



# EINLADUNG zum IFP-SEMINAR

Orbital physics in correlated electron systems: from spin liquid to excitonic insulator

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Host: Jan Kuneš  
Termin: **Freitag, 14. Oktober 2016, 15:00 Uhr**  
Ort: Institut für Festkörperphysik, TU Wien  
Wiedner Hauptstraße 8-10, 1040 Wien  
Seminarraum DB gelb 09 (gelber Bereich, 9. OG)  
Förderer: ERC-CoG-646807 EXMAG

It is widely recognized that the orbital degree of freedom influences significantly the magnetic, optical, and structural properties in correlated electron materials. As an example, a macroscopic symmetry breaking of a degenerate orbital wave function is often seen in several transition-metal compounds, rare-earth magnets, as well as molecular solids. I introduce in this seminar our recent researches on the orbital degree of freedom in correlated electron solids. 1) Dynamical Jahn-Teller (DJT) effect in a spin-orbital coupled system on a honeycomb lattice is examined, motivated from recently observed spin-liquid behavior in  $\text{Ba}_3\text{CuSb}_2\text{O}_9$  [1]. We find that the DJT effect induces a spin-orbital resonant state where local spin-singlet states and parallel orbital configurations are entangled with each other. 2) The orbital-lattice coupled excitation dynamics in orbitally degenerate correlated systems is revisited [2]. We find that two characteristic excitation modes coexist, a low-energy dispersive mode and a high-energy multipeak mode. 3) An excitonic-insulating system is recently suggested to be realized in some transition-metal oxides [3]. We study the excitonic insulating system from a viewpoint of the orbital physics in strongly correlated electron systems [4]. The ground state phase diagram and the collective excitation modes are calculated. The magnetic field effects on the excitonic insulating phase are also studied [5].

## References:

- [1] J. Nasu, and S. Ishihara, Phys. Rev. B 88, 094408 (2013).
- [2] J. Nasu and S. Ishihara, Phys. Rev. B 88, 205110 (2013).
- [3] J. Kunes, and P. Augustinsky, Phys. Rev. B 89, 115134 (2014).
- [4] J. Nasu, T. Watanabe, M. Naka, S. Ishihara, Phys. Rev. B 93, 205136 (2016).
- [5] T. Tatsuno, E. Mizoguchi, J. Nasu, M. Nasu, and S. Ishihara, J. Phys. Soc. Jpn. 85, 083706 (2016). Abstract