PHYSIKALISCHES KOLLOQUIUM

Sommersemester 2024

Das Kolloquium findet (soweit nicht anders angegeben) **jeweils montags um 16:15 Uhr in Präsenz im Röntgen-Hörsaal** des Physikalischen Instituts, Hubland Campus Süd, Universität Würzburg **und online via Zoom statt**. (Der jeweilige Link wird noch zur Verfügung gestellt.)

15.07.2024

Vorstellungsvortrag im Rahmen des Habilitationsverfahrens

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Tailoring advanced photonics with correlated quasiparticles in 2D material heterostructures and hybrid emitter microcavities

Abstract

In the first part, we will discuss the recent advance of organic exciton-cavity polaritons in hemispherical microcavities. Polaritons, hybrid quasiparticles composed of both light and matter, exhibit significant nonlinearities and emerged as a promising system to be implemented on-chip. Studies presented have primarily involved the fluorescent protein mCherry in various microcavity configurations, from single hemispherical cavities to linear 1D and SSH chains. Recently, these investigations have been extended to a two-dimensional honeycomb lattice [1], demonstrating the formation of photonic band structures and analyzing their lasing properties through mode tomography and Michelson interferometry.

Building on this foundation, the talk will explore two advanced research themes. First, the design of microcavities with hybrid structures combining III-V and organic materials promises exciting advancements. These hybrid systems merge Frenkel and Wannier-Mott excitons, offering strong polariton interactions and potential for room-temperature operation. Although initial realizations show promise [2,3], fundamental questions remain, necessitating deeper exploration of hybrid polaritonic devices.

Next, the study of hybrid interlayer excitons in two-dimensional (2D) materials will be discussed. Transition metal dichalcogenides allow precise assembly of monolayers, unveiling novel excitonic systems such as hybrid interlayer excitons. These systems enable tunable multiparticle complexes with significant potential in polaritonics, drawing an analogy to dipolaritons in coupled quantum well pairs [4]. Recent studies highlight their strong optical

nonlinearities and responsiveness to external fields [5], paving the way for practical applications.

[1] S. Betzold et al., Adv. Sci., e2400672 (2024).

[2] G.G. Paschos et al., Sci. Rep., 7, 11377 (2017).

[3] R. Jayaprakash et al., Light sci. appl., 8, 81 (2019).

[4] P. Cristofolini et al, Science 336, 704-707 (2012).

[5] C. Louca et al., Nat. Commun. 14, 3818 (2023).

Für die Dozentinnen bzw. Dozenten der Fakultät

Prof. Dr. Hinkov, Prof. Dr. Hinrichsen, Prof. Dr. Porod, Dr. Ünzelmann und Hr. Kuhr