

$$\rho(r) = \rho_0(r) [1 + \epsilon(r)]$$

$$F_0(\omega) \xleftrightarrow{FT} \rho_0(\vec{r})$$

$$A(\omega) \leftrightarrow \epsilon(\vec{r})$$

$$F(\omega) = F_0(\omega) + F_0(\omega) \otimes A(\omega)$$

$$F_0 \otimes A = \int d^3 q' A(q') F_0(\omega - \omega')$$

$$\epsilon(r) = \int e^{i q \cdot r} A(q) d^3 q$$

$$\rho_0(r) = \int e^{i q \cdot r} F_0(q) d^3 q$$

$$\epsilon(r) \rho_0(r) = \int d^3 q \int d^3 q' e^{i q \cdot r} e^{i q' \cdot r} A(q) F_0(q')$$

$$\epsilon(r) \rho(r) = \int d^3q \int d^3q' e^{i\mathbf{q}\cdot\mathbf{r}} e^{i\mathbf{q}'\cdot\mathbf{r}} A(\mathbf{q}) F_0(\mathbf{q}') \\ \mathbf{q} + \mathbf{q}' = \mathbf{q}_0$$

$$= \int d^3q_0 e^{i\mathbf{q}_0\cdot\mathbf{r}} \left[ \int d^3q A(\mathbf{q}) F_0(\mathbf{q}_0 - \mathbf{q}) \right]$$

$$\epsilon(r) \rho(r) \xrightarrow{\text{F.T.}} A(\mathbf{q}) F(\mathbf{q}_0 - \mathbf{q})$$

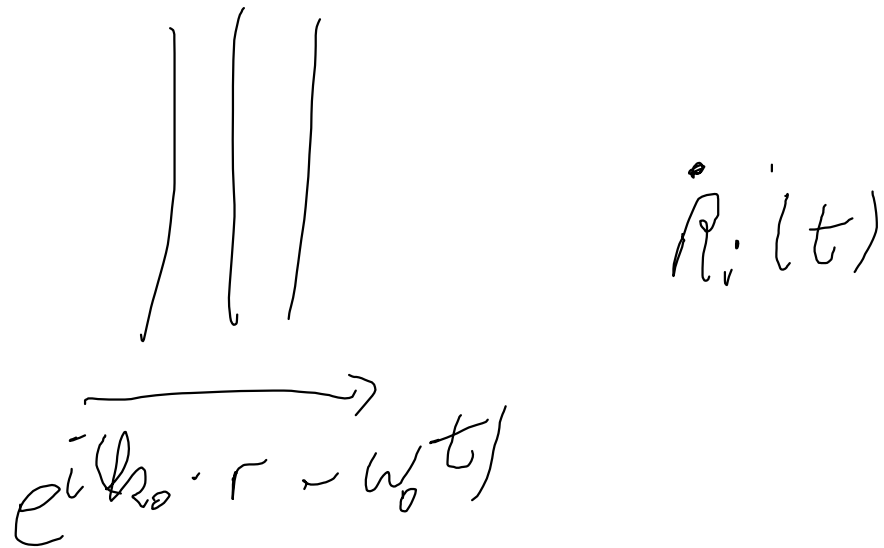
$$\bar{a}(\vec{k}) = a_0 \cos(\vec{k}\cdot\vec{r})$$

$$F(\mathbf{q}) = \frac{a_0}{2} \left( \delta(\mathbf{q} - \mathbf{k}) + \delta(\mathbf{q} + \mathbf{k}) \right)$$



$r_i(t)$  Scattering from a collection  
of moving nuclei

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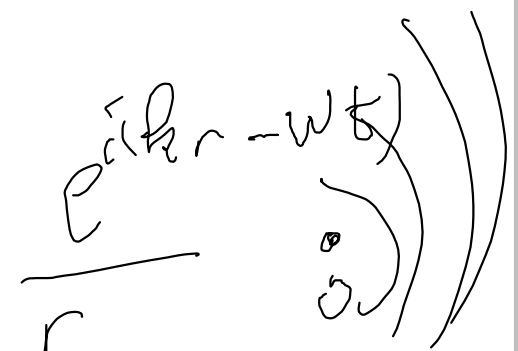


The diagram illustrates the scattering process. On the left, three vertical lines represent the wavefronts of an incident plane wave. An arrow points to the right from the center of these lines, indicating the direction of wave propagation. Below the arrow is the mathematical expression for the incident wave:  $e^{i(k_0 \cdot r - \omega_0 t)}$ . To the right of the wavefronts, a single dot represents a nucleus, with a vertical line passing through it. To the right of this nucleus is the expression  $\dot{R}_i(t)$ , representing the velocity of the nucleus.

$$\frac{a_i}{r} e^{i(k_2 r - \omega_2 t)} \quad \left[ \frac{a_i}{|\vec{r} - \vec{R}_i(t_i)|} e^{i(k_2 |\vec{r} - \vec{R}_i(t_i)| - \omega_2 (t - t_i))} \right] e^{i(k_1 \cdot \vec{R}_i(t_i) - \omega_1 t_i)}$$

~~$(r - R_i(t_i))$~~

$$\frac{a_i}{r} e^{i(k_2 r - \omega_2 t)}$$



Spherical wave from 0

Spherical wave from  $\vec{R}_i(t_i)$



$$\frac{a_i}{r} e^{i[\mathbf{k}_2 \cdot \vec{R}_i(t_i) - \omega_2(t-t_i)]} \times e^{i(\mathbf{k}_1 \cdot \vec{R}_i(t_i) - \omega_1 t_i)}$$

~~(r) X(t\_i)~~

$$\left( \frac{a_i}{r} \right) e^{i(\mathbf{k}_2 \cdot \vec{r} - \omega_2 t)} \left( e^{-i\mathbf{k}_2 \cdot \vec{R}_i(t_i) + i(\omega_2 - \omega_1)t_i} + i\mathbf{k}_1 \cdot \vec{R}_i(t_i) \right)$$

$$\sum_i \frac{a_i}{r} e^{i(\mathbf{k}_2 \cdot \vec{r} - \omega_2 t)} \left[ e^{i[\mathbf{Q} \cdot \vec{R}_i(t_i) + \Delta\omega t_i]} \right]$$

$$\sum_{i,j} (a_i a_j) e^{i\mathbf{Q} \cdot (\vec{R}_i - \vec{R}_j) + \Delta\omega t_i}$$

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