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Polaritonic Chemistry: Challenges & Opportunities

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Polaritons are hybrid light-matter states that form when material excitations strongly interact with "trapped or confined light", such as in optical cavities or plasmonic nanostructures. While the physics community has studied polaritonic phenomena with atoms and inorganic semiconductors for several decades, significant interest in molecular polaritons has only emerged over the past decade. This interest was sparked by experiments demonstrating the possibility to manipulate the chemistry of molecules via polariton formation, giving rise to the field of polaritonic chemistry. Molecular polaritons offer opportunities to modify both thermal and excited-state processes, depending on whether the molecular excitation coupled to the cavity photon is vibrational or electronic. Despite the potential of polaritonic chemistry to make an impact in areas such as catalysis or optoelectronics, many fundamental questions remain unanswered. Progress in the field is currently hampered by a lack of understanding of key experimental observations. Additionally, unlike atoms, molecules have a very rich internal structure, which significantly complicates the theoretical modeling of the coupled light-matter system. In this talk, I will provide an overview of this emerging field, highlighting both the challenges it faces and the opportunities that lie ahead.

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