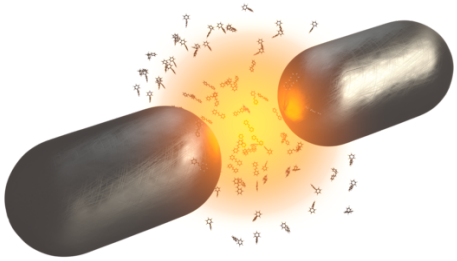
Available PhD positions

Department of Theoretical Condensed Matter Physics and IFIMAC
Universidad Autónoma de Madrid

There are two PhD student positions open to work on **Modification of Molecular Structure Under Strong Coupling to Confined Light Modes**. This project at the interface of quantum optics, molecular science, and condensed matter physics is financially supported by an **ERC Starting Grant** running from 2017 to 2022. All applicants should be highly motivated and enjoy working and collaborating closely within an international team.



The project is based on modern advances in nanophotonics that allow us to confine light modes so strongly that their effect on matter is felt even in the absence of external driving. In this regime of "strong coupling" or "vacuum Rabi splitting", the fundamental excitations are so-called polaritons, hybrid light-matter states which combine the properties of both constituents. The overarching goal of the project is to develop, refine and apply theoretical methods in order to understand the modification of molecular structure under strong coupling to confined light modes, and its effect on the dynamics of the formed polaritons.

The PhD students will work in one of two main research directions:

1) A **microscopic description of the coupled molecule-cavity system** explicitly including electronic, nuclear and photonic degrees of freedom. Standard quantum chemistry packages and concepts will be combined with the methods of quantum optics and polariton physics. Applicants will work on excited-state molecular dynamics (including nonadiabatic nuclear motion) as modified by the coupling to quantized light fields.
2) Investigation of the **influence of internal molecular dynamics on polaritons in a macroscopic setting** involving large numbers of molecules and (quantized) light modes. This is the regime explored in most experiments up to now, which have found a complex interplay between internal dynamics (such as vibrational relaxation) and macroscopic effects (such as bosonic stimulation and condensation) due to the collective nature of the polaritons. This thesis will rely on the techniques of many-body quantum optics and open quantum systems, and develop approximate models to represent the internal molecular degrees of freedom.

References:

[1] J. Galego, F. J. Garcia-Vidal, and J. Feist, Phys. Rev. X **5**, 41022 (2015).
[2] J. Galego, F. J. Garcia-Vidal, and J. Feist, Nat. Commun. **7**, 13841 (2016).

For further information and to apply, please contact Johannes Feist at johannes.feist@uam.es. Applications should include a cover letter, CV, contact information for at least two references, and grade transcripts. Applications received until February 20, 2017 will receive full consideration. Applications received after this deadline may be considered until the positions are filled.

Relevant links:
http://johannesfeist.eu
http://ifimac.uam.es
http://mmuscles.eu (under construction)