

凝縮系物理学ゼミナール

Condensed Matter Seminar

Location: **Room 413**, School of Science Bldg. 5 (理学 5 号館 413 号室)

Date: **13:30-14:15**, Wednesday, 15 May 2019

“Magnetic quadrupole moment and (gravito)magnetolectric effect”

Speaker:

Atsuo Shitade (Condensed Matter Theory Group)

Abstract:

Multipole moments characterize the anisotropy of the charge and charge current densities in classical electromagnetism in matter. Among them, the magnetic quadrupole moment (MQM) has been believed to be an important ingredient for the magnetoelectric (ME) effect. However, when we calculate the multipole moments quantum mechanically in periodic systems, we suffer from the fact that the position operator is unbounded.

We are going to talk about quantum-mechanical formulas of the orbital [1] and spin MQMs [2] in periodic systems. Starting from a thermodynamic definition, we prove a direct relation between the MQM and ME susceptibility beyond the symmetry argument.

We also discuss what we call gravito-ME effect, in which the magnetization is induced by a temperature gradient. Although the Kubo formula of the gravito-ME susceptibility diverges at zero temperature, we prove that the correct susceptibility is obtained by subtracting the spin MQM from the Kubo formula and related to the ME susceptibility by the Mott relation.

References

[1] A. Shitade, H. Watanabe, and Y. Yanase, Phys. Rev. B **98**, 020407 (2018).

[2] A. Shitade, A. Daido, and Y. Yanase, Phys. Rev. B **99**, 024404 (2019).