

Seminar of Igor Žutić University at Buffalo, USA

Friday 3rd July, 2026 – 14:00 PM
IJL- Room 2-A013

Unconventional Spintronics from Chiral Perovskites

Spintronic devices typically employ heterostructures with ferromagnets which break time-reversal symmetry and have net magnetization. With the growing class of materials that support spin-polarized carriers, current, and excitations, it is possible to envision emerging spintronic applications that are not limited to net magnetization and magnetoresistance. Here we focus on chiral perovskites with no net magnetization where the space-inversion and mirror symmetries are broken to induce chiral structure. The known importance of these perovskites is further expanded by the demonstration of the chiral-induced spin selectivity (CISS) [1]. However, the generation of the spin-polarized carriers across the interface with these chiral perovskites remains to be fully understood. Our first-principles studies for two-dimensional PbBr₄-based chiral perovskites provide their electronic structure and an orbital-based symmetry analysis, which allows us to establish an effective Hamiltonian to elucidate the underlying origin of their chirality [2]. The resulting chiral proximity effect can be viewed as an equilibrium precursor to CISS and an element in materials design through proximity effects [3]. We also use this analysis for the so-called Edelstein effect, discovered by other researchers, which is responsible for electrical generation of the nonequilibrium spin polarization in many materials. In chiral perovskites such an effect could be a mechanism contributing to CISS. To accurately obtain optical properties and excitonic energies in these materials, we combine quasi-particle self-consistent Green function framework for calculating the self-energy of the many-body from first principles together with the Bethe-Salpeter equations [2,4]. Furthermore, by examining optical properties of chiral perovskites and the opportunity to use them to realize tunable altermagnets, another class of zero-magnetization spintronic materials, we put forth a versatile materials platform for unconventional spintronics.

- [1] S. Acharya,... I. Žutić, Challenges and Opportunities in Chiral Induced Spin Selectivity, *Newton* (invited perspective, 20 pages)
- [2] Y. Liu, Shrestha, K. Denisov, D. Ayala, M. van Schilfgaarde, W. Nie, and I. Žutić, Unconventional Spintronics from Chiral Perovskites, *Adv. Funct Mater.* **35**, e09127 (2025)
- [3]. I. Žutić, A. Matos-Abiague, B. Scharf, H. Dery, and K. Belashchenko, Proximitized Materials, *Mater. Today* **22**, 85 (2019)
- [4] D. Pashov et al., "Questaal: A package of electronic structure methods based on the linear muffin-tin orbital technique, *Comput. Phys. Commun.* **249**,107065 (2020)



Igor Žutić is a Professor of Physics at the University at Buffalo, the State University of New York. He received PhD in theoretical physics at the University of Minnesota in 1998. His work spans topics from spin transport, superconductors, and Majorana fermions, to magnetic semiconductors, proximity effects, and two-dimensional materials. His predictions for spin devices not limited to magnetoresistance, such as spin-photodiodes, transistors, and lasers, have been experimentally realized. Igor Žutić is a fellow of the American Physical Society, a recipient of 2006 National Science Foundation CAREER Award, and 2019 State University of New York Chancellor's Award for Excellence

Séminaire organisé dans le cadre du programme interdisciplinaire MAT-PULSE



MAT-PULSE

Materials and Physics @ Ultimate Scale: Nanotech for a sustainable digital world