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Phonon Emergence

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Phonons are essential constituents of almost every condensed matter model, yet their dynamical origin is never described. The emergence of phonons from a spatially-modulated order parameter is arguably the best candidate mechanism to explain the anomalous resistivity of strongly-correlated electron systems. The description of the translation-breaking dynamics defines a novel type of effective-theory, which combines aspects of fundamental and standard effective field theories. It implements the Goldstone and analogous low-energy theorems in a constructive way. We show field theoretic and holographic models where phonons and pseudo-phonons emerge dynamically and discuss their theoretical and phenomenological implications.

Primary author: MUSSO, Daniele

Presenter: MUSSO, Daniele