SFB 1432

Colloquium

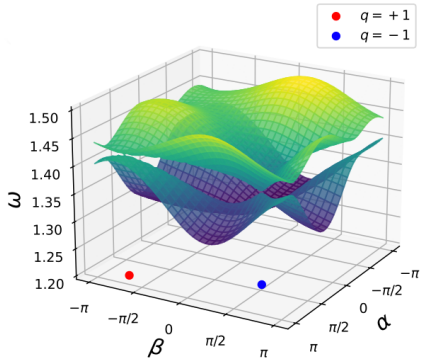
Universität Konstanz

November 16, 2023
Talk at 15:15
in P 603
refreshment afterwards

Prof. Dr. András Pályi

BME Budapest

Weyl points beyond band structures: classical mechanics, spin qubits, Josephson junctions



In the past decade, research on Weyl semimetals has evolved into a major theme within condensed-matter physics. Defining characteristics of Weyl semimetals are Weyl points, i.e., touching points (a.k.a. degeneracy points or conical intersections) between neighbouring energy bands in the electronic band structure. Further characteristics of such a Weyl point are its robustness against fluctuations, and the linear energy dispersion in its vicinity. In this talk, I will discuss the simple mathematical origin of the robustness of Weyl points, and illustrate that similar degeneracy points appear in a plethora of physical systems described by parameter-dependent matrices, e.g., in the frequency spectrum of coupled linear oscillators [1], and in the energy spectrum of interacting spin qubits [2,3,4] or Josephson junctions [5,6]. I will also highlight universal patterns describing the creation, annihiliation, merger, and separation of Weyl points as control parameters are varied [6,7]. Interestingly, much of this universal behaviour is described by known results from a specific branch of mathematics called singularity theory.

[1] Z. Guba, Gy. Frank, G. Pinter, A. Palyi, Weyl points in ball-and-spring mechanical systems, https://arxiv.org/abs/2302.08241
[2] Z. Scherubl, A. Palyi, et al., Observation of spin-orbit coupling induced Weyl points in a two-electron double quantum dot, Comms. Phys. 2, 108 (2019), https://arxiv.org/abs/1804.06447
[3] Gy. Frank, Z. Scherubl, Sz. Csonka, G. Zarand, A. Palyi, Magnetic degeneracy points in interacting two-spin systems: geometrical patterns, topological charge distributions, and their stability, Phys. Rev. B 101, 245409 (2020), https://arxiv.org/abs/1910.02831
[4] A. Sen, Gy. Frank, B. Kolok, J. Danon, A. Palyi, Classification and magic magnetic-field directions for spin-orbit-coupled double quantum dots, https://arxiv.org/abs/2307.02958
[5] Gy. Frank, D. Varjas, G. Pinter, A. Palyi, Weyl-point teleportation, https://arxiv.org/abs/2112.14556
[6] Gy. Frank, G. Pinter, A. Palyi, Singularity theory of Weyl-point creation and annihilation, https://arxiv.org/abs/2309.05506
[7] G. Pinter, Gy. Frank, D. Varjas, A. Palyi, Birth Quota of Non-Generic Degeneracy Points, https://arxiv.org/abs/2202.05825

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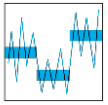

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