



Seminar, Department of Physical Sciences, Bose Institute, Kolkata

Probing and controlling the properties of halide perovskite semiconductors with high magnetic fields

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Abstract: Halide perovskite materials are widely studied for their impressive optoelectronic and photovoltaic characteristics, such as tunable bandgaps, long carrier diffusion lengths, and bright emission. Their versatility is further enhanced by the ability to tailor them through composition changes and the incorporation of dopants, including magnetic ions. The soft, polar lattices of these materials often facilitate strong coupling between electronic, spin, and lattice degrees of freedom, enabling structural and magnetostructural phase transitions that can significantly alter exciton behavior and magnetic order.

Excitonic luminescence in methylammonium lead iodide (MAPbI_3) exhibits abrupt changes across structural phase transitions [1]. High magnetic fields offer a powerful probe to study how these transitions affect excitonic properties like binding energy [2], and this approach can be extended to characterize formamidinium-doped MAPbI_3 ($\text{FAXMA}(1-x)\text{PbI}_3$) [3]. Beyond serving as a probe, magnetic fields can also act as a control parameter in certain perovskites, such as $\text{Cs}_2\text{NaFeCl}_6$, where they drive structural phase transitions. I will briefly discuss how Raman spectroscopy, combined with dilatometry, can be used to study such transformations [4].

Generating steady magnetic fields above 20 T is typically possible only at a handful of large-scale facilities worldwide, but in this presentation, I will show how pulsed magnetic fields exceeding 35T can be achieved in a modest laboratory setting, and one can build a versatile experimental platform to explore a wide range of phenomena in magneto-optics and magneto-transport.

References:

- [1] Mukhuti et al., Phys. Rev. Lett. 134, 076901 (2025).
 - [2] Mukhuti et al., Appl. Phys. Lett. 121, 182104 (2022)
 - [3] Mukhuti et al., Under review in Adv. Func. Mater.
 - [4] Mopoung et al., Chem. Mater. 37, 6974–6982 (2025)
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- **Date/time: July 28, 2026 (Tuesday) at 03:00 PM**
 - **Venue: Room 204, Physics Seminar Room, (Second floor, UAC, BI)**