



IFMP Seminar

Date Monday, June 30, 2025, at 14:50

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Zoom: 688 4227 2214, Passcode: IFMP2024-5

Speaker **Andrey Zelenskiy**
Université Paris-Saclay, France

Title **Order, Excitations, and Duality in AB-Stacked Kagome Magnets**

Abstract Geometric frustration occurs when interactions favour local configurations that are incompatible with the global geometry of the system. This often gives rise to complex structures and patterns, which are formed from "suboptimal" local arrangements. In magnetic crystals, geometric frustration often stabilizes noncollinear spin configurations, which in turn influence bulk properties relevant to technological applications.

I will present a study of magnets with a hexagonal AB-stacked kagome structure. These materials gained a significant amount of attention due to the observation of the anomalous Hall effect in Mn_3X ($X = \text{Ge, Sn, Ga}$), related to the noncollinear spin structure, as well as studies of incommensurate phases in Fe_3Sn_2 compounds. Despite significant experimental and theoretical advances, the exact form of the microscopic Hamiltonian remains debated in the literature. I will present a symmetry-based microscopic model, which includes a number of previously overlooked magnetic interactions [3]. These magnetic couplings are categorized by the "degree" of anisotropy: isotropic, XY, and fully anisotropic. Surprisingly, at each level of anisotropy, we are able to identify a number self-duality transformations, which connect the properties of distinct magnetic phases. We use these transformations to systematically characterize the static and dynamic properties of the AB-stacked kagome magnets [4].

Finally, I will discuss an unconventional type of magnetic phase, which is stabilized by strong intra- and inter-layer Dzyaloshinskii-Moriya interactions. These phases manifest as disordered patterns with short-range order, emerging after a nematic transition a chiral paramagnetic state [5].

[1] Ikhlās, M., *et al.* Nature Phys. **13**, 1085–1090 (2017)

[2] Kong, L., *et al.* Phys. Rev. B **107**, 174425 (2023)

[3] Zelenskiy, A., Monchesky, T. L., Plumer, M. L., and Southern, B. W. Phys. Rev. B **103**, 144401 (2021)

[4] Zelenskiy, A., Monchesky, T. L., Plumer, M. L., and Southern, B. W. Phys. Rev. B **106**, 144433 (2022)

[5] Zelenskiy, A., Plumer, M. L., Southern, B. W., Zhitomirsky, M. E., Monchesky, M. L. Phys. Rev. B **108**, L060402 (2023)

Host: D. Inosov