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Fractons on curved spacetime

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Fracton phases of matter are characterised by excitations with restricted mobility. While much of their theoretical description remains shrouded in mystery, a robust line of attack involves their spacetime symmetries and their coupling to geometric backgrounds which realise these symmetries locally. One class of fracton theories derive their mobility constraints from a conserved dipole moment. The simplest theory with a global dipole symmetry involves a complex scalar, while gauging the dipole symmetry leads to a symmetric tensor gauge field and a scalar gauge field whose dynamics are governed by "scalar charge gauge theories" that generalise Maxwell theory. The spacetime symmetries of these theories are Aristotelian (which in particular means no boost symmetry), and the curved spacetimes to which these theories couple are those which locally realise the Aristotelian symmetry algebra: so-called Aristotelian spacetimes, which are examples of non-Lorentzian geometries. I will sketch the coupling of both the scalar dipole symmetric theory and the scalar charge gauge theory to curved Aristotelian background. While the scalar theory can be coupled to arbitrary backgrounds, the scalar charge gauge theory can only be coupled to curved spacetimes if the magnetic sector is traceless, and even then the geometry must satisfy a certain condition that can be enforced with a Lagrange multiplier. If we only curve the spatial part of the background, this condition reduces to the requirement that the background has constant sectional curvature.

Presenter: HAVE, Emil