313`, β → -0.6796572966843853`,
  kᵣ → 0.16528181385912982`, γ'ᵣ → 2.1696733279850027`, η* → 6.58670691885709` / η,
  μ* → 0.5668016806487961` / μ, K₂ → -0.11233499079858794`,
  kᵢ → 1.3674346280453993`, γᵢ → 0, Pᵢ → 0, ωᵣ → 1.3322676295501878`*^-15,
  ωᵢ → -1.7013128856994042`, Ω₂ → -0.7870412890402464`}]
```

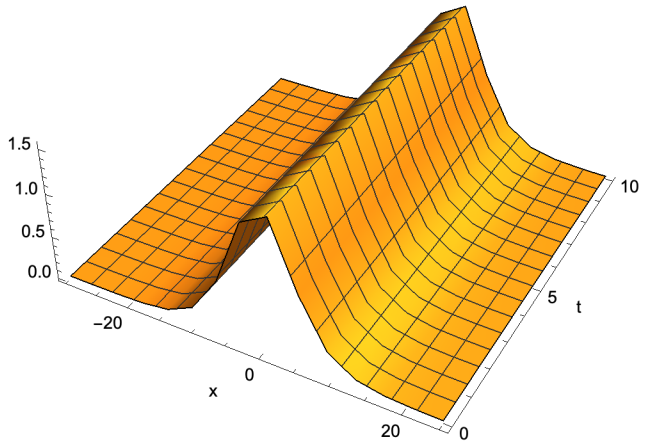
Out[•]=
$$\left\{\Phi[x, t]\,\Phi^*[x, t] \to \frac{6.58671\ e^{\left(2.66454\times10^{-15}+0.\,i\right)\,t+(0.330564+0.\,i)\,x}}{\left(1+e^{2.66454\times10^{-15}\,t+0.330564\,x}\right)^2},\right.$$
$$\left.\Psi[x, t]\,\Psi^*[x, t] \to \frac{0.566802\ \left(1-e^{2.66454\times10^{-15}\,t+0.330564\,x}\right)^2}{\left(1+e^{2.66454\times10^{-15}\,t+0.330564\,x}\right)^2}\right\}$$

In[•]:=
```
Simplify[%]
```

Out[•]=
$$\left\{\Phi[x, t]\, \Phi^*[x, t] \to \frac{6.58671\, e^{2.66454\times10^{-15}\, t+0.330564\, x}}{\left(1. + e^{2.66454\times10^{-15}\, t+0.330564\, x}\right)^2},\right.$$
$$\left.\Psi[x, t]\, \Psi^*[x, t] \to \frac{0.566802\, \left(-1. + e^{2.66454\times10^{-15}\, t+0.330564\, x}\right)^2}{\left(1. + e^{2.66454\times10^{-15}\, t+0.330564\, x}\right)^2}\right\}$$

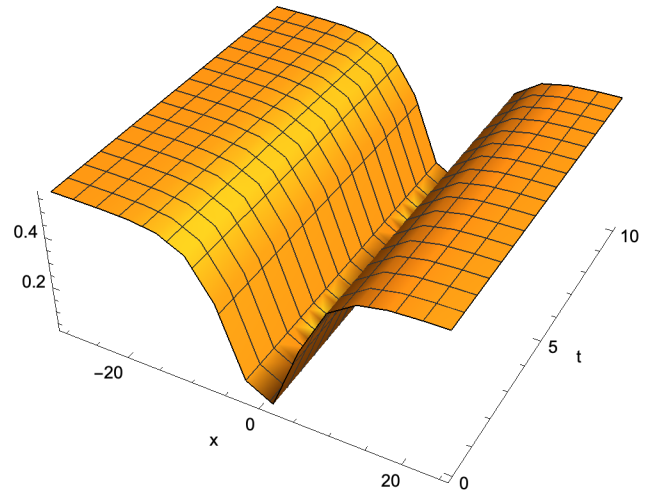
In[•]:=
```
Plot3D[6.58670691885709` e^(2.6645352591003757`*^-15 t+0.33056362771825964` x)/(1.` + e^(2.6645352591003757`*^-15 t+0.33056362771825964` x))^2, {x, -30, 25},
 {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|Φ|^2  "}]
```

Out[•]=



In[•]:=
```
Plot3D[0.5668016806487961` (-1.` + e^(2.6645352591003757`*^-15 t+0.33056362771825964` x))^2/(1.` + e^(2.6645352591003757`*^-15 t+0.33056362771825964` x))^2,
 {x, -30, 25}, {t, 0, 10}, {PlotRange → All},
 Boxed → False, AxesLabel → {"x", "t", "|Ψ|^2  "}]
```

Out[•]=



In[•]:=
$$\left\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to k_r^2\left(\left(-1+\alpha^2\right) p_i - 2\,\alpha\, p_r\right) + \gamma_r - \mu\, R_i\, \mu^*,\right.$$
$$\omega_i \to k_r^2\left(-2\,\alpha\, p_i - \left(-1+\alpha^2\right) p_r\right) + \mu\, R_r\, \mu^*,\ \Omega_2 \to K_2^2\, p_{2r} - \gamma_{2i} - \mu\, q_{2r}\, \mu^*,$$
$$K_2 \to \frac{4\,k_r^2\left(5\,\beta\, p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) + \eta\, R_{2r}\, \eta^* - 4\,\mu\, q_{2r}\, \mu^*}{8\, k_r\, p_{2i}},$$
$$\mu^* \to \frac{k_r^2\left(-p_r\left(\left(-2+\alpha^2\right) q_i + 3\,\alpha\, q_r\right) + p_i\left(-3\,\alpha\, q_i + \left(-2+\alpha^2\right) q_r\right)\right)}{\mu\left(q_r\, R_i - q_i\, R_r\right)},$$
$$\eta^* \to \frac{4\,k_r^2\left(-p_r\left(\left(-2+\alpha^2\right) R_i + 3\,\alpha\, R_r\right) + p_i\left(-3\,\alpha\, R_i + \left(-2+\alpha^2\right) R_r\right)\right)}{\eta\left(q_r\, R_i - q_i\, R_r\right)},\ k_r \to$$
$$\sqrt{\frac{q_r\, R_i\, \gamma_r - q_i\, R_r\, \gamma_r}{-3\,\alpha\, p_i\, q_i\, R_i + 2\, p_r\, q_i\, R_i - \alpha^2\, p_r\, q_i\, R_i - p_i\, q_r\, R_i - \alpha\, p_r\, q_r\, R_i - p_i\, q_i\, R_r + \alpha^2\, p_i\, q_i\, R_r - 2\,\alpha\, p_r\, q_i\, R_r}},$$
$$\gamma_{2r} \to \left(\left(q_{2i}\left(\left(-2+\beta^2\right) p_{2r}\, q_r - \left(3\,\alpha\, p_i + \left(-2+\alpha^2\right) p_r\right) R_{2r}\right) + \beta\, p_{2i}\left(3\, q_{2i}\, q_r - \beta\, q_r\, q_{2r} + \beta\, R_r\, R_{2r}\right)\right)\gamma_r\right) \Big/ \left(\left(3\,\beta\, p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) q_i\, R_r + p_i\left(-3\,\alpha\, q_i\, q_{2r} - q_r\, q_{2r} + R_r\, R_{2r}\right) + p_r\left(-\left(-2+\alpha^2\right) q_i\, q_{2r} - \alpha\, q_r\, q_{2r} + \alpha\, R_r\, R_{2r}\right)\right),$$
$$\left(-3\,\alpha\, p_i\, q_i\, q_{2r} + 2\, p_r\, q_i\, q_{2r} - \alpha^2\, p_r\, q_i\, q_{2r} - 2\, p_i\, q_r\, q_{2r} + \alpha^2\, p_i\, q_r\, q_{2r} - 3\,\alpha\, p_r\, q_r\, q_{2r} - 3\,\beta\, p_{2i}\, q_r\, R_i + 2\, p_{2r}\, q_r\, R_i - \beta^2\, p_{2r}\, q_r\, R_i + 3\,\beta\, p_{2i}\, q_i\, R_r - 2\, p_{2r}\, q_i\, R_r + \beta^2\, p_{2r}\, q_i\, R_r + 3\,\alpha\, p_i\, R_i\, R_{2r} - 2\, p_r\, R_i\, R_{2r} + \alpha^2\, p_r\, R_i\, R_{2r} + 2\, p_i\, R_r\, R_{2r} - \alpha^2\, p_i\, R_r\, R_{2r} + 3\,\alpha\, p_r\, R_r\, R_{2r}\right) \to 0,$$
$$\left(-3\,\alpha\, p_i\, q_i\, q_{2i} + 2\, p_r\, q_i\, q_{2i} - \alpha^2\, p_r\, q_i\, q_{2i} - 2\, p_i\, q_{2i}\, q_r + \alpha^2\, p_i\, q_{2i}\, q_r - 3\,\alpha\, p_r\, q_{2i}\, q_r + 2\, p_{2i}\, q_r\, R_i - \beta^2\, p_{2i}\, q_r\, R_i + 3\,\beta\, p_{2r}\, q_r\, R_i + 3\,\alpha\, p_i\, R_i\, R_{2i} - 2\, p_r\, R_i\, R_{2i} + \alpha^2\, p_r\, R_i\, R_{2i} - 2\, p_{2i}\, q_i\, R_r + \beta^2\, p_{2i}\, q_i\, R_r - 3\,\beta\, p_{2r}\, q_i\, R_r + 2\, p_i\, R_{2i}\, R_r - \alpha^2\, p_i\, R_{2i}\, R_r + 3\,\alpha\, p_r\, R_{2i}\, R_r\right) \to 0\Big\}$$

Out[•]=
$$\left\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to k_r^2\left(\left(-1+\alpha^2\right) p_i - 2\,\alpha\, p_r\right) + \gamma_r - \mu\, R_i\, \mu^*,\right.$$
$$\omega_i \to k_r^2\left(-2\,\alpha\, p_i - \left(-1+\alpha^2\right) p_r\right) + \mu\, R_r\, \mu^*,\ \Omega_2 \to K_2^2\, p_{2r} - \gamma_{2i} - \mu\, q_{2r}\, \mu^*,$$
$$K_2 \to \frac{4\,k_r^2\left(5\,\beta\, p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) + \eta\, R_{2r}\, \eta^* - 4\,\mu\, q_{2r}\, \mu^*}{8\, k_r\, p_{2i}},$$
$$\mu^* \to \frac{k_r^2\left(-p_r\left(\left(-2+\alpha^2\right) q_i + 3\,\alpha\, q_r\right) + p_i\left(-3\,\alpha\, q_i + \left(-2+\alpha^2\right) q_r\right)\right)}{\mu\left(q_r\, R_i - q_i\, R_r\right)},$$
$$\eta^* \to \frac{4\,k_r^2\left(-p_r\left(\left(-2+\alpha^2\right) R_i + 3\,\alpha\, R_r\right) + p_i\left(-3\,\alpha\, R_i + \left(-2+\alpha^2\right) R_r\right)\right)}{\eta\left(q_r\, R_i - q_i\, R_r\right)},\ k_r \to$$
$$\sqrt{\frac{q_r\, R_i\, \gamma_r - q_i\, R_r\, \gamma_r}{-3\,\alpha\, p_i\, q_i\, R_i + 2\, p_r\, q_i\, R_i - \alpha^2\, p_r\, q_i\, R_i - p_i\, q_r\, R_i - \alpha\, p_r\, q_r\, R_i - p_i\, q_i\, R_r + \alpha^2\, p_i\, q_i\, R_r - 2\,\alpha\, p_r\, q_i\, R_r}},$$
$$\gamma_{2r} \to \left(\left(q_{2i}\left(\left(-2+\beta^2\right) p_{2r}\, q_r - \left(3\,\alpha\, p_i + \left(-2+\alpha^2\right) p_r\right) R_{2r}\right) + \beta\, p_{2i}\left(3\, q_{2i}\, q_r - \beta\, q_r\, q_{2r} + \beta\, R_r\, R_{2r}\right)\right)\gamma_r\right) \Big/ \left(\left(3\,\beta\, p_{2i} + \left(-2+\beta^2\right) p_{2r}\right) q_i\, R_r + p_i\left(-3\,\alpha\, q_i\, q_{2r} - q_r\, q_{2r} + R_r\, R_{2r}\right) + p_r\left(\left(2-\alpha^2\right) q_i\, q_{2r} - \alpha\, q_r\, q_{2r} + \alpha\, R_r\, R_{2r}\right)\right),$$
$$-3\,\alpha\, p_i\, q_i\, q_{2r} + 2\, p_r\, q_i\, q_{2r} - \alpha^2\, p_r\, q_i\, q_{2r} - 2\, p_i\, q_r\, q_{2r} + \alpha^2\, p_i\, q_r\, q_{2r} - 3\,\alpha\, p_r\, q_r\, q_{2r} - 3\,\beta\, p_{2i}\, q_r\, R_i + 2\, p_{2r}\, q_r\, R_i - \beta^2\, p_{2r}\, q_r\, R_i + 3\,\beta\, p_{2i}\, q_i\, R_r - 2\, p_{2r}\, q_i\, R_r + \beta^2\, p_{2r}\, q_i\, R_r + 3\,\alpha\, p_i\, R_i\, R_{2r} - 2\, p_r\, R_i\, R_{2r} + \alpha^2\, p_r\, R_i\, R_{2r} + 2\, p_i\, R_r\, R_{2r} - \alpha^2\, p_i\, R_r\, R_{2r} + 3\,\alpha\, p_r\, R_r\, R_{2r} \to 0,$$
$$-3\,\alpha\, p_i\, q_i\, q_{2i} + 2\, p_r\, q_i\, q_{2i} - \alpha^2\, p_r\, q_i\, q_{2i} - 2\, p_i\, q_{2i}\, q_r + \alpha^2\, p_i\, q_{2i}\, q_r - 3\,\alpha\, p_r\, q_{2i}\, q_r + 2\, p_{2i}\, q_r\, R_i - \beta^2\, p_{2i}\, q_r\, R_i + 3\,\beta\, p_{2r}\, q_r\, R_i + 3\,\alpha\, p_i\, R_i\, R_{2i} - 2\, p_r\, R_i\, R_{2i} + \alpha^2\, p_r\, R_i\, R_{2i} - 2\, p_{2i}\, q_i\, R_r + \beta^2\, p_{2i}\, q_i\, R_r - 3\,\beta\, p_{2r}\, q_i\, R_r + 2\, p_i\, R_{2i}\, R_r - \alpha^2\, p_i\, R_{2i}\, R_r + 3\,\alpha\, p_r\, R_{2i}\, R_r \to 0\Big\}$$

In[•]:=
```
ReplaceAll[%, {p1r → Pr, p1i → Pi, p2r → P'r, p2i → P'i, q1r → Q1r, q1i → Q1i, R1r → Q2r,
  R1i → Q2i, R2r → Q'1r, R2i → Q'1i, q2r → Q'2r, q2i → Q'2i, ϒ2r → ϒ'r, ϒ2i → ϒ'i }]
```

Out[•]=
$$\Big\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to k_r^2\left(\left(-1+\alpha^2\right)P_i - 2\,\alpha\,P_r\right) + \gamma_r - \mu\,Q_{2i}\,\mu^*,$$
$$\omega_i \to k_r^2\left(-2\,\alpha\,P_i - \left(-1+\alpha^2\right)P_r\right) + \mu\,Q_{2r}\,\mu^*,\ \Omega_2 \to K_2^2\,P'_r - \gamma'_i - \mu\,Q'_{2r}\,\mu^*,$$
$$K_2 \to \frac{4\,k_r^2\left(5\,\beta\,P'_i + \left(-2+\beta^2\right)P'_r\right) + \eta\,Q'_r\,\eta^* - 4\,\mu\,Q'_{2r}\,\mu^*}{8\,k_r\,P'_i},$$
$$\mu^* \to \frac{k_r^2\left(-P_r\left(\left(-2+\alpha^2\right)Q_i + 3\,\alpha\,Q_r\right) + P_i\left(-3\,\alpha\,Q_i + \left(-2+\alpha^2\right)Q_r\right)\right)}{\mu\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)},$$
$$\eta^* \to \frac{4\,k_r^2\left(-P_r\left(\left(-2+\alpha^2\right)Q_{2i} + 3\,\alpha\,Q_{2r}\right) + P_i\left(-3\,\alpha\,Q_{2i} + \left(-2+\alpha^2\right)Q_{2r}\right)\right)}{\eta\left(Q_{2i}\,Q_r - Q_i\,Q_{2r}\right)},$$
$$k_r \to \sqrt{\left(\left(Q_{2i}\,Q_r\,\gamma_r - Q_i\,Q_{2r}\,\gamma_r\right) \Big/ \left(-3\,\alpha\,P_i\,Q_i\,Q_{2i} + 2\,P_r\,Q_i\,Q_{2i} - \right.\right.}$$
$$\left.\left.\alpha^2\,P_r\,Q_i\,Q_{2i} - P_i\,Q_{2i}\,Q_r - \alpha\,P_r\,Q_{2i}\,Q_r - P_i\,Q_i\,Q_{2r} + \alpha^2\,P_i\,Q_i\,Q_{2r} - 2\,\alpha\,P_r\,Q_i\,Q_{2r}\right)\right),$$
$$\gamma'_r \to \left(\gamma_r\left(Q'_{2i}\left(\left(-2+\beta^2\right)Q_r\,P'_r - \left(3\,\alpha\,P_i + \left(-2+\alpha^2\right)P_r\right)Q'_r\right) + \right.\right.$$
$$\left.\left.\beta\,P'_i\left(3\,Q_r\,Q'_{2i} + \beta\,Q_{2r}\,Q'_r - \beta\,Q_r\,Q'_{2r}\right)\right)\right) \Big/ \left(Q_i\,Q_{2r}\left(3\,\beta\,P'_i + \left(-2+\beta^2\right)P'_r\right) + \right.$$
$$\left.P_i\left(Q_{2r}\,Q'_r - 3\,\alpha\,Q_i\,Q'_{2r} - Q_r\,Q'_{2r}\right) + P_r\left(\alpha\,Q_{2r}\,Q'_r + \left(2-\alpha^2\right)Q_i\,Q'_{2r} - \alpha\,Q_r\,Q'_{2r}\right)\right),$$
$$-3\,\beta\,Q_{2i}\,Q_r\,P'_i + 3\,\beta\,Q_i\,Q_{2r}\,P'_i + 2\,Q_{2i}\,Q_r\,P'_r - \beta^2\,Q_{2i}\,Q_r\,P'_r - 2\,Q_i\,Q_{2r}\,P'_r + \beta^2\,Q_i\,Q_{2r}\,P'_r +$$
$$3\,\alpha\,P_i\,Q_{2i}\,Q'_r - 2\,P_r\,Q_{2i}\,Q'_r + \alpha^2\,P_r\,Q_{2i}\,Q'_r + 2\,P_i\,Q_{2r}\,Q'_r - \alpha^2\,P_i\,Q_{2r}\,Q'_r + 3\,\alpha\,P_r\,Q_{2r}\,Q'_r -$$
$$3\,\alpha\,P_i\,Q_i\,Q'_{2r} + 2\,P_r\,Q_i\,Q'_{2r} - \alpha^2\,P_r\,Q_i\,Q'_{2r} - 2\,P_i\,Q_r\,Q'_{2r} + \alpha^2\,P_i\,Q_r\,Q'_{2r} - 3\,\alpha\,P_r\,Q_r\,Q'_{2r} \to 0,$$
$$2\,Q_{2i}\,Q_r\,P'_i - \beta^2\,Q_{2i}\,Q_r\,P'_i - 2\,Q_i\,Q_{2r}\,P'_i + \beta^2\,Q_i\,Q_{2r}\,P'_i + 3\,\beta\,Q_{2i}\,Q_r\,P'_r - 3\,\beta\,Q_i\,Q_{2r}\,P'_r +$$
$$3\,\alpha\,P_i\,Q_{2i}\,Q'_i - 2\,P_r\,Q_{2i}\,Q'_i + \alpha^2\,P_r\,Q_{2i}\,Q'_i + 2\,P_i\,Q_{2r}\,Q'_i - \alpha^2\,P_i\,Q_{2r}\,Q'_i + 3\,\alpha\,P_r\,Q_{2r}\,Q'_i -$$
$$3\,\alpha\,P_i\,Q_i\,Q'_{2i} + 2\,P_r\,Q_i\,Q'_{2i} - \alpha^2\,P_r\,Q_i\,Q'_{2i} - 2\,P_i\,Q_r\,Q'_{2i} + \alpha^2\,P_i\,Q_r\,Q'_{2i} - 3\,\alpha\,P_r\,Q_r\,Q'_{2i} \to 0\Big\}$$

In[•]:=
```
ReplaceAll[%, {Pr → 2, Pi → -2, P'r → 3`, P'i → -3.5, Q1r → -1, Q1i → 2.4`, ϒr → 3.5,
  ϒ'i → 1.25, Q'2i → 3.75`, Q'2r → -0.75`, Q2r → 3.5, Q2i → 4.58, Q'r → -0.3, Q'i → 1.10}]
```

Out[•]=
$$\Big\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to 3.5 + \left(-4\,\alpha - 2\left(-1+\alpha^2\right)\right)k_r^2 - 4.58\,\mu\,\mu^*,$$
$$\omega_i \to \left(4\,\alpha - 2\left(-1+\alpha^2\right)\right)k_r^2 + 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$$
$$K_2 \to -\frac{0.0357143\left(4\left(-17.5\,\beta + 3.\left(-2+\beta^2\right)\right)k_r^2 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)}{k_r},$$
$$\mu^* \to -\frac{0.0770416\left(-2\left(2 - 7.2\,\alpha - \alpha^2\right) - 2\left(-3\,\alpha + 2.4\left(-2+\alpha^2\right)\right)\right)k_r^2}{\mu},$$
$$\eta^* \to -\frac{0.308166\left(-2\left(-13.74\,\alpha + 3.5\left(-2+\alpha^2\right)\right) - 2\left(10.5\,\alpha + 4.58\left(-2+\alpha^2\right)\right)\right)k_r^2}{\eta},$$
$$k_r \to 6.74018\sqrt{-\frac{1}{51.608 + 41.512\,\alpha - 38.784\,\alpha^2}},$$
$$\gamma'_r \to \frac{3.5\left(-3.5\left(-11.25 - 1.8\,\beta\right)\beta + 3.75\left(0.3\left(-6\,\alpha + 2\left(-2+\alpha^2\right)\right) - 3.\left(-2+\beta^2\right)\right)\right)}{-2\left(-1.8 + 5.4\,\alpha\right) + 2\left(-1.8\,\alpha - 1.8\left(2-\alpha^2\right)\right) + 8.4\left(-10.5\,\beta + 3.\left(-2+\beta^2\right)\right)},$$
$$-72.384 - 13.356\,\alpha - 2.748\,\alpha^2 - 136.29\,\beta + 38.94\,\beta^2 \to 0,$$
$$76.308 + 69.372\,\alpha + 7.276\,\alpha^2 - 116.82\,\beta - 45.43\,\beta^2 \to 0\Big\}$$

In[•]:=
```
Solve[
 {-72.384` - 13.356000000000002` α - 2.748` α^2 - 136.29` β + 38.940000000000005` β^2 == 0,
  76.30799999999999` + 69.372` α + 7.276000000000002` α^2 -
    116.82` β - 45.43000000000001` β^2 == 0}, {α, β}]
```

Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

Out[•]=
$$\{\{\alpha \to -34.0061,\ \beta \to 10.4025\},\ \{\alpha \to -6.83118,\ \beta \to -0.673117\},\ \{\alpha \to -2.10171,\ \beta \to -0.374198\},\ \{\alpha \to 16.5065,\ \beta \to 7.20993\}\}$$

In[•]:=
```
{γi → 0, ki → α kr, ωr → 3.5` + (-4 α - 2 (-1 + α^2)) kr^2 - 4.58` μ μ*,
 ωi → (4 α - 2 (-1 + α^2)) kr^2 + 3.5` μ μ*, Ω2 → -1.25` + 3.` K2^2 + 0.75` μ μ*,
 K2 → -(0.03571428571428571` (4 (-17.5` β + 3.` (-2 + β^2)) kr^2 - 0.3` η η* + 3.` μ μ*))/kr,
 μ* → -(0.07704160246533127` (-2 (2 - 7.199999999999999` α - α^2) - 2 (-3 α + 2.4` (-2 + α^2))) kr^2)/μ,
 η* → -(0.3081664098613251` (-2 (-13.74` α + 3.5` (-2 + α^2)) - 2 (10.5` α + 4.58` (-2 + α^2))) kr^2)/η,
 kr → 6.740178039191546` Sqrt[-1/(51.60799999999999` + 41.512` α - 38.784` α^2)],
 γ'r → (3.5` (-3.5` (-11.25` - 1.8` β) β + 3.75` (0.3` (-6 α + 2 (-2 + α^2)) - 3.` (-2 + β^2))))/
   (-2 (-1.8` + 5.3999999999999995` α) +
     2 (-1.8` α - 1.7999999999999998` (2 - α^2)) + 8.4` (-10.5` β + 3.` (-2 + β^2))),
 -72.384` - 13.356000000000002` α - 2.748` α^2 - 136.29` β + 38.940000000000005` β^2 → 0,
 76.30799999999999` + 69.372` α +
   7.276000000000002` α^2 - 116.82` β - 45.43000000000001` β^2 → 0}
```

Out[•]=
$$\{\gamma i \to 0,\ ki \to \alpha\, kr,\ \omega r \to 3.5 + (-4\alpha - 2(-1+\alpha^2))\, kr^2 - 4.58\,\mu\mu^*,$$
$$\omega i \to (4\alpha - 2(-1+\alpha^2))\, kr^2 + 3.5\,\mu\mu^*,\ \Omega 2 \to -1.25 + 3.\, K2^2 + 0.75\,\mu\mu^*,$$
$$K2 \to -\frac{0.0357143\,(4(-17.5\,\beta + 3.(-2+\beta^2))\,kr^2 - 0.3\,\eta\eta^* + 3.\,\mu\mu^*)}{kr},$$
$$\mu^* \to -\frac{0.0770416\,(-2(2 - 7.2\,\alpha - \alpha^2) - 2(-3\alpha + 2.4(-2+\alpha^2)))\,kr^2}{\mu},$$
$$\eta^* \to -\frac{0.308166\,(-2(-13.74\,\alpha + 3.5(-2+\alpha^2)) - 2(10.5\,\alpha + 4.58(-2+\alpha^2)))\,kr^2}{\eta},$$
$$kr \to 6.74018\sqrt{-\frac{1}{51.608 + 41.512\,\alpha - 38.784\,\alpha^2}},$$
$$\gamma' r \to \frac{3.5\,(-3.5\,(-11.25 - 1.8\,\beta)\,\beta + 3.75\,(0.3\,(-6\alpha + 2(-2+\alpha^2)) - 3.\,(-2+\beta^2)))}{-2(-1.8 + 5.4\,\alpha) + 2(-1.8\,\alpha - 1.8\,(2-\alpha^2)) + 8.4\,(-10.5\,\beta + 3.\,(-2+\beta^2))},$$
$$-72.384 - 13.356\,\alpha - 2.748\,\alpha^2 - 136.29\,\beta + 38.94\,\beta^2 \to 0,$$
$$76.308 + 69.372\,\alpha + 7.276\,\alpha^2 - 116.82\,\beta - 45.43\,\beta^2 \to 0\}$$

In[•]:= **ReplaceAll[%, {α → -34.006050303892685`, β → 10.402498632270799`}]**

Out[•]= $\{\gamma_i \to 0,\ k_i \to -34.0061\, k_r,\ \omega_r \to 3.5 - 2174.8\, k_r^2 - 4.58\, \mu\, \mu^*,$
$\omega_i \to -2446.85\, k_r^2 + 3.5\, \mu\, \mu^*,\ \Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,$
$K_2 \to -\frac{0.0357143\, \left(546.369\, k_r^2 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right)}{k_r},\ \mu^* \to \frac{302.471\, k_r^2}{\mu},\ \eta^* \to \frac{5816.84\, k_r^2}{\eta},$
$k_r \to 0.0313546,\ \gamma'_r \to 1.48746,\ 4.54747 \times 10^{-13} \to 0,\ 1.81899 \times 10^{-12} \to 0\}$

In[•]:= **ReplaceAll[%, {k_r → 0.03135464678639694`, γ'_r → 1.4874598745035315`}]**

Out[•]= $\{\gamma_i \to 0,\ k_i \to -1.06625,\ \omega_r \to 1.36193 - 4.58\, \mu\, \mu^*,\ \omega_i \to -2.40553 + 3.5\, \mu\, \mu^*,$
$\Omega_2 \to -1.25 + 3.\, K_2^2 + 0.75\, \mu\, \mu^*,\ K_2 \to -1.13904\, \left(0.537143 - 0.3\, \eta\, \eta^* + 3.\, \mu\, \mu^*\right),$
$\mu^* \to \frac{0.297364}{\mu},\ \eta^* \to \frac{5.71862}{\eta},\ 0.0313546 \to 0.0313546,$
$1.48746 \to 1.48746,\ 4.54747 \times 10^{-13} \to 0,\ 1.81899 \times 10^{-12} \to 0\}$

In[•]:= **ReplaceAll[%, {k_i → -1.0662476958790015`, μ* → 0.29736358283406594`/μ, η* → 5.7186168874460135`/η}]**

Out[•]= $\{\gamma_i \to 0,\ -1.06625 \to -1.06625,\ \omega_r \to 8.88178 \times 10^{-16},\ \omega_i \to -1.36476,$
$\Omega_2 \to -1.02698 + 3.\, K_2^2,\ K_2 \to 0.326167,\ \frac{0.297364}{\mu} \to \frac{0.297364}{\mu},\ \frac{5.71862}{\eta} \to \frac{5.71862}{\eta},$
$0.0313546 \to 0.0313546,\ 1.48746 \to 1.48746,\ 4.54747 \times 10^{-13} \to 0,\ 1.81899 \times 10^{-12} \to 0\}$

In[•]:= **ReplaceAll[%, {K_2 → 0.3261666703108278`}]**

Out[•]= $\{\gamma_i \to 0,\ -1.06625 \to -1.06625,\ \omega_r \to 8.88178 \times 10^{-16},\ \omega_i \to -1.36476,$
$\Omega_2 \to -0.707823,\ 0.326167 \to 0.326167,\ \frac{0.297364}{\mu} \to \frac{0.297364}{\mu},\ \frac{5.71862}{\eta} \to \frac{5.71862}{\eta},$
$0.0313546 \to 0.0313546,\ 1.48746 \to 1.48746,\ 4.54747 \times 10^{-13} \to 0,\ 1.81899 \times 10^{-12} \to 0\}$

In[79]:= $\{A[x, t]\, A^*[x, t] \to \frac{e^{x\,(-i\,k_i + k_r) + x\,(i\,k_i + k_r) + t\,(-i\,\omega_i + \omega_r) + t\,(i\,\omega_i + \omega_r)}\, \eta\, \eta^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2},$
$B[x, t]\, B^*[x, t] \to \frac{\left(1 - e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2\, \mu\, \mu^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2}\}$

Out[79]= $\{A[x, t]\, A^*[x, t] \to \frac{e^{x\,(-i\,k_i + k_r) + x\,(i\,k_i + k_r) + t\,(-i\,\omega_i + \omega_r) + t\,(i\,\omega_i + \omega_r)}\, \eta\, \eta^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2},$
$B[x, t]\, B^*[x, t] \to \frac{\left(1 - e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2\, \mu\, \mu^*}{\left(1 + e^{2\,x\,k_r + 2\,t\,\omega_r}\right)^2}\}$

In[80]:=
```
ReplaceAll[%, {α → -34.006050303892685`, β → 10.402498632270799`,
  k_r → 0.03135464678639694`, γ'_r → 1.4874598745035315`, k_i → -1.0662476958790015`,
  μ* → 0.29736358283406594`/μ, η* → 5.7186168874460135`/η, γ_i → 0,
  γ'_r → 3.6233952626657584`, K_2 → 0.3261666703108278`, ω_r → 8.881784197001252`*^-16,
  ω_i → -1.3647568098295118`, Ω_2 → -0.7078232224094939`}]
```

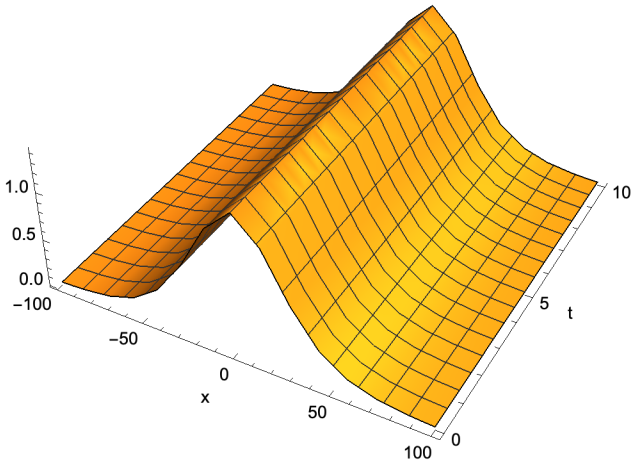
Out[80]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{5.71862\, e^{(1.77636\times10^{-15}+0.\,i)\,t+(0.0627093+0.\,i)\,x}}{\left(1+e^{1.77636\times10^{-15}\,t+0.0627093\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.297364\left(1-e^{1.77636\times10^{-15}\,t+0.0627093\,x}\right)^2}{\left(1+e^{1.77636\times10^{-15}\,t+0.0627093\,x}\right)^2}\right\}$$

In[81]:=
```
Simplify[%]
```

Out[81]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{5.71862\, e^{1.77636\times10^{-15}\,t+0.0627093\,x}}{\left(1.+e^{1.77636\times10^{-15}\,t+0.0627093\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.297364\left(-1.+e^{1.77636\times10^{-15}\,t+0.0627093\,x}\right)^2}{\left(1.+e^{1.77636\times10^{-15}\,t+0.0627093\,x}\right)^2}\right\}$$

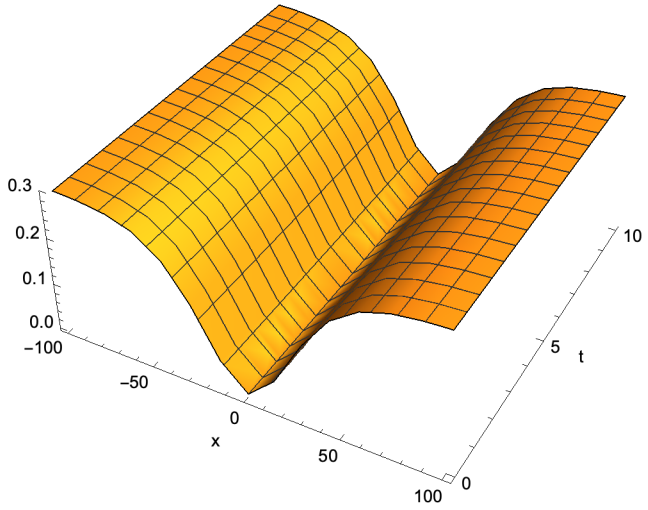
In[82]:=
```
Plot3D[5.7186168874460135` e^(1.7763568394002505`*^-15 t+0.06270929357279388` x)/(1.` + e^(1.7763568394002505`*^-15 t+0.06270929357279388` x))^2,
 {x, -100, 100}, {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[82]=



In[83]:=
```
Plot3D[0.29736358283406594` (-1.` + E^(1.7763568394002505`*^-15 t+0.06270929357279388` x))^2 /
  (1.` + E^(1.7763568394002505`*^-15 t+0.06270929357279388` x))^2,
 {x, -100, 100}, {t, 0, 10}, {PlotRange → All},
 Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[83]=



ok

Out[•]=
```
{{α → -34.0061, β → 10.4025}, {α → -6.83118, β → -0.673117},
 {α → -2.10171, β → -0.374198}, {α → 16.5065, β → 7.20993}}
```

In[•]:=
$$\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to 3.5` + \left(-4\,\alpha - 2\left(-1+\alpha^2\right)\right) k_r^2 - 4.58`\,\mu\,\mu^*,$$
$$\omega_i \to \left(4\,\alpha - 2\left(-1+\alpha^2\right)\right) k_r^2 + 3.5`\,\mu\,\mu^*,\ \Omega_2 \to -1.25` + 3.`\,K_2^2 + 0.75`\,\mu\,\mu^*,$$
$$K_2 \to -\frac{0.03571428571428571`\left(4\left(-17.5`\,\beta + 3.`\left(-2+\beta^2\right)\right) k_r^2 - 0.3`\,\eta\,\eta^* + 3.`\,\mu\,\mu^*\right)}{k_r},\ \mu^* \to$$
$$-\frac{0.07704160246533127`\left(-2\left(2 - 7.199999999999999`\,\alpha - \alpha^2\right) - 2\left(-3\,\alpha + 2.4`\left(-2+\alpha^2\right)\right)\right) k_r^2}{\mu},$$
$$\eta^* \to -\frac{0.3081664098613251`\left(-2\left(-13.74`\,\alpha + 3.5`\left(-2+\alpha^2\right)\right) - 2\left(10.5`\,\alpha + 4.58`\left(-2+\alpha^2\right)\right)\right) k_r^2}{\eta},$$
$$k_r \to 6.740178039191546`\sqrt{-\frac{1}{51.60799999999999` + 41.512`\,\alpha - 38.784`\,\alpha^2}},$$
$$\gamma'_r \to \left(3.5`\left(-3.5`\left(-11.25` - 1.8`\,\beta\right)\beta + 3.75`\left(0.3`\left(-6\,\alpha + 2\left(-2+\alpha^2\right)\right) - 3.`\left(-2+\beta^2\right)\right)\right)\right) /$$
$$\left(-2\left(-1.8` + 5.3999999999999995`\,\alpha\right) + 2\left(-1.8`\,\alpha - 1.7999999999999998`\left(2-\alpha^2\right)\right) + 8.4`\left(-10.5`\,\beta + 3.`\left(-2+\beta^2\right)\right)\right),$$
$$-72.384` - 13.356000000000002`\,\alpha - 2.748`\,\alpha^2 - 136.29`\,\beta + 38.940000000000005`\,\beta^2 \to 0,$$
$$76.30799999999999` + 69.372`\,\alpha + 7.276000000000002`\,\alpha^2 - 116.82`\,\beta - 45.43000000000001`\,\beta^2 \to 0\}$$

Out[•]=
$$\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to 3.5 + \left(-4\,\alpha - 2\left(-1+\alpha^2\right)\right) k_r^2 - 4.58\,\mu\,\mu^*,$$
$$\omega_i \to \left(4\,\alpha - 2\left(-1+\alpha^2\right)\right) k_r^2 + 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$$
$$K_2 \to -\frac{0.0357143\left(4\left(-17.5\,\beta + 3.\left(-2+\beta^2\right)\right) k_r^2 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)}{k_r},$$
$$\mu^* \to -\frac{0.0770416\left(-2\left(2 - 7.2\,\alpha - \alpha^2\right) - 2\left(-3\,\alpha + 2.4\left(-2+\alpha^2\right)\right)\right) k_r^2}{\mu},$$
$$\eta^* \to -\frac{0.308166\left(-2\left(-13.74\,\alpha + 3.5\left(-2+\alpha^2\right)\right) - 2\left(10.5\,\alpha + 4.58\left(-2+\alpha^2\right)\right)\right) k_r^2}{\eta},$$
$$k_r \to 6.74018\sqrt{-\frac{1}{51.608 + 41.512\,\alpha - 38.784\,\alpha^2}},$$
$$\gamma'_r \to \frac{3.5\left(-3.5\left(-11.25 - 1.8\,\beta\right)\beta + 3.75\left(0.3\left(-6\,\alpha + 2\left(-2+\alpha^2\right)\right) - 3.\left(-2+\beta^2\right)\right)\right)}{-2\left(-1.8 + 5.4\,\alpha\right) + 2\left(-1.8\,\alpha - 1.8\left(2-\alpha^2\right)\right) + 8.4\left(-10.5\,\beta + 3.\left(-2+\beta^2\right)\right)},$$
$$-72.384 - 13.356\,\alpha - 2.748\,\alpha^2 - 136.29\,\beta + 38.94\,\beta^2 \to 0,$$
$$76.308 + 69.372\,\alpha + 7.276\,\alpha^2 - 116.82\,\beta - 45.43\,\beta^2 \to 0\}$$

In[•]:=
```
ReplaceAll[%, {α → -6.831183870133112`, β → -0.6731171322014438`}]
```

Out[•]=
$$\{\gamma_i \to 0,\ k_i \to -6.83118\,k_r,\ \omega_r \to 3.5 - 64.0054\,k_r^2 - 4.58\,\mu\,\mu^*,$$
$$\omega_i \to -118.655\,k_r^2 + 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$$
$$K_2 \to -\frac{0.0357143\left(28.5552\,k_r^2 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)}{k_r},\ \mu^* \to \frac{20.3712\,k_r^2}{\mu},\ \eta^* \to \frac{236.072\,k_r^2}{\eta},$$
$$k_r \to 0.149163,\ \gamma'_r \to 1.73498,\ 1.42109\times10^{-14} \to 0,\ 9.9476\times10^{-14} \to 0\}$$

In[•]:= **ReplaceAll[%, {k_r → 0.14916329619815658`}]**

Out[•]= $\{\gamma_i \to 0,\ k_i \to -1.01896,\ \omega_r \to 2.0759 - 4.58\,\mu\,\mu^*,\ \omega_i \to -2.64003 + 3.5\,\mu\,\mu^*,$
$\Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,\ K_2 \to -0.239431\,\left(0.635345 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right),\ \mu^* \to \frac{0.453253}{\mu},$
$\eta^* \to \frac{5.25253}{\eta},\ 0.149163 \to 0.149163,\ \gamma'_r \to 1.73498,\ 1.42109 \times 10^{-14} \to 0,\ 9.9476 \times 10^{-14} \to 0\}$

In[•]:= **ReplaceAll[%, {k_i → -1.0189619030047348`, $\mu^*$ → $\frac{0.45325317094442485`}{\mu}$,**
η^* → $\frac{5.252528649715894`}{\eta}$, $\gamma'_r$ → 1.7349830224615372`}]

Out[•]= $\{\gamma_i \to 0,\ -1.01896 \to -1.01896,\ \omega_r \to 8.88178 \times 10^{-16},\ \omega_i \to -1.05365,$
$\Omega_2 \to -0.91006 + 3.\,K_2^2,\ K_2 \to -0.100404,\ \frac{0.453253}{\mu} \to \frac{0.453253}{\mu},\ \frac{5.25253}{\eta} \to \frac{5.25253}{\eta},$
$0.149163 \to 0.149163,\ 1.73498 \to 1.73498,\ 1.42109 \times 10^{-14} \to 0,\ 9.9476 \times 10^{-14} \to 0\}$

In[•]:= **ReplaceAll[%, {K_2 → -0.100404370166617 56`}]**

Out[•]= $\{\gamma_i \to 0,\ -1.01896 \to -1.01896,\ \omega_r \to 8.88178 \times 10^{-16},\ \omega_i \to -1.05365,\ \Omega_2 \to -0.879817,$
$-0.100404 \to -0.100404,\ \frac{0.453253}{\mu} \to \frac{0.453253}{\mu},\ \frac{5.25253}{\eta} \to \frac{5.25253}{\eta},$
$0.149163 \to 0.149163,\ 1.73498 \to 1.73498,\ 1.42109 \times 10^{-14} \to 0,\ 9.9476 \times 10^{-14} \to 0\}$

In[84]:= $\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$
$\left.B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$

Out[84]= $\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$
$\left.B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$

In[85]:=
```
ReplaceAll[%, {α → -6.831183870133112`, β → -0.6731171322014438`,
  k_r → 0.14916329619815658`, k_i → -1.0189619030047348`,
  μ* → 0.45325317094442485`/μ, η* → 5.252528649715894`/η, γ'_r → 1.7349830224615372`,
  K_2 → -0.10040437016661756`, γ_i → 0, ω_r → 8.881784197001252`*^-16,
  ω_i → -1.0536481079893063`, Ω_2 → -0.8798170091460159`}]
```

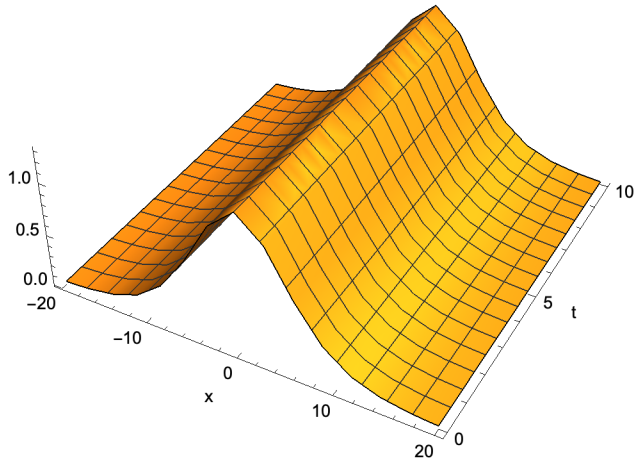
Out[85]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{5.25253\, e^{(1.77636\times10^{-15}+0.\,i)\,t+(0.298327+0.\,i)\,x}}{\left(1+e^{1.77636\times10^{-15}\,t+0.298327\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.453253\left(1-e^{1.77636\times10^{-15}\,t+0.298327\,x}\right)^2}{\left(1+e^{1.77636\times10^{-15}\,t+0.298327\,x}\right)^2}\right\}$$

In[86]:=
```
Simplify[%]
```

Out[86]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{5.25253\, e^{1.77636\times10^{-15}\,t+0.298327\,x}}{\left(1.+e^{1.77636\times10^{-15}\,t+0.298327\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.453253\left(-1.+e^{1.77636\times10^{-15}\,t+0.298327\,x}\right)^2}{\left(1.+e^{1.77636\times10^{-15}\,t+0.298327\,x}\right)^2}\right\}$$

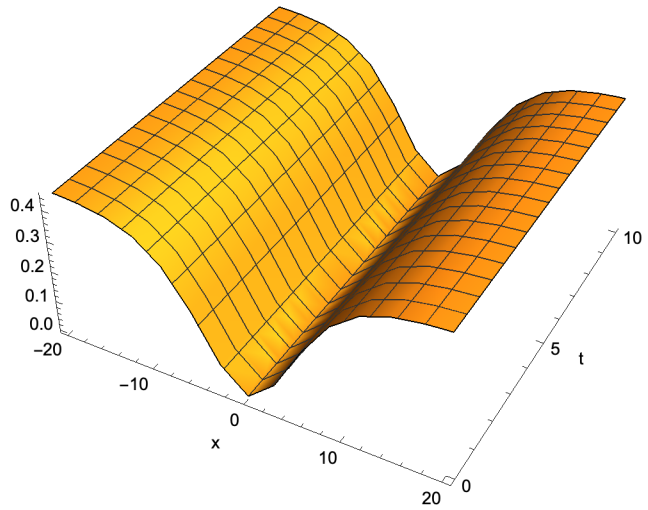
In[87]:=
```
Plot3D[5.252528649715894` e^(1.7763568394002505`*^-15 t+0.29832659239631315` x)/
  (1.` + e^(1.7763568394002505`*^-15 t+0.29832659239631315` x))^2, {x, -20, 20},
 {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[87]=



In[88]:=
```
Plot3D[0.45325317094442485` (-1.` + E^(1.7763568394002505`*^-15 t+0.29832659239631315` x))^2/(1.` + E^(1.7763568394002505`*^-15 t+0.29832659239631315` x))^2,
 {x, -20, 20}, {t, 0, 10}, {PlotRange → All},
 Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[88]=



ok

Out[•]=
```
{{α → -34.0061, β → 10.4025}, {α → -6.83118, β → -0.673117},
 {α → -2.10171, β → -0.374198}, {α → 16.5065, β → 7.20993}}
```

In[•]:=
```
{γi → 0, ki → α kr, ωr → 3.5` + (-4 α - 2 (-1 + α^2)) kr^2 - 4.58` μ μ*,
 ωi → (4 α - 2 (-1 + α^2)) kr^2 + 3.5` μ μ*, Ω2 → -1.25` + 3.` K2^2 + 0.75` μ μ*,
 K2 → -(0.03571428571428571` (4 (-17.5` β + 3.` (-2 + β^2)) kr^2 - 0.3` η η* + 3.` μ μ*))/kr,
 μ* → -(0.07704160246533127` (-2 (2 - 7.199999999999999` α - α^2) - 2 (-3 α + 2.4` (-2 + α^2))) kr^2)/μ,
 η* → -(0.3081664098613251` (-2 (-13.74` α + 3.5` (-2 + α^2)) - 2 (10.5` α + 4.58` (-2 + α^2))) kr^2)/η,
 kr → 6.740178039191546` Sqrt[-1/(51.60799999999999` + 41.512` α - 38.784` α^2)],
 γ'r → (3.5` (-3.5` (-11.25` - 1.8` β) β + 3.75` (0.3` (-6 α + 2 (-2 + α^2)) - 3.` (-2 + β^2))))/
   (-2 (-1.8` + 5.3999999999999995` α) +
     2 (-1.8` α - 1.7999999999999998` (2 - α^2)) + 8.4` (-10.5` β + 3.` (-2 + β^2))),
 -72.384` - 13.356000000000002` α - 2.748` α^2 - 136.29` β + 38.940000000000005` β^2 → 0,
 76.30799999999999` + 69.372` α +
   7.276000000000002` α^2 - 116.82` β - 45.43000000000001` β^2 → 0}
```

Out[•]=
```
{γi → 0, ki → α kr, ωr → 3.5 + (-4 α - 2 (-1 + α^2)) kr^2 - 4.58 μ μ*,
 ωi → (4 α - 2 (-1 + α^2)) kr^2 + 3.5 μ μ*, Ω2 → -1.25 + 3. K2^2 + 0.75 μ μ*,
 K2 → -(0.0357143 (4 (-17.5 β + 3. (-2 + β^2)) kr^2 - 0.3 η η* + 3. μ μ*))/kr,
 μ* → -(0.0770416 (-2 (2 - 7.2 α - α^2) - 2 (-3 α + 2.4 (-2 + α^2))) kr^2)/μ,
 η* → -(0.308166 (-2 (-13.74 α + 3.5 (-2 + α^2)) - 2 (10.5 α + 4.58 (-2 + α^2))) kr^2)/η,
 kr → 6.74018 Sqrt[-1/(51.608 + 41.512 α - 38.784 α^2)],
 γ'r → (3.5 (-3.5 (-11.25 - 1.8 β) β + 3.75 (0.3 (-6 α + 2 (-2 + α^2)) - 3. (-2 + β^2))))/
   (-2 (-1.8 + 5.4 α) + 2 (-1.8 α - 1.8 (2 - α^2)) + 8.4 (-10.5 β + 3. (-2 + β^2))),
 -72.384 - 13.356 α - 2.748 α^2 - 136.29 β + 38.94 β^2 → 0,
 76.308 + 69.372 α + 7.276 α^2 - 116.82 β - 45.43 β^2 → 0}
```

In[•]:=
```
ReplaceAll[%, {α → -2.1017131454934583`, β → -0.37419796480419576`}]
```

Out[•]=
```
{γi → 0, ki → -2.10171 kr, ωr → 3.5 + 1.57246 kr^2 - 4.58 μ μ*,
 ωi → -15.2412 kr^2 + 3.5 μ μ*, Ω2 → -1.25 + 3. K2^2 + 0.75 μ μ*,
 K2 → -(0.0357143 (3.87415 kr^2 - 0.3 η η* + 3. μ μ*))/kr, μ* → 3.82458 kr^2/μ,
 η* → 16.2345 kr^2/η, kr → 0.468526, γ'r → 3.25593, -7.10543 × 10^-15 → 0, 0. → 0}
```

In[•]:= **ReplaceAll[%, {k_r → 0.46852576801628615`}]**

Out[•]= $\{\gamma_i \to 0,\ k_i \to -0.984707,\ \omega_r \to 3.84518 - 4.58\,\mu\,\mu^*,$
$\omega_i \to -3.3457 + 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$
$K_2 \to -0.0762269\,\left(0.850439 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right),\ \mu^* \to \frac{0.839559}{\mu},\ \eta^* \to \frac{3.56374}{\eta},$
$0.468526 \to 0.468526,\ \gamma'_r \to 3.25593,\ -7.10543\times 10^{-15} \to 0,\ 0. \to 0\}$

In[•]:= **ReplaceAll[%, {k_i → -0.9847067656422471`, $\mu^*$ → $\frac{0.8395589381136983`}{\mu}$,**
η^* → $\frac{3.5637437035379396`}{\eta}$, $\gamma'_r$ → 3.2559275807854147`}]

Out[•]= $\{\gamma_i \to 0,\ -0.984707 \to -0.984707,\ \omega_r \to 4.44089\times 10^{-16},\ \omega_i \to -0.407248,$
$\Omega_2 \to -0.620331 + 3.\,K_2^2,\ K_2 \to -0.175321,\ \frac{0.839559}{\mu} \to \frac{0.839559}{\mu},\ \frac{3.56374}{\eta} \to \frac{3.56374}{\eta},$
$0.468526 \to 0.468526,\ 3.25593 \to 3.25593,\ -7.10543\times 10^{-15} \to 0,\ 0. \to 0\}$

In[•]:= **ReplaceAll[%, {K_2 → -0.17532138885001702`}]**

Out[•]= $\{\gamma_i \to 0,\ -0.984707 \to -0.984707,\ \omega_r \to 4.44089\times 10^{-16},\ \omega_i \to -0.407248,\ \Omega_2 \to -0.528118,$
$-0.175321 \to -0.175321,\ \frac{0.839559}{\mu} \to \frac{0.839559}{\mu},\ \frac{3.56374}{\eta} \to \frac{3.56374}{\eta},$
$0.468526 \to 0.468526,\ 3.25593 \to 3.25593,\ -7.10543\times 10^{-15} \to 0,\ 0. \to 0\}$

In[89]:= $\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$
$\left.B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$

Out[89]= $\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$
$\left.B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$

In[90]:=
```
ReplaceAll[%, {α → -2.1017131454934583`, β → -0.37419796480419576`,
  k_r → 0.46852576801628615`, k_i → -0.9847067656422471`,
  μ* → 0.8395589381136983`/μ, η* → 3.5637437035379396`/η, γ'_r → 3.2559275807854147`,
  K_2 → -0.17532138885001702`, γ_i → 0, ω_r → 4.440892098500626`*^-16,
  ω_i → -0.40724772918825236`, Ω_2 → -0.5281180282498296`}]
```

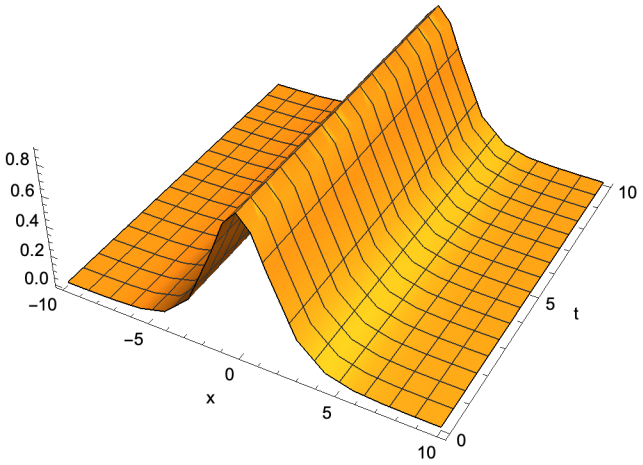
Out[90]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{3.56374\, e^{\left(8.88178\times10^{-16}+0.\,i\right)t+(0.937052+0.\,i)x}}{\left(1+e^{8.88178\times10^{-16}t+0.937052x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.839559\left(1-e^{8.88178\times10^{-16}t+0.937052x}\right)^2}{\left(1+e^{8.88178\times10^{-16}t+0.937052x}\right)^2}\right\}$$

In[91]:=
```
Simplify[%]
```

Out[91]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{3.56374\, e^{8.88178\times10^{-16}t+0.937052x}}{\left(1.+e^{8.88178\times10^{-16}t+0.937052x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.839559\left(-1.+e^{8.88178\times10^{-16}t+0.937052x}\right)^2}{\left(1.+e^{8.88178\times10^{-16}t+0.937052x}\right)^2}\right\}$$

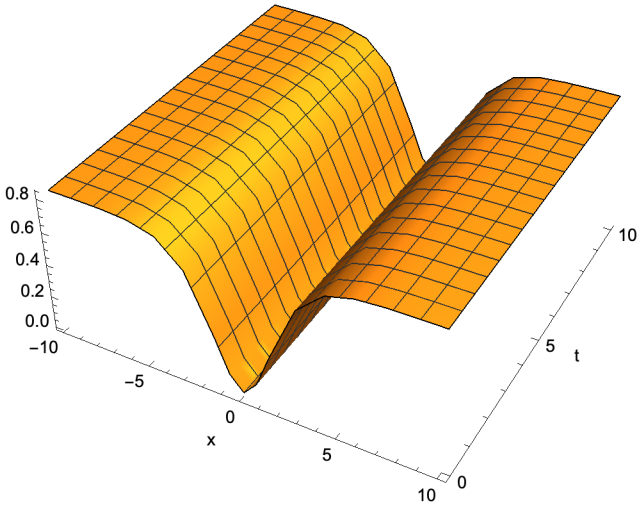
In[92]:=
```
Plot3D[3.5637437035379396` e^(8.881784197001252`*^-16 t+0.9370515360325723` x)/(1.` + e^(8.881784197001252`*^-16 t+0.9370515360325723` x))^2,
 {x, -10, 10}, {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[92]=



In[93]:=
```
Plot3D[0.8395589381136983` (-1.` + E^(8.881784197001252`*^-16 t+0.9370515360325723` x))^2 /
  (1.` + E^(8.881784197001252`*^-16 t+0.9370515360325723` x))^2,
 {x, -10, 10}, {t, 0, 10}, {PlotRange → All},
 Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[93]=



oK

Out[•]=
```
{{α → -34.0061, β → 10.4025}, {α → -6.83118, β → -0.673117},
 {α → -2.10171, β → -0.374198}, {α → 16.5065, β → 7.20993}}
```

In[•]:=
$$\left\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to 3.5` + \left(-4\,\alpha - 2\left(-1+\alpha^2\right)\right) k_r^2 - 4.58`\,\mu\,\mu^*,\right.$$
$$\omega_i \to \left(4\,\alpha - 2\left(-1+\alpha^2\right)\right) k_r^2 + 3.5`\,\mu\,\mu^*,\ \Omega_2 \to -1.25` + 3.`\,K_2^2 + 0.75`\,\mu\,\mu^*,$$
$$K_2 \to -\frac{0.03571428571428571`\left(4\left(-17.5`\,\beta + 3.`\left(-2+\beta^2\right)\right) k_r^2 - 0.3`\,\eta\,\eta^* + 3.`\,\mu\,\mu^*\right)}{k_r},\ \mu^* \to$$
$$-\frac{0.07704160246533127`\left(-2\left(2 - 7.199999999999999`\,\alpha - \alpha^2\right) - 2\left(-3\,\alpha + 2.4`\left(-2+\alpha^2\right)\right)\right) k_r^2}{\mu},$$
$$\eta^* \to$$
$$-\frac{0.3081664098613251`\left(-2\left(-13.74`\,\alpha + 3.5`\left(-2+\alpha^2\right)\right) - 2\left(10.5`\,\alpha + 4.58`\left(-2+\alpha^2\right)\right)\right) k_r^2}{\eta},$$
$$k_r \to 6.740178039191546`\sqrt{-\frac{1}{51.60799999999999` + 41.512`\,\alpha - 38.784`\,\alpha^2}},$$
$$\gamma'_r \to \left(3.5`\left(-3.5`\left(-11.25` - 1.8`\,\beta\right)\beta + 3.75`\left(0.3`\left(-6\,\alpha + 2\left(-2+\alpha^2\right)\right) - 3.`\left(-2+\beta^2\right)\right)\right)\right) /$$
$$\left(-2\left(-1.8` + 5.3999999999999995`\,\alpha\right) + 2\left(-1.8`\,\alpha - 1.7999999999999998`\left(2-\alpha^2\right)\right) + 8.4`\left(-10.5`\,\beta + 3.`\left(-2+\beta^2\right)\right)\right),$$
$$-72.384` - 13.356000000000002`\,\alpha - 2.748`\,\alpha^2 - 136.29`\,\beta + 38.940000000000005`\,\beta^2 \to 0,$$
$$76.30799999999999` + 69.372`\,\alpha + 7.276000000000002`\,\alpha^2 - 116.82`\,\beta - 45.43000000000001`\,\beta^2 \to 0\Big\}$$

Out[•]=
$$\left\{\gamma_i \to 0,\ k_i \to \alpha\, k_r,\ \omega_r \to 3.5 + \left(-4\,\alpha - 2\left(-1+\alpha^2\right)\right) k_r^2 - 4.58\,\mu\,\mu^*,\right.$$
$$\omega_i \to \left(4\,\alpha - 2\left(-1+\alpha^2\right)\right) k_r^2 + 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$$
$$K_2 \to -\frac{0.0357143\left(4\left(-17.5\,\beta + 3.\left(-2+\beta^2\right)\right) k_r^2 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)}{k_r},$$
$$\mu^* \to -\frac{0.0770416\left(-2\left(2 - 7.2\,\alpha - \alpha^2\right) - 2\left(-3\,\alpha + 2.4\left(-2+\alpha^2\right)\right)\right) k_r^2}{\mu},$$
$$\eta^* \to -\frac{0.308166\left(-2\left(-13.74\,\alpha + 3.5\left(-2+\alpha^2\right)\right) - 2\left(10.5\,\alpha + 4.58\left(-2+\alpha^2\right)\right)\right) k_r^2}{\eta},$$
$$k_r \to 6.74018\sqrt{-\frac{1}{51.608 + 41.512\,\alpha - 38.784\,\alpha^2}},$$
$$\gamma'_r \to \frac{3.5\left(-3.5\left(-11.25 - 1.8\,\beta\right)\beta + 3.75\left(0.3\left(-6\,\alpha + 2\left(-2+\alpha^2\right)\right) - 3.\left(-2+\beta^2\right)\right)\right)}{-2\left(-1.8 + 5.4\,\alpha\right) + 2\left(-1.8\,\alpha - 1.8\left(2-\alpha^2\right)\right) + 8.4\left(-10.5\,\beta + 3.\left(-2+\beta^2\right)\right)},$$
$$-72.384 - 13.356\,\alpha - 2.748\,\alpha^2 - 136.29\,\beta + 38.94\,\beta^2 \to 0,$$
$$76.308 + 69.372\,\alpha + 7.276\,\alpha^2 - 116.82\,\beta - 45.43\,\beta^2 \to 0\Big\}$$

In[•]:=
```
ReplaceAll[%, {α → 16.506514887086823`, β → 7.209927029845406`}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ k_i \to 16.5065\,k_r,\ \omega_r \to 3.5 - 608.956\,k_r^2 - 4.58\,\mu\,\mu^*,\right.$$
$$\omega_i \to -476.904\,k_r^2 + 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$$
$$K_2 \to -\frac{0.0357143\left(95.1017\,k_r^2 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right)}{k_r},\ \mu^* \to \frac{32.4013\,k_r^2}{\mu},\ \eta^* \to \frac{1313.95\,k_r^2}{\eta},$$
$$k_r \to 0.0679805,\ \gamma'_r \to 1.40233,\ 4.54747\times10^{-13} \to 0,\ 4.54747\times10^{-13} \to 0\Big\}$$

In[•]:=
```
ReplaceAll[%, {k_r → 0.06798052358074447`}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ k_i \to 1.12212,\ \omega_r \to 0.6858 - 4.58\,\mu\,\mu^*,\right.$$
$$\omega_i \to -2.20394 + 3.5\,\mu\,\mu^*,\ \Omega_2 \to -1.25 + 3.\,K_2^2 + 0.75\,\mu\,\mu^*,$$
$$K_2 \to -0.525361\,\left(0.439498 - 0.3\,\eta\,\eta^* + 3.\,\mu\,\mu^*\right),\ \mu^* \to \frac{0.149738}{\mu},\ \eta^* \to \frac{6.0722}{\eta},$$
$$\left.0.0679805 \to 0.0679805,\ \gamma'_r \to 1.40233,\ 4.54747 \times 10^{-13} \to 0,\ 4.54747 \times 10^{-13} \to 0\right\}$$

In[•]:=
```
ReplaceAll[%, {k_i → 1.1221215245175153`, μ* → 0.1497379119148258`/μ,
  η* → 6.072203523905371`/η, γ'_r → 1.4023289607290237`}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ 1.12212 \to 1.12212,\ \omega_r \to 1.11022 \times 10^{-15},\ \omega_i \to -1.67986,\right.$$
$$\Omega_2 \to -1.1377 + 3.\,K_2^2,\ K_2 \to 0.490135,\ \frac{0.149738}{\mu} \to \frac{0.149738}{\mu},\ \frac{6.0722}{\eta} \to \frac{6.0722}{\eta},$$
$$\left.0.0679805 \to 0.0679805,\ 1.40233 \to 1.40233,\ 4.54747 \times 10^{-13} \to 0,\ 4.54747 \times 10^{-13} \to 0\right\}$$

In[•]:=
```
ReplaceAll[%, {K_2 → 0.4901346144678525`}]
```

Out[•]=
$$\left\{\gamma_i \to 0,\ 1.12212 \to 1.12212,\ \omega_r \to 1.11022 \times 10^{-15},\ \omega_i \to -1.67986,\right.$$
$$\Omega_2 \to -0.417001,\ 0.490135 \to 0.490135,\ \frac{0.149738}{\mu} \to \frac{0.149738}{\mu},\ \frac{6.0722}{\eta} \to \frac{6.0722}{\eta},$$
$$\left.0.0679805 \to 0.0679805,\ 1.40233 \to 1.40233,\ 4.54747 \times 10^{-13} \to 0,\ 4.54747 \times 10^{-13} \to 0\right\}$$

In[94]:=
```
{A[x, t] A*[x, t] → e^(x (-i k_i+k_r)+x (i k_i+k_r)+t (-i ω_i+ω_r)+t (i ω_i+ω_r)) η η* /
    (1 + e^(2 x k_r+2 t ω_r))^2,
  B[x, t] B*[x, t] → (1 - e^(2 x k_r+2 t ω_r))^2 μ μ* / (1 + e^(2 x k_r+2 t ω_r))^2}
```

Out[94]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$$
$$\left.B[x,t]\,B^*[x,t] \to \frac{\left(1-e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2\,\mu\,\mu^*}{\left(1+e^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$$

In[95]:=
```
ReplaceAll[%, {α → 16.506514887086823`, β → 7.209927029845406`,
  k_r → 0.06798052358074447`, k_i → 1.1221215245175153`,
  μ* → 0.1497379119148258`/μ, η* → 6.072203523905371`/η, γ'_r → 1.4023289607290237`,
  K_2 → 0.4901346144678525`, γ_i → 0, ω_r → 1.1102230246251565`*^-15,
  ω_i → -1.679858401664815`, Ω_2 → -0.41700074516522945`}]
```

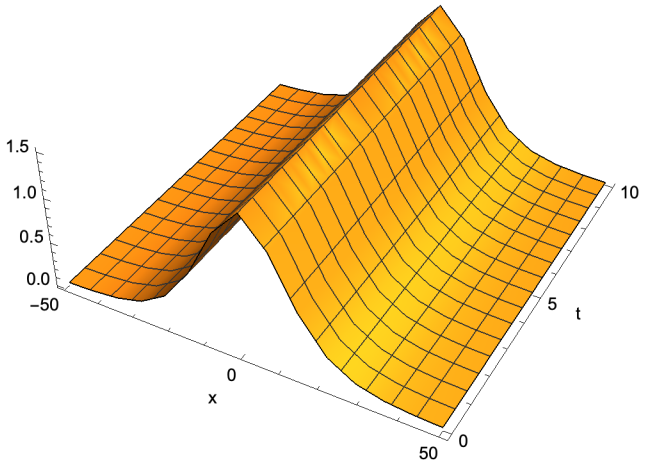
Out[95]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{6.0722\, e^{(2.22045\times10^{-15}+0.\,i)\,t+(0.135961+0.\,i)\,x}}{\left(1+e^{2.22045\times10^{-15}\,t+0.135961\,x}\right)^2},\right.$$
$$\left. B[x,t]\,B^*[x,t] \to \frac{0.149738\left(1-e^{2.22045\times10^{-15}\,t+0.135961\,x}\right)^2}{\left(1+e^{2.22045\times10^{-15}\,t+0.135961\,x}\right)^2}\right\}$$

In[•]:=
```
Simplify[%]
```

Out[•]=
$$\left\{\Phi[x,t]\,\Phi^*[x,t] \to \frac{6.0722\, e^{2.22045\times10^{-15}\,t+0.135961\,x}}{\left(1.+e^{2.22045\times10^{-15}\,t+0.135961\,x}\right)^2},\right.$$
$$\left. \Psi[x,t]\,\Psi^*[x,t] \to \frac{0.149738\left(-1.+e^{2.22045\times10^{-15}\,t+0.135961\,x}\right)^2}{\left(1.+e^{2.22045\times10^{-15}\,t+0.135961\,x}\right)^2}\right\}$$

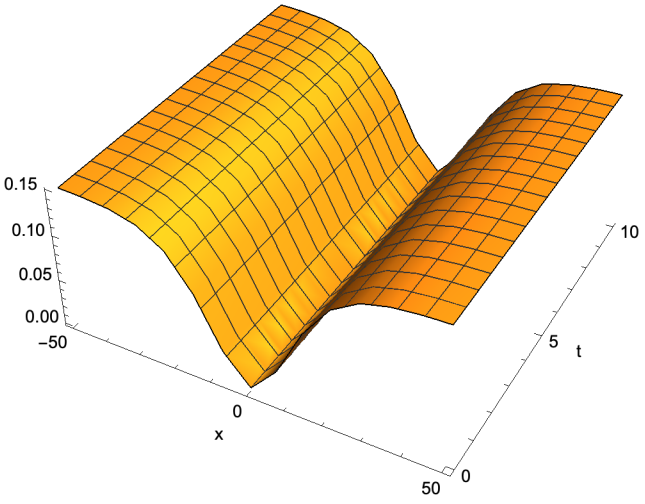
In[96]:=
```
Plot3D[6.072203523905371` e^(2.220446049250313`*^-15 t+0.13596104716148893` x)/(1.` + e^(2.220446049250313`*^-15 t+0.13596104716148893` x))^2, {x, -50, 50},
 {t, 0, 10}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[96]=



In[97]:=
```
Plot3D[0.1497379119148258` (-1.` + E^(2.220446049250313`*^-15 t+0.13596104716148893` x))^2 /
  (1.` + E^(2.220446049250313`*^-15 t+0.13596104716148893` x))^2,
 {x, -50, 50}, {t, 0, 10}, {PlotRange → All},
 Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[97]=



Kink - Bright

```
ReplaceAll[%, {A[x, t] → G[x, t]/f[x, t]^m Exp[I (K1 x - Ω1 t)],
  B[x, t] → H[x, t]/f[x, t]^n Exp[I (K2 x - Ω2 t)], A*[x, t] → G*[x, t]/f[x, t]^{m*} Exp[-I (K1 x - Ω1 t)],
  B*[x, t] → H*[x, t]/f[x, t]^{n*} Exp[-I (K2 x - Ω2 t)]}]

ReplaceAll[%, {G[x, t] → η Exp[k x + ω t],
  G*[x, t] → η* Exp[k* x + ω* t], H[x, t] → μ Exp[(k + k*) x + (ω + ω*) t],
  H*[x, t] → μ* Exp[(k + k*) x + (ω + ω*) t], f[x, t] → 1 + Exp[(k + k*) x + (ω + ω*) t]}]

ReplaceAll[%, {Ω1 → 0, K1 → 0, (n (1 + n) p2 (k + k*)^2 - η r2 η* + μ q2 μ*) → 0,
  (I (ω + ω*) + p2 (k + k*)^2 + 2 I K2 p2 (k + k*) - K2^2 p2 - I γ2 + Ω2) → 0,
  (-2 + n) p2 (k + k*)^2 - I (ω + ω*) - 2 I K2 p2 (k + k*) + μ q2 μ*/n → 0,
  m (1 + m) p1 (k + k*)^2 - η q1 η* + μ r1 μ* → 0, I ω + k^2 p1 - I γ1 → 0,
  -2 I γ1 + (-1 + m) p1 (k + k*)^2 + (k*)^2 (p1 - (p1)*) + μ r1 μ*/m → 0}],
ReplaceAll[%, {p1 → p1r + I p1i, p2 → p2r + I p2i, q1 → q1r + I q1i, q2 → q2r + I q2i,
  r1 → R1r + I R1i, r2 → R2r + I R2i, k* → kr - I ki, k → kr + I ki, ω* → ωr - I ωi, ω → ωr + I ωi}],
ReplaceAll[%, {n → 1 + I β, m → 1 + I α, m* → 1 - I α, n* → 1 - I β}]
```

In[98]:=
```
{Ω2 → 4 kr K2 P'i - 4 kr^2 P'r + K2^2 P'r - γ'i,
 ωi → -2 ki kr Pi - ki^2 Pr + kr^2 Pr + γi, ωr → ki^2 Pi - kr^2 Pi - 2 ki kr Pr + γr,
```

$$\mu^* \to \frac{4\,k_r^2\,\left(-P_r\,\left(\left(-2+\alpha^2\right)\,Q_i+3\,\alpha\,Q_r\right)+P_i\,\left(-3\,\alpha\,Q_i+\left(-2+\alpha^2\right)\,Q_r\right)\right)}{\mu\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)},$$

$$\eta^* \to \frac{4\,k_r^2\,\left(-P_r\,\left(\left(-2+\alpha^2\right)\,Q_{2\,i}+3\,\alpha\,Q_{2\,r}\right)+P_i\,\left(-3\,\alpha\,Q_{2\,i}+\left(-2+\alpha^2\right)\,Q_{2\,r}\right)\right)}{\eta\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)},$$

$$K_2 \to \left(2\,k_i\,k_r\,P_r\,\left(-Q_{2\,i}\,Q_r+Q_i\,Q_{2\,r}\right)+\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,\left(k_i^2\,P_i+\gamma_r\right)+k_r^2\,\left(2\,\left(\left(1+\beta^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,P'_i+P_r\,\left(\left(-2+\alpha^2\right)\,Q_i+3\,\alpha\,Q_r\right)\,Q'_{2\,i}\right)+P_i\,\left(Q_i\,\left(Q_{2\,r}+6\,\alpha\,Q'_{2\,i}\right)-Q_r\,\left(Q_{2\,i}+2\,\left(-2+\alpha^2\right)\,Q'_{2\,i}\right)\right)\right)\right)\Big/\left(2\,k_r\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,\left(\beta\,P'_i-P'_r\right)\right),\ k_i \to \frac{1}{\left(1+\alpha^2\right)\,\left(1+\beta^2\right)\,P_r\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,P'_i}$$

$$k_r\,\left(\left(1+\alpha^2\right)\,\left(1+\beta^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,\left(P'\right)_i^2+\left(1+\alpha^2\right)\,P'_r\,\left(\left(1+\beta^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,P'_r+P_r\,\left(\left(-2+\alpha^2\right)\,Q_i+3\,\alpha\,Q_r\right)\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)\right)-P_i\,\left(-3\,\alpha\,Q_i+\left(-2+\alpha^2\right)\,Q_r\right)\,\left(\left(1+\alpha^2\right)\,P'_r\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)+P'_i\,\left(-\left(1+\beta^2\right)\,\left(Q_{2\,i}-\alpha\,Q_{2\,r}\right)+\left(1+\alpha^2\right)\,Q'_{2\,i}-\left(1+\alpha^2\right)\,\beta\,Q'_{2\,r}\right)\right)+P_r\,P'_i\,\left(\alpha\,Q_r\,\left(\left(1+\beta^2\right)\,\left(\left(-2+\alpha^2\right)\,Q_{2\,i}+3\,\alpha\,Q_{2\,r}\right)+3\,\left(1+\alpha^2\right)\,Q'_{2\,i}-3\,\left(1+\alpha^2\right)\,\beta\,Q'_{2\,r}\right)+Q_i\,\left(-\left(1+\beta^2\right)\,\left(\left(-2+\alpha^2\right)\,Q_{2\,i}+3\,\alpha\,Q_{2\,r}\right)+\left(-2-\alpha^2+\alpha^4\right)\,Q'_{2\,i}+\left(2+\alpha^2-\alpha^4\right)\,\beta\,Q'_{2\,r}\right)\right)\right),$$

$$k_r \to \left\{\sqrt{\left(-\left(\left(\left(1+\beta^2\right)^2\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)^2\,P'_i\,\gamma'_r\right)\Big/\left(\left(1+\beta^2\right)^2\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)^2\,\left(-\beta\,P'_i+P'_r\right)^2+P_r^2\,\left(\left(-2+\alpha^2\right)\,Q_i+3\,\alpha\,Q_r\right)^2\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)^2+P_i^2\,\left(-3\,\alpha\,Q_i+\left(-2+\alpha^2\right)\,Q_r\right)^2\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)^2-2\,\left(1+\beta^2\right)\,P_r\,\left(\left(-2+\alpha^2\right)\,Q_i+3\,\alpha\,Q_r\right)\,\left(-Q_{2\,i}\,Q_r+Q_i\,Q_{2\,r}\right)\,\left(P'_r\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)+P'_i\,\left(\left(2+\beta^2\right)\,Q'_{2\,i}-\beta\,Q'_{2\,r}\right)\right)-2\,P_i\,\left(-3\,\alpha\,Q_i+\left(-2+\alpha^2\right)\,Q_r\right)\,\left(P_r\,\left(\left(-2+\alpha^2\right)\,Q_i+3\,\alpha\,Q_r\right)\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)^2+\left(1+\beta^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,\left(P'_r\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)+P'_i\,\left(\left(2+\beta^2\right)\,Q'_{2\,i}-\beta\,Q'_{2\,r}\right)\right)\right)\right)\right)\right)\right\},$$

$$\gamma_r \to -k_i^2\,P_i-\left(k_r^2\,\left(2\,P_r\,\left(Q_i-\alpha\,Q_r\right)\,\left(\left(-2+\alpha^2\right)\,Q_{2\,i}+3\,\alpha\,Q_{2\,r}\right)+P_i\,\left(Q_i\,\left(6\,\alpha\,Q_{2\,i}+\left(1-5\,\alpha^2\right)\,Q_{2\,r}\right)+Q_r\,\left(-3\,\left(-1+\alpha^2\right)\,Q_{2\,i}+2\,\alpha\,\left(-2+\alpha^2\right)\,Q_{2\,r}\right)\right)\right)\Big/\left(\left(1+\alpha^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\right),\ \gamma_i \to 2\,k_r\,\left(-k_i\,P_i+\frac{k_r\,\left(P_r\,\left(\left(-2+\alpha^2\right)\,Q_i+3\,\alpha\,Q_r\right)\,\left(\alpha\,Q_{2\,i}+Q_{2\,r}\right)-P_i\,\left(\alpha\,Q_i+Q_r\right)\,\left(-3\,\alpha\,Q_{2\,i}+\left(-2+\alpha^2\right)\,Q_{2\,r}\right)\right)}{\left(1+\alpha^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)}\right),\ \text{OR},$$

$$\gamma_r \to -\left(\left(\left(1+\beta^2\right)^2\,P'_i\,\left(\left(-1-\alpha^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,\left(2\,P_r\,\left(Q_i-\alpha\,Q_r\right)\,\left(\left(-2+\alpha^2\right)\,Q_{2\,i}+3\,\alpha\,Q_{2\,r}\right)+P_i\,\left(Q_i\,\left(6\,\alpha\,Q_{2\,i}+\left(1-5\,\alpha^2\right)\,Q_{2\,r}\right)+Q_r\,\left(-3\,\left(-1+\alpha^2\right)\,Q_{2\,i}+2\,\alpha\,\left(-2+\alpha^2\right)\,Q_{2\,r}\right)\right)\right)-\frac{1}{\left(1+\beta^2\right)^2\,P_r^2\,\left(P'\right)_i^2}P_i\,\left(\left(1+\alpha^2\right)\,\left(1+\beta^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,\left(P'\right)_i^2+\left(1+\alpha^2\right)\,P'_r\,\left(\left(1+\beta^2\right)\,\left(Q_{2\,i}\,Q_r-Q_i\,Q_{2\,r}\right)\,P'_r+P_r\,\left(\left(-2+\alpha^2\right)\,Q_i+3\,\alpha\,Q_r\right)\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)\right)-P_i\,\left(-3\,\alpha\,Q_i+\left(-2+\alpha^2\right)\,Q_r\right)\,\left(\left(1+\alpha^2\right)\,P'_r\,\left(\beta\,Q'_{2\,i}+Q'_{2\,r}\right)+P'_i\,\left(-\left(1+\beta^2\right)\,\left(Q_{2\,i}-\alpha\,Q_{2\,r}\right)+\left(1+\alpha^2\right)\,Q'_{2\,i}-\left(1+\alpha^2\right)\,\beta\,Q'_{2\,r}\right)\right)+P_r\,P'_i\,\left(\alpha\,Q_r\,\left(\left(1+\beta^2\right)\,\left(\left(-2+\alpha^2\right)\,Q_{2\,i}+3\,\alpha\,Q_{2\,r}\right)+3\,\left(1+\alpha^2\right)\,Q'_{2\,i}-3\,\left(1+\alpha^2\right)\,\beta\,Q'_{2\,r}\right)+Q_i\,\left(-\left(1+\beta^2\right)\,\left(\left(-2+\alpha^2\right)\,Q_{2\,i}+3\,\alpha\,Q_{2\,r}\right)+\left(-2-\alpha^2+\alpha^4\right)\,Q'_{2\,i}+\left(2+\alpha^2-\alpha^4\right)\,\beta\,Q'_{2\,r}\right)\right)\right)^2\right)\gamma'_r\right)\Big/\left(\left(1+\alpha^2\right)^2\right.$$

$$\left(\left(1+\beta^2\right)^2\left(Q_{2i}Q_r-Q_iQ_{2r}\right)^2\left(-\beta P'_i+P'_r\right)^2+P_r^2\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)^2\left(\beta Q'_{2i}+Q'_{2r}\right)^2+\right.$$
$$P_i^2\left(-3\alpha Q_i+\left(-2+\alpha^2\right)Q_r\right)^2\left(\beta Q'_{2i}+Q'_{2r}\right)^2-2\left(1+\beta^2\right)P_r\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)$$
$$\left(-Q_{2i}Q_r+Q_iQ_{2r}\right)\left(P'_r\left(\beta Q'_{2i}+Q'_{2r}\right)+P'_i\left(\left(2+\beta^2\right)Q'_{2i}-\beta Q'_{2r}\right)\right)-$$
$$2P_i\left(-3\alpha Q_i+\left(-2+\alpha^2\right)Q_r\right)\left(P_r\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)\left(\beta Q'_{2i}+Q'_{2r}\right)^2+\right.$$
$$\left.\left.\left.\left.\left(1+\beta^2\right)\left(Q_{2i}Q_r-Q_iQ_{2r}\right)\left(P'_r\left(\beta Q'_{2i}+Q'_{2r}\right)+P'_i\left(\left(2+\beta^2\right)Q'_{2i}-\beta Q'_{2r}\right)\right)\right)\right)\right),$$

$$\gamma_i\to-\left(\left(2\left(1+\beta^2\right)^2\left(Q_{2i}Q_r-Q_iQ_{2r}\right)P'_i\left(P_r\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)\left(\alpha Q_{2i}+Q_{2r}\right)-\right.\right.\right.$$
$$P_i\left(\alpha Q_i+Q_r\right)\left(-3\alpha Q_{2i}+\left(-2+\alpha^2\right)Q_{2r}\right)-\frac{1}{\left(1+\beta^2\right)P_rP'_i}$$
$$P_i\left(\left(1+\alpha^2\right)\left(1+\beta^2\right)\left(Q_{2i}Q_r-Q_iQ_{2r}\right)\left(P'\right)_i^2+\left(1+\alpha^2\right)P'_r\left(\left(1+\beta^2\right)\left(Q_{2i}Q_r-Q_iQ_{2r}\right)\right.\right.$$
$$P'_r+P_r\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)\left(\beta Q'_{2i}+Q'_{2r}\right)\Big)-P_i\left(-3\alpha Q_i+\left(-2+\alpha^2\right)Q_r\right)$$
$$\left(\left(1+\alpha^2\right)P'_r\left(\beta Q'_{2i}+Q'_{2r}\right)+P'_i\left(-\left(1+\beta^2\right)\left(Q_{2i}-\alpha Q_{2r}\right)+\left(1+\alpha^2\right)Q'_{2i}-\right.\right.$$
$$\left.\left(1+\alpha^2\right)\beta Q'_{2r}\right)\Big)+P_rP'_i\left(\alpha Q_r\left(\left(1+\beta^2\right)\left(\left(-2+\alpha^2\right)Q_{2i}+3\alpha Q_{2r}\right)+\right.\right.$$
$$3\left(1+\alpha^2\right)Q'_{2i}-3\left(1+\alpha^2\right)\beta Q'_{2r}\Big)+Q_i\left(-\left(1+\beta^2\right)\left(\left(-2+\alpha^2\right)Q_{2i}+\right.\right.$$
$$\left.\left.\left.\left.\left.3\alpha Q_{2r}\right)+\left(-2-\alpha^2+\alpha^4\right)Q'_{2i}+\left(2+\alpha^2-\alpha^4\right)\beta Q'_{2r}\right)\right)\right)\gamma'_r\Big)\Big/$$
$$\left(\left(1+\alpha^2\right)\left(\left(1+\beta^2\right)^2\left(Q_{2i}Q_r-Q_iQ_{2r}\right)^2\left(-\beta P'_i+P'_r\right)^2+P_r^2\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)^2\right.\right.$$
$$\left(\beta Q'_{2i}+Q'_{2r}\right)^2+P_i^2\left(-3\alpha Q_i+\left(-2+\alpha^2\right)Q_r\right)^2\left(\beta Q'_{2i}+Q'_{2r}\right)^2-$$
$$2\left(1+\beta^2\right)P_r\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)\left(-Q_{2i}Q_r+Q_iQ_{2r}\right)$$
$$\left(P'_r\left(\beta Q'_{2i}+Q'_{2r}\right)+P'_i\left(\left(2+\beta^2\right)Q'_{2i}-\beta Q'_{2r}\right)\right)-$$
$$2P_i\left(-3\alpha Q_i+\left(-2+\alpha^2\right)Q_r\right)\left(P_r\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)\left(\beta Q'_{2i}+Q'_{2r}\right)^2+\right.$$
$$\left.\left.\left.\left.\left(1+\beta^2\right)\left(Q_{2i}Q_r-Q_iQ_{2r}\right)\left(P'_r\left(\beta Q'_{2i}+Q'_{2r}\right)+P'_i\left(\left(2+\beta^2\right)Q'_{2i}-\beta Q'_{2r}\right)\right)\right)\right)\right),$$

$$\left\{-3\beta\left(Q_{2i}Q_r-Q_iQ_{2r}\right)P'_i-\beta^2\left(Q_{2i}Q_r-Q_iQ_{2r}\right)P'_r-\right.$$
$$\alpha^2\left(P_r\left(-Q_{2i}Q'_r+Q_iQ'_{2r}\right)+P_i\left(Q_{2r}Q'_r-Q_rQ'_{2r}\right)\right)+$$
$$2\left(\left(Q_{2i}Q_r-Q_iQ_{2r}\right)P'_r+P_r\left(-Q_{2i}Q'_r+Q_iQ'_{2r}\right)+P_i\left(Q_{2r}Q'_r-Q_rQ'_{2r}\right)\right)-$$
$$3\alpha\left(P_i\left(-Q_{2i}Q'_r+Q_iQ'_{2r}\right)+P_r\left(-Q_{2r}Q'_r+Q_rQ'_{2r}\right)\right)\to$$
$$0,-\beta^2\left(Q_{2i}Q_r-Q_iQ_{2r}\right)P'_i+$$
$$3\beta\left(Q_{2i}Q_r-Q_iQ_{2r}\right)P'_r-$$
$$\alpha^2\left(P_r\left(-Q_{2i}Q'_i+Q_iQ'_{2i}\right)+P_i\left(Q_{2r}Q'_i-Q_rQ'_{2i}\right)\right)+$$
$$2\left(\left(Q_{2i}Q_r-Q_iQ_{2r}\right)P'_i+P_r\left(-Q_{2i}Q'_i+Q_iQ'_{2i}\right)+P_i\left(Q_{2r}Q'_i-Q_rQ'_{2i}\right)\right)-$$
$$\left.3\alpha\left(P_i\left(-Q_{2i}Q'_i+Q_iQ'_{2i}\right)+P_r\left(-Q_{2r}Q'_i+Q_rQ'_{2i}\right)\right)\to0\right\}\Big\}$$

Out[98]=
$$\Big\{\Omega_2\to4k_rK_2P'_i-4k_r^2P'_r+K_2^2P'_r-\gamma'_i,$$
$$\omega_i\to-2k_ik_rP_i-k_i^2P_r+k_r^2P_r+\gamma_i,\ \omega_r\to k_i^2P_i-k_r^2P_i-2k_ik_rP_r+\gamma_r,$$
$$\mu^*\to\frac{4k_r^2\left(-P_r\left(\left(-2+\alpha^2\right)Q_i+3\alpha Q_r\right)+P_i\left(-3\alpha Q_i+\left(-2+\alpha^2\right)Q_r\right)\right)}{\mu\left(Q_{2i}Q_r-Q_iQ_{2r}\right)},$$
$$\eta^*\to\frac{4k_r^2\left(-P_r\left(\left(-2+\alpha^2\right)Q_{2i}+3\alpha Q_{2r}\right)+P_i\left(-3\alpha Q_{2i}+\left(-2+\alpha^2\right)Q_{2r}\right)\right)}{\eta\left(Q_{2i}Q_r-Q_iQ_{2r}\right)},$$
$$K_2\to\left(2k_ik_rP_r\left(-Q_{2i}Q_r+Q_iQ_{2r}\right)+\left(Q_{2i}Q_r-Q_iQ_{2r}\right)\left(k_i^2P_i+\gamma_r\right)+\right.$$

$$k_r^2 \left(2 \left(\left(1+\beta^2\right) \left(Q_{2i} Q_r - Q_i Q_{2r}\right) P'_i + P_r \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right) Q'_{2i}\right) + P_i \left(Q_i \left(Q_{2r} + 6\,\alpha\, Q'_{2i}\right) - Q_r \left(Q_{2i} + 2\left(-2+\alpha^2\right) Q'_{2i}\right)\right)\right) \Big/ \left(2\, k_r \left(Q_{2i} Q_r - Q_i Q_{2r}\right) \left(\beta\, P'_i - P'_r\right)\right),\ k_i \to \frac{1}{\left(1+\alpha^2\right)\left(1+\beta^2\right) P_r \left(Q_{2i} Q_r - Q_i Q_{2r}\right) P'_i}$$

$$k_r \left(\left(1+\alpha^2\right)\left(1+\beta^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right)\left(P'\right)_i^2 + \left(1+\alpha^2\right) P'_r \left(\left(1+\beta^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right) P'_r + P_r \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)\left(\beta\, Q'_{2i} + Q'_{2r}\right)\right) - P_i \left(-3\,\alpha\, Q_i + \left(-2+\alpha^2\right) Q_r\right) \left(\left(1+\alpha^2\right) P'_r \left(\beta\, Q'_{2i} + Q'_{2r}\right) + P'_i \left(\left(-1-\beta^2\right)\left(Q_{2i} - \alpha\, Q_{2r}\right) + \left(1+\alpha^2\right) Q'_{2i} - \left(1+\alpha^2\right)\beta\, Q'_{2r}\right)\right) + P_r P'_i \left(\alpha\, Q_r \left(\left(1+\beta^2\right)\left(\left(-2+\alpha^2\right) Q_{2i} + 3\,\alpha\, Q_{2r}\right) + 3\left(1+\alpha^2\right) Q'_{2i} - 3\left(1+\alpha^2\right)\beta\, Q'_{2r}\right) + Q_i \left(\left(-1-\beta^2\right)\left(\left(-2+\alpha^2\right) Q_{2i} + 3\,\alpha\, Q_{2r}\right) + \left(-2-\alpha^2+\alpha^4\right) Q'_{2i} + \left(2+\alpha^2-\alpha^4\right)\beta\, Q'_{2r}\right)\right)\right),$$

$$k_r \to \left\{\sqrt{\left(-\left(\left(\left(1+\beta^2\right)^2 \left(Q_{2i} Q_r - Q_i Q_{2r}\right)^2 P'_i\, \gamma'_r\right)\right) \Big/ \left(\left(1+\beta^2\right)^2 \left(Q_{2i} Q_r - Q_i Q_{2r}\right)^2 \left(-\beta\, P'_i + P'_r\right)^2 + P_r^2 \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)^2 \left(\beta\, Q'_{2i} + Q'_{2r}\right)^2 + P_i^2 \left(-3\,\alpha\, Q_i + \left(-2+\alpha^2\right) Q_r\right)^2 \left(\beta\, Q'_{2i} + Q'_{2r}\right)^2 - 2\left(1+\beta^2\right) P_r \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)\left(-Q_{2i} Q_r + Q_i Q_{2r}\right)\left(P'_r \left(\beta\, Q'_{2i} + Q'_{2r}\right) + P'_i \left(\left(2+\beta^2\right) Q'_{2i} - \beta\, Q'_{2r}\right)\right) - 2\, P_i \left(-3\,\alpha\, Q_i + \left(-2+\alpha^2\right) Q_r\right)\left(P_r \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)\left(\beta\, Q'_{2i} + Q'_{2r}\right)^2 + \left(1+\beta^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right)\left(P'_r \left(\beta\, Q'_{2i} + Q'_{2r}\right) + P'_i \left(\left(2+\beta^2\right) Q'_{2i} - \beta\, Q'_{2r}\right)\right)\right)\right)\right)\right\},$$

$$\gamma_r \to -k_i^2 P_i - \left(k_r^2 \left(2 P_r \left(Q_i - \alpha\, Q_r\right)\left(\left(-2+\alpha^2\right) Q_{2i} + 3\,\alpha\, Q_{2r}\right) + P_i \left(Q_i \left(6\,\alpha\, Q_{2i} + \left(1-5\,\alpha^2\right) Q_{2r}\right) + Q_r \left(-3\left(-1+\alpha^2\right) Q_{2i} + 2\,\alpha\left(-2+\alpha^2\right) Q_{2r}\right)\right)\right)\right) \Big/ \left(\left(1+\alpha^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right)\right),\ \gamma_i \to 2\, k_r \left(-k_i P_i + \frac{k_r \left(P_r \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)\left(\alpha\, Q_{2i} + Q_{2r}\right) - P_i \left(\alpha\, Q_i + Q_r\right)\left(-3\,\alpha\, Q_{2i} + \left(-2+\alpha^2\right) Q_{2r}\right)\right)}{\left(1+\alpha^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right)}\right),\ \text{OR},$$

$$\gamma_r \to -\left(\left(\left(1+\beta^2\right)^2 P'_i \left(\left(-1-\alpha^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right)\left(2 P_r \left(Q_i - \alpha\, Q_r\right)\left(\left(-2+\alpha^2\right) Q_{2i} + 3\,\alpha\, Q_{2r}\right) + P_i \left(Q_i \left(6\,\alpha\, Q_{2i} + \left(1-5\,\alpha^2\right) Q_{2r}\right) + Q_r \left(-3\left(-1+\alpha^2\right) Q_{2i} + 2\,\alpha\left(-2+\alpha^2\right) Q_{2r}\right)\right)\right) - \frac{1}{\left(1+\beta^2\right)^2 P_r^2 \left(P'\right)_i^2} P_i \left(\left(1+\alpha^2\right)\left(1+\beta^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right)\left(P'\right)_i^2 + \left(1+\alpha^2\right) P'_r \left(\left(1+\beta^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right) P'_r + P_r \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)\left(\beta\, Q'_{2i} + Q'_{2r}\right)\right) - P_i \left(-3\,\alpha\, Q_i + \left(-2+\alpha^2\right) Q_r\right)\left(\left(1+\alpha^2\right) P'_r \left(\beta\, Q'_{2i} + Q'_{2r}\right) + P'_i \left(\left(-1-\beta^2\right)\left(Q_{2i} - \alpha\, Q_{2r}\right) + \left(1+\alpha^2\right) Q'_{2i} - \left(1+\alpha^2\right)\beta\, Q'_{2r}\right)\right) + P_r P'_i \left(\alpha\, Q_r \left(\left(1+\beta^2\right)\left(\left(-2+\alpha^2\right) Q_{2i} + 3\,\alpha\, Q_{2r}\right) + 3\left(1+\alpha^2\right) Q'_{2i} - 3\left(1+\alpha^2\right)\beta\, Q'_{2r}\right) + Q_i \left(\left(-1-\beta^2\right)\left(\left(-2+\alpha^2\right) Q_{2i} + 3\,\alpha\, Q_{2r}\right) + \left(-2-\alpha^2+\alpha^4\right) Q'_{2i} + \left(2+\alpha^2-\alpha^4\right)\beta\, Q'_{2r}\right)\right)^2\right) \gamma'_r\right) \Big/ \left(\left(1+\alpha^2\right)^2 \left(\left(1+\beta^2\right)^2 \left(Q_{2i} Q_r - Q_i Q_{2r}\right)^2 \left(-\beta\, P'_i + P'_r\right)^2 + P_r^2 \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)^2 \left(\beta\, Q'_{2i} + Q'_{2r}\right)^2 + P_i^2 \left(-3\,\alpha\, Q_i + \left(-2+\alpha^2\right) Q_r\right)^2 \left(\beta\, Q'_{2i} + Q'_{2r}\right)^2 - 2\left(1+\beta^2\right) P_r \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)\left(-Q_{2i} Q_r + Q_i Q_{2r}\right)\left(P'_r \left(\beta\, Q'_{2i} + Q'_{2r}\right) + P'_i \left(\left(2+\beta^2\right) Q'_{2i} - \beta\, Q'_{2r}\right)\right) - 2\, P_i \left(-3\,\alpha\, Q_i + \left(-2+\alpha^2\right) Q_r\right)\left(P_r \left(\left(-2+\alpha^2\right) Q_i + 3\,\alpha\, Q_r\right)\left(\beta\, Q'_{2i} + Q'_{2r}\right)^2 + \left(1+\beta^2\right)\left(Q_{2i} Q_r - Q_i Q_{2r}\right)\left(P'_r \left(\beta\, Q'_{2i} + Q'_{2r}\right) + P'_i \left(\left(2+\beta^2\right) Q'_{2i} - \beta\, Q'_{2r}\right)\right)\right)\right)\right),$$

$$\gamma_i \to -\Bigg(\Bigg(\Big(2\,\big(1+\beta^2\big)^2\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,P'_i\,\Big(P_r\,\big(\big(-2+\alpha^2\big)\,Q_i + 3\,\alpha\,Q_r\big)\,\big(\alpha\,Q_{2i}+Q_{2r}\big) - P_i\,\big(\alpha\,Q_i+Q_r\big)\,\big(-3\,\alpha\,Q_{2i}+\big(-2+\alpha^2\big)\,Q_{2r}\big) - \frac{1}{\big(1+\beta^2\big)\,P_r\,P'_i}\,P_i\,\Big(\big(1+\alpha^2\big)\,\big(1+\beta^2\big)\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,\big(P'\big)_i^2 + \big(1+\alpha^2\big)\,P'_r\,\Big(\big(1+\beta^2\big)\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,P'_r + P_r\,\big(\big(-2+\alpha^2\big)\,Q_i + 3\,\alpha\,Q_r\big)\,\big(\beta\,Q'_{2i}+Q'_{2r}\big)\Big) - P_i\,\big(-3\,\alpha\,Q_i+\big(-2+\alpha^2\big)\,Q_r\big)\,\Big(\big(1+\alpha^2\big)\,P'_r\,\big(\beta\,Q'_{2i}+Q'_{2r}\big) + P'_i\,\Big(\big(-1-\beta^2\big)\,\big(Q_{2i}-\alpha\,Q_{2r}\big) + \big(1+\alpha^2\big)\,Q'_{2i} - \big(1+\alpha^2\big)\,\beta\,Q'_{2r}\Big)\Big) + P_r\,P'_i\,\Big(\alpha\,Q_r\,\Big(\big(1+\beta^2\big)\,\big(\big(-2+\alpha^2\big)\,Q_{2i}+3\,\alpha\,Q_{2r}\big) + 3\,\big(1+\alpha^2\big)\,Q'_{2i} - 3\,\big(1+\alpha^2\big)\,\beta\,Q'_{2r}\Big) + Q_i\,\Big(\big(-1-\beta^2\big)\,\big(\big(-2+\alpha^2\big)\,Q_{2i}+3\,\alpha\,Q_{2r}\big) + \big(-2-\alpha^2+\alpha^4\big)\,Q'_{2i} + \big(2+\alpha^2-\alpha^4\big)\,\beta\,Q'_{2r}\Big)\Big)\Big)\Big)\,\gamma'_r\Big)\Big/ \Big(\big(1+\alpha^2\big)\,\Big(\big(1+\beta^2\big)^2\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)^2\,\big(-\beta\,P'_i + P'_r\big)^2 + P_r^2\,\big(\big(-2+\alpha^2\big)\,Q_i + 3\,\alpha\,Q_r\big)^2\,\big(\beta\,Q'_{2i}+Q'_{2r}\big)^2 + P_i^2\,\big(-3\,\alpha\,Q_i+\big(-2+\alpha^2\big)\,Q_r\big)^2\,\big(\beta\,Q'_{2i}+Q'_{2r}\big)^2 - 2\,\big(1+\beta^2\big)\,P_r\,\big(\big(-2+\alpha^2\big)\,Q_i+3\,\alpha\,Q_r\big)\,\big(-Q_{2i}\,Q_r+Q_i\,Q_{2r}\big)\,\big(P'_r\,\big(\beta\,Q'_{2i}+Q'_{2r}\big) + P'_i\,\big(\big(2+\beta^2\big)\,Q'_{2i} - \beta\,Q'_{2r}\big)\big) - 2\,P_i\,\big(-3\,\alpha\,Q_i+\big(-2+\alpha^2\big)\,Q_r\big)\,\Big(P_r\,\big(\big(-2+\alpha^2\big)\,Q_i+3\,\alpha\,Q_r\big)\,\big(\beta\,Q'_{2i}+Q'_{2r}\big)^2 + \big(1+\beta^2\big)\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,\big(P'_r\,\big(\beta\,Q'_{2i}+Q'_{2r}\big) + P'_i\,\big(\big(2+\beta^2\big)\,Q'_{2i} - \beta\,Q'_{2r}\big)\big)\Big)\Big)\Big)\Bigg),$$

$$\Big\{-3\,\beta\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,P'_i - \beta^2\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,P'_r - \frac{\alpha^2}{3}\,\big(P_r\,\big(-Q_{2i}\,Q'_r + Q_i\,Q'_{2r}\big) + P_i\,\big(Q_{2r}\,Q'_r - Q_r\,Q'_{2r}\big)\big) + 2\,\big(\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,P'_r + P_r\,\big(-Q_{2i}\,Q'_r + Q_i\,Q'_{2r}\big) + P_i\,\big(Q_{2r}\,Q'_r - Q_r\,Q'_{2r}\big)\big) - \frac{3\,\alpha}{}\,\big(P_i\,\big(-Q_{2i}\,Q'_r + Q_i\,Q'_{2r}\big) + P_r\,\big(-Q_{2r}\,Q'_r + Q_r\,Q'_{2r}\big)\big) \to 0,$$

$$-\beta^2\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,P'_i + 3\,\beta\,\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,P'_r - \frac{\alpha^2}{3\,\alpha}\,\big(P_r\,\big(-Q_{2i}\,Q'_i + Q_i\,Q'_{2i}\big) + P_i\,\big(Q_{2r}\,Q'_i - Q_r\,Q'_{2i}\big)\big) + 2\,\big(\big(Q_{2i}\,Q_r - Q_i\,Q_{2r}\big)\,P'_i + P_r\,\big(-Q_{2i}\,Q'_i + Q_i\,Q'_{2i}\big) + P_i\,\big(Q_{2r}\,Q'_i - Q_r\,Q'_{2i}\big)\big) - \frac{3\,\alpha}{}\,\big(P_i\,\big(-Q_{2i}\,Q'_i + Q_i\,Q'_{2i}\big) + P_r\,\big(-Q_{2r}\,Q'_i + Q_r\,Q'_{2i}\big)\big) \to 0\Big\}\Big\}$$

In[•]:=
```
ReplaceAll[%, {P_r → 2, P_i → -3.5, P'_r → 3`, P'_i → 0.6`, Q_1r → -1, Q_1i → 2.4`, γ'_i → 1.25,
  γ'_r → -0.5, Q'_2i → 3.75`, Q'_2r → -0.75`, Q_2r → -3.5, Q_2i → 4.58, Q'_r → -0.3, Q'_i → 1.10}]
```

Out[•]=

$$\Big\{\Omega_2 \to -1.25 - 12.\,k_r^2 + 2.4\,k_r\,K_2 + 3.\,K_2^2,\ \omega_i \to -2\,k_i^2 + 7.\,k_i\,k_r + 2\,k_r^2 + \gamma_i,\ \omega_r \to -3.5\,k_i^2 - 4\,k_i\,k_r + 3.5\,k_r^2 + \gamma_r,\ \mu^* \to \frac{1.04712\,\big(-3.5\,\big(2 - 7.2\,\alpha - \alpha^2\big) - 2\,\big(-3\,\alpha + 2.4\,\big(-2+\alpha^2\big)\big)\big)\,k_r^2}{\mu},\ \eta^* \to \frac{1.04712\,\big(-3.5\,\big(-13.74\,\alpha - 3.5\,\big(-2+\alpha^2\big)\big) - 2\,\big(-10.5\,\alpha + 4.58\,\big(-2+\alpha^2\big)\big)\big)\,k_r^2}{\eta},\ K_2 \to$$

$$\frac{1}{(-3.+0.6\,\beta)\,k_r}0.13089\,\Big(-15.28\,k_i\,k_r+\Big(-3.5\,\big(4.58+2.4\,\big(-3.5+22.5\,\alpha\big)+7.5\,\big(-2+\alpha^2\big)\big)+$$
$$2\,\big(7.5\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)+2.292\,\big(1+\beta^2\big)\big)\Big)\,k_r^2+3.82\,\big(-3.5\,k_i^2+\gamma_r\big)\Big),$$

$$k_i\to\frac{1}{\big(1+\alpha^2\big)\,\big(1+\beta^2\big)}0.21815\,\Big(1.3752\,\big(1+\alpha^2\big)\,\big(1+\beta^2\big)+$$
$$3.\,\big(1+\alpha^2\big)\,\big(2\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)\,\big(-0.75+3.75\,\beta\big)+11.46\,\big(1+\beta^2\big)\big)+$$
$$3.5\,\big(2-7.2\,\alpha-\alpha^2\big)\,\Big(3.\,\big(1+\alpha^2\big)\,\big(-0.75+3.75\,\beta\big)+$$
$$0.6\,\big(3.75\,\big(1+\alpha^2\big)+0.75\,\big(1+\alpha^2\big)\,\beta-\big(4.58+3.5\,\alpha\big)\,\big(1+\beta^2\big)\big)\Big)+$$
$$1.2\,\Big(2.4\,\big(3.75\,\big(-2-\alpha^2+\alpha^4\big)-0.75\,\big(2+\alpha^2-\alpha^4\big)\,\beta-\big(-10.5\,\alpha+4.58\,\big(-2+\alpha^2\big)\big)\,\big(1+\beta^2\big)\big)-$$
$$\alpha\,\big(11.25\,\big(1+\alpha^2\big)+2.25\,\big(1+\alpha^2\big)\,\beta+\big(-10.5\,\alpha+4.58\,\big(-2+\alpha^2\big)\big)\,\big(1+\beta^2\big)\big)\big)\Big)\,k_r,$$

$$k_r\to\Big\{2.0923\,\sqrt{\Big(\big(1+\beta^2\big)^2\Big/\Big(12.25\,\big(2-7.2\,\alpha-\alpha^2\big)^2\,\big(-0.75+3.75\,\beta\big)^2+$$
$$4\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)^2\,\big(-0.75+3.75\,\beta\big)^2+14.5924\,\big(3.-0.6\,\beta\big)^2\,\big(1+\beta^2\big)^2+15.28$$
$$\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)\,\big(1+\beta^2\big)\,\big(3.\,\big(-0.75+3.75\,\beta\big)+0.6\,\big(0.75\,\beta+3.75\,\big(2+\beta^2\big)\big)\big)+$$
$$7.\,\big(2-7.2\,\alpha-\alpha^2\big)\,\Big(2\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)\,\big(-0.75+3.75\,\beta\big)^2+$$
$$3.82\,\big(1+\beta^2\big)\,\big(3.\,\big(-0.75+3.75\,\beta\big)+0.6\,\big(0.75\,\beta+3.75\,\big(2+\beta^2\big)\big)\big)\Big)\Big)\Big)\Big\},$$

$$\gamma_r\to 3.5\,k_i^2-\frac{1}{1+\alpha^2}0.26178\,\Big(4\,\big(2.4+\alpha\big)\,\big(-10.5\,\alpha+4.58\,\big(-2+\alpha^2\big)\big)-$$
$$3.5\,\big(7.\,\alpha\,\big(-2+\alpha^2\big)+13.74\,\big(-1+\alpha^2\big)+2.4\,\big(27.48\,\alpha-3.5\,\big(1-5\,\alpha^2\big)\big)\big)\Big)\,k_r^2,$$

$$\gamma_i\to 2\,k_r\,\Big(3.5\,k_i+\frac{1}{1+\alpha^2}0.26178\,\Big(3.5\,\big(-1+2.4\,\alpha\big)\,\big(-13.74\,\alpha-3.5\,\big(-2+\alpha^2\big)\big)+$$
$$2\,\big(-3.5+4.58\,\alpha\big)\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)\Big)\,k_r\Big),\ \text{OR},$$

$$\gamma_r\to\Big(0.3\,\big(1+\beta^2\big)^2\,\Big(3.82\,\big(-1-\alpha^2\big)\,\Big(4\,\big(2.4+\alpha\big)\,\big(-10.5\,\alpha+4.58\,\big(-2+\alpha^2\big)\big)-$$
$$3.5\,\big(7.\,\alpha\,\big(-2+\alpha^2\big)+13.74\,\big(-1+\alpha^2\big)+2.4\,\big(27.48\,\alpha-3.5\,\big(1-5\,\alpha^2\big)\big)\big)\Big)+$$
$$\frac{1}{\big(1+\beta^2\big)^2}2.43056\,\Big(1.3752\,\big(1+\alpha^2\big)\,\big(1+\beta^2\big)+3.\,\big(1+\alpha^2\big)$$
$$\big(2\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)\,\big(-0.75+3.75\,\beta\big)+11.46\,\big(1+\beta^2\big)\big)+$$
$$3.5\,\big(2-7.2\,\alpha-\alpha^2\big)\,\Big(3.\,\big(1+\alpha^2\big)\,\big(-0.75+3.75\,\beta\big)+0.6\,\Big(3.75\,\big(1+\alpha^2\big)+0.75$$
$$\big(1+\alpha^2\big)\,\beta-\big(4.58+3.5\,\alpha\big)\,\big(1+\beta^2\big)\Big)+1.2\,\Big(2.4\,\Big(3.75\,\big(-2-\alpha^2+\alpha^4\big)-$$
$$0.75\,\big(2+\alpha^2-\alpha^4\big)\,\beta-\big(-10.5\,\alpha+4.58\,\big(-2+\alpha^2\big)\big)\,\big(1+\beta^2\big)\Big)-\alpha\,\Big(11.25$$
$$\big(1+\alpha^2\big)+2.25\,\big(1+\alpha^2\big)\,\beta+\big(-10.5\,\alpha+4.58\,\big(-2+\alpha^2\big)\big)\,\big(1+\beta^2\big)\big)\big)\Big)^2\Big)\Big)\Big/$$
$$\Big(\big(1+\alpha^2\big)^2\,\Big(12.25\,\big(2-7.2\,\alpha-\alpha^2\big)^2\,\big(-0.75+3.75\,\beta\big)^2+4\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)^2$$
$$\big(-0.75+3.75\,\beta\big)^2+14.5924\,\big(3.-0.6\,\beta\big)^2\,\big(1+\beta^2\big)^2+15.28\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)$$
$$\big(1+\beta^2\big)\,\big(3.\,\big(-0.75+3.75\,\beta\big)+0.6\,\big(0.75\,\beta+3.75\,\big(2+\beta^2\big)\big)\big)+$$
$$7.\,\big(2-7.2\,\alpha-\alpha^2\big)\,\Big(2\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)\,\big(-0.75+3.75\,\beta\big)^2+$$
$$3.82\,\big(1+\beta^2\big)\,\big(3.\,\big(-0.75+3.75\,\beta\big)+0.6\,\big(0.75\,\beta+3.75\,\big(2+\beta^2\big)\big)\big)\Big)\Big)\Big),$$

$$\gamma_i\to\Big(2.292\,\big(1+\beta^2\big)^2\,\Big(3.5\,\big(-1+2.4\,\alpha\big)\,\big(-13.74\,\alpha-3.5\,\big(-2+\alpha^2\big)\big)+$$
$$2\,\big(-3.5+4.58\,\alpha\big)\,\big(-3\,\alpha+2.4\,\big(-2+\alpha^2\big)\big)+\frac{1}{1+\beta^2}2.91667\,\big(1.3752\,\big(1+\alpha^2\big)\,\big(1+\beta^2\big)+$$

```
      3. (1 + α^2) (2 (-3 α + 2.4 (-2 + α^2)) (-0.75 + 3.75 β) + 11.46 (1 + β^2)) +
      3.5 (2 - 7.2 α - α^2) (3. (1 + α^2) (-0.75 + 3.75 β) +
          0.6 (3.75 (1 + α^2) + 0.75 (1 + α^2) β - (4.58 + 3.5 α) (1 + β^2))) + 1.2 (2.4 (3.75
              (-2 - α^2 + α^4) - 0.75 (2 + α^2 - α^4) β - (-10.5 α + 4.58 (-2 + α^2)) (1 + β^2)) -
            α (11.25 (1 + α^2) + 2.25 (1 + α^2) β + (-10.5 α + 4.58 (-2 + α^2)) (1 + β^2))))) /
   ((1 + α^2) (12.25 (2 - 7.2 α - α^2)^2 (-0.75 + 3.75 β)^2 + 4 (-3 α + 2.4 (-2 + α^2))^2
        (-0.75 + 3.75 β)^2 + 14.5924 (3. - 0.6 β)^2 (1 + β^2)^2 + 15.28 (-3 α + 2.4 (-2 + α^2))
        (1 + β^2) (3. (-0.75 + 3.75 β) + 0.6 (0.75 β + 3.75 (2 + β^2))) +
      7. (2 - 7.2 α - α^2) (2 (-3 α + 2.4 (-2 + α^2)) (-0.75 + 3.75 β)^2 +
          3.82 (1 + β^2) (3. (-0.75 + 3.75 β) + 0.6 (0.75 β + 3.75 (2 + β^2))))))},
  {19.116 - 2.673 α + 1.902 α^2 - 6.876 β - 11.46 β^2 →
    0,
   21.132 + 41.001 α -
     8.274 α^2 +
     34.38 β -
     2.292 β^2 → 0}}
```

In[•]:=
```
Solve[
 {19.116` - 2.6729999999999987` α + 1.9020000000000001` α^2 - 6.876` β - 11.46` β^2 == 0,
  21.132` + 41.00099999999999` α - 8.274000000000001` α^2 +
    34.38` β - 2.2920000000000003` β^2 == 0}, {α, β}]
```

... Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

Out[•]=
```
{{α → -1.16758, β → 1.20222}, {α → 1.37388, β → -1.62321},
 {α → 2.77057, β → -1.84461}, {α → 6.62185, β → 2.43699}}
```

In[•]:=
```
{Ω2 → -1.25` - 12.` k_r^2 + 2.4` k_r K2 + 3.` K2^2,
 ω_i → -2 k_i^2 + 7.` k_i k_r + 2 k_r^2 + γ_i, ω_r → -3.5` k_i^2 - 4 k_i k_r + 3.5` k_r^2 + γ_r, μ* →
  1.0471204188481675` (-3.5` (2 - 7.199999999999999` α - α^2) - 2 (-3 α + 2.4` (-2 + α^2))) k_r^2
  / μ
 , η* → 1/η 1.0471204188481675`
  (-3.5` (-13.74` α - 3.5` (-2 + α^2)) - 2 (-10.5` α + 4.58` (-2 + α^2))) k_r^2,
 K2 → 1/((-3.` + 0.6` β) k_r) 0.13089005235602094`
  (-15.280000000000001` k_i k_r + (-3.5` (4.58` + 2.4` (-3.5` + 22.5` α) + 7.5` (-2 + α^2)) +
      2 (7.5` (-3 α + 2.4` (-2 + α^2)) + 2.2920000000000003` (1 + β^2))) k_r^2 +
    3.8200000000000003` (-3.5` k_i^2 + γ_r)),
 k_i → 1/((1 + α^2) (1 + β^2)) 0.2181500872600349` (1.3752` (1 + α^2) (1 + β^2) +
    3.` (1 + α^2) (2 (-3 α + 2.4` (-2 + α^2)) (-0.75` + 3.75` β) + 11.46` (1 + β^2)) +
    3.5` (2 - 7.199999999999999` α - α^2) (3.` (1 + α^2) (-0.75` + 3.75` β) +
```

$$0.6` \left(3.75` \left(1+\alpha^2\right)+0.75` \left(1+\alpha^2\right) \beta-\left(4.58`+3.5` \alpha\right) \left(1+\beta^2\right)\right)+1.2` \left(2.4` \left(3.75` \left(-2-\alpha^2+\alpha^4\right)-0.75` \left(2+\alpha^2-\alpha^4\right) \beta-\left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)\right)-\alpha \left(11.25` \left(1+\alpha^2\right)+2.25` \left(1+\alpha^2\right) \beta+\left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)\right)\right) k_r,$$

$$k_r \to \{2.0923001696697345` \sqrt{\left(\left(1+\beta^2\right)^2 / \left(12.25` \left(2-7.199999999999999` \alpha-\alpha^2\right)^2 \left(-0.75`+3.75` \beta\right)^2+4 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right)^2 \left(-0.75`+3.75` \beta\right)^2+14.592400000000001` \left(3.`-0.6` \beta\right)^2 \left(1+\beta^2\right)^2+15.280000000000001` \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right) \left(3.` \left(-0.75`+3.75` \beta\right)+0.6` \left(0.75` \beta+3.75` \left(2+\beta^2\right)\right)\right)+7.` \left(2-7.199999999999999` \alpha-\alpha^2\right) \left(2 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(-0.75`+3.75` \beta\right)^2+3.8200000000000003` \left(1+\beta^2\right) \left(3.` \left(-0.75`+3.75` \beta\right)+0.6` \left(0.75` \beta+3.75` \left(2+\beta^2\right)\right)\right)\right)\right)\right)\},$$

$$\gamma_r \to 3.5` k_i^2-\frac{1}{1+\alpha^2} 0.2617801047120419` \left(4 \left(2.4`+\alpha\right) \left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right)-3.5` \left(7.` \alpha \left(-2+\alpha^2\right)+13.74` \left(-1+\alpha^2\right)+2.4` \left(27.48` \alpha-3.5` \left(1-5 \alpha^2\right)\right)\right)\right) k_r^2, \gamma_i \to 2 k_r \left(3.5` k_i+\frac{1}{1+\alpha^2} 0.2617801047120419` \left(3.5` \left(-1+2.4` \alpha\right) \left(-13.74` \alpha-3.5` \left(-2+\alpha^2\right)\right)+2 \left(-3.5`+4.58` \alpha\right) \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right)\right) k_r\right), \text{OR}, \gamma_r \to$$

$$\left(0.3` \left(1+\beta^2\right)^2 \left(3.8200000000000003` \left(-1-\alpha^2\right) \left(4 \left(2.4`+\alpha\right) \left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right)-3.5` \left(7.` \alpha \left(-2+\alpha^2\right)+13.74` \left(-1+\alpha^2\right)+2.4` \left(27.48` \alpha-3.5` \left(1-5 \alpha^2\right)\right)\right)\right)+\frac{1}{\left(1+\beta^2\right)^2} 2.4305555555555554` \left(1.3752` \left(1+\alpha^2\right) \left(1+\beta^2\right)+3.` \left(1+\alpha^2\right) \left(2 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(-0.75`+3.75` \beta\right)+11.46` \left(1+\beta^2\right)\right)+3.5` \left(2-7.199999999999999` \alpha-\alpha^2\right) \left(3.` \left(1+\alpha^2\right) \left(-0.75`+3.75` \beta\right)+0.6` \left(3.75` \left(1+\alpha^2\right)+0.75` \left(1+\alpha^2\right) \beta-\left(4.58`+3.5` \alpha\right) \left(1+\beta^2\right)\right)\right)+1.2` \left(2.4` \left(3.75` \left(-2-\alpha^2+\alpha^4\right)-0.75` \left(2+\alpha^2-\alpha^4\right) \beta-\left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)\right)-\alpha \left(11.25` \left(1+\alpha^2\right)+2.25` \left(1+\alpha^2\right) \beta+\left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)\right)\right)^2\right)\right) / \left(\left(1+\alpha^2\right)^2 \left(12.25` \left(2-7.199999999999999` \alpha-\alpha^2\right)^2 \left(-0.75`+3.75` \beta\right)^2+4 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right)^2 \left(-0.75`+3.75` \beta\right)^2+14.592400000000001` \left(3.`-0.6` \beta\right)^2 \left(1+\beta^2\right)^2+15.280000000000001` \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right) \left(3.` \left(-0.75`+3.75` \beta\right)+0.6` \left(0.75` \beta+3.75` \left(2+\beta^2\right)\right)\right)+7.` \left(2-7.199999999999999` \alpha-\alpha^2\right) \left(2 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(-0.75`+3.75` \beta\right)^2+3.8200000000000003` \left(1+\beta^2\right) \left(3.` \left(-0.75`+3.75` \beta\right)+0.6` \left(0.75` \beta+3.75` \left(2+\beta^2\right)\right)\right)\right)\right)\right),$$

$$\gamma_i \to \left(2.2920000000000003` \left(1+\beta^2\right)^2 \left(3.5` \left(-1+2.4` \alpha\right) \left(-13.74` \alpha-3.5` \left(-2+\alpha^2\right)\right)+2 \left(-3.5`+4.58` \alpha\right) \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right)+\frac{1}{1+\beta^2} 2.916666666666667` \left(1.3752` \left(1+\alpha^2\right) \left(1+\beta^2\right)+\right.\right.$$

$$
\begin{aligned}
&3.` \left(1+\alpha^2\right)\left(2\left(-3\,\alpha+2.4`\left(-2+\alpha^2\right)\right)\left(-0.75`+3.75`\,\beta\right)+11.46`\left(1+\beta^2\right)\right)+\\
&3.5`\left(2-7.199999999999999`\,\alpha-\alpha^2\right)\left(3.`\left(1+\alpha^2\right)\left(-0.75`+3.75`\,\beta\right)+\right.\\
&\quad\left.0.6`\left(3.75`\left(1+\alpha^2\right)+0.75`\left(1+\alpha^2\right)\beta-\left(4.58`+3.5`\,\alpha\right)\left(1+\beta^2\right)\right)\right)+\\
&1.2`\left(2.4`\left(3.75`\left(-2-\alpha^2+\alpha^4\right)-0.75`\left(2+\alpha^2-\alpha^4\right)\beta-\right.\right.\\
&\quad\left(-10.5`\,\alpha+4.58`\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\Big)-\alpha\left(11.25`\left(1+\alpha^2\right)+\\
&\quad\left.\left.2.25`\left(1+\alpha^2\right)\beta+\left(-10.5`\,\alpha+4.58`\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)\right)\Big)\Big)\Big/\\
&\Big(\left(1+\alpha^2\right)\Big(12.25`\left(2-7.199999999999999`\,\alpha-\alpha^2\right)^2\left(-0.75`+3.75`\,\beta\right)^2+\\
&\quad4\left(-3\,\alpha+2.4`\left(-2+\alpha^2\right)\right)^2\left(-0.75`+3.75`\,\beta\right)^2+\\
&\quad14.592400000000001`\left(3.`-0.6`\,\beta\right)^2\left(1+\beta^2\right)^2+\\
&\quad15.280000000000001`\left(-3\,\alpha+2.4`\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\\
&\quad\left(3.`\left(-0.75`+3.75`\,\beta\right)+0.6`\left(0.75`\,\beta+3.75`\left(2+\beta^2\right)\right)\right)+\\
&\quad7.`\left(2-7.199999999999999`\,\alpha-\alpha^2\right)\\
&\quad\Big(2\left(-3\,\alpha+2.4`\left(-2+\alpha^2\right)\right)\left(-0.75`+3.75`\,\beta\right)^2+3.8200000000000003`\\
&\qquad\left(1+\beta^2\right)\left(3.`\left(-0.75`+3.75`\,\beta\right)+0.6`\left(0.75`\,\beta+3.75`\left(2+\beta^2\right)\right)\right)\Big)\Big)\Big),\\
&\Big\{19.116`-2.6729999999999987`\,\alpha+1.9020000000000001`\,\alpha^2-\\
&\quad6.876`\,\beta-\\
&\quad11.46`\,\beta^2\to 0,\\
&\;21.132`+41.00099999999999`\,\alpha-8.274000000000001`\,\alpha^2+\\
&\quad34.38`\,\beta-\\
&\quad2.2920000000000003`\,\beta^2\to 0\Big\}\Big\}
\end{aligned}
$$

Out[•]=

$$
\begin{aligned}
&\Big\{\Omega_2\to -1.25-12.\,k_r^2+2.4\,k_r\,K_2+3.\,K_2^2,\\
&\omega_i\to -2\,k_i^2+7.\,k_i\,k_r+2\,k_r^2+\gamma_i,\ \omega_r\to -3.5\,k_i^2-4\,k_i\,k_r+3.5\,k_r^2+\gamma_r,\\
&\mu^*\to\frac{1.04712\left(-3.5\left(2-7.2\,\alpha-\alpha^2\right)-2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\right)k_r^2}{\mu},\\
&\eta^*\to\frac{1.04712\left(-3.5\left(-13.74\,\alpha-3.5\left(-2+\alpha^2\right)\right)-2\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\right)k_r^2}{\eta},\ K_2\to\\
&\quad\frac{1}{\left(-3.+0.6\,\beta\right)k_r}0.13089\left(-15.28\,k_i\,k_r+\left(-3.5\left(4.58+2.4\left(-3.5+22.5\,\alpha\right)+7.5\left(-2+\alpha^2\right)\right)+\right.\right.\\
&\qquad\left.\left.2\left(7.5\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)+2.292\left(1+\beta^2\right)\right)\right)k_r^2+3.82\left(-3.5\,k_i^2+\gamma_r\right)\right),\\
&k_i\to\frac{1}{\left(1+\alpha^2\right)\left(1+\beta^2\right)}0.21815\left(1.3752\left(1+\alpha^2\right)\left(1+\beta^2\right)+\right.\\
&\quad3.\left(1+\alpha^2\right)\left(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)+11.46\left(1+\beta^2\right)\right)+\\
&\quad3.5\left(2-7.2\,\alpha-\alpha^2\right)\left(3.\left(1+\alpha^2\right)\left(-0.75+3.75\,\beta\right)+\right.\\
&\qquad\left.0.6\left(3.75\left(1+\alpha^2\right)+0.75\left(1+\alpha^2\right)\beta-\left(4.58+3.5\,\alpha\right)\left(1+\beta^2\right)\right)\right)+\\
&\quad1.2\left(2.4\left(3.75\left(-2-\alpha^2+\alpha^4\right)-0.75\left(2+\alpha^2-\alpha^4\right)\beta-\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)-\right.\\
&\qquad\left.\left.\alpha\left(11.25\left(1+\alpha^2\right)+2.25\left(1+\alpha^2\right)\beta+\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)\right)\right)k_r,\\
&k_r\to\Big\{2.0923\sqrt{\Big(\left(1+\beta^2\right)^2\Big/\Big(12.25\left(2-7.2\,\alpha-\alpha^2\right)^2\left(-0.75+3.75\,\beta\right)^2+\\
&\qquad4\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)^2\left(-0.75+3.75\,\beta\right)^2+14.5924\left(3.-0.6\,\beta\right)^2\left(1+\beta^2\right)^2+15.28\\
&\qquad\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)+\\
&\qquad7.\left(2-7.2\,\alpha-\alpha^2\right)\Big(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)^2+
\end{aligned}
$$

$$3.82\,(1+\beta^2)\,(3.\,(-0.75+3.75\,\beta)+0.6\,(0.75\,\beta+3.75\,(2+\beta^2)))))\}\},$$

$$\gamma_r \to 3.5\,k_i^2-\frac{1}{1+\alpha^2}0.26178\,(4\,(2.4+\alpha)\,(-10.5\,\alpha+4.58\,(-2+\alpha^2))-$$
$$3.5\,(7.\,\alpha\,(-2+\alpha^2)+13.74\,(-1+\alpha^2)+2.4\,(27.48\,\alpha-3.5\,(1-5\,\alpha^2))))\,k_r^2,$$

$$\gamma_i \to 2\,k_r\left(3.5\,k_i+\frac{1}{1+\alpha^2}0.26178\,(3.5\,(-1+2.4\,\alpha)\,(-13.74\,\alpha-3.5\,(-2+\alpha^2))+\right.$$
$$\left.2\,(-3.5+4.58\,\alpha)\,(-3\,\alpha+2.4\,(-2+\alpha^2)))\,k_r\right),\ \text{OR},$$

$$\gamma_r \to \left(0.3\,(1+\beta^2)^2\left(3.82\,(-1-\alpha^2)\,(4\,(2.4+\alpha)\,(-10.5\,\alpha+4.58\,(-2+\alpha^2))-\right.\right.$$
$$3.5\,(7.\,\alpha\,(-2+\alpha^2)+13.74\,(-1+\alpha^2)+2.4\,(27.48\,\alpha-3.5\,(1-5\,\alpha^2))))+$$
$$\frac{1}{(1+\beta^2)^2}2.43056\,(1.3752\,(1+\alpha^2)\,(1+\beta^2)+3.\,(1+\alpha^2)$$
$$(2\,(-3\,\alpha+2.4\,(-2+\alpha^2))\,(-0.75+3.75\,\beta)+11.46\,(1+\beta^2))+$$
$$3.5\,(2-7.2\,\alpha-\alpha^2)\,(3.\,(1+\alpha^2)\,(-0.75+3.75\,\beta)+0.6\,(3.75\,(1+\alpha^2)+0.75$$
$$(1+\alpha^2)\,\beta-(4.58+3.5\,\alpha)\,(1+\beta^2)))+1.2\,(2.4\,(3.75\,(-2-\alpha^2+\alpha^4)-$$
$$0.75\,(2+\alpha^2-\alpha^4)\,\beta-(-10.5\,\alpha+4.58\,(-2+\alpha^2))\,(1+\beta^2))-\alpha\,(11.25$$
$$\left.\left.(1+\alpha^2)+2.25\,(1+\alpha^2)\,\beta+(-10.5\,\alpha+4.58\,(-2+\alpha^2))\,(1+\beta^2))))^2\right)\right)\Big/$$
$$\left((1+\alpha^2)^2\left(12.25\,(2-7.2\,\alpha-\alpha^2)^2\,(-0.75+3.75\,\beta)^2+4\,(-3\,\alpha+2.4\,(-2+\alpha^2))^2\right.\right.$$
$$(-0.75+3.75\,\beta)^2+14.5924\,(3.-0.6\,\beta)^2\,(1+\beta^2)^2+15.28\,(-3\,\alpha+2.4\,(-2+\alpha^2))$$
$$(1+\beta^2)\,(3.\,(-0.75+3.75\,\beta)+0.6\,(0.75\,\beta+3.75\,(2+\beta^2)))+$$
$$7.\,(2-7.2\,\alpha-\alpha^2)\,(2\,(-3\,\alpha+2.4\,(-2+\alpha^2))\,(-0.75+3.75\,\beta)^2+$$
$$\left.\left.3.82\,(1+\beta^2)\,(3.\,(-0.75+3.75\,\beta)+0.6\,(0.75\,\beta+3.75\,(2+\beta^2)))))\right)\right),$$

$$\gamma_i \to \left(2.292\,(1+\beta^2)^2\left(3.5\,(-1+2.4\,\alpha)\,(-13.74\,\alpha-3.5\,(-2+\alpha^2))+\right.\right.$$
$$2\,(-3.5+4.58\,\alpha)\,(-3\,\alpha+2.4\,(-2+\alpha^2))+\frac{1}{1+\beta^2}2.91667\,(1.3752\,(1+\alpha^2)\,(1+\beta^2)+$$
$$3.\,(1+\alpha^2)\,(2\,(-3\,\alpha+2.4\,(-2+\alpha^2))\,(-0.75+3.75\,\beta)+11.46\,(1+\beta^2))+$$
$$3.5\,(2-7.2\,\alpha-\alpha^2)\,(3.\,(1+\alpha^2)\,(-0.75+3.75\,\beta)+$$
$$0.6\,(3.75\,(1+\alpha^2)+0.75\,(1+\alpha^2)\,\beta-(4.58+3.5\,\alpha)\,(1+\beta^2)))+1.2\,(2.4\,(3.75$$
$$(-2-\alpha^2+\alpha^4)-0.75\,(2+\alpha^2-\alpha^4)\,\beta-(-10.5\,\alpha+4.58\,(-2+\alpha^2))\,(1+\beta^2))-$$
$$\left.\left.\alpha\,(11.25\,(1+\alpha^2)+2.25\,(1+\alpha^2)\,\beta+(-10.5\,\alpha+4.58\,(-2+\alpha^2))\,(1+\beta^2))))\right)\right)\Big/$$
$$\left((1+\alpha^2)\left(12.25\,(2-7.2\,\alpha-\alpha^2)^2\,(-0.75+3.75\,\beta)^2+4\,(-3\,\alpha+2.4\,(-2+\alpha^2))^2\right.\right.$$
$$(-0.75+3.75\,\beta)^2+14.5924\,(3.-0.6\,\beta)^2\,(1+\beta^2)^2+15.28\,(-3\,\alpha+2.4\,(-2+\alpha^2))$$
$$(1+\beta^2)\,(3.\,(-0.75+3.75\,\beta)+0.6\,(0.75\,\beta+3.75\,(2+\beta^2)))+$$
$$7.\,(2-7.2\,\alpha-\alpha^2)\,(2\,(-3\,\alpha+2.4\,(-2+\alpha^2))\,(-0.75+3.75\,\beta)^2+$$
$$\left.\left.3.82\,(1+\beta^2)\,(3.\,(-0.75+3.75\,\beta)+0.6\,(0.75\,\beta+3.75\,(2+\beta^2)))))\right)\right),$$

$$\{19.116-2.673\,\alpha+1.902\,\alpha^2-6.876\,\beta-11.46\,\beta^2\to$$
$$0,$$
$$21.132+41.001\,\alpha-$$

$$8.274\,\alpha^2 + 34.38\,\beta - 2.292\,\beta^2 \to 0\Big\}\Big\}$$

In[•]:= **ReplaceAll[%, {α → 6.621854449506012`, β → 2.436985673870325`}]**

Out[•]= $\Big\{\Omega_2 \to -1.25 - 12.\,k_r^2 + 2.4\,k_r\,K_2 + 3.\,K_2^2,\ \omega_i \to -2\,k_i^2 + 7.\,k_i\,k_r + 2\,k_r^2 + \gamma_i,$
$\omega_r \to -3.5\,k_i^2 - 4\,k_i\,k_r + 3.5\,k_r^2 + \gamma_r,\ \mu^* \to \frac{159.37\,k_r^2}{\mu},\ \eta^* \to \frac{614.468\,k_r^2}{\eta},$
$K_2 \to -\frac{0.0851147\,\left(-15.28\,k_i\,k_r - 1096.31\,k_r^2 + 3.82\,\left(-3.5\,k_i^2 + \gamma_r\right)\right)}{k_r},\ k_i \to -109.68\,k_r,$
$k_r \to \{0.012854\},\ \gamma_r \to 3.5\,k_i^2 + 72.3035\,k_r^2,\ \gamma_i \to 2\,\left(3.5\,k_i - 47.0098\,k_r\right)\,k_r,\ \text{OR},$
$\gamma_r \to 6.9686,\ \gamma_i \to -0.142388,\ \left\{1.42109 \times 10^{-14} \to 0,\ -8.52651 \times 10^{-14} \to 0\right\}\Big\}$

In[•]:= **ReplaceAll[%, {k_r → 0.012853992823882825`}]**

Out[•]= $\Big\{\Omega_2 \to -1.25198 + 0.0308496\,K_2 + 3.\,K_2^2,\ \omega_i \to 0.00033045 + 0.0899779\,k_i - 2\,k_i^2 + \gamma_i,$
$\omega_r \to 0.000578288 - 0.051416\,k_i - 3.5\,k_i^2 + \gamma_r,\ \mu^* \to \frac{0.0263319}{\mu},\ \eta^* \to \frac{0.101526}{\eta},$
$K_2 \to -6.62165\,\left(-0.181138 - 0.196409\,k_i + 3.82\,\left(-3.5\,k_i^2 + \gamma_r\right)\right),\ k_i \to -1.40983,$
$0.012854 \to \{0.012854\},\ \gamma_r \to 0.0119464 + 3.5\,k_i^2,\ \gamma_i \to 0.025708\,\left(-0.604263 + 3.5\,k_i\right),$
$\text{OR},\ \gamma_r \to 6.9686,\ \gamma_i \to -0.142388,\ \left\{1.42109 \times 10^{-14} \to 0,\ -8.52651 \times 10^{-14} \to 0\right\}\Big\}$

In[•]:= **ReplaceAll[%, {k_i → -1.4098282046068895`}]**

Out[•]= $\Big\{\Omega_2 \to -1.25198 + 0.0308496\,K_2 + 3.\,K_2^2,\ \omega_i \to -4.10175 + \gamma_i,\ \omega_r \to -6.88359 + \gamma_r,$
$\mu^* \to \frac{0.0263319}{\mu},\ \eta^* \to \frac{0.101526}{\eta},\ K_2 \to -6.62165\,\left(0.0957652 + 3.82\,\left(-6.95665 + \gamma_r\right)\right),$
$-1.40983 \to -1.40983,\ 0.012854 \to \{0.012854\},\ \gamma_r \to 6.9686,\ \gamma_i \to -0.142388,$
$\text{OR},\ \gamma_r \to 6.9686,\ \gamma_i \to -0.142388,\ \left\{1.42109 \times 10^{-14} \to 0,\ -8.52651 \times 10^{-14} \to 0\right\}\Big\}$

In[•]:= **ReplaceAll[%, {γ_r → 6.968600835042393`, γ_i → -0.1423878397134657`}]**

Out[•]= $\Big\{\Omega_2 \to -1.25198 + 0.0308496\,K_2 + 3.\,K_2^2,\ \omega_i \to -4.24414,\ \omega_r \to 0.0850123,$
$\mu^* \to \frac{0.0263319}{\mu},\ \eta^* \to \frac{0.101526}{\eta},\ K_2 \to -0.936303,\ -1.40983 \to -1.40983,$
$0.012854 \to \{0.012854\},\ 6.9686 \to 6.9686,\ -0.142388 \to -0.142388,\ \text{OR},$
$6.9686 \to 6.9686,\ -0.142388 \to -0.142388,\ \left\{1.42109 \times 10^{-14} \to 0,\ -8.52651 \times 10^{-14} \to 0\right\}\Big\}$

In[•]:= **ReplaceAll[%, {K_2 → -0.9363033322740433`}]**

Out[•]= $\Big\{\Omega_2 \to 1.34912,\ \omega_i \to -4.24414,\ \omega_r \to 0.0850123,\ \mu^* \to \frac{0.0263319}{\mu},\ \eta^* \to \frac{0.101526}{\eta},$
$-0.936303 \to -0.936303,\ -1.40983 \to -1.40983,\ 0.012854 \to \{0.012854\},$
$6.9686 \to 6.9686,\ -0.142388 \to -0.142388,\ \text{OR},\ 6.9686 \to 6.9686,$
$-0.142388 \to -0.142388,\ \left\{1.42109 \times 10^{-14} \to 0,\ -8.52651 \times 10^{-14} \to 0\right\}\Big\}$

$$\left\{\alpha \to 6.621854449506012`,\ \beta \to 2.436985673870325`,\ k_r \to 0.012853992823882825`,\ k_i \to -1.4098282046068895`,\ \gamma_r \to 6.968600835042393`,\ \gamma_i \to -0.1423878397134657`,\ K_2 \to -0.9363033322740433`\ \Omega_2 \to 1.3491245213505676`,\ \omega_i \to -4.244141973835076`,\ \omega_r \to 0.08501232673459924`,\ \mu^* \to \frac{0.026331905951786586`}{\mu},\ \eta^* \to \frac{0.1015256009291747`}{\eta}\right\}$$

```
ReplaceAll[%, {{α → 6.621854449506012`, β → 2.436985673870325`,
    k_r → 0.012853992823882825`, k_i → -1.4098282046068895`, γ_r → 6.968600835042393`,
    γ_i → -0.1423878397134657`, K_2 → -0.9363033322740433` Ω_2 → 1.3491245213505676`,
    ω_i → -4.244141973835076`, ω_r → 0.08501232673459924`,
    μ* → 0.026331905951786586`/μ, η* → 0.1015256009291747`/η}}]
```

In[99]:=
```
{A[x, t] A*[x, t] → ℯ^(i (x K_1 - t Ω_1)) f[x, t]^(-1-i α) G[x, t] ℯ^(-i (x K_1 - t Ω_1)) f[x, t]^(-1+i α) G*[x, t],
 B[x, t] B*[x, t] → ℯ^(i (x K_2 - t Ω_2)) f[x, t]^(-1-i β) H[x, t] ℯ^(-i (x K_2 - t Ω_2)) f[x, t]^(-1+i β) H*[x, t]}
```

Out[99]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{G[x,t]\,G^*[x,t]}{f[x,t]^2},\ B[x,t]\,B^*[x,t] \to \frac{H[x,t]\,H^*[x,t]}{f[x,t]^2}\right\}$$

In[100]:=
```
ReplaceAll[%, {G[x, t] → η Exp[k x + ω t],
  G*[x, t] → η* Exp[k* x + ω* t], H[x, t] → μ Exp[(k + k*) x + (ω + ω*) t],
  H*[x, t] → μ* Exp[(k + k*) x + (ω + ω*) t], f[x, t] → 1 + Exp[(k + k*) x + (ω + ω*) t]}]
```

Out[100]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{\mathrm{e}^{k\,x+t\,\omega+x\,k^*+t\,\omega^*}\,\eta\,\eta^*}{\left(1+\mathrm{e}^{x\,(k+k^*)+t\,(\omega+\omega^*)}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{\mathrm{e}^{2\,x\,(k+k^*)+2\,t\,(\omega+\omega^*)}\,\mu\,\mu^*}{\left(1+\mathrm{e}^{x\,(k+k^*)+t\,(\omega+\omega^*)}\right)^2}\right\}$$

In[•]:=
```
ReplaceAll[%, {k → k_r + I k_i, k* → k_r - I k_i, ω → ω_r + I ω_i, ω* → ω_r - I ω_i}]
```

Out[•]=
$$\left\{\Phi[x,t]\,\Phi^*[x,t] \to \frac{\mathrm{e}^{x\,(-i\,k_i+k_r)+x\,(i\,k_i+k_r)+t\,(-i\,\omega_i+\omega_r)+t\,(i\,\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+\mathrm{e}^{2\,x\,k_r+2\,t\,\omega_r}\right)^2},\right.$$
$$\left.\Psi[x,t]\,\Psi^*[x,t] \to \frac{\mathrm{e}^{4\,x\,k_r+4\,t\,\omega_r}\,\mu\,\mu^*}{\left(1+\mathrm{e}^{2\,x\,k_r+2\,t\,\omega_r}\right)^2}\right\}$$

In[•]:=
```
ReplaceAll[%, {{Ω_1 → 0, K_1 → 0, α → 6.621854449506012`, β → 2.436985673870325`,
    k_r → 0.012853992823882825`, k_i → -1.4098282046068895`, γ_r → 6.968600835042393`,
    γ_i → -0.1423878397134657`, K_2 → -0.9363033322740433` Ω_2 → 1.3491245213505676`,
    ω_i → -4.244141973835076`, ω_r → 0.08501232673459924`,
    μ* → 0.026331905951786586`/μ, η* → 0.1015256009291747`/η}}]
```

Out[•]=
$$\left\{\left\{\Phi[x,t]\,\Phi^*[x,t] \to \frac{0.101526\,\mathrm{e}^{(0.170025+0.\,i)\,t+(0.025708+0.\,i)\,x}}{\left(1+\mathrm{e}^{0.170025\,t+0.025708\,x}\right)^2},\right.\right.$$
$$\left.\left.\Psi[x,t]\,\Psi^*[x,t] \to \frac{0.0263319\,\mathrm{e}^{0.340049\,t+0.051416\,x}}{\left(1+\mathrm{e}^{0.170025\,t+0.025708\,x}\right)^2}\right\}\right\}$$

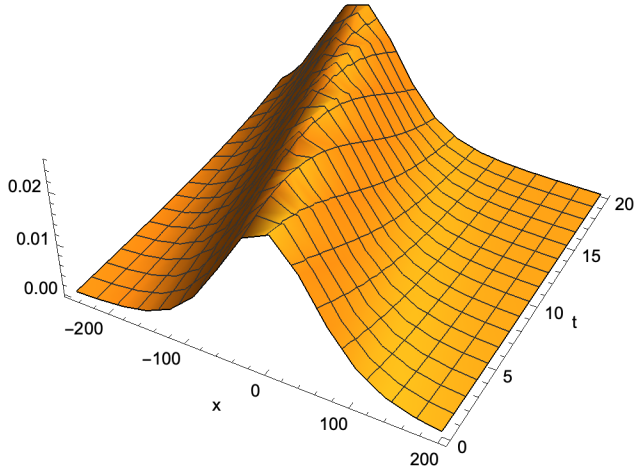
In[•]:= **Simplify[%]**

Out[•]= $\left\{\left\{\Phi[x, t]\ \Phi^*[x, t] \to \frac{0.101526\ e^{0.170025\,t+0.025708\,x}}{\left(1. + e^{0.170025\,t+0.025708\,x}\right)^2},\right.\right.$

$\left.\left.\Psi[x, t]\ \Psi^*[x, t] \to \frac{0.0263319\ e^{0.340049\,t+0.051416\,x}}{\left(1 + e^{0.170025\,t+0.025708\,x}\right)^2}\right\}\right\}$

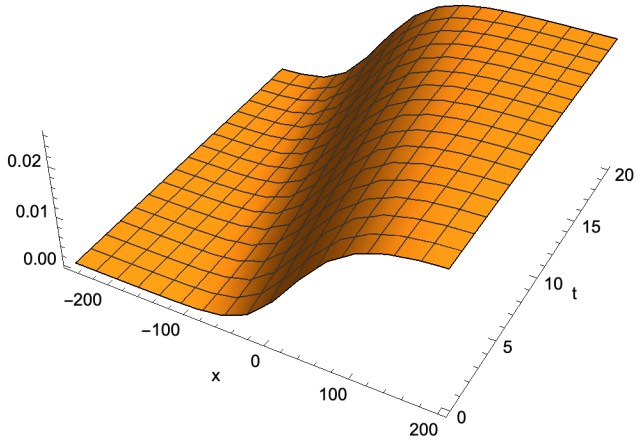
In[•]:= **Plot3D[$\frac{0.1015256009291747`\ e^{0.17002465346919848`\,t+0.02570798564776565`\,x}}{\left(1.` + e^{0.17002465346919848`\,t+0.02570798564776565`\,x}\right)^2}$, {x, -250, 200}, {t, 0, 20}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "$|\Phi|^2$ "}]**

Out[•]=



In[•]:= **Plot3D[$\frac{0.026331905951786586`\ e^{0.34004930693839697`\,t+0.0514159712955313`\,x}}{\left(1 + e^{0.17002465346919848`\,t+0.02570798564776565`\,x}\right)^2}$, {x, -250, 200}, {t, 0, 20}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "$|\Psi|^2$ "}]**

Out[•]=



Ok

In[•]:=
```
Solve[
 {19.116` - 2.6729999999999987` α + 1.9020000000000001` α^2 - 6.876` β - 11.46` β^2 == 0,
  21.132` + 41.00099999999999` α - 8.274000000000001` α^2 +
    34.38` β - 2.2920000000000003` β^2 == 0}, {α, β}]
```

Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

Out[•]=
$$\{\{\alpha \to -1.16758, \beta \to 1.20222\}, \{\alpha \to 1.37388, \beta \to -1.62321\}, \{\alpha \to 2.77057, \beta \to -1.84461\}, \{\alpha \to 6.62185, \beta \to 2.43699\}\}$$

In[•]:=
$$\{\Omega_2 \to -1.25` - 12.` k_r^2 + 2.4` k_r K_2 + 3.` K_2^2,$$
$$\omega_i \to -2 k_i^2 + 7.` k_i k_r + 2 k_r^2 + \gamma_i,\ \omega_r \to -3.5` k_i^2 - 4 k_i k_r + 3.5` k_r^2 + \gamma_r,\ \mu^* \to$$
$$\frac{1.0471204188481675` \left(-3.5` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) - 2 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)\right) k_r^2}{\mu},$$
$$\eta^* \to \frac{1}{\eta} 1.0471204188481675` \left(-3.5` \left(-13.74` \alpha - 3.5` \left(-2 + \alpha^2\right)\right) - 2 \left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right)\right) k_r^2,$$
$$K_2 \to \frac{1}{\left(-3.` + 0.6` \beta\right) k_r} 0.13089005235602094` \left(-15.280000000000001` k_i k_r + \left(-3.5` \left(4.58` + 2.4` \left(-3.5` + 22.5` \alpha\right) + 7.5` \left(-2 + \alpha^2\right)\right) + 2 \left(7.5` \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right) + 2.2920000000000003` \left(1 + \beta^2\right)\right)\right) k_r^2 + 3.8200000000000003` \left(-3.5` k_i^2 + \gamma_r\right)\right),$$
$$k_i \to \frac{1}{\left(1 + \alpha^2\right)\left(1 + \beta^2\right)} 0.2181500872600349` \left(1.3752` \left(1 + \alpha^2\right)\left(1 + \beta^2\right) + 3.` \left(1 + \alpha^2\right) \left(2 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)\left(-0.75` + 3.75` \beta\right) + 11.46` \left(1 + \beta^2\right)\right) + 3.5` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) \left(3.` \left(1 + \alpha^2\right)\left(-0.75` + 3.75` \beta\right) + 0.6` \left(3.75` \left(1 + \alpha^2\right) + 0.75` \left(1 + \alpha^2\right) \beta - \left(4.58` + 3.5` \alpha\right)\left(1 + \beta^2\right)\right)\right) + 1.2` \left(2.4` \left(3.75` \left(-2 - \alpha^2 + \alpha^4\right) - 0.75` \left(2 + \alpha^2 - \alpha^4\right) \beta - \left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right)\left(1 + \beta^2\right)\right) - \alpha \left(11.25` \left(1 + \alpha^2\right) + 2.25` \left(1 + \alpha^2\right) \beta + \left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right)\left(1 + \beta^2\right)\right)\right)\right) k_r,$$
$$k_r \to \{2.0923001696697345` \sqrt{\left(\left(1 + \beta^2\right)^2 \Big/ \left(12.25` \left(2 - 7.199999999999999` \alpha - \alpha^2\right)^2 \left(-0.75` + 3.75` \beta\right)^2 + 4 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)^2 \left(-0.75` + 3.75` \beta\right)^2 + 14.592400000000001` \left(3.` - 0.6` \beta\right)^2 \left(1 + \beta^2\right)^2 + 15.280000000000001` \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)\left(1 + \beta^2\right)\left(3.` \left(-0.75` + 3.75` \beta\right) + 0.6` \left(0.75` \beta + 3.75` \left(2 + \beta^2\right)\right)\right) + 7.` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) \left(2 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)\left(-0.75` + 3.75` \beta\right)^2 + 3.8200000000000003` \left(1 + \beta^2\right)\left(3.` \left(-0.75` + 3.75` \beta\right) + 0.6` \left(0.75` \beta + 3.75` \left(2 + \beta^2\right)\right)\right)\right)\right)\right)\},$$
$$\gamma_r \to 3.5` k_i^2 - \frac{1}{1 + \alpha^2} 0.2617801047120419` \left(4 \left(2.4` + \alpha\right)\left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right) - 3.5` \left(7.` \alpha \left(-2 + \alpha^2\right) + 13.74` \left(-1 + \alpha^2\right) + 2.4` \left(27.48` \alpha - 3.5` \left(1 - 5 \alpha^2\right)\right)\right)\right) k_r^2,\ \gamma_i \to$$
$$2 k_r \left(3.5` k_i + \frac{1}{1 + \alpha^2} 0.2617801047120419` \left(3.5` \left(-1 + 2.4` \alpha\right)\left(-13.74` \alpha - 3.5` \left(-2 + \alpha^2\right)\right) + 2 \left(-3.5` + 4.58` \alpha\right)\left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)\right) k_r\right), \text{OR}, \gamma_r \to$$

$$\left(0.3` \left(1+\beta^2\right)^2 \left(3.8200000000000003` \left(-1-\alpha^2\right) \left(4 \left(2.4` +\alpha\right) \left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right)-\right.\right.\right.$$
$$\left.\left.\left.3.5` \left(7.` \alpha \left(-2+\alpha^2\right)+13.74` \left(-1+\alpha^2\right)+2.4` \left(27.48` \alpha-3.5` \left(1-5 \alpha^2\right)\right)\right)\right)+\right.$$
$$\frac{1}{\left(1+\beta^2\right)^2} 2.4305555555555554` \left(1.3752` \left(1+\alpha^2\right) \left(1+\beta^2\right)+\right.$$
$$3.` \left(1+\alpha^2\right) \left(2 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(-0.75` +3.75` \beta\right)+11.46` \left(1+\beta^2\right)\right)+$$
$$3.5` \left(2-7.199999999999999` \alpha-\alpha^2\right) \left(3.` \left(1+\alpha^2\right) \left(-0.75` +3.75` \beta\right)+0.6` \right.$$
$$\left.\left(3.75` \left(1+\alpha^2\right)+0.75` \left(1+\alpha^2\right) \beta-\left(4.58` +3.5` \alpha\right) \left(1+\beta^2\right)\right)\right)+$$
$$1.2` \left(2.4` \left(3.75` \left(-2-\alpha^2+\alpha^4\right)-0.75` \left(2+\alpha^2-\alpha^4\right) \beta-\right.\right.$$
$$\left.\left.\left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)\right)-\alpha \left(11.25` \left(1+\alpha^2\right)+\right.\right.$$
$$\left.\left.\left.\left.2.25` \left(1+\alpha^2\right) \beta+\left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)\right)\right)\right)^2\right)\Big/$$
$$\left(\left(1+\alpha^2\right)^2 \left(12.25` \left(2-7.199999999999999` \alpha-\alpha^2\right)^2 \left(-0.75` +3.75` \beta\right)^2+\right.$$
$$4 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right)^2 \left(-0.75` +3.75` \beta\right)^2+$$
$$14.592400000000001` \left(3.` -0.6` \beta\right)^2 \left(1+\beta^2\right)^2+$$
$$15.280000000000001` \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)$$
$$\left(3.` \left(-0.75` +3.75` \beta\right)+0.6` \left(0.75` \beta+3.75` \left(2+\beta^2\right)\right)\right)+$$
$$7.` \left(2-7.199999999999999` \alpha-\alpha^2\right)$$
$$\left.\left(2 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(-0.75` +3.75` \beta\right)^2+3.8200000000000003` \right.\right.$$
$$\left.\left.\left(1+\beta^2\right) \left(3.` \left(-0.75` +3.75` \beta\right)+0.6` \left(0.75` \beta+3.75` \left(2+\beta^2\right)\right)\right)\right)\right)\Big),$$
$$\gamma_i \to \left(2.2920000000000003` \left(1+\beta^2\right)^2 \left(3.5` \left(-1+2.4` \alpha\right) \left(-13.74` \alpha-3.5` \left(-2+\alpha^2\right)\right)+\right.$$
$$2 \left(-3.5` +4.58` \alpha\right) \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right)+$$
$$\frac{1}{1+\beta^2} 2.916666666666667` \left(1.3752` \left(1+\alpha^2\right) \left(1+\beta^2\right)+\right.$$
$$3.` \left(1+\alpha^2\right) \left(2 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(-0.75` +3.75` \beta\right)+11.46` \left(1+\beta^2\right)\right)+$$
$$3.5` \left(2-7.199999999999999` \alpha-\alpha^2\right) \left(3.` \left(1+\alpha^2\right) \left(-0.75` +3.75` \beta\right)+\right.$$
$$\left.0.6` \left(3.75` \left(1+\alpha^2\right)+0.75` \left(1+\alpha^2\right) \beta-\left(4.58` +3.5` \alpha\right) \left(1+\beta^2\right)\right)\right)+$$
$$1.2` \left(2.4` \left(3.75` \left(-2-\alpha^2+\alpha^4\right)-0.75` \left(2+\alpha^2-\alpha^4\right) \beta-\right.\right.$$
$$\left.\left.\left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)\right)-\alpha \left(11.25` \left(1+\alpha^2\right)+\right.\right.$$
$$\left.\left.\left.\left.2.25` \left(1+\alpha^2\right) \beta+\left(-10.5` \alpha+4.58` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)\right)\right)\right)\Big)\Big/$$
$$\left(\left(1+\alpha^2\right) \left(12.25` \left(2-7.199999999999999` \alpha-\alpha^2\right)^2 \left(-0.75` +3.75` \beta\right)^2+\right.$$
$$4 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right)^2 \left(-0.75` +3.75` \beta\right)^2+$$
$$14.592400000000001` \left(3.` -0.6` \beta\right)^2 \left(1+\beta^2\right)^2+$$
$$15.280000000000001` \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(1+\beta^2\right)$$
$$\left(3.` \left(-0.75` +3.75` \beta\right)+0.6` \left(0.75` \beta+3.75` \left(2+\beta^2\right)\right)\right)+$$
$$7.` \left(2-7.199999999999999` \alpha-\alpha^2\right)$$
$$\left.\left(2 \left(-3 \alpha+2.4` \left(-2+\alpha^2\right)\right) \left(-0.75` +3.75` \beta\right)^2+3.8200000000000003` \right.\right.$$
$$\left.\left.\left(1+\beta^2\right) \left(3.` \left(-0.75` +3.75` \beta\right)+0.6` \left(0.75` \beta+3.75` \left(2+\beta^2\right)\right)\right)\right)\right)\Big),$$
$$\left\{19.116` -2.6729999999999987` \alpha+1.9020000000000001` \alpha^2-\right.$$

$$6.876` \beta - 11.46` \beta^2 \to 0,\ 21.132` + 41.00999999999999` \alpha - 8.274000000000001` \alpha^2 + 34.38` \beta - 2.2920000000000003` \beta^2 \to 0\}\}$$

Out[•]=

$$\{\Omega_2 \to -1.25 - 12.\, k_r^2 + 2.4\, k_r K_2 + 3.\, K_2^2,$$

$$\omega_i \to -2\, k_i^2 + 7.\, k_i k_r + 2\, k_r^2 + \gamma_i,\ \omega_r \to -3.5\, k_i^2 - 4\, k_i k_r + 3.5\, k_r^2 + \gamma_r,$$

$$\mu^* \to \frac{1.04712 \left(-3.5 \left(2 - 7.2\, \alpha - \alpha^2\right) - 2 \left(-3\, \alpha + 2.4 \left(-2 + \alpha^2\right)\right)\right) k_r^2}{\mu},$$

$$\eta^* \to \frac{1.04712 \left(-3.5 \left(-13.74\, \alpha - 3.5 \left(-2 + \alpha^2\right)\right) - 2 \left(-10.5\, \alpha + 4.58 \left(-2 + \alpha^2\right)\right)\right) k_r^2}{\eta},\ K_2 \to$$

$$\frac{1}{\left(-3. + 0.6\, \beta\right) k_r} 0.13089 \left(-15.28\, k_i k_r + \left(-3.5 \left(4.58 + 2.4 \left(-3.5 + 22.5\, \alpha\right) + 7.5 \left(-2 + \alpha^2\right)\right) + 2 \left(7.5 \left(-3\, \alpha + 2.4 \left(-2 + \alpha^2\right)\right) + 2.292 \left(1 + \beta^2\right)\right)\right) k_r^2 + 3.82 \left(-3.5\, k_i^2 + \gamma_r\right)\right),$$

$$k_i \to \frac{1}{\left(1 + \alpha^2\right) \left(1 + \beta^2\right)} 0.21815 \left(1.3752 \left(1 + \alpha^2\right) \left(1 + \beta^2\right) + 3. \left(1 + \alpha^2\right) \left(2 \left(-3\, \alpha + 2.4 \left(-2 + \alpha^2\right)\right) \left(-0.75 + 3.75\, \beta\right) + 11.46 \left(1 + \beta^2\right)\right) + 3.5 \left(2 - 7.2\, \alpha - \alpha^2\right) \left(3. \left(1 + \alpha^2\right) \left(-0.75 + 3.75\, \beta\right) + 0.6 \left(3.75 \left(1 + \alpha^2\right) + 0.75 \left(1 + \alpha^2\right) \beta - \left(4.58 + 3.5\, \alpha\right) \left(1 + \beta^2\right)\right)\right) + 1.2 \left(2.4 \left(3.75 \left(-2 - \alpha^2 + \alpha^4\right) - 0.75 \left(2 + \alpha^2 - \alpha^4\right) \beta - \left(-10.5\, \alpha + 4.58 \left(-2 + \alpha^2\right)\right) \left(1 + \beta^2\right)\right) - \alpha \left(11.25 \left(1 + \alpha^2\right) + 2.25 \left(1 + \alpha^2\right) \beta + \left(-10.5\, \alpha + 4.58 \left(-2 + \alpha^2\right)\right) \left(1 + \beta^2\right)\right)\right)\right) k_r,$$

$$k_r \to \{2.0923 \sqrt{\left(\left(1 + \beta^2\right)^2 \Big/ \left(12.25 \left(2 - 7.2\, \alpha - \alpha^2\right)^2 \left(-0.75 + 3.75\, \beta\right)^2 + 4 \left(-3\, \alpha + 2.4 \left(-2 + \alpha^2\right)\right)^2 \left(-0.75 + 3.75\, \beta\right)^2 + 14.5924 \left(3. - 0.6\, \beta\right)^2 \left(1 + \beta^2\right)^2 + 15.28 \left(-3\, \alpha + 2.4 \left(-2 + \alpha^2\right)\right) \left(1 + \beta^2\right) \left(3. \left(-0.75 + 3.75\, \beta\right) + 0.6 \left(0.75\, \beta + 3.75 \left(2 + \beta^2\right)\right)\right) + 7. \left(2 - 7.2\, \alpha - \alpha^2\right) \left(2 \left(-3\, \alpha + 2.4 \left(-2 + \alpha^2\right)\right) \left(-0.75 + 3.75\, \beta\right)^2 + 3.82 \left(1 + \beta^2\right) \left(3. \left(-0.75 + 3.75\, \beta\right) + 0.6 \left(0.75\, \beta + 3.75 \left(2 + \beta^2\right)\right)\right)\right)\right)\right)\},$$

$$\gamma_r \to 3.5\, k_i^2 - \frac{1}{1 + \alpha^2} 0.26178 \left(4 \left(2.4 + \alpha\right) \left(-10.5\, \alpha + 4.58 \left(-2 + \alpha^2\right)\right) - 3.5 \left(7.\, \alpha \left(-2 + \alpha^2\right) + 13.74 \left(-1 + \alpha^2\right) + 2.4 \left(27.48\, \alpha - 3.5 \left(1 - 5\, \alpha^2\right)\right)\right)\right) k_r^2,$$

$$\gamma_i \to 2\, k_r \left(3.5\, k_i + \frac{1}{1 + \alpha^2} 0.26178 \left(3.5 \left(-1 + 2.4\, \alpha\right) \left(-13.74\, \alpha - 3.5 \left(-2 + \alpha^2\right)\right) + 2 \left(-3.5 + 4.58\, \alpha\right) \left(-3\, \alpha + 2.4 \left(-2 + \alpha^2\right)\right)\right) k_r\right),\ \text{OR},$$

$$\gamma_r \to \left(0.3 \left(1 + \beta^2\right)^2 \left(3.82 \left(-1 - \alpha^2\right) \left(4 \left(2.4 + \alpha\right) \left(-10.5\, \alpha + 4.58 \left(-2 + \alpha^2\right)\right) - 3.5 \left(7.\, \alpha \left(-2 + \alpha^2\right) + 13.74 \left(-1 + \alpha^2\right) + 2.4 \left(27.48\, \alpha - 3.5 \left(1 - 5\, \alpha^2\right)\right)\right)\right) + \frac{1}{\left(1 + \beta^2\right)^2} 2.43056 \left(1.3752 \left(1 + \alpha^2\right) \left(1 + \beta^2\right) + 3. \left(1 + \alpha^2\right) \left(2 \left(-3\, \alpha + 2.4 \left(-2 + \alpha^2\right)\right) \left(-0.75 + 3.75\, \beta\right) + 11.46 \left(1 + \beta^2\right)\right) + 3.5 \left(2 - 7.2\, \alpha - \alpha^2\right) \left(3. \left(1 + \alpha^2\right) \left(-0.75 + 3.75\, \beta\right) + 0.6 \left(3.75 \left(1 + \alpha^2\right) + 0.75 \left(1 + \alpha^2\right) \beta - \left(4.58 + 3.5\, \alpha\right) \left(1 + \beta^2\right)\right)\right) + 1.2 \left(2.4 \left(3.75 \left(-2 - \alpha^2 + \alpha^4\right) - 0.75 \left(2 + \alpha^2 - \alpha^4\right) \beta - \left(-10.5\, \alpha + 4.58 \left(-2 + \alpha^2\right)\right) \left(1 + \beta^2\right)\right) - \alpha \left(11.25\right.\right.\right.$$

$$\left(1+\alpha^2\right)+2.25\left(1+\alpha^2\right)\beta+\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\Big)\Big)\Big)^2\Big)\Big)\Big/$$

$$\Big(\left(1+\alpha^2\right)^2\Big(12.25\left(2-7.2\,\alpha-\alpha^2\right)^2\left(-0.75+3.75\,\beta\right)^2+4\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)^2$$
$$\left(-0.75+3.75\,\beta\right)^2+14.5924\left(3.-0.6\,\beta\right)^2\left(1+\beta^2\right)^2+15.28\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)$$
$$\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)+$$
$$7.\left(2-7.2\,\alpha-\alpha^2\right)\Big(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)^2+$$
$$3.82\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)\Big)\Big)\Big),$$

$$\gamma_i\to\Big(2.292\left(1+\beta^2\right)^2\Big(3.5\left(-1+2.4\,\alpha\right)\left(-13.74\,\alpha-3.5\left(-2+\alpha^2\right)\right)+$$
$$2\left(-3.5+4.58\,\alpha\right)\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)+\frac{1}{1+\beta^2}2.91667\left(1.3752\left(1+\alpha^2\right)\left(1+\beta^2\right)+$$
$$3.\left(1+\alpha^2\right)\left(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)+11.46\left(1+\beta^2\right)\right)+$$
$$3.5\left(2-7.2\,\alpha-\alpha^2\right)\left(3.\left(1+\alpha^2\right)\left(-0.75+3.75\,\beta\right)+$$
$$0.6\left(3.75\left(1+\alpha^2\right)+0.75\left(1+\alpha^2\right)\beta-\left(4.58+3.5\,\alpha\right)\left(1+\beta^2\right)\right)\right)+1.2\left(2.4\left(3.75\right.\right.$$
$$\left.\left(-2-\alpha^2+\alpha^4\right)-0.75\left(2+\alpha^2-\alpha^4\right)\beta-\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)-$$
$$\alpha\left(11.25\left(1+\alpha^2\right)+2.25\left(1+\alpha^2\right)\beta+\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)\Big)\Big)\Big)\Big/$$

$$\Big(\left(1+\alpha^2\right)\Big(12.25\left(2-7.2\,\alpha-\alpha^2\right)^2\left(-0.75+3.75\,\beta\right)^2+4\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)^2$$
$$\left(-0.75+3.75\,\beta\right)^2+14.5924\left(3.-0.6\,\beta\right)^2\left(1+\beta^2\right)^2+15.28\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)$$
$$\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)+$$
$$7.\left(2-7.2\,\alpha-\alpha^2\right)\Big(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)^2+$$
$$3.82\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)\Big)\Big)\Big),$$

$$\Big\{19.116-2.673\,\alpha+1.902\,\alpha^2-6.876\,\beta-11.46\,\beta^2\to$$
$$0,$$
$$21.132+41.001\,\alpha-$$
$$8.274\,\alpha^2+$$
$$34.38\,\beta-$$
$$2.292\,\beta^2\to 0\Big\}\Big\}$$

In[•]:=
```
ReplaceAll[%, {α → 2.7705685329581273`, β → -1.8446105538140034`}]
```

Out[•]=
$$\Big\{\Omega_2\to-1.25-12.\,k_r^2+2.4\,k_r\,K_2+3.\,K_2^2,\ \omega_i\to-2\,k_i^2+7.\,k_i\,k_r+2\,k_r^2+\gamma_i,$$
$$\omega_r\to-3.5\,k_i^2-4\,k_i\,k_r+3.5\,k_r^2+\gamma_r,\ \mu^*\to\frac{82.7883\,k_r^2}{\mu},\ \eta^*\to\frac{218.804\,k_r^2}{\eta},$$
$$K_2\to-\frac{0.0318718\left(-15.28\,k_i\,k_r-559.42\,k_r^2+3.82\left(-3.5\,k_i^2+\gamma_r\right)\right)}{k_r},\ k_i\to 112.149\,k_r,$$
$$k_r\to\{0.0145051\},\ \gamma_r\to 3.5\,k_i^2+75.699\,k_r^2,\ \gamma_i\to 2\left(3.5\,k_i-31.6182\,k_r\right)k_r,$$
$$\text{OR},\ \gamma_r\to 9.2778,\ \gamma_i\to 0.151866,\ \Big\{7.10543\times10^{-15}\to 0,\ -5.68434\times10^{-14}\to 0\Big\}\Big\}$$

In[•]:= **ReplaceAll[%, k_r → {0.014505060675579122`}]**

Out[•]= $\{\Omega_2 \to \{-1.25252 + 0.0348121\, K_2 + 3.\, K_2^2\},\ \omega_i \to \{0.000420794 + 0.101535\, k_i - 2\, k_i^2 + \gamma_i\},$
$\omega_r \to \{0.000736389 - 0.0580202\, k_i - 3.5\, k_i^2 + \gamma_r\},\ \mu^* \to \{\frac{0.0174184}{\mu}\},$
$\eta^* \to \{\frac{0.0460356}{\eta}\},\ K_2 \to \{-2.19729\,(-0.1177 - 0.221637\, k_i + 3.82\,(-3.5\, k_i^2 + \gamma_r))\},$
$k_i \to \{1.62673\},\ \{0.0145051\} \to \{0.0145051\},\ \gamma_r \to \{0.0159268 + 3.5\, k_i^2\},$
$\gamma_i \to \{0.0290101\,(-0.458624 + 3.5\, k_i)\},\ OR,\ \gamma_r \to 9.2778,$
$\gamma_i \to 0.151866,\ \{7.10543 \times 10^{-15} \to 0,\ -5.68434 \times 10^{-14} \to 0\}\}$

In[•]:= **ReplaceAll[%, k_i → {1.6267301220247674`}]**

Out[•]= $\{\Omega_2 \to \{-1.25252 + 0.0348121\, K_2 + 3.\, K_2^2\},\ \omega_i \to \{\{-5.12691 + \gamma_i\}\},$
$\omega_r \to \{\{-9.35553 + \gamma_r\}\},\ \mu^* \to \{\frac{0.0174184}{\mu}\},\ \eta^* \to \{\frac{0.0460356}{\eta}\},$
$K_2 \to \{\{-2.19729\,(-0.478244 + 3.82\,(-9.26188 + \gamma_r))\}\},\ \{1.62673\} \to \{1.62673\},$
$\{0.0145051\} \to \{0.0145051\},\ \gamma_r \to \{\{9.2778\}\},\ \gamma_i \to \{\{0.151866\}\},\ OR,$
$\gamma_r \to 9.2778,\ \gamma_i \to 0.151866,\ \{7.10543 \times 10^{-15} \to 0,\ -5.68434 \times 10^{-14} \to 0\}\}$

In[•]:= **ReplaceAll[%, {γ_r → 9.277804943089405`, $\gamma_i$ → 0.1518659869884017`}]**

In[•]:= **$\{\Omega_2 \to \{-1.2525247614224269` + 0.034812145621389894`\, K_2 + 3.`\, K_2^2\},$**
$\omega_i \to \{\{-4.975044265387293`\}\},\ \omega_r \to \{\{-0.07772005931293613`\}\},$
$\mu^* \to \{\frac{0.017418402468302074`}{\mu}\},\ \eta^* \to \{\frac{0.04603560408748697`}{\eta}\},$
$K_2 \to \{\{0.9171566452103205`\}\},\ \{1.6267301220247674`\} \to \{1.6267301220247674`\},$
$\{0.014505060675579122`\} \to \{0.014505060675579122`\},$
$9.277804943089405` \to \{\{9.277804943089407`\}\},$
$0.1518659869884017` \to \{\{0.15186598698840165`\}\},\ OR,$
$9.277804943089405` \to 9.277804943089405`,\ 0.1518659869884017` \to 0.1518659869884017`,$
$\{7.105427357601002`*^-15 \to 0,\ -5.684341886080802`*^-14 \to 0\}\}$

Out[•]= $\{\Omega_2 \to \{-1.25252 + 0.0348121\, K_2 + 3.\, K_2^2\},\ \omega_i \to \{\{-4.97504\}\},\ \omega_r \to \{\{-0.0777201\}\},$
$\mu^* \to \{\frac{0.0174184}{\mu}\},\ \eta^* \to \{\frac{0.0460356}{\eta}\},\ K_2 \to \{\{0.917157\}\},\ \{1.62673\} \to \{1.62673\},$
$\{0.0145051\} \to \{0.0145051\},\ 9.2778 \to \{\{9.2778\}\},\ 0.151866 \to \{\{0.151866\}\},\ OR,$
$9.2778 \to 9.2778,\ 0.151866 \to 0.151866,\ \{7.10543 \times 10^{-15} \to 0,\ -5.68434 \times 10^{-14} \to 0\}\}$

In[•]:= **ReplaceAll[%, {K_2 → 0.9171566452103205`}]**

Out[•]= $\{\Omega_2 \to \{1.30293\},\ \omega_i \to \{\{-4.97504\}\},\ \omega_r \to \{\{-0.0777201\}\},\ \mu^* \to \{\frac{0.0174184}{\mu}\},$
$\eta^* \to \{\frac{0.0460356}{\eta}\},\ 0.917157 \to \{\{0.917157\}\},\ \{1.62673\} \to \{1.62673\},$
$\{0.0145051\} \to \{0.0145051\},\ 9.2778 \to \{\{9.2778\}\},\ 0.151866 \to \{\{0.151866\}\},\ OR,$
$9.2778 \to 9.2778,\ 0.151866 \to 0.151866,\ \{7.10543 \times 10^{-15} \to 0,\ -5.68434 \times 10^{-14} \to 0\}\}$

$$\left\{\alpha \to 2.7705685329581273`,\ \beta \to -1.8446105538140034`,\ k_r \to 0.014505060675579122`,\ k_i \to 1.6267301220247674`,\ \gamma_r \to 9.277804943089405`,\ \gamma_i \to 0.1518659869884017`,\ K_2 \to 0.9171566452103205`,\ \Omega_2 \to \{1.3029323648286093`\},\ \omega_i \to -4.975044265387293`,\ \omega_r \to -0.07772005931293613`,\ \mu^* \to \frac{0.017418402468302074`}{\mu},\ \eta^* \to \frac{0.04603560408748697`}{\eta}\right\}$$

$$\text{ReplaceAll}\left[\%,\ \left\{\left\{\alpha \to 6.621854449506012`,\ \beta \to 2.436985673870325`,\ k_r \to 0.012853992823882825`,\ k_i \to -1.4098282046068895`,\ \gamma_r \to 6.968600835042393`,\ \gamma_i \to -0.1423878397134657`,\ K_2 \to -0.9363033322740433`\ \Omega_2 \to 1.3491245213505676`,\ \omega_i \to -4.244141973835076`,\ \omega_r \to 0.08501232673459924`,\ \mu^* \to \frac{0.026331905951786586`}{\mu},\ \eta^* \to \frac{0.1015256009291747`}{\eta}\right\}\right\}\right]$$

In[101]:=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x(-i k_i+k_r)+x(i k_i+k_r)+t(-i\omega_i+\omega_r)+t(i\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2 x k_r+2 t \omega_r}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{e^{4 x k_r+4 t \omega_r}\,\mu\,\mu^*}{\left(1+e^{2 x k_r+2 t \omega_r}\right)^2}\right\}$$

Out[101]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x(-i k_i+k_r)+x(i k_i+k_r)+t(-i\omega_i+\omega_r)+t(i\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2 x k_r+2 t \omega_r}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{e^{4 x k_r+4 t \omega_r}\,\mu\,\mu^*}{\left(1+e^{2 x k_r+2 t \omega_r}\right)^2}\right\}$$

In[102]:=
$$\text{ReplaceAll}\left[\%,\ \left\{\alpha \to 2.7705685329581273`,\ \beta \to -1.8446105538140034`,\ k_r \to 0.014505060675579122`,\ k_i \to 1.6267301220247674`,\ \gamma_r \to 9.277804943089405`,\ \gamma_i \to 0.1518659869884017`,\ K_2 \to 0.9171566452103205`,\ \Omega_2 \to \{1.3029323648286093`\},\ \omega_i \to -4.975044265387293`,\ \omega_r \to -0.07772005931293613`,\ \mu^* \to \frac{0.017418402468302074`}{\mu},\ \eta^* \to \frac{0.04603560408748697`}{\eta}\right\}\right]$$

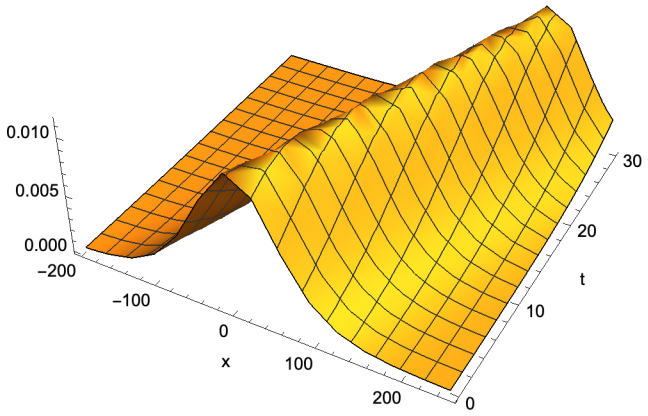
Out[102]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{0.0460356\,e^{(-0.15544+0.\,i)\,t+(0.0290101+0.\,i)\,x}}{\left(1+e^{-0.15544\,t+0.0290101\,x}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{0.0174184\,e^{-0.31088\,t+0.0580202\,x}}{\left(1+e^{-0.15544\,t+0.0290101\,x}\right)^2}\right\}$$

In[•]:=
$$\text{Simplify}[\%]$$

Out[•]=
$$\left\{\Phi[x,t]\,\Phi^*[x,t] \to \frac{0.0460356\,e^{0.15544\,t+0.0290101\,x}}{\left(e^{0.15544\,t}+e^{0.0290101\,x}\right)^2},\ \Psi[x,t]\,\Psi^*[x,t] \to \frac{0.0174184\,e^{0.0580202\,x}}{\left(e^{0.15544\,t}+e^{0.0290101\,x}\right)^2}\right\}$$

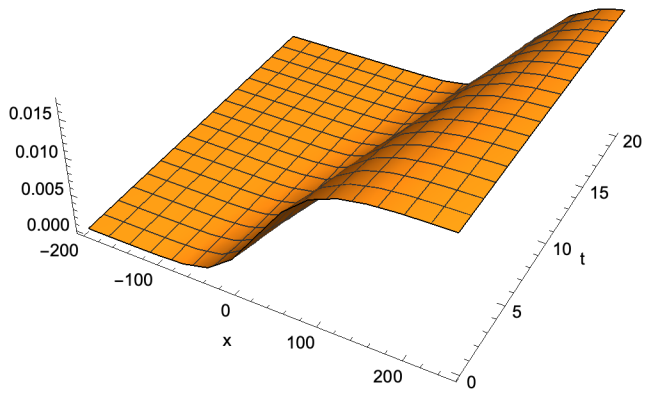
In[103]:=
```
Plot3D[0.04603560408748697` e^(0.15544011862587226` t+0.029010121351158245` x) / (e^(0.15544011862587226` t) + e^(0.029010121351158245` x))^2, {x, -200, 250},
 {t, 0, 30}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[103]=



In[104]:=
```
Plot3D[0.017418402468302074` e^(0.05802024270231649` x) / (e^(0.15544011862587226` t) + e^(0.029010121351158245` x))^2, {x, -200, 250}, {t, 0, 20},
 {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[104]=



ok

In[•]:=
```
Solve[
 {19.116` - 2.6729999999999987` α + 1.9020000000000001` α^2 - 6.876` β - 11.46` β^2 == 0,
  21.132` + 41.00099999999999` α - 8.274000000000001` α^2 +
    34.38` β - 2.2920000000000003` β^2 == 0}, {α, β}]
```

… Solve: Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result.

Out[•]=
```
{{α → -1.16758, β → 1.20222}, {α → 1.37388, β → -1.62321},
 {α → 2.77057, β → -1.84461}, {α → 6.62185, β → 2.43699}}
```

In[•]:=
$$\Big\{\Omega_2 \to -1.25` - 12.` k_r^2 + 2.4` k_r K_2 + 3.` K_2^2,$$
$$\omega_i \to -2 k_i^2 + 7.` k_i k_r + 2 k_r^2 + \gamma_i,\ \omega_r \to -3.5` k_i^2 - 4 k_i k_r + 3.5` k_r^2 + \gamma_r,\ \mu^* \to$$
$$\frac{1.0471204188481675` \left(-3.5` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) - 2 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)\right) k_r^2}{\mu}$$
$$, \eta^* \to \frac{1}{\eta} 1.0471204188481675`$$
$$\left(-3.5` \left(-13.74` \alpha - 3.5` \left(-2 + \alpha^2\right)\right) - 2 \left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right)\right) k_r^2,$$
$$K_2 \to \frac{1}{\left(-3.` + 0.6` \beta\right) k_r} 0.13089005235602094`$$
$$\left(-15.280000000000001` k_i k_r + \left(-3.5` \left(4.58` + 2.4` \left(-3.5` + 22.5` \alpha\right) + 7.5` \left(-2 + \alpha^2\right)\right) + 2 \left(7.5` \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right) + 2.2920000000000003` \left(1 + \beta^2\right)\right)\right) k_r^2 + 3.8200000000000003` \left(-3.5` k_i^2 + \gamma_r\right)\right),$$
$$k_i \to \frac{1}{\left(1 + \alpha^2\right) \left(1 + \beta^2\right)} 0.2181500872600349` \left(1.3752` \left(1 + \alpha^2\right) \left(1 + \beta^2\right) + 3.` \left(1 + \alpha^2\right) \left(2 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right) \left(-0.75` + 3.75` \beta\right) + 11.46` \left(1 + \beta^2\right)\right) + 3.5` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) \left(3.` \left(1 + \alpha^2\right) \left(-0.75` + 3.75` \beta\right) + 0.6` \left(3.75` \left(1 + \alpha^2\right) + 0.75` \left(1 + \alpha^2\right) \beta - \left(4.58` + 3.5` \alpha\right) \left(1 + \beta^2\right)\right)\right) + 1.2` \left(2.4` \left(3.75` \left(-2 - \alpha^2 + \alpha^4\right) - 0.75` \left(2 + \alpha^2 - \alpha^4\right) \beta - \left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right) \left(1 + \beta^2\right)\right) - \alpha \left(11.25` \left(1 + \alpha^2\right) + 2.25` \left(1 + \alpha^2\right) \beta + \left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right) \left(1 + \beta^2\right)\right)\right)\right) k_r,$$
$$k_r \to \Big\{2.0923001696697345` \sqrt{\Big(\left(1 + \beta^2\right)^2 \Big/ \Big(12.25` \left(2 - 7.199999999999999` \alpha - \alpha^2\right)^2 \left(-0.75` + 3.75` \beta\right)^2 + 4 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)^2 \left(-0.75` + 3.75` \beta\right)^2 + 14.592400000000001` \left(3.` - 0.6` \beta\right)^2 \left(1 + \beta^2\right)^2 + 15.280000000000001` \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right) \left(1 + \beta^2\right) \left(3.` \left(-0.75` + 3.75` \beta\right) + 0.6` \left(0.75` \beta + 3.75` \left(2 + \beta^2\right)\right)\right) + 7.` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) \Big(2 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right) \left(-0.75` + 3.75` \beta\right)^2 + 3.8200000000000003` \left(1 + \beta^2\right) \left(3.` \left(-0.75` + 3.75` \beta\right) + 0.6` \left(0.75` \beta + 3.75` \left(2 + \beta^2\right)\right)\right)\Big)\Big)\Big)\Big\},$$
$$\gamma_r \to 3.5` k_i^2 - \frac{1}{1 + \alpha^2} 0.2617801047120419` \left(4 \left(2.4` + \alpha\right) \left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right) - 3.5` \left(7.` \alpha \left(-2 + \alpha^2\right) + 13.74` \left(-1 + \alpha^2\right) + 2.4` \left(27.48` \alpha - 3.5` \left(1 - 5 \alpha^2\right)\right)\right)\right) k_r^2,\ \gamma_i \to$$
$$2 k_r \left(3.5` k_i + \frac{1}{1 + \alpha^2} 0.2617801047120419` \left(3.5` \left(-1 + 2.4` \alpha\right) \left(-13.74` \alpha - 3.5` \left(-2 + \alpha^2\right)\right) + 2 \left(-3.5` + 4.58` \alpha\right) \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right)\right) k_r\right), \text{OR}, \gamma_r \to$$
$$\Big(0.3` \left(1 + \beta^2\right)^2 \Big(3.8200000000000003` \left(-1 - \alpha^2\right) \left(4 \left(2.4` + \alpha\right) \left(-10.5` \alpha + 4.58` \left(-2 + \alpha^2\right)\right) - 3.5` \left(7.` \alpha \left(-2 + \alpha^2\right) + 13.74` \left(-1 + \alpha^2\right) + 2.4` \left(27.48` \alpha - 3.5` \left(1 - 5 \alpha^2\right)\right)\right)\right) + \frac{1}{\left(1 + \beta^2\right)^2} 2.4305555555555554` \left(1.3752` \left(1 + \alpha^2\right) \left(1 + \beta^2\right) + 3.` \left(1 + \alpha^2\right) \left(2 \left(-3 \alpha + 2.4` \left(-2 + \alpha^2\right)\right) \left(-0.75` + 3.75` \beta\right) + 11.46` \left(1 + \beta^2\right)\right) + 3.5` \left(2 - 7.199999999999999` \alpha - \alpha^2\right) \left(3.` \left(1 + \alpha^2\right) \left(-0.75` + 3.75` \beta\right) + 0.6` \left(3.75` \left(1 + \alpha^2\right) + 0.75` \left(1 + \alpha^2\right) \beta - \left(4.58` + 3.5` \alpha\right) \left(1 + \beta^2\right)\right)\right) + 1.2` \left(2.4` \left(3.75` \left(-2 - \alpha^2 + \alpha^4\right) - 0.75` \left(2 + \alpha^2 - \alpha^4\right) \beta -$$

```
                    (-10.5` α + 4.58` (-2 + α^2)) (1 + β^2)) - α (11.25` (1 + α^2) +
                    2.25` (1 + α^2) β + (-10.5` α + 4.58` (-2 + α^2)) (1 + β^2))))^2)) /
  ((1 + α^2)^2 (12.25` (2 - 7.199999999999999` α - α^2)^2 (-0.75` + 3.75` β)^2 +
      4 (-3 α + 2.4` (-2 + α^2))^2 (-0.75` + 3.75` β)^2 +
      14.592400000000001` (3.` - 0.6` β)^2 (1 + β^2)^2 +
      15.280000000000001` (-3 α + 2.4` (-2 + α^2)) (1 + β^2)
       (3.` (-0.75` + 3.75` β) + 0.6` (0.75` β + 3.75` (2 + β^2))) +
      7.` (2 - 7.199999999999999` α - α^2)
       (2 (-3 α + 2.4` (-2 + α^2)) (-0.75` + 3.75` β)^2 + 3.8200000000000003`
          (1 + β^2) (3.` (-0.75` + 3.75` β) + 0.6` (0.75` β + 3.75` (2 + β^2))))))),
 γi → (2.2920000000000003` (1 + β^2)^2 (3.5` (-1 + 2.4` α) (-13.74` α - 3.5` (-2 + α^2)) +
      2 (-3.5` + 4.58` α) (-3 α + 2.4` (-2 + α^2)) +
      1/(1 + β^2) 2.916666666666667` (1.3752` (1 + α^2) (1 + β^2) +
         3.` (1 + α^2) (2 (-3 α + 2.4` (-2 + α^2)) (-0.75` + 3.75` β) + 11.46` (1 + β^2)) +
         3.5` (2 - 7.199999999999999` α - α^2) (3.` (1 + α^2) (-0.75` + 3.75` β) +
            0.6` (3.75` (1 + α^2) + 0.75` (1 + α^2) β - (4.58` + 3.5` α) (1 + β^2))) +
         1.2` (2.4` (3.75` (-2 - α^2 + α^4) - 0.75` (2 + α^2 - α^4) β -
               (-10.5` α + 4.58` (-2 + α^2)) (1 + β^2)) - α (11.25` (1 + α^2) +
               2.25` (1 + α^2) β + (-10.5` α + 4.58` (-2 + α^2)) (1 + β^2)))))) /
  ((1 + α^2) (12.25` (2 - 7.199999999999999` α - α^2)^2 (-0.75` + 3.75` β)^2 +
      4 (-3 α + 2.4` (-2 + α^2))^2 (-0.75` + 3.75` β)^2 +
      14.592400000000001` (3.` - 0.6` β)^2 (1 + β^2)^2 +
      15.280000000000001` (-3 α + 2.4` (-2 + α^2)) (1 + β^2)
       (3.` (-0.75` + 3.75` β) + 0.6` (0.75` β + 3.75` (2 + β^2))) +
      7.` (2 - 7.199999999999999` α - α^2)
       (2 (-3 α + 2.4` (-2 + α^2)) (-0.75` + 3.75` β)^2 + 3.8200000000000003`
          (1 + β^2) (3.` (-0.75` + 3.75` β) + 0.6` (0.75` β + 3.75` (2 + β^2))))))),
 {19.116` - 2.6729999999999987` α + 1.9020000000000001` α^2 -
    6.876` β -
    11.46` β^2 → 0,
  21.132` + 41.00099999999999` α - 8.274000000000001` α^2 +
    34.38` β -
    2.2920000000000003` β^2 → 0}}
```

Out[•]=

$$\left\{\Omega_2 \to -1.25 - 12.\, k_r^2 + 2.4\, k_r\, K_2 + 3.\, K_2^2,\right.$$
$$\omega_i \to -2\, k_i^2 + 7.\, k_i\, k_r + 2\, k_r^2 + \gamma_i,\ \omega_r \to -3.5\, k_i^2 - 4\, k_i\, k_r + 3.5\, k_r^2 + \gamma_r,$$
$$\left.\mu^* \to \frac{1.04712\left(-3.5\left(2 - 7.2\,\alpha - \alpha^2\right) - 2\left(-3\,\alpha + 2.4\left(-2 + \alpha^2\right)\right)\right) k_r^2}{\mu},\right.$$

$$\eta^* \to \frac{1.04712\left(-3.5\left(-13.74\,\alpha-3.5\left(-2+\alpha^2\right)\right)-2\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\right)k_r^2}{\eta},\ K_2 \to$$

$$\frac{1}{\left(-3.+0.6\,\beta\right)k_r}0.13089\left(-15.28\,k_i\,k_r+\left(-3.5\left(4.58+2.4\left(-3.5+22.5\,\alpha\right)+7.5\left(-2+\alpha^2\right)\right)+\right.\right.$$
$$\left.\left.2\left(7.5\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)+2.292\left(1+\beta^2\right)\right)\right)k_r^2+3.82\left(-3.5\,k_i^2+\gamma_r\right)\right),$$

$$k_i \to \frac{1}{\left(1+\alpha^2\right)\left(1+\beta^2\right)}0.21815\left(1.3752\left(1+\alpha^2\right)\left(1+\beta^2\right)+\right.$$
$$3.\left(1+\alpha^2\right)\left(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)+11.46\left(1+\beta^2\right)\right)+$$
$$3.5\left(2-7.2\,\alpha-\alpha^2\right)\left(3.\left(1+\alpha^2\right)\left(-0.75+3.75\,\beta\right)+\right.$$
$$\left.0.6\left(3.75\left(1+\alpha^2\right)+0.75\left(1+\alpha^2\right)\beta-\left(4.58+3.5\,\alpha\right)\left(1+\beta^2\right)\right)\right)+$$
$$1.2\left(2.4\left(3.75\left(-2-\alpha^2+\alpha^4\right)-0.75\left(2+\alpha^2-\alpha^4\right)\beta-\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)-\right.$$
$$\left.\left.\alpha\left(11.25\left(1+\alpha^2\right)+2.25\left(1+\alpha^2\right)\beta+\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)\right)\right)k_r,$$

$$k_r \to \left\{2.0923\sqrt{\left(\left(1+\beta^2\right)^2\Big/\left(12.25\left(2-7.2\,\alpha-\alpha^2\right)^2\left(-0.75+3.75\,\beta\right)^2+\right.\right.\right.$$
$$4\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)^2\left(-0.75+3.75\,\beta\right)^2+14.5924\left(3.-0.6\,\beta\right)^2\left(1+\beta^2\right)^2+15.28$$
$$\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)+$$
$$7.\left(2-7.2\,\alpha-\alpha^2\right)\left(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)^2+\right.$$
$$\left.\left.\left.\left.3.82\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)\right)\right)\right)\right\},$$

$$\gamma_r \to 3.5\,k_i^2-\frac{1}{1+\alpha^2}0.26178\left(4\left(2.4+\alpha\right)\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)-\right.$$
$$\left.3.5\left(7.\,\alpha\left(-2+\alpha^2\right)+13.74\left(-1+\alpha^2\right)+2.4\left(27.48\,\alpha-3.5\left(1-5\,\alpha^2\right)\right)\right)\right)k_r^2,$$

$$\gamma_i \to 2\,k_r\left(3.5\,k_i+\frac{1}{1+\alpha^2}0.26178\left(3.5\left(-1+2.4\,\alpha\right)\left(-13.74\,\alpha-3.5\left(-2+\alpha^2\right)\right)+\right.\right.$$
$$\left.\left.2\left(-3.5+4.58\,\alpha\right)\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\right)k_r\right),\ \text{OR},$$

$$\gamma_r \to \left(0.3\left(1+\beta^2\right)^2\left(3.82\left(-1-\alpha^2\right)\left(4\left(2.4+\alpha\right)\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)-\right.\right.\right.$$
$$\left.\left.\left.3.5\left(7.\,\alpha\left(-2+\alpha^2\right)+13.74\left(-1+\alpha^2\right)+2.4\left(27.48\,\alpha-3.5\left(1-5\,\alpha^2\right)\right)\right)\right)+\right.$$
$$\frac{1}{\left(1+\beta^2\right)^2}2.43056\left(1.3752\left(1+\alpha^2\right)\left(1+\beta^2\right)+3.\left(1+\alpha^2\right)\right.$$
$$\left(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)+11.46\left(1+\beta^2\right)\right)+$$
$$3.5\left(2-7.2\,\alpha-\alpha^2\right)\left(3.\left(1+\alpha^2\right)\left(-0.75+3.75\,\beta\right)+0.6\left(3.75\left(1+\alpha^2\right)+0.75\right.\right.$$
$$\left.\left(1+\alpha^2\right)\beta-\left(4.58+3.5\,\alpha\right)\left(1+\beta^2\right)\right)+1.2\left(2.4\left(3.75\left(-2-\alpha^2+\alpha^4\right)-\right.\right.$$
$$\left.\left.\left.\left.0.75\left(2+\alpha^2-\alpha^4\right)\beta-\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)-\alpha\left(11.25\right.\right.\right.\right.$$
$$\left.\left.\left.\left.\left.\left(1+\alpha^2\right)+2.25\left(1+\alpha^2\right)\beta+\left(-10.5\,\alpha+4.58\left(-2+\alpha^2\right)\right)\left(1+\beta^2\right)\right)\right)\right)^2\right)\Big/$$
$$\left(\left(1+\alpha^2\right)^2\left(12.25\left(2-7.2\,\alpha-\alpha^2\right)^2\left(-0.75+3.75\,\beta\right)^2+4\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)^2\right.\right.$$
$$\left(-0.75+3.75\,\beta\right)^2+14.5924\left(3.-0.6\,\beta\right)^2\left(1+\beta^2\right)^2+15.28\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)$$
$$\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)+$$
$$7.\left(2-7.2\,\alpha-\alpha^2\right)\left(2\left(-3\,\alpha+2.4\left(-2+\alpha^2\right)\right)\left(-0.75+3.75\,\beta\right)^2+\right.$$
$$\left.\left.\left.3.82\left(1+\beta^2\right)\left(3.\left(-0.75+3.75\,\beta\right)+0.6\left(0.75\,\beta+3.75\left(2+\beta^2\right)\right)\right)\right)\right)\right),$$

$$\gamma_i \to \Bigg(2.292\,\left(1+\beta^2\right)^2\,\Big(3.5\,\left(-1+2.4\,\alpha\right)\,\left(-13.74\,\alpha-3.5\,\left(-2+\alpha^2\right)\right)+$$
$$2\,\left(-3.5+4.58\,\alpha\right)\,\left(-3\,\alpha+2.4\,\left(-2+\alpha^2\right)\right)+\frac{1}{1+\beta^2}\,2.91667\,\Big(1.3752\,\left(1+\alpha^2\right)\,\left(1+\beta^2\right)+$$
$$3.\,\left(1+\alpha^2\right)\,\left(2\,\left(-3\,\alpha+2.4\,\left(-2+\alpha^2\right)\right)\right)\,\left(-0.75+3.75\,\beta\right)+11.46\,\left(1+\beta^2\right)\Big)+$$
$$3.5\,\left(2-7.2\,\alpha-\alpha^2\right)\,\Big(3.\,\left(1+\alpha^2\right)\,\left(-0.75+3.75\,\beta\right)+$$
$$0.6\,\Big(3.75\,\left(1+\alpha^2\right)+0.75\,\left(1+\alpha^2\right)\,\beta-\left(4.58+3.5\,\alpha\right)\,\left(1+\beta^2\right)\Big)\Big)+1.2\,\Big(2.4\,\Big(3.75$$
$$\left(-2-\alpha^2+\alpha^4\right)-0.75\,\left(2+\alpha^2-\alpha^4\right)\,\beta-\left(-10.5\,\alpha+4.58\,\left(-2+\alpha^2\right)\right)\,\left(1+\beta^2\right)\Big)-$$
$$\alpha\,\Big(11.25\,\left(1+\alpha^2\right)+2.25\,\left(1+\alpha^2\right)\,\beta+\left(-10.5\,\alpha+4.58\,\left(-2+\alpha^2\right)\right)\,\left(1+\beta^2\right)\Big)\Big)\Big)\Bigg)\Big/$$
$$\Big(\left(1+\alpha^2\right)\,\Big(12.25\,\left(2-7.2\,\alpha-\alpha^2\right)^2\,\left(-0.75+3.75\,\beta\right)^2+4\,\left(-3\,\alpha+2.4\,\left(-2+\alpha^2\right)\right)^2$$
$$\left(-0.75+3.75\,\beta\right)^2+14.5924\,\left(3.-0.6\,\beta\right)^2\,\left(1+\beta^2\right)^2+15.28\,\left(-3\,\alpha+2.4\,\left(-2+\alpha^2\right)\right)$$
$$\left(1+\beta^2\right)\,\left(3.\,\left(-0.75+3.75\,\beta\right)+0.6\,\left(0.75\,\beta+3.75\,\left(2+\beta^2\right)\right)\right)+$$
$$7.\,\left(2-7.2\,\alpha-\alpha^2\right)\,\Big(2\,\left(-3\,\alpha+2.4\,\left(-2+\alpha^2\right)\right)\,\left(-0.75+3.75\,\beta\right)^2+$$
$$3.82\,\left(1+\beta^2\right)\,\left(3.\,\left(-0.75+3.75\,\beta\right)+0.6\,\left(0.75\,\beta+3.75\,\left(2+\beta^2\right)\right)\right)\Big)\Big)\Big),$$
$$\Big\{19.116-2.673\,\alpha+1.902\,\alpha^2-6.876\,\beta-11.46\,\beta^2\to$$
$$0,$$
$$21.132+41.001\,\alpha-$$
$$8.274\,\alpha^2+$$
$$34.38\,\beta-$$
$$2.292\,\beta^2\to 0\Big\}\Big\}$$

In[•]:=
```
ReplaceAll[%, {α → 1.3738827227222048`, β → -1.6232099992963207`}]
```

Out[•]=
$$\Big\{\Omega_2\to -1.25-12.\,k_r^2+2.4\,k_r\,K_2+3.\,K_2^2,\ \omega_i\to -2\,k_i^2+7.\,k_i\,k_r+2\,k_r^2+\gamma_i,$$
$$\omega_r\to -3.5\,k_i^2-4\,k_i\,k_r+3.5\,k_r^2+\gamma_r,\ \mu^*\to\frac{45.038\,k_r^2}{\mu},\ \eta^*\to\frac{99.0305\,k_r^2}{\eta},$$
$$K_2\to -\frac{0.0329372\,\left(-15.28\,k_i\,k_r-292.553\,k_r^2+3.82\,\left(-3.5\,k_i^2+\gamma_r\right)\right)}{k_r},\ k_i\to 76.5034\,k_r,$$
$$k_r\to\{0.0237617\},\ \gamma_r\to 3.5\,k_i^2+75.2138\,k_r^2,\ \gamma_i\to 2\,\left(3.5\,k_i-15.697\,k_r\right)\,k_r,$$
$$\text{OR},\ \gamma_r\to 11.6085,\ \gamma_i\to 0.28464,\ \Big\{0.\to 0,\ -1.42109\times 10^{-14}\to 0\Big\}\Big\}$$

In[•]:=
```
ReplaceAll[%, k_r → 0.023761652736403918`]
```

Out[•]=
$$\Big\{\Omega_2\to -1.25678+0.057028\,K_2+3.\,K_2^2,\ \omega_i\to 0.00112923+0.166332\,k_i-2\,k_i^2+\gamma_i,$$
$$\omega_r\to 0.00197616-0.0950466\,k_i-3.5\,k_i^2+\gamma_r,\ \mu^*\to\frac{0.0254292}{\mu},\ \eta^*\to\frac{0.0559142}{\eta},$$
$$K_2\to -1.38615\,\left(-0.16518-0.363078\,k_i+3.82\,\left(-3.5\,k_i^2+\gamma_r\right)\right),\ k_i\to 1.81785,$$
$$0.0237617\to\{0.0237617\},\ \gamma_r\to 0.0424669+3.5\,k_i^2,\ \gamma_i\to 0.0475233\,\left(-0.372987+3.5\,k_i\right),$$
$$\text{OR},\ \gamma_r\to 11.6085,\ \gamma_i\to 0.28464,\ \Big\{0.\to 0,\ -1.42109\times 10^{-14}\to 0\Big\}\Big\}$$

In[•]:= **ReplaceAll[%, k_i → 1.8178468865375728`]**

Out[•]= $\{\Omega_2 \to -1.25678 + 0.057028\, K_2 + 3.\, K_2^2,\ \omega_i \to -6.30564 + \gamma_i,\ \omega_r \to -11.7368 + \gamma_r,$
$\mu^* \to \frac{0.0254292}{\mu},\ \eta^* \to \frac{0.0559142}{\eta},\ K_2 \to -1.38615\,(-0.8252 + 3.82\,(-11.566 + \gamma_r)),$
$1.81785 \to 1.81785,\ 0.0237617 \to \{0.0237617\},\ \gamma_r \to 11.6085,\ \gamma_i \to 0.28464,$
$OR,\ \gamma_r \to 11.6085,\ \gamma_i \to 0.28464,\ \{0. \to 0,\ -1.42109 \times 10^{-14} \to 0\}\}$

In[•]:= **ReplaceAll[%, {γ_r → 11.608452507900731`, $\gamma_i$ → 0.2846397709554432`}]**

Out[•]= $\{\Omega_2 \to -1.25678 + 0.057028\, K_2 + 3.\, K_2^2,\ \omega_i \to -6.021,\ \omega_r \to -0.128337,$
$\mu^* \to \frac{0.0254292}{\mu},\ \eta^* \to \frac{0.0559142}{\eta},\ K_2 \to 0.918985,\ 1.81785 \to 1.81785,$
$0.0237617 \to \{0.0237617\},\ 11.6085 \to 11.6085,\ 0.28464 \to 0.28464,\ OR,$
$11.6085 \to 11.6085,\ 0.28464 \to 0.28464,\ \{0. \to 0,\ -1.42109 \times 10^{-14} \to 0\}\}$

In[•]:= **ReplaceAll[%, {K_2 → 0.9189851062101754`}]**

Out[•]= $\{\Omega_2 \to 1.32923,\ \omega_i \to -6.021,\ \omega_r \to -0.128337,\ \mu^* \to \frac{0.0254292}{\mu},$
$\eta^* \to \frac{0.0559142}{\eta},\ 0.918985 \to 0.918985,\ 1.81785 \to 1.81785,$
$0.0237617 \to \{0.0237617\},\ 11.6085 \to 11.6085,\ 0.28464 \to 0.28464,\ OR,$
$11.6085 \to 11.6085,\ 0.28464 \to 0.28464,\ \{0. \to 0,\ -1.42109 \times 10^{-14} \to 0\}\}$

In[•]:= **{Ω_2 → {-1.2525247614224269` + 0.034812145621389894` K_2 + 3.` K_2^2},**
ω_i → {{-4.975044265387293`}}, $\omega_r$ → {{-0.07772005931293613`}},
μ^* → $\left\{\frac{0.017418402468302074`}{\mu}\right\}$, $\eta^*$ → $\left\{\frac{0.04603560408748697`}{\eta}\right\}$,
K_2 → {{0.9171566452103205`}}, {1.6267301220247674`} → {1.6267301220247674`},
{0.014505060675579122`} → {0.014505060675579122`},
9.277804943089405` → {{9.277804943089407`}},
0.1518659869884017` → {{0.15186598698840165`}}, OR,
9.277804943089405` → 9.277804943089405`, 0.1518659869884017` → 0.1518659869884017`,
{7.105427357601002`*^-15 → 0, -5.684341886080802`*^-14 → 0}}

Out[•]= $\{\Omega_2 \to \{-1.25252 + 0.0348121\, K_2 + 3.\, K_2^2\},\ \omega_i \to \{\{-4.97504\}\},\ \omega_r \to \{\{-0.0777201\}\},$
$\mu^* \to \left\{\frac{0.0174184}{\mu}\right\},\ \eta^* \to \left\{\frac{0.0460356}{\eta}\right\},\ K_2 \to \{\{0.917157\}\},\ \{1.62673\} \to \{1.62673\},$
$\{0.0145051\} \to \{0.0145051\},\ 9.2778 \to \{\{9.2778\}\},\ 0.151866 \to \{\{0.151866\}\},\ OR,$
$9.2778 \to 9.2778,\ 0.151866 \to 0.151866,\ \{7.10543 \times 10^{-15} \to 0,\ -5.68434 \times 10^{-14} \to 0\}\}$

Out[•]= $\{\Omega_2 \to \{1.30293\},\ \omega_i \to \{\{-4.97504\}\},\ \omega_r \to \{\{-0.0777201\}\},\ \mu^* \to \left\{\frac{0.0174184}{\mu}\right\},$
$\eta^* \to \left\{\frac{0.0460356}{\eta}\right\},\ 0.917157 \to \{\{0.917157\}\},\ \{1.62673\} \to \{1.62673\},$
$\{0.0145051\} \to \{0.0145051\},\ 9.2778 \to \{\{9.2778\}\},\ 0.151866 \to \{\{0.151866\}\},\ OR,$
$9.2778 \to 9.2778,\ 0.151866 \to 0.151866,\ \{7.10543 \times 10^{-15} \to 0,\ -5.68434 \times 10^{-14} \to 0\}\}$

$$\left\{\alpha \to 1.3738827227222048`,\ \beta \to -1.6232099992963207`,\ k_r \to 0.023761652736403918`,\ k_i \to 1.8178468865375728`,\ \gamma_r \to 11.608452507900731`,\ \gamma_i \to 0.2846397709554432`,\ K_2 \to 0.9189851062101754`,\ \Omega_2 \to 1.329233334532061`,\ \omega_i \to -6.021000277430708`,\ \omega_r \to -0.1283370815202396`,\ \mu^* \to \frac{0.025429200130276934`}{\mu},\ \eta^* \to \frac{0.055914201497810824`}{\eta}\right\}$$

```
ReplaceAll[%, {α → 1.3738827227222048`, β → -1.6232099992963207`,
  k_r → 0.023761652736403918`, k_i → 1.8178468865375728`,
  γ_r → 11.608452507900731`, γ_i → 0.2846397709554432`, K_2 → 0.9189851062101754`,
  Ω_2 → 1.329233334532061`, ω_i → -6.021000277430708`, ω_r → -0.1283370815202396`,
  μ* → 0.025429200130276934`/μ, η* → 0.055914201497810824`/η}]
```

In[105]:=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x(-i k_i+k_r)+x(i k_i+k_r)+t(-i\omega_i+\omega_r)+t(i\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2 x k_r+2 t\omega_r}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{e^{4 x k_r+4 t\omega_r}\,\mu\,\mu^*}{\left(1+e^{2 x k_r+2 t\omega_r}\right)^2}\right\}$$

Out[105]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{e^{x(-i k_i+k_r)+x(i k_i+k_r)+t(-i\omega_i+\omega_r)+t(i\omega_i+\omega_r)}\,\eta\,\eta^*}{\left(1+e^{2 x k_r+2 t\omega_r}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{e^{4 x k_r+4 t\omega_r}\,\mu\,\mu^*}{\left(1+e^{2 x k_r+2 t\omega_r}\right)^2}\right\}$$

In[106]:=
```
ReplaceAll[%, {α → 1.3738827227222048`, β → -1.6232099992963207`,
  k_r → 0.023761652736403918`, k_i → 1.8178468865375728`,
  γ_r → 11.608452507900731`, γ_i → 0.2846397709554432`, K_2 → 0.9189851062101754`,
  Ω_2 → 1.329233334532061`, ω_i → -6.021000277430708`, ω_r → -0.1283370815202396`,
  μ* → 0.025429200130276934`/μ, η* → 0.055914201497810824`/η}]
```

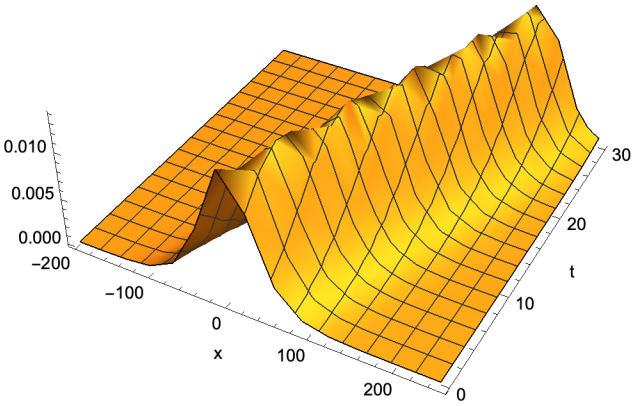
Out[106]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{0.0559142\,e^{(-0.256674+0.\,i)\,t+(0.0475233+0.\,i)\,x}}{\left(1+e^{-0.256674\,t+0.0475233\,x}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{0.0254292\,e^{-0.513348\,t+0.0950466\,x}}{\left(1+e^{-0.256674\,t+0.0475233\,x}\right)^2}\right\}$$

In[107]:=
```
Simplify[%]
```

Out[107]=
$$\left\{A[x,t]\,A^*[x,t] \to \frac{0.0559142\,e^{0.256674\,t+0.0475233\,x}}{\left(e^{0.256674\,t}+e^{0.0475233\,x}\right)^2},\ B[x,t]\,B^*[x,t] \to \frac{0.0254292\,e^{0.0950466\,x}}{\left(e^{0.256674\,t}+e^{0.0475233\,x}\right)^2}\right\}$$

In[108]:=
```
Plot3D[0.055914201497810824` ℯ^(0.2566741630404792` t+0.047523305472807836` x) / (ℯ^(0.2566741630404792` t) + ℯ^(0.047523305472807836` x))^2, {x, -200, 250},
 {t, 0, 30}, {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|A|^2  "}]
```

Out[108]=



In[109]:=
```
Plot3D[0.025429200130276934` ℯ^(0.09504661094561567` x) / (ℯ^(0.2566741630404792` t) + ℯ^(0.047523305472807836` x))^2, {x, -200, 250}, {t, 0, 20},
 {PlotRange → All}, Boxed → False, AxesLabel → {"x", "t", "|B|^2  "}]
```

Out[109]=