Electron coupling to a waveguide mode

$$\frac{\Gamma_{\parallel}(\omega,k_{\parallel})}{L} = \frac{2e^{2}}{\pi\hbar v^{2}} \frac{k e^{-2k_{\parallel}z_{e}}}{\sqrt{k_{\parallel}^{2} - \omega^{2}/v^{2}}} \left[\operatorname{Im}\left\{r_{123}^{\mathrm{s}}(k_{\parallel})\right\} + \operatorname{Im}\left\{r_{123}^{\mathrm{p}}(k_{\parallel})\right\}\right], \ r_{123}^{\nu} = r_{12}^{\nu} + \frac{t_{12}^{\nu}t_{21}^{\nu}r_{23}^{\nu}e^{2\mathrm{i}k_{z2}h}}{1 - r_{21}^{\nu}r_{23}^{\nu}e^{2\mathrm{i}k_{z2}h}}, \ h = \frac{t_{12}^{\nu}t_{22}^{\nu}e^{2\mathrm{i}k_{z2}h}}{1 - r_{21}^{\nu}r_{23}^{\nu}e^{2\mathrm{i}k_{z2}h}}, \ h = \frac{t_{12}^{\nu}t_{23}^{\nu}e^{2\mathrm{i}k_{z2}h}}{1 - r_{21}^{\nu}r_{23}^{\nu}e^{2\mathrm{i}k_{z2}h}}, \ h = \frac{t_{12}^{\nu}t_{23}^{\nu}e^{2\mathrm{i}k_{z2}h}}{1 - r_{22}^{\nu}r_{23}^{\nu}e^{2\mathrm{i}k_{z2}h}}, \ h = \frac{t$$



