When light becomes small

Prof. Javier Aizpurua

Theory of Nanophotonics Group, Universidad del Pais Vasco

Electronic excitations and vibrations of molecules can be efficiently excited by light thanks to the action of optical resonators which improve the interaction between light and matter. Plasmonic cavities emerge as a special type of optical resonators which "make light small " giving rise to a reduction of the electromagnetic effective mode volume down to the nanoscale, as well as to a dramatic enhancement of the local near-fields. This enhanced "small light" allows for bringing molecular spectroscopy such as fluorescence or Raman scattering to extreme levels of detection and manipulation at the atomic scale, reaching the single-molecule regime. Furthermore, atomic-scale morphological features in plasmonic cavities produce the ultimate confinement of light, setting sub-nanometric access and control of single-molecule electronic excitations and nanoscale molecular optomechanics. To describe the interaction of light and matter at this extreme level, quantum theoretical frameworks need to be developed.