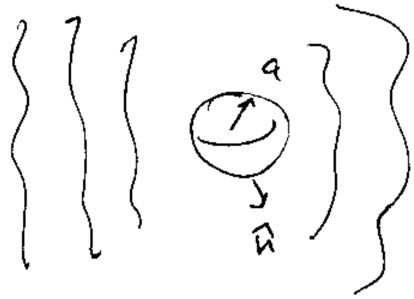
$$\begin{cases} \vec{E} = \vec{E}_{inc} + \vec{E}_{sc} \\ \vec{H} = \vec{H}_{inc} + \vec{H}_{sc} \end{cases}$$



<u>Scattered power:</u>

← surface of sphere

$$P_{sc} = \frac{a^2}{2} \int d\Omega \ \hat{n} \cdot \mathrm{Re}\left[\vec{E}_{sc} \times \vec{H}^*_{sc}\right] = \frac{a^2}{2} \int d\Omega \ \mathrm{Re}\left[\vec{E}_{sc} \times \vec{H}^*_{sc}\right] \cdot \hat{n}$$

$$= \frac{a^2}{2} \int d\Omega \ \mathrm{Re} \ \vec{E}_{sc} \cdot \left(\vec{H}^*_{sc} \times \hat{n}\right) = -\frac{a^2}{2} \int d\Omega \ \mathrm{Re} \ \vec{E}_{sc} \cdot \left(\hat{n} \times \vec{H}^*_{sc}\right)$$

Scattering cross section $\sigma_{scatt} = \dfrac{P_{scatt}}{S_{inc}}$

<u>Absorbed power:</u>

$$P_{abs} = \frac{1}{2} \int_{\text{surface of sphere}} da \left(-\hat{n} \cdot \vec{S}\right) = -\frac{a^2}{2} \int d\Omega \ \hat{n} \cdot \mathrm{Re}\left[\vec{E} \times \vec{H}^*\right]$$

$$= \frac{a^2}{2} \int d\Omega \ \mathrm{Re} \, \vec{E} \cdot \left(\hat{n} \times \vec{H}^*\right)$$

total power deposited inside the sphere!

$$P_{abs} = -\frac{1}{2} \int_{\text{surface of sphere}} da \ \vec{S} \cdot \hat{n} = -\frac{1}{2} \int_{\text{volume of sphere}} d^3x \ \vec{\nabla} \cdot \vec{S}$$

Now $\dfrac{\partial u}{\partial t} + \vec{\nabla} \cdot \vec{S} = -\vec{J} \cdot \vec{E}$ => as time-averaged

energy density is $\langle u \rangle = \frac{1}{4} \mathrm{Re}\left[\vec{E} \cdot \vec{D}^* + \vec{B} \cdot \vec{H}^*\right] \Rightarrow \dfrac{\partial \langle u \rangle}{\partial t} = 0$

$\Rightarrow \vec{\nabla} \cdot \vec{S} = -\vec{J} \cdot \vec{E}$

$$\Rightarrow P_{abs} = \frac{1}{2} \int_{\text{volume of the sphere}} d^3x \ \vec{J} \cdot \vec{E}$$

~ work done to move the charges inside.

$$\sigma_{abs} = \frac{P_{abs}}{S_{inc}}$$