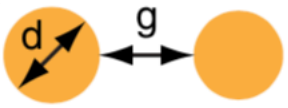
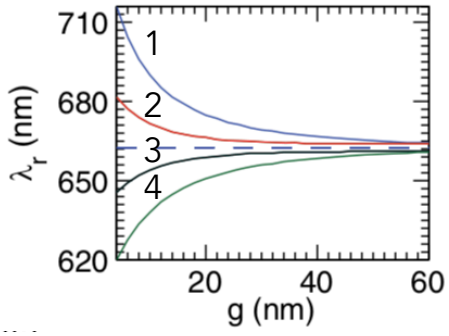
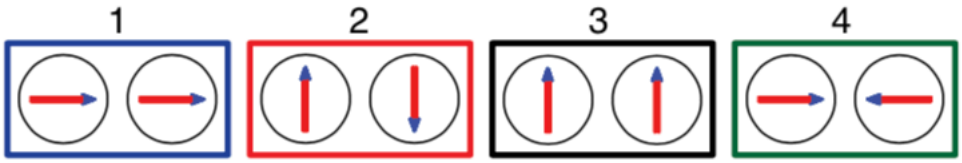
Hybridization of plasmonic modes

Plasmon hybridisation occurs when two or more plasmonic modes interact with each other resulting in the formation of hybrid modes.



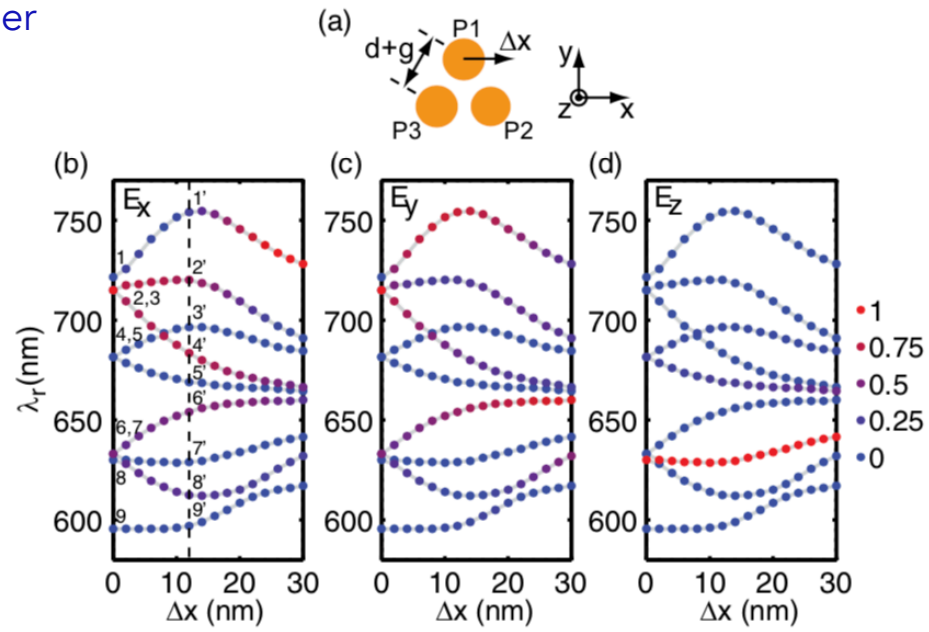
For example, consider a nanoparticle dimer (two spherical nanoparticles separated by a gap g; see the schematic on the right). For a very large gap this system exhibits one single mode (triply degenerate for each particle), as the spatial overlap of the modes if very small. However, for smaller gaps (g~4 nm), the modes hybridise leading to the splitting of the energy levels. A total of 4 distinct modes (two bonding and two anti-bonding) are formed.





Modes of a nanoparticle trimer

As you increase the number of particles, the total number of modes in the system increases. For example, the figure to the right shows the mode wavelengths for the various modes of a nanoparticle trimer. The colour scheme indicates if the mode can be excited using the given polarisation. Note that only some modes can be excited for a given incident condition.



Some relevant publications

- **A hybridisation model for the plasmon response of complex nanostructures**. E. Prodan, *et al.*, Science, 2003, Vol. 302, Issue 5644, p. 419-422. Link
- **Plasmon hybridisation in nanoparticle dimers.** P. Nordlander *et al.*, Nano Letters, 2004, Vol. 4, Issue 5, p. 899. Link
- **Insight into the eigenmodes of plasmonic nano clusters based on the Green's tensor method**. S. Dutta-Gupta and O. J. F. Martin, JOSA B, 2015, Vol. 32, Issue 2, p. 194. Link
- **A molecular ruler based on plasmon coupling of single gold and silver nanoparticles.** C. Sonnichsen *et al.*, Nature Biotechnology, 2005, Vol. 23, p. 741. Link