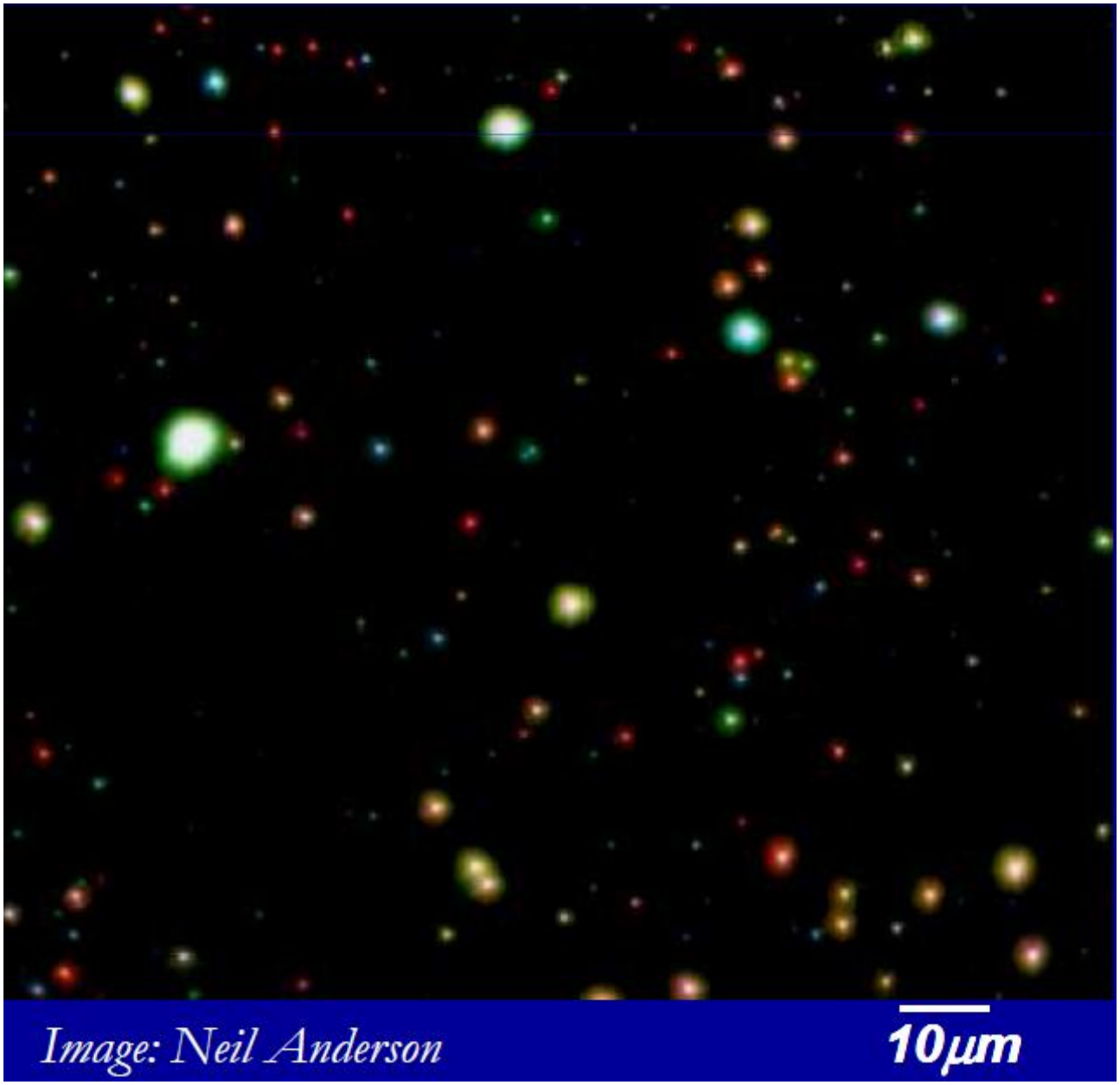


Image: Neil Anderson
10µm

Localized surface plasmons

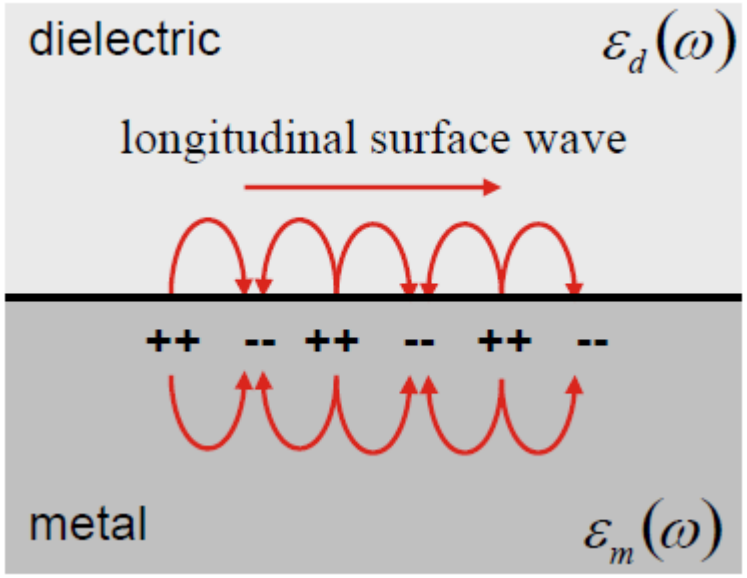
Sören Waßerroth

Excitation of surface plasmons

- Surface Plasmon Polariton
- Localized Surface Plasmon

Surface plasmon polariton

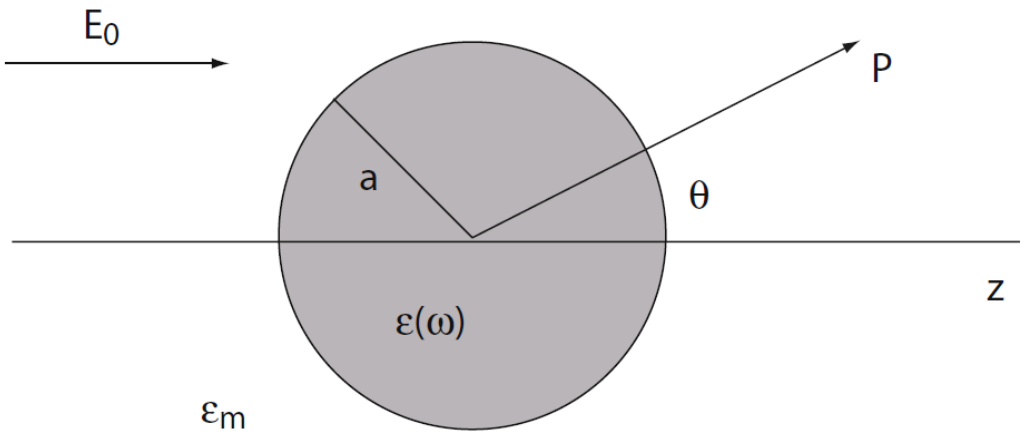
- propagating EM-waves @ interface
- special techniques to excite SPPs
  - prisms, gratings →match wave vectors



Localized surface plasmons

Localized surface plasmon

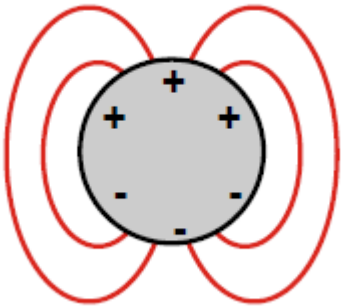
- Assumptions:
  - metallic particle
  - $d \ll \lambda$ (d<100nm)
  - constant E-field



- Solve Laplace's equation: $\nabla^2 \Phi = 0$

Quasi static approximation

$$\Phi_{out} = \underbrace{-E_0 r\cos(\Theta)}_{\text{applied field}} + \underbrace{\frac{\vec{p}\cdot\vec{r}}{4\pi\varepsilon_0\varepsilon_m r^3}}_{\text{dipole field}}$$



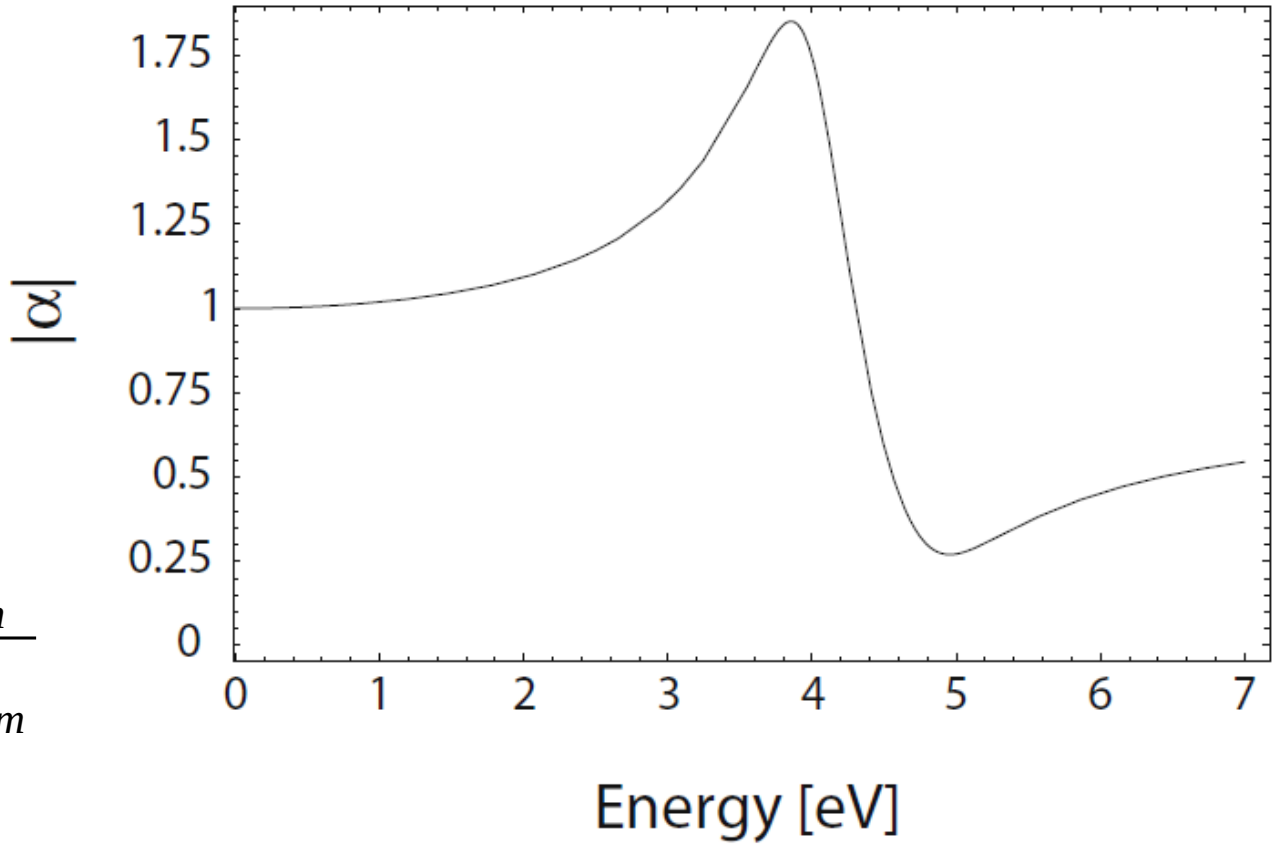
$$\vec{p} = \varepsilon_0\varepsilon_m\alpha E_0$$

$$\alpha = 4\pi a^3\frac{\varepsilon-\varepsilon_m}{\varepsilon+2\varepsilon_m}$$

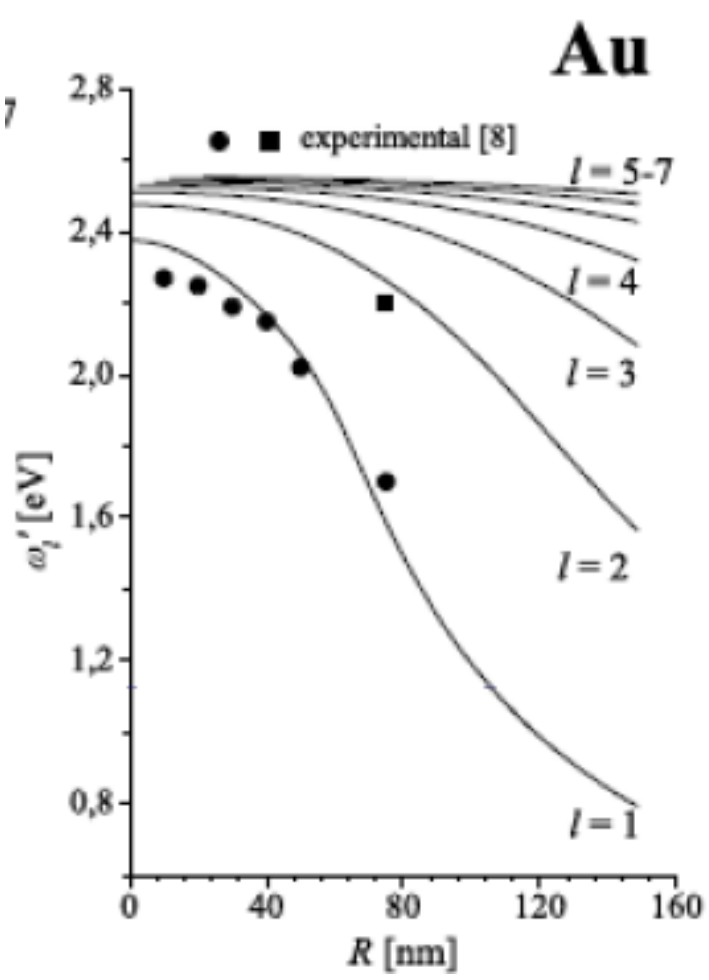
Fröhlich‘s condition

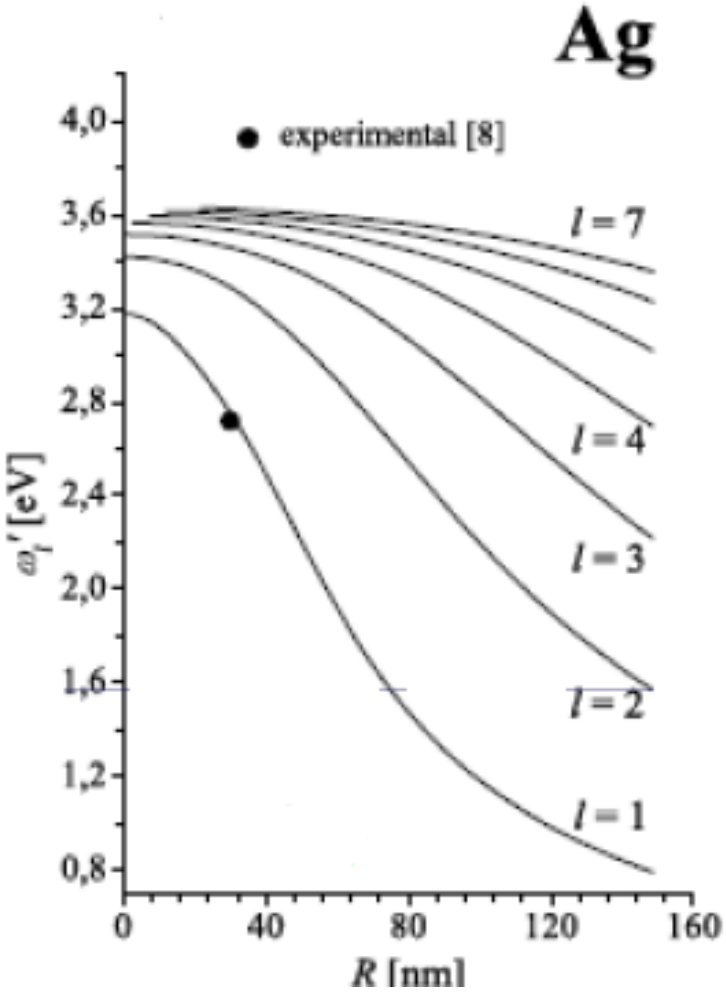
$$\alpha = 4\pi a^3 \frac{\varepsilon - \varepsilon_m}{\varepsilon + 2\varepsilon_m}$$

$$\varepsilon(\omega) = 1 - \frac{\omega_p^2}{\omega^2 + i\gamma\omega}$$



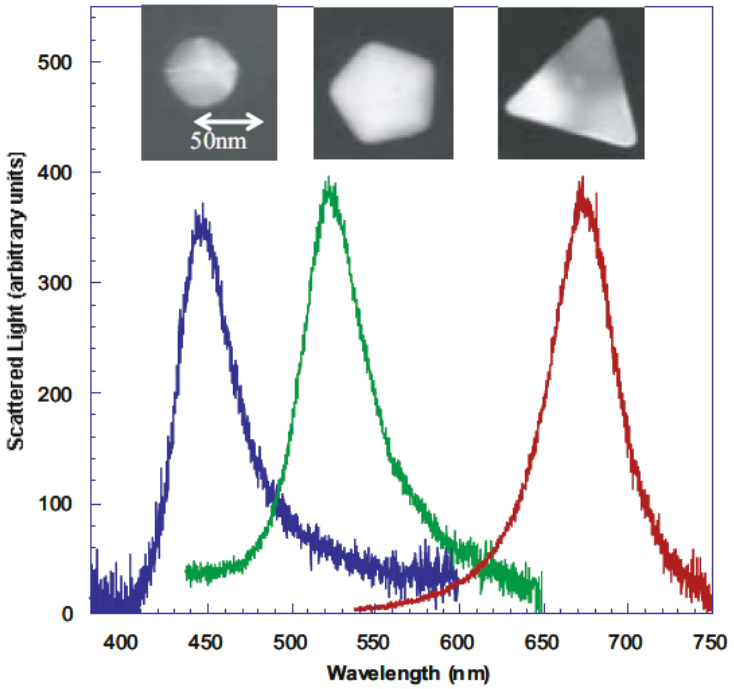
Plasmon size characteristics





Generalizations

- particle shape
- core shell particles



- bigger particles → Mie scattering

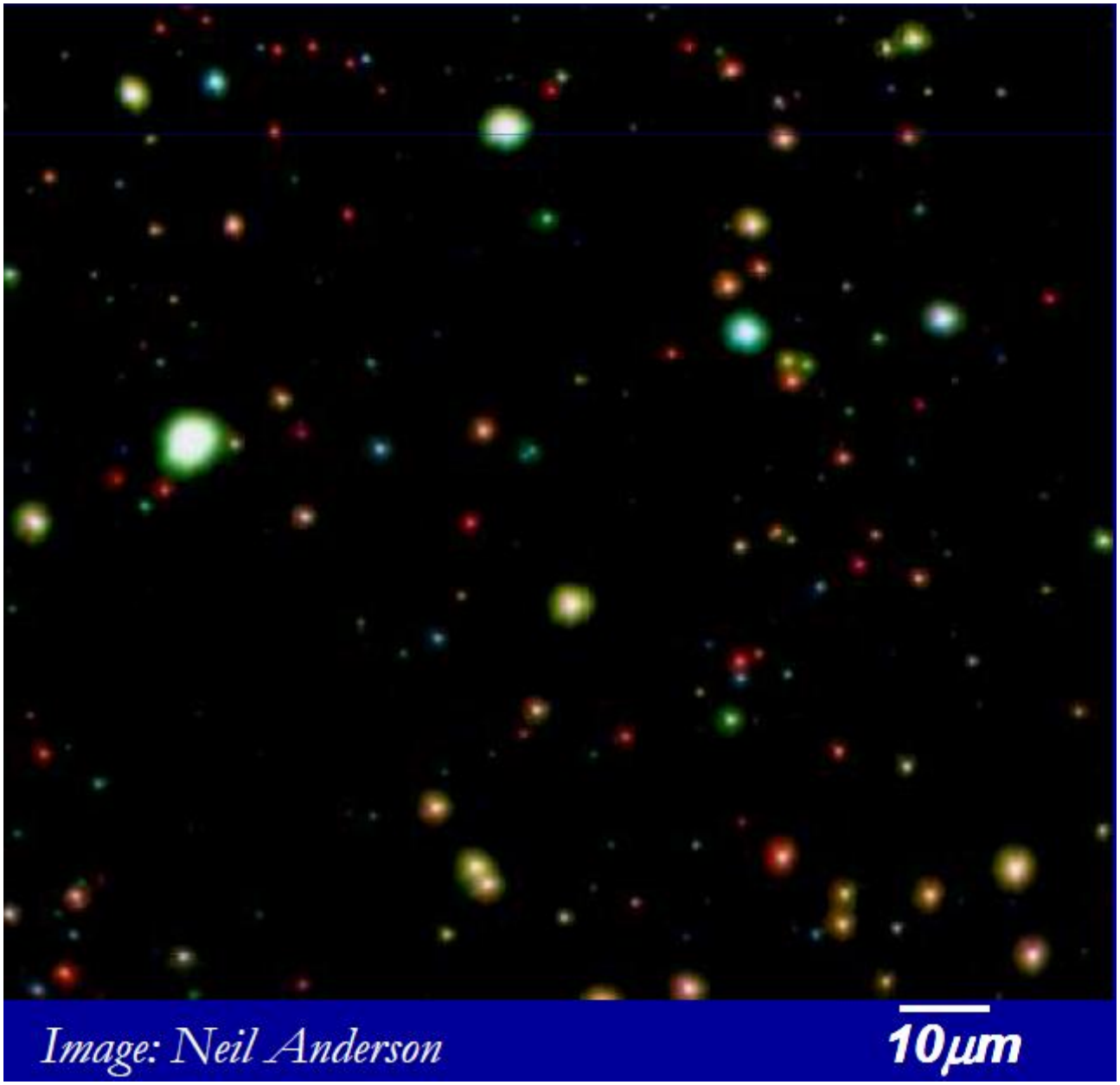
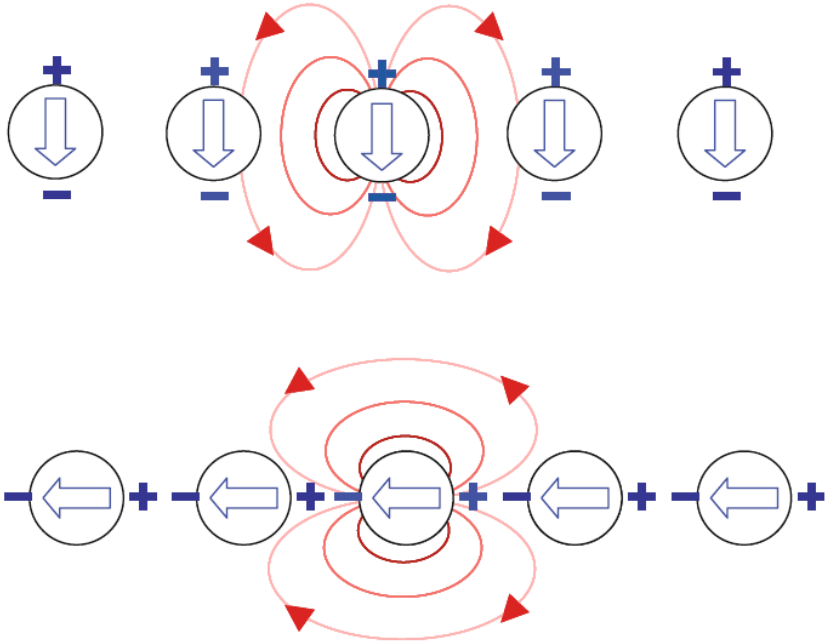


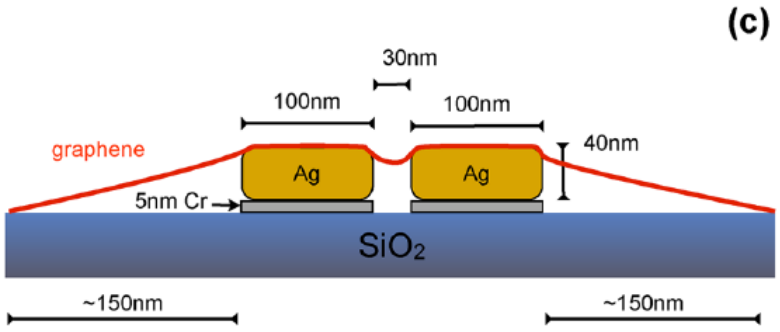
Image: Neil Anderson
10µm

Coupling between localized plasmons

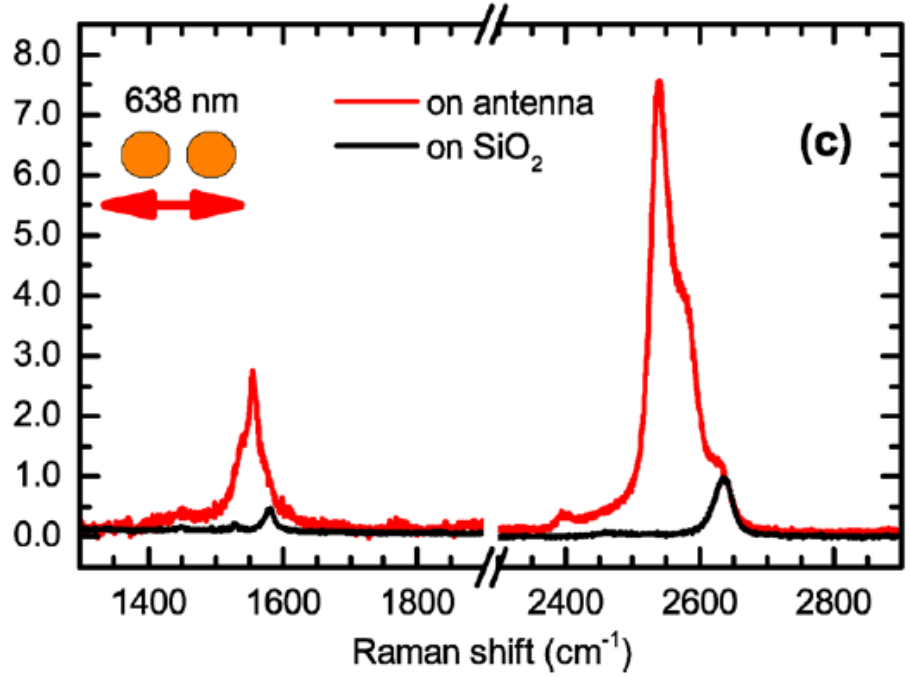
- dipole-dipole interaction
- shift of resonance

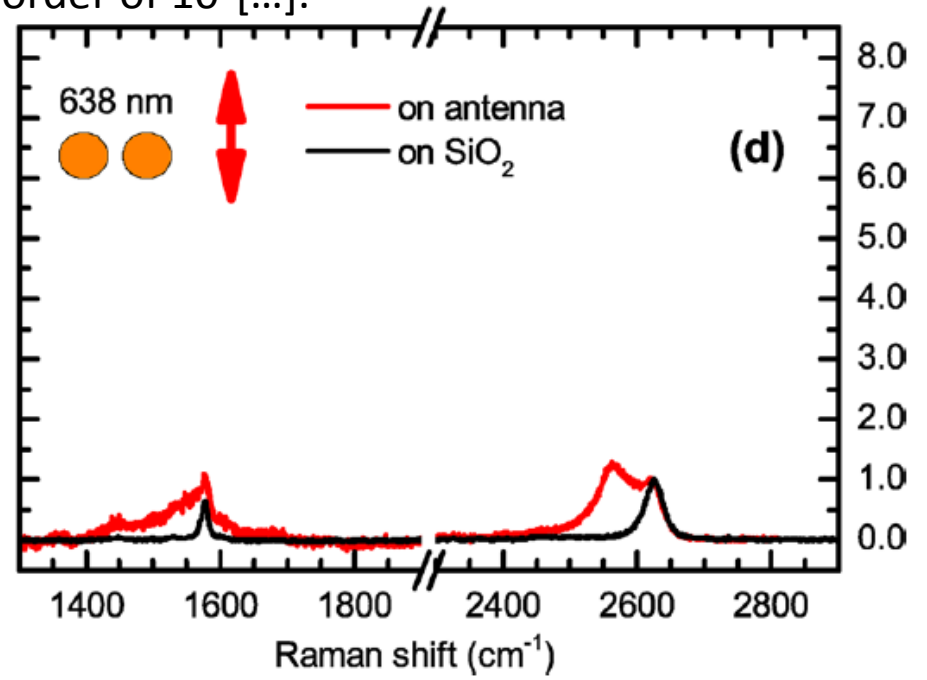


„Graphene paper“



„By rotating the polarization of the excitation, we switch between the dots acting as single plasmonic particles and a coupling regime, realizing a plasmonic cavity. In the cavity we observerve a plasmonic enhancement of the order of 10^3[…].“





Thank you for your attention!

Sources

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- The Lycurgus Cup – A Roman Nanotechnology – Ian Freestone et al., Gold Bulletin (2007)
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