1 Aoki Group

Subject: Theoretical condensed-matter physics

Member: Hideo Aoki

Our main interests are many-body and topological effects in electron and cold-atom systems, i.e., **superconductivity, magnetism and topological phenomena**, for which we envisage a **materials design** and novel **non-equilibrium** phenomena should be realised. Studies in the 2016 academic year include:

- **Superconductivity**
  - — Electron correlation and High-Tc superconductivity
  - — Tc dome and Pomeranchuk instability [1]
  - — Flat-band superconductivity [2]
- **Topological systems**
  - — Quantum Hall effect and chiral symmetry in graphene [3]
  - — Designed ferromagnetic and topological organic material [4]
  - — Three-dimensional graphene [5,6]
  - — Electronic birefringence in bilayer graphene
- **Non-equilibrium and non-linear phenomena**
  - — Higgs modes in superconductors [7-10]
  - — Collective excitations in two-band superconductors [11]
  - — Superconductivity in non-equilibrium [12]
  - — Floquet topological phase transitions [13,14]

[1] Motoharu Kitatani, Naoto Tsuji and Hideo Aoki: Interplay of Pomeranchuk instability and superconductivity in the two-dimensional repulsive Hubbard model, *Phys. Rev. B* **95**, 075109 (2017).

[2] Keita Kobayashi, Masahiko Okumura, Susumu Yamada, Masahiko Machida, and Hideo Aoki: Superconductivity in repulsively interacting fermions on a diamond chain — flat-band induced pairing, *Phys. Rev. B* **94**, 214501 (2016).

[3] Tohru Kawarabayashi, Hideo Aoki and Yasuhiro Hatsugai: Lattice realization of the generalized chiral symmetry in two dimensions, *Phys. Rev. B* **94**, 235307 (2016).

[4] Masahiko G. Yamada, Tomohiro Soejima, Naoto Tsuji, Daisuke Hirai, Mircea Dinca and Hideo Aoki: First-principles design of a half-filled flat band of the Kagome lattice in two-dimensional metal-organic frameworks, *Phys. Rev. B* **94**, 081102(R) (2016).

[5] Mikito Koshino and Hideo Aoki: Dirac electrons on three-dimensional graphitic zeolites — a scalable mass gap, *Phys. Rev. B* **93**, 041412(R) (2016).

[6] Yoichi Tanabe, Yoshikazu Ito, Katsuaki Sugawara, Daisuke Hojo, Mikito Koshino,Takeshi Fujita, Tsutomu Aida, Xiandong Xu, Khuong Kim Huynh, Hidekazu Shimotani, Tadafumi Adschiri, Takashi Takahashi, Katsumi Tanigaki, Hideo Aoki, and Mingwei Chen: Electric properties of Dirac fermions captured into 3D nanoporous graphene networks, *Advanced Materials* **28**, 10304 (2016).

[7] Yuta Murakami, Philipp Werner, Naoto Tsuji and Hideo Aoki: Multiple amplitude modes in strongly coupled phonon-mediated superconductors, *Phys. Rev. B* **93**, 094509 (2016).

[8] Y. Murakami, P. Werner, N. Tsuji and H. Aoki: Damping of the collective amplitude mode in superconductors with strong electron-phonon coupling, *Phys. Rev. B* **94**, 115126 (2016).

[9] Naoto Tsuji, Yuta Murakami and Hideo Aoki: Nonlinear light-Higgs coupling in superconductors beyond BCS: Effects of the retarded phonon-mediated interaction, *Phys. Rev. B* **94**, 224519 (2016).

[10] Ryusuke Matsunaga, Naoto Tsuji, Kazumasa Makise, Hirotaka Terai, Hideo Aoki, and Ryo Shimano: Polarization-resolved terahertz third-harmonic generation in a superconductor NbN — dominance of Higgs mode beyond the BCS approximation, submitted (arXiv:1703.02815).

[11] Yuta Murotani, Naoto Tsuji and Hideo Aoki: Theory of light-induced resonances with collective Higgs and Leggett modes in multiband superconductors, *Phys. Rev. B* **95**, 104503 (2017).

[12] Sota Kitamura and Hideo Aoki: η-pairing superfluid in periodically-driven fermionic Hubbard model with strong attraction, *Phys. Rev. B* **94**, 174503 (2016).

[13] Takahiro Mikami, Sota Kitamura, Kenji Yasuda, Naoto Tsuji, Takashi Oka and Hideo Aoki: Brillouin-Wigner theory for high-frequency expansion in periodically driven systems — Application to Floquet topological insulators, *Phys. Rev. B* **93**, 144307 (2016).

[14] Sota Kitamura, Takashi Oka and Hideo Aoki: Probing and controlling spin chirality in Mott insulators by circularly polarized laser, submitted (arXiv:1703.04315).