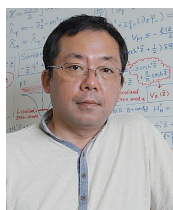


Visiting Professors



Visiting Professor

KISHINE, Jun-ichiro (*from The Open University of Japan*)

Theoretical Studies on Chiral Material Science

The concept of chirality is ubiquitous in natural sciences. However, until only recently, research fields on chirality had been fragmented into separated branches of physics, chemistry and biology. Even inside physics, a term “chiral” has been used in different meanings in condensed matter and high-energy physics.

One of the most important mission of our project is to integrate the scattered concepts of chirality and make a roadmap toward an attempt at synthesis of chiral material sciences. Let us remind the Laurence Barron’s definition of the true chirality, *i.e.*, true chirality is shown by systems existing in two distinct enantiomeric states that are interconverted by space inversion, but not by time reversal combined with any proper spatial rotation. The space inversion is a matter of geometrical symmetry, while time reversal is a matter of dynamical motion. This unambiguous definition clearly indicates that the concept of chirality ties geometry and dynamics. Conversion of geometry into dynamics naturally leads to material functionalities. The main purpose of this research project is to integrate these concepts in a unified manner. During this one year, we have focused on theoretical description of the chirality-induced phonon in non-centrosymmetric crystals.



Visiting Associate Professor

FURUKAWA, Ko (*from Niigata University*)

Advanced ESR Study of Molecule-Based Functional Materials

To develop the high-efficiency molecule-based device, it’s vital to clarify the mechanism of the functional molecules/materials. We investigate the mechanism of the solid-state functional materials in terms of advanced electron spin resonance (ESR) spectroscopy such as high-field/high-frequency ESR, time-resolved ESR, pulsed-ESR and so on. Recently, our themes are following three (I) spin dynamics study of molecule-based materials with the complex function combined to photoconductivity and photo-induced magnetic properties, (II) operand ESR study of the novel oxygen reduction reaction (ORR) catalyst for fuel cell, and (III) the soil environments were investigated by using ESR spectroscopy for the vegetable food such as the rice and tea leaves.



Visiting Associate Professor

OSHIMA, Yugo (*from RIKEN*)

Development of ESR Probe for Molecular Field-Effect Transistor (FET) Devices

Recently, a novel type of ferromagnet (Et-4BrT)[Ni(dmit)₂]₂ has been developed by Kusamoto Group and Yamamoto Group in IMS (dmit is 1,3-dithiol-2-thiole-4,5-dithiolate and Et-4BrT is ethyl-4-bromothiazolium). We have found that this ferromagnet is the first realization of the Nagaoka-Penn ferromagnetism, where the ferromagnetism is achieved by the light hole-doping of the insulating Ni(dmit)₂ layer owing to the internal dipole moment of the monovalent cation Et-4BrT (*Sci. Rep.* **11**, 1332 (2021)).

Our latest interest is whether the ferromagnetism of this material can be controlled by electrical doping or not. In collaboration with Yamamoto Group, we have newly developed an ESR sample holder for field-effect transistors (FETs), so that we can control precisely the electrical doping of (Et-4BrT)[Ni(dmit)₂]₂ by means of FET structure. We will investigate the magnetic properties of (Et-4BrT)[Ni(dmit)₂]₂ by carrier doping from ESR spectroscopy.