Awardees of the "CRC-Spin Award 2023"

The Core Research Cluster for Spintronics at Tohoku University ("CRC-Spin") and the Center for Science and Innovation in Spintronics (CSIS) have launched the Core Research Cluster for Spintronics Award (CRC-Spin Award) since 2023 to honor early career researchers who have produced outstanding academic achievements and/or industrial applications in Spintronics in a broad definition of the field. The award ceremony and lecture will be given at the 7th Symp. for the Core Research Clusters for Materials Science and Spintronics and the 6th Symp. on Int'l Joint Graduate Program in Materials Science and Spintronics.

Dr. Shun Kanai

(Research Institute of Electrical Communication, Tohoku Univ)

Investigation of probabilistic and quantum spin dynamics for unconventional electronics

There is an increasing interest in developing computing hardware capable of addressing hard problems that the conventional deterministic computers cannot readily execute. This demand poses a challenge to explore the functionalities of solid-state systems which have not been utilized effectively in today's electronics.
Dr. Shun Kanai studied probabilistic collective spin dynamics and quantum single spin dynamics to realize such unconventional computing hardware from both theoretical and experimental approaches. The specific achievements include:

- Establishment of theoretical basis to describe the thermal fluctuation of magnetization direction by introducing the relative entropy and experimental demonstration of nanosecond random telegraph noise, 10 million times faster than the previous reports [1,2]
- Discovery of generalized scaling law of the spin coherence time allowing effective exploration of quantum materials and prediction of 700 materials promising for quantum applications [3]

[1] S. Kanai et al., Phys. Rev. B 103, 094423 (2021).
[2] K. Hayakawa, S. Kanai et al., Phys. Rev. Lett. 126, 117202 (2021).
[3] S. Kanai et al., Proc. Nat. Acad. Sci. 119, e2121808119 (2022).

Dr. Ping Tang

(Advanced Institute for Materials Research, Tohoku Univ)

Spintronic analog of ferroelectric materials

Magnets and ferroelectrics are "ferroic" materials that below a critical temperature exhibit spontaneous order of magnetic and electric dipoles, respectively. They are both technologically important and similar in many respects, such as non-volatile memory devices, sensors, actuators, etc. Based on magnetic materials, the field of spintronics has developed a lot over the past several decades, mostly focusing on the coupling of spin, heat, and charge currents.
Dr. Ping Tang's research generalized the concept and scheme of spintronics to ferroelectric materials, in which the electric dipoles of atoms take the place of their spins (or magnetic dipoles). The specific achievements include:

- Prediction of "ferron" excitations and the associated transport of electric polarization in ferroelectrics [1,2]
- Prediction of nonlocal ferron-drag thermoelectricity generated by ferroelectric van der Waals heterostructures [3]
- Prediction of sliding phase transition in ferroelectric van der Waals Bilayers [4]

[1] P. Tang et al., Phys. Rev. Lett. 128, 047601 (2022).
[2] P. Tang et al., Phys. Rev. B 106, L081105 (2022).
[3] P. Tang et al., Phys. Rev. B 107, L121406 (2023).
[4] P. Tang et al., Phys. Rev. Lett. 130, 176801 (2023).

Congratulations!