Enhanced Absorption by Resonant Sites

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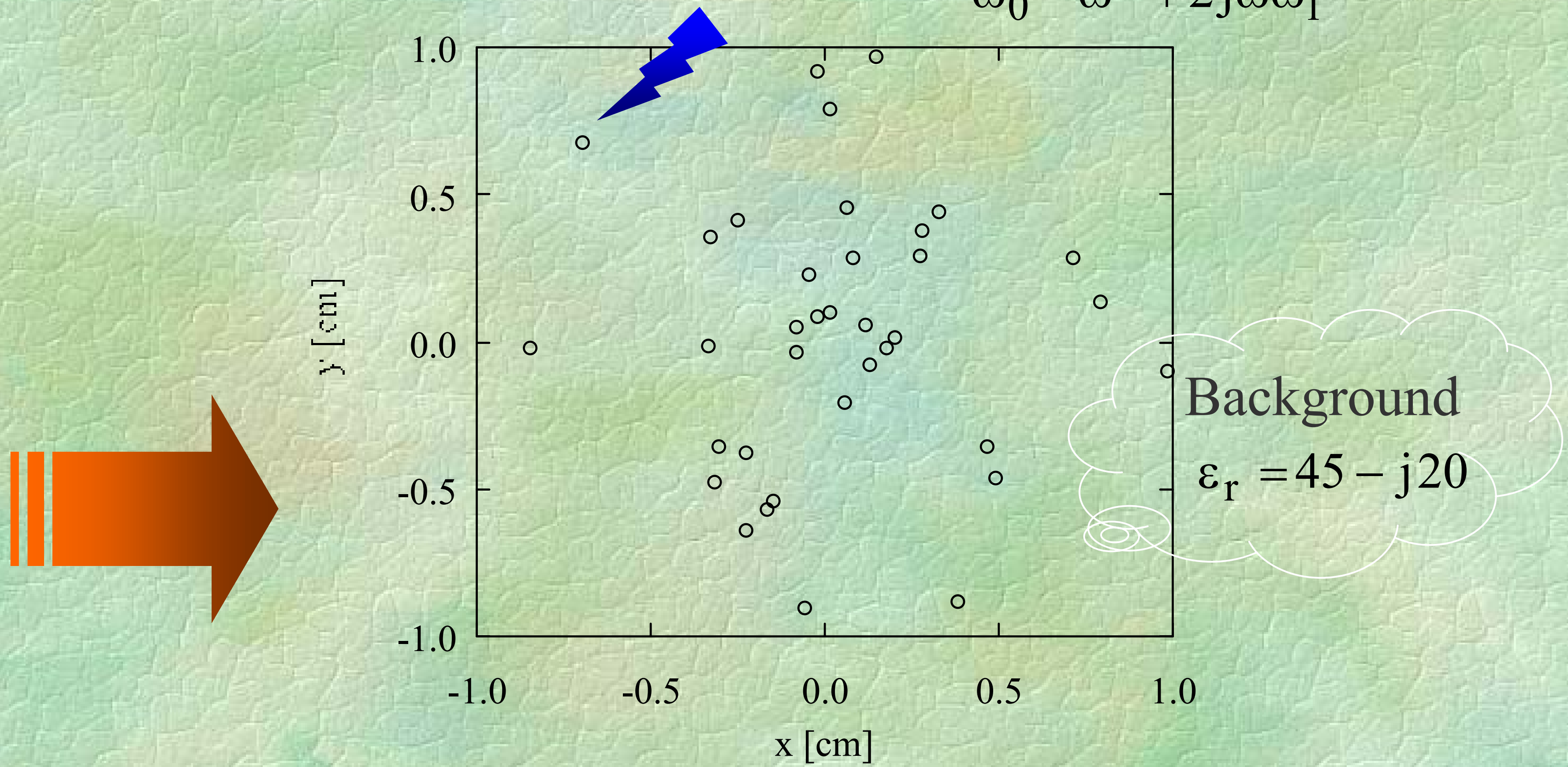
Basic Idea

- ***Global absorption - dielectric coeff.***
- ***External observer:***
  Individual resonances of molecules in vacuum are smeared out by lossy background.
- ***Resonant sites:***
  Experience enhanced absorption

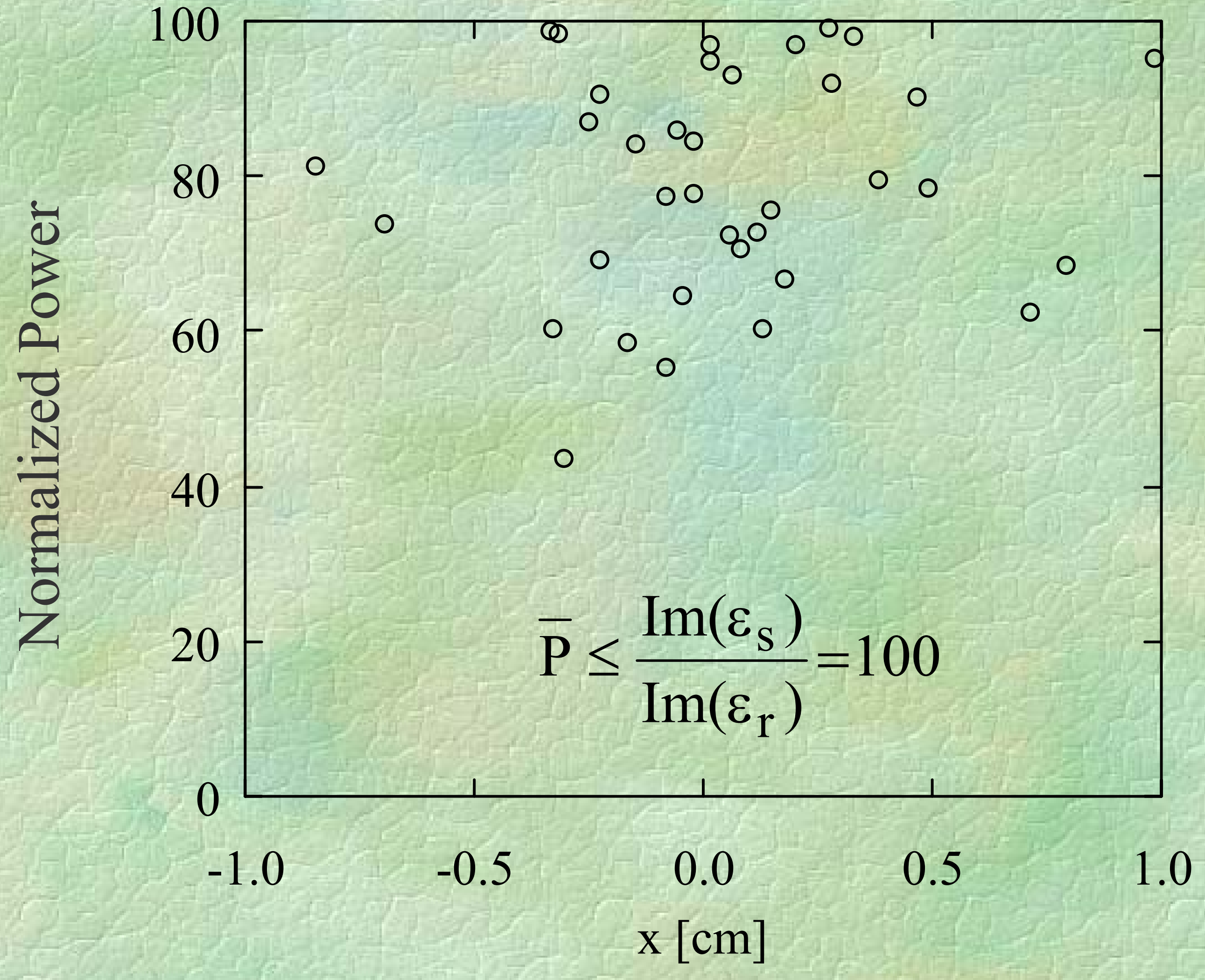
Resonant Sites

$$J_z = j\omega\varepsilon_0 \frac{\omega_p^2}{\omega_0^2 - \omega^2 + 2j\omega\omega_1} E_z$$

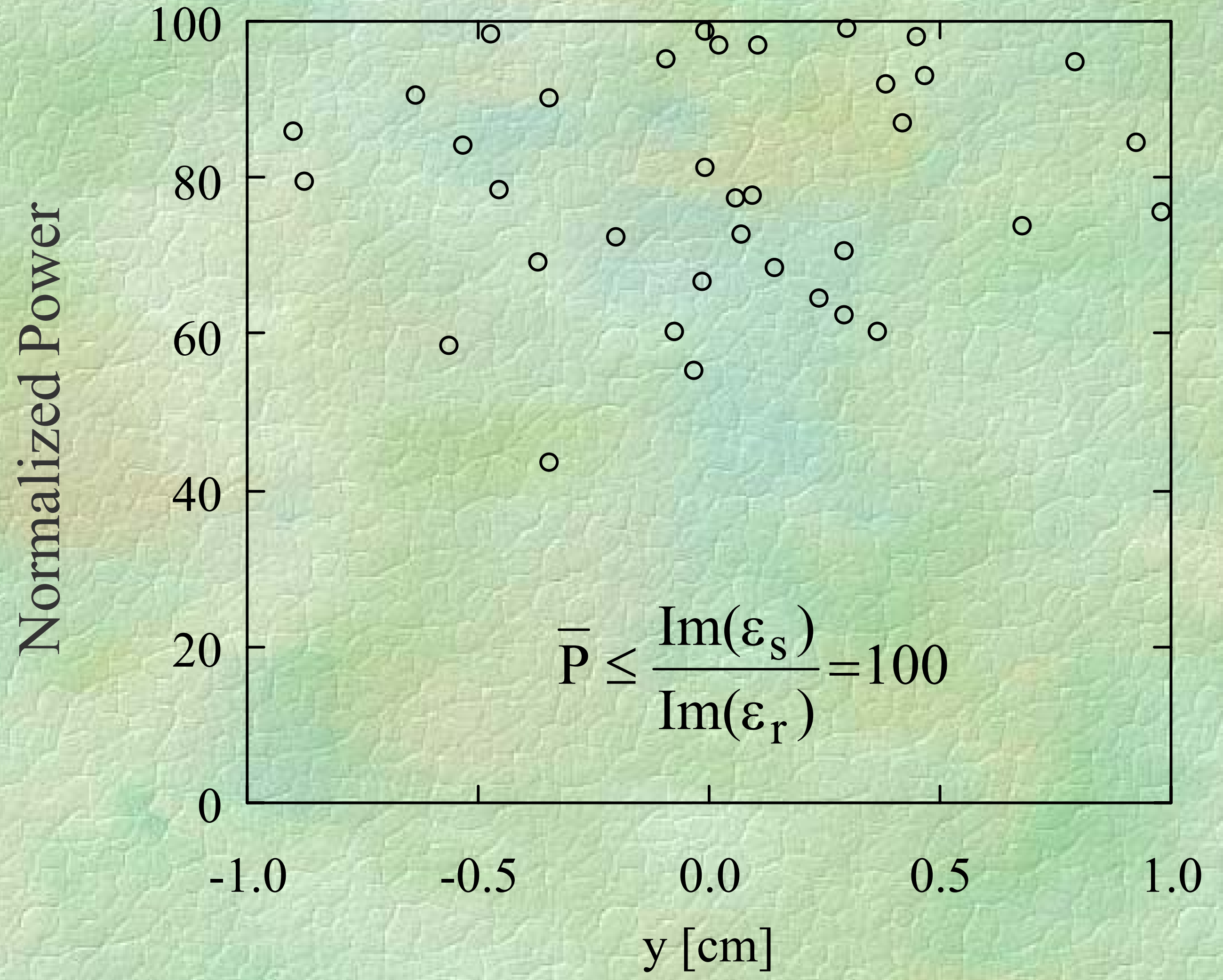


$$\text{Power} = \frac{1}{2}\mathrm{Re}\left(E_z J_z^*\right) = \frac{1}{2}\omega\varepsilon_0 \frac{\omega_p^2}{2\omega_0\omega_1}\left|E_z\right|^2 = \frac{1}{2}\omega\varepsilon_0\,\mathrm{Im}\left(\varepsilon_s\right)\left|E_z\right|^2$$

Enhanced Absorption



Enhanced Absorption



Conclusion

- It is possible to conceive a situation in which the volume of the resonant sites is very small compared to the control volume ($< 10^{-8}$) therefore even for a loss ratio of 100 the effect of the resonant sites on the absorbed power is negligible

$$\frac{\delta P}{P} \leq \frac{\mathrm{Im}(\varepsilon_s)}{\mathrm{Im}(\varepsilon_r)} \frac{\text{Volume of Resonant Sites}}{\text{Control Volume}}$$

- Consequently, although **locally** the power may be by a factor of 100 larger than the power absorbed in the background, there is no significant change in the **global** absorbed power as measured by an **external observer**.