Carl von Ossietzky
Universität
Oldenburg

Institut für PHYSIK

PHYSICAL COLLOQUIUM

INVITATION

Monday, 27.06.2022, 4.15 p.m., Room W02 1-148 and per
video conference: https://meeting.uol.de/b/anj-2vc-j6s-fwe

speaks

Dr. Florian Dirnberger,
Department of Physics,
City College of New York, New York, USA

about

"Strongly correlated excitons and exciton-polaritons in van der Waals magnetic crystals"

The revolutionary impact of graphene and single layer transition-metal dichalcogenides on solid- state physics has led a quest for materials with novel optical, electronic and magnetic properties. As a result of this process, more and more van der Waals materials characterized by a collective behavior of their electronic constituents have made an appearance on the center of the stage of solid-state research. So far, these quantum materials encompass correlated insulators, topological insulators, and superconductors, as well as a fascinatingly broad palette of ferroelectric, multifer- roic, and magnetic crystals.

Optical spectroscopy studies of these materials recently discovered excitons that are deeply intertwined with a collective quantum state. With properties that have no analog amongst excitons in conventional band semiconductors, these excitons not only inherit a tremendous potential for the design of novel optoelectronic devices, but also represent an exciting material platform to uncover new facets of light-matter interactions. In this talk, I will introduce two di erent types of van der Waals magnetic crystals reported to date to host such strongly correlated excitons, followed by a discussion of their fundamental prop- erties. I will then present our recent study [1] on strong light-matter coupling in the correlated van der Waals insulator nickel phosphorus trisul de ($NiPS_3$), a magnetic crystal with antiferromag- netic spin ordering below the Neel temperature. In this material, a previously unobserved class of polaritonic quasiparticles emerges from the strong coupling between spin-correlated excitons and the photons inside a microcavity.

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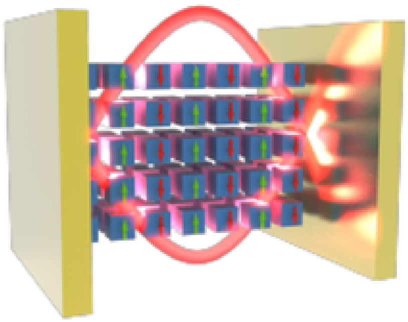
The hybridization with light o ers unique opportunities to study the origin and interactions of magnetically coupled excitations in antiferromagnetic in- sulators. By establishing strong coupling between photons and correlated optical excitations in a magnetic crystal, our work introduces van der Waals quantum materials to the of strong light-matter physics and provides a path towards the design and control of correlated quantum states via cavity quantum electrodynamics.



References

[1] F. Dirnberger, R. Bushati, B. Datta, A. Kumar, A. H. MacDonald, E. Baldini, and V. M. Menon, \ Observation of spin-correlated exciton-polaritons in a van der waals magnet," arXiv: 2203.06129.

All interested persons are cordially invited.

Prof. Dr. Christian Schneider/Prof. Dr. Sascha Schäfer