भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर

Indian Institute of Technology Bhubaneswar

Press Release

IIT Bhubaneswar Researcher Predicts Potentially Infinite Spin Lifetime in a Nonmagnetic 2D Material

New study could help researchers design materials for next-generation electronics that use electron spin to process and store information

Bhubaneswar, 10th November 2026: A new study identifies a specific surface of the cubic zinc- blende silver iodide (AgI) semiconductor as a promising host for persistent spin texture (PST) – an intriguing quantum phenomenon that holds immense potential for advancing next-generation electronic devices that utilizes the electron spin to process and store information. The research, led by Dr. Manish Kumar Mohanta, Ramanujan Faculty in the Department of Physics at the Indian Institute of Technology (IIT) Bhubaneswar, has been published in Physical Review B, a leading international journal in condensed-matter physics published by the American Physical Society.

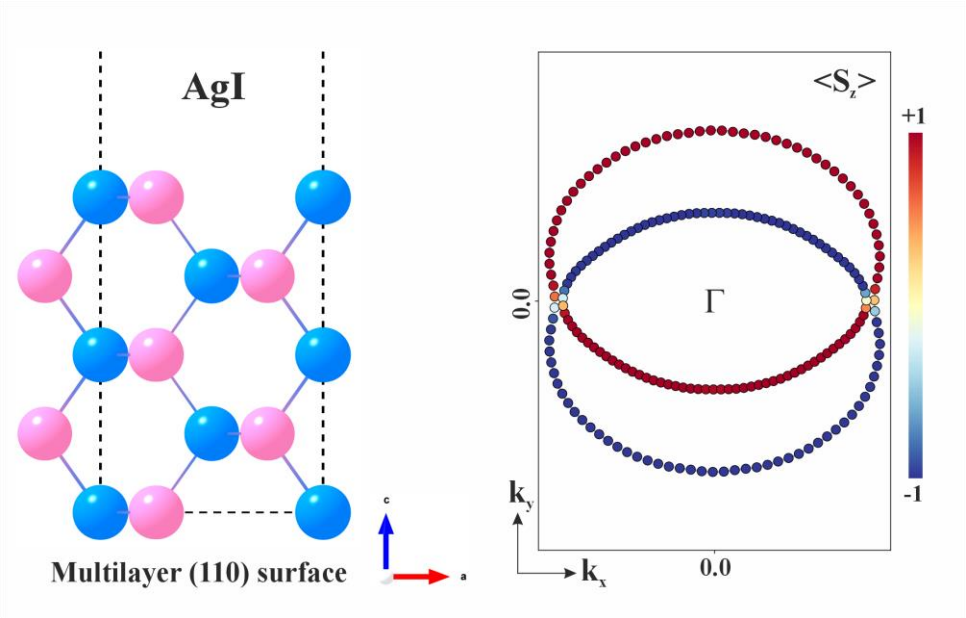
Electrons possess an intrinsic property called spin, which can be exploited to carry information alongside their electric charge. In a certain nonmagnetic semiconductor, the electron spins exhibit a remarkably stable, unidirectional alignment, a phenomenon known as persistent spin texture (PST). This remarkable property makes such semiconductors promising candidates for next-generation spintronic devices, as it can suppress unwanted spin relaxation and enable the preservation of spin information over extended periods.

Using first-principles quantum mechanical simulations supported by mathematical models, Dr. Mohanta demonstrated that (110) surface of AgI exhibits a unidirectional spin pattern, highlighting its promise for future spintronic technologies. The study further reveals that the PST remains robust under moderate mechanical strain. However, an electric field applied perpendicular to the surface can disrupt the spin texture, potentially allowing the spin pattern to be manipulated electrically.

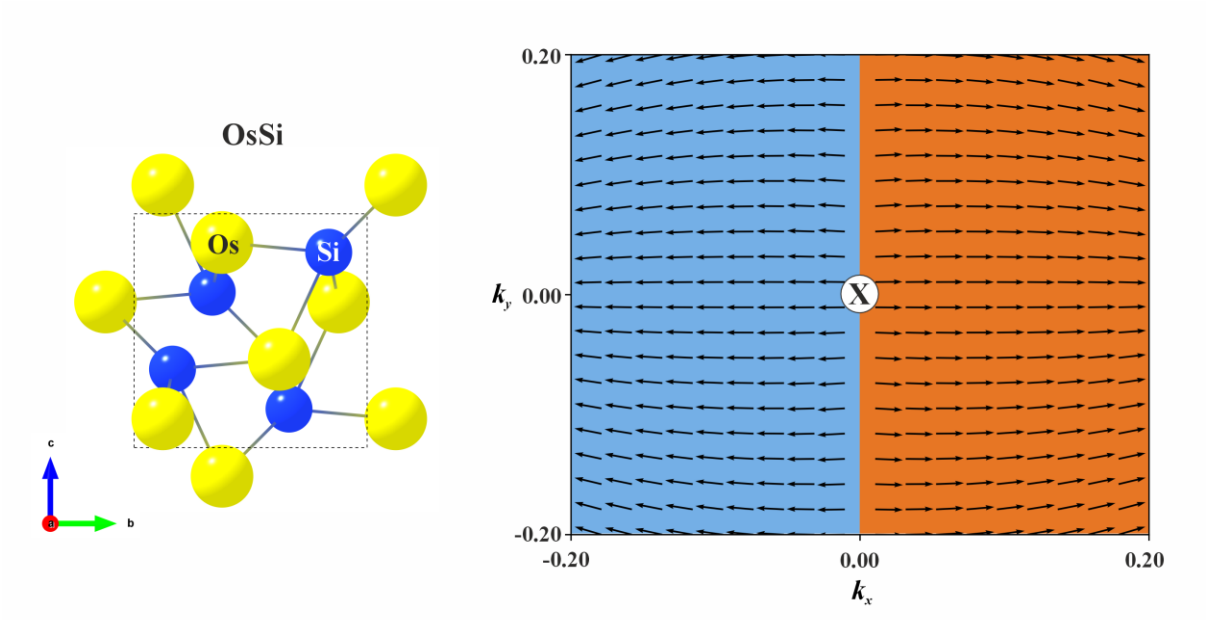
In this work, Dr. Mohanta also introduces two new mathematical model to explain the unusual spin pattern observed in the bulk semiconductor OsSi. The study also raises a fundamental question: Can a nonmagnetic bulk semiconductor exhibit a unidirectional spin pattern similar to that found in 2D materials? The central contribution of this research lies in developing new mathematical models that expand our understanding of electron spin patterns, offering new ways to describe, interpret and predict their behaviour in quantum materials.

For Dr. Mohanta, this study also marks an important milestone as his first independent research work since joining IIT Bhubaneswar as a Ramanujan Faculty. The research strengthens the understanding of behavior of spins in nonmagnetic semiconductors and provides a theoretical foundation for exploring materials that could support more efficient, spin-based electronic technologies.

The research paper is available at: https://link.aps.org/doi/10.1103/6dcb-r2xb.



The figure illustrates the (110) surface of cubic zinc-blende AgI alongside its spin-projected Fermi surface, highlighting the persistent spin texture (PST) feature in its electronic structure.



The figure illustrates the bulk crystal structure of OsSi and its distinctive partial persistent spin texture (PST) in the electronic structure.