

量子物理学・ナノサイエンス第 115 回特別セミナー

Modulated symmetries from generalized Lieb-Schultz-Mattis anomalies

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概 要

Symmetry is one of the important guiding principles of physics, allowing us to simplify problems in various contexts. Recently, there have been growing interests in updating the concept of physics, such as generalized symmetry (symmetry associated with extended objects such as lines), and noninvertible symmetry. We focus on one of such new types of symmetries, modulated symmetry, where symmetry operations depend on spatial coordinates (i.e., symmetry operations are inhomogeneous), originally invented in the context of fracton topological phases, which are unconventional topological phases of matter with mobility constraints. The key feature of this symmetry is that it imposes a mobility constraint on a system, leading to intriguing physical phenomena, such as the Hilbert space fragmentation, breaking ergodicity. In this talk, we elucidate the interplay between quantum spin systems defined on two or three dimensional lattice with anomaly in the sense that two global symmetries exhibit nontrivial commutation relation, depending on the system size in a manner akin to the Lieb-Schultz-Mattis type anomaly, and modulated symmetry.

We demonstrate that by gauging one of the global symmetries in an anomalous spin model, there exist modulated symmetries, especially dipole symmetries associated with conservation of dipole. Moreover, these modulated symmetries form unusual dipole algebra – p-form and q-form symmetry operators are related with one another via translational operators. Our consideration provides a new insight into the emergence of modulated symmetries in a concrete quantum system on a lattice with anomaly, making better understanding of these exotic symmetries, especially the ones in spatial dimension more than one.

This talk is based on a joint work with B. Han and W. Cao (to appear)

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