

791st ASRC Seminar

Date: 10月8日 (木) 13:30 ~ 14:30

Location: 先端基礎研究交流棟 2階ロビー

Speaker: 下出敦夫 氏

(自然科学研究機構/分子科学研究所)

Title: Geometric Spin-Orbit Coupling and
Chirality-Induced Spin Selectivity

「幾何学的スピン軌道相互作用とカイラリティ誘起スピン選択性」

Abstract:

It was experimentally reported that photoelectrons transmitted through chiral molecules, such as DNA and α -helical peptides, acquire the chirality-dependent spin polarization [1]. Such a spin filtering effect is called chirality-induced spin selectivity (CISS). Surprisingly, the energy scale of a spin-orbit coupling (SOC) relevant to the CISS was estimated as hundreds of meV [2], which is unexpected in molecules composed of light elements.

Here, we report a new type of SOC called geometric SOC [3]. Starting from the relativistic Dirac Lagrangian in curved space, we derive an effective nonrelativistic Hamiltonian in a generic one-dimensional curve. The geometric SOC is of $O(m^{-1})$, in contrast to the conventional one of $O(m^{-2})$. The energy scale is estimated to be a hundred meV for a nanoscale helix. We also investigate the Edelstein effect in a coupled-helix model. We find that the current-induced spin polarization depends on the chirality and is a representative of the CISS.

[1] Göhler *et al.*, Science 331, 894 (2011).

[2] Xie *et al.*, Nano Lett. 11, 4652 (2011).

[3] Shitade and Minamitani, arXiv:2002.05371.

<Contact>

家田淳一(81-3449)

Advanced Science Research Center