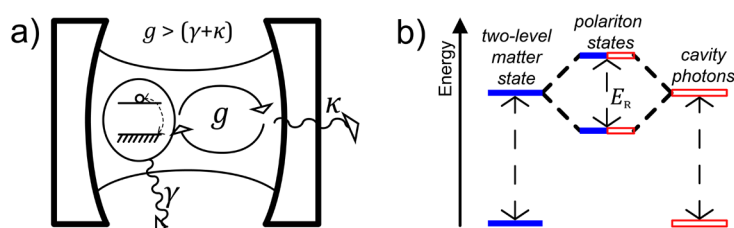


Polaritonic Influence on Gas-Phase Chemical Reactivity

Within an optical cavity, strong interactions between molecules and confined light can create hybrid quantum states called polaritons. Polaritons arise when an optically bright transition in matter is matched in frequency to the confined photonic mode of an optical cavity, typically consisting of two parallel mirrors. When the rate of reversible energy exchange between the material and the cavity modes is faster than the rate of energy dissipation from the system, polaritons are formed (panel a). Under these 'strong coupling' conditions, the resultant hybridized polariton states (panel b) inherit aspects of both light and matter.



Over the last fifteen years, polaritons have provoked great excitement in chemistry, following observations of altered energetics and reactivities in cavity-coupled solution-phase molecules.^[1] Polariton chemistry offers the prospect of selectively modifying chemical reactions by making polaritons from only a specific molecular vibration, in order to improve synthetic yields or open up pathways to produce currently unavailable chemical products.^[2]

However, there remain serious issues regarding mechanistic understanding and reproducibility which are holding polariton chemistry back from rational application. Critically, it is not yet possible to either predict or intentionally modify non-trivial polaritonic effects on chemistry.^[3] Efforts to align theory and experiments have been hindered still further by concerns about reproducibility.

This research project will examine polariton chemistry in gas-phase molecules, avoiding the complications of solvent interactions and allowing individual quantum states to be coupled to the cavity. The PhD student on this project will first prepare gas-phase molecular polaritons within an optical cavity,^[4,5] becoming acquainted with optical cavity fabrication. Subsequently, they will use time-resolved spectroscopy to study the influence of polariton formation on benchmark gas-phase chemical processes. However, no particular prior experience of these techniques is required.

This project would suit budding scientists with a taste for spectroscopy, from physics or physical chemistry backgrounds. This PhD studentship is available for start in October 2027. To discuss this project further, please contact Adam Wright: a.d.wright@warwick.ac.uk. More information about the Wright Lab can be found on our group website: <https://adwrightlab.com/>

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