SEMINAR GREMAN

THURSDAY 17 SEPTEMBER

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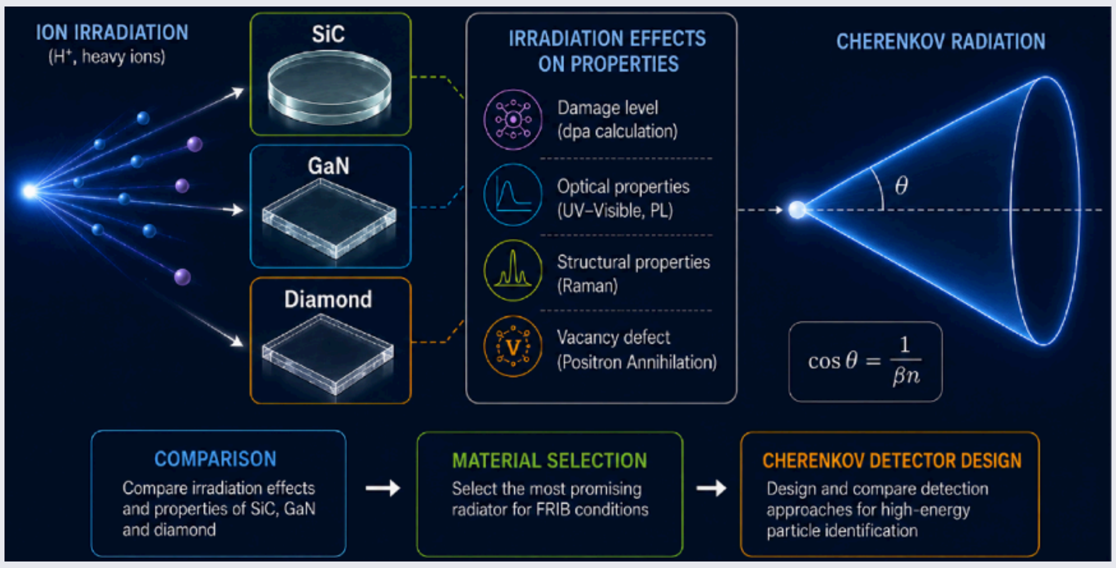
🕐 1:30pm - 2:30pm 📍Petit Amphi - INSA CVL - Blois (A&P site)

Comparative study of irradiation effects on wide-bandgap semiconductors for potential use as Cherenkov radiators at FRIB



In this talk, I will give an overview of how we can explore experimentally the physics of quantum magnets, in and out of equilibrium, with arrays of single atoms trapped in optical tweezers arranged in almost arbitrary geometries, and made to interact by promoting them to highly-excited Rydberg states. I'll introduce the basics experimental tools at play, and give a few recent examples of the quantum many-body systems we explore using them. The Facility for Rare Isotope Beams (FRIB) at Michigan State University provides high-energy ion beams for the production and study of rare isotopes. As beam energies increase to access increasingly exotic nuclei, particle identification using conventional energy-loss and time-of-flight techniques becomes more challenging. In this context, the detection of Cherenkov photons represents a promising complementary approach for high-energy particle identification.

This work was conducted with the MoNA Collaboration at FRIB and investigates three wide-bandgap materials: SiC, GaN, and diamond as potential Cherenkov radiators, with particular emphasis on their optical properties and radiation resistance. Samples were irradiated with hydrogen and heavy ions under different conditions and characterized using UV-Visible spectroscopy, photoluminescence, Raman spectroscopy, and positron annihilation spectroscopy. Experimental investigations were complemented by SRIM, GEANT4, and ROOT Monte Carlo simulations.

Monocrystalline diamond exhibited the highest radiation resistance, although its cost limits its use for large-scale (i.e., 30×40 cm^2) detector applications required for the planned experiments. Under irradiation conditions relevant to FRIB, undoped SiC and GaN showed no significant absorption in the visible range. However, high-energy irradiation induced identifiable defect-related photoluminescence in GaN. Overall, the experimental results, together with ROOT simulations of isotope-separation performance, identify undoped SiC as the most promising Cherenkov radiator among the investigated materials.

Based on these findings, a preliminary Cherenkov detector design is proposed, and different detection approaches for future high-energy particle-identification applications are discussed.

📅 Upcoming GREMAN seminars:

- **Tuesday 6 October** — 11am - *TBC - Seminar*
- **Thursday 15 October** — 1:30pm - How to manage the bibliography? *Journal Club*
- **Thursday 5 November** — 1:30pm - *TBC - Seminar*

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