31/10/2023

Clusters)

$$\Gamma_{sp} = \frac{2}{\hbar}\left|\overbrace{\frac{1}{1/\alpha_1 - G^{ref}}E^{ext}}^{p}\right|^2 \quad S_i \approx \frac{2}{\hbar}\frac{|E^{ext}|^2}{S_i}$$

$$S_i \gg S_i^0 = -\frac{2k^3}{3}$$

$$\Gamma_{EELS} = \frac{2}{\hbar}\left(|\alpha_2|^2 \frac{2k^3}{3}\right)\left(E^{ext}\right)^2 \approx \frac{2}{\hbar}\frac{|E^{ext}|^2}{S_i^0}$$

$G^{ref} = 0$

$\alpha_2 \in \mathbb{I}$ $\quad \alpha_2 = \frac{1}{\left(\frac{2k^3}{3}\right)} \Longrightarrow = \frac{1}{\left(\frac{2k^3}{3}\right)}$

S_i^{ref}

$$S_i^0 = \lim_{r\to 0}\left\{\left(k^2\mathbb{I} + \nabla\nabla\right)\frac{e^{ikr}}{r}\right\}$$

$$= \lim_{r\to 0}\mathrm{Im}\left\{\int \frac{d\vec{q}}{(2\pi)^3}\frac{4\pi e^{i\vec{q}\cdot\vec{r}}}{q^2-k^2-i0^+}\left(k^2\mathbb{I}-\vec{q}\vec{q}\right)\right\}$$

$$\overset{?}{=} -\frac{4\pi^2}{(2\pi)^3}\int d\vec{q}\;\delta(q^2-k^2)\left(k^2\mathbb{I}-\vec{q}\vec{q}\right)$$

$$\left(\int d\Omega\; q_x^2 = \frac{4\pi q^2}{3}\right)$$

$$= -\frac{1}{2\pi}\mathbb{I}\; 4\pi\int_0^\infty q^2\,dq\;\underbrace{\delta(q^2-k^2)}_{\frac{1}{2k}\delta(q-k)}\left(k^2-\frac{q^2}{3}\right)$$

$$= -\mathbb{I}\;\frac{1}{k}k^2k^2\left(1-\frac{1}{3}\right) = -\frac{2k^3}{3}\mathbb{I}$$

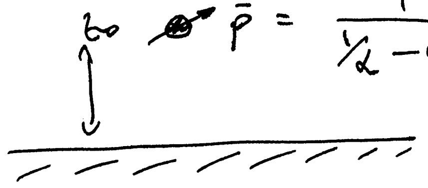
$$\frac{1}{\alpha_1} - G^{ref} = \mathrm{Im}\left\{\frac{1}{\alpha_1}\right\} - S_i$$

$$= -\frac{2k^3}{3} - S_i$$

$S_i \sim S_i^0$

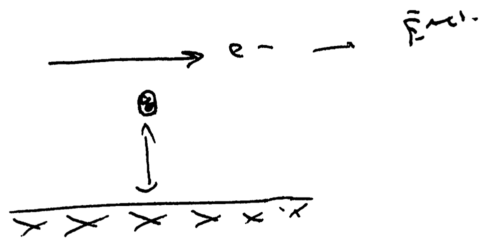
$$\frac{\Gamma_{sp}}{\Gamma_{EELS}} \approx \frac{S_i^0}{S_i} \ll 1 \quad \text{if} \quad S_i \gg S_i^0$$

intermediate distance $\longrightarrow S_i \sim S_i^0 \longrightarrow \Gamma_{sp}/\Gamma_{EELS} \sim 1$



$$\bar{p} = \frac{1}{1/\alpha - G} \text{ "}\bar{E}^{ext}\text{"}$$

$$\Gamma_{sp} = |p|^2 \; F$$



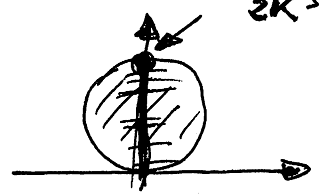
$$\mathrm{Im}\left\{\frac{-1}{\alpha}\right\} \leq \frac{2k^3}{3}$$

$=$ → lossless

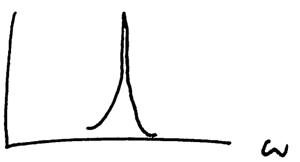
$$\mathrm{Re}\{1/\alpha\} = \mathrm{Re}\{G\}$$

lossless if $\mathrm{Re}\{\alpha\} = 0$

$$\rightarrow \mathrm{Im}\{\alpha\} = \frac{3}{2k^3}$$



$\Gamma_{EELS}(\omega)$



$$\left[\int d\omega \, \Gamma_{EELS}(\omega)\right] = 1$$

$$[\Gamma_{EELS}(\omega)] = \left[\frac{1}{\omega}\right] = T$$

$$[\bar{E}(t)] = \frac{C}{L^2}$$

$$[\bar{E}(\omega)] = \frac{C}{L^2}\left[\frac{1}{\omega}\right] = \frac{CT}{L^2}$$

31/01/2023

$$\Gamma_{sp} = \frac{2}{\hbar} \left| \frac{1}{1/\alpha_1 - S_{refl}} E^{ext} \right|^2 g^i_{refl}$$

$$\Gamma_{EELS} = \frac{2}{\hbar} \left| \underbrace{\frac{1}{\alpha_2} E^{ext}}_{(*)} \right|^2 (-S^i_0) \to \frac{2k^3}{3}$$

$$I_m \left\{ \frac{1}{\alpha_1}, \frac{1}{\alpha_2} \right\} \simeq -\frac{2k^3}{3}$$

$$\frac{2}{\hbar} |E^{ext}|^2 \left| \frac{\cancel{\alpha^i_{sp}}\ 1}{S^i_0 - S^i_{ref}} \right|^2 S^i_{ref}$$

$$\frac{2}{\hbar} |E^{ext}|^2 \frac{1}{S^i_0}$$

$$\frac{\Gamma_{sp}}{\Gamma_{EELS}} \sim 1 \qquad \frac{S^i_0}{S^i_{ref}} \sim 1$$

(*) $\boxed{\longrightarrow e^- \quad \varnothing}$: $\vec{\lambda}_e = \frac{e}{2\pi v} \cdot \frac{\omega}{v} \left[i K_0\left(\frac{\omega|b|}{v}\right); -2K_1\left(\frac{\omega|b|}{v}\right); -K_1\left(\frac{\omega|b|}{v}\right) \right]$

option 1 (without surface)

(*) option 2 : $\vec{\lambda}_x = \frac{1}{\alpha_2} \cdot \frac{ie}{2\pi v} \cdot \frac{\omega}{v} \left[K_0\left(\frac{\omega|b|}{v}\right) - 2\pi i \frac{R_p k_p}{\sqrt{k_p^2 - \omega^2/v^2}} e^{-k_p(2z_0 + |b|)} \right]$