Molecules in a Quantum-Optical Flask

Interactions of molecules with light play a fundamental role in nature, where photons usually act on the molecules and drive chemical reactions and other processes. However, when confined to sub-wavelength regions, the interaction with light can be enhanced up to the point where the quantum-coherent interactions overcome all other processes. In this "strong light-matter coupling" regime the photons and the material start to behave as a single entity, having its own quantum states and energy levels. In my talk I will present the fundamental physics of strong coupling in hybrid photonic-molecular structures, and how such cavity-QED effects can be used in order to control material properties and molecular processes.