Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **3339** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Fractonic quantum phases in breathing pyrochlore lattice

Wednesday, June 8, 2022 1:30 PM (15 minutes)

Fractonic phases of matter are characterized as possessing unusual mobility restricted quasiparticle excitations, and a ground state degeneracy that is sub-extensive and geometry dependent. While there exist a number of exactly solvable models with interactions between multiple particles/spins, the realization of such models in real materials is extremely challenging. In this talk, we investigate a realistic novel fractonic phase of matter that arises from a quantum model of quadratic spin interaction on the breathing pyrochlore lattice. Using membrane operators, we demonstrate the existence of a sub-extensive ground state degeneracy explicitly depending on the lattice geometry. This work provides a natural and realistic scenario to realize such exotic phases of matter, and a promising foundation for future theoretical and experimental investigations. [arXiv:2109.03835]

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Session Classification: W2-8 Condensed matter theory II (DCMMP/DTP) | Théorie de la matière condensée II (DPMCM/DPT)

Track Classification: Technical Sessions / Sessions techniques: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)