In[37]:=
```
ClearAll["Global`*"]
```

```
(* Define symbolic variables *)
γ = γ;
ω = ω;

(* Define Lindbladian matrix symbolically *)
LmatrixSymbolic = {
 {0, I * ω, - I * ω, γ},
 {I * ω, γ / 2 , 0, -I * ω},
 {-I * ω, 0, -γ / 2, I * ω},
 {0, -I * ω, I * ω, 0}
};
(* Solve the eigenvalue problem *)
eigenvalues = Eigenvalues[LmatrixSymbolic];
(* Find the eigenvectors (density matrices) *)
eigenvectors = Eigenvectors[LmatrixSymbolic];
eigenvalues
eigenvectors // Simplify

{a, b, c} = {eigenvalues[[2]], eigenvalues[[3]], eigenvalues[[4]]};
n_e = (Exp[a * t] + Exp[b * t] + Exp[c * t])^2
```

Out[43]=

$$\left\{0,\ \frac{\gamma}{2},\ \frac{1}{4}\left(-\gamma-\sqrt{\gamma^2-64\,\omega^2}\right),\ \frac{1}{4}\left(-\gamma+\sqrt{\gamma^2-64\,\omega^2}\right)\right\}$$

Out[44]=

$$\left\{\left\{\frac{i\,\gamma}{2\,\omega},\ 1,\ 1,\ 0\right\},\ \left\{1,\ \frac{i\,\gamma}{2\,\omega},\ 0,\ 1\right\},\right.$$

$$\left\{-\frac{\gamma^2+16\,\omega^2-\gamma\,\sqrt{\gamma^2-64\,\omega^2}}{16\,\omega^2},\ -\frac{i\left(-\gamma+\sqrt{\gamma^2-64\,\omega^2}\right)}{8\,\omega},\ \frac{i\left(3\,\gamma+\sqrt{\gamma^2-64\,\omega^2}\right)}{8\,\omega},\ 1\right\},$$

$$\left.\left\{-\frac{\gamma^2+16\,\omega^2+\gamma\,\sqrt{\gamma^2-64\,\omega^2}}{16\,\omega^2},\ \frac{i\left(\gamma+\sqrt{\gamma^2-64\,\omega^2}\right)}{8\,\omega},\ -\frac{i\left(-3\,\gamma+\sqrt{\gamma^2-64\,\omega^2}\right)}{8\,\omega},\ 1\right\}\right\}$$

Out[46]=

$$\left(e^{\frac{t\,\gamma}{2}}+e^{\frac{1}{4}\,t\left(-\gamma-\sqrt{\gamma^2-64\,\omega^2}\right)}+e^{\frac{1}{4}\,t\left(-\gamma+\sqrt{\gamma^2-64\,\omega^2}\right)}\right)^2$$