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**Synthetic gauge fields in synthetic dimensions: the effect of interactions** LEONARDO MAZZA, Dpartment e Physique, Ecole Normale Suprieure, SIMONE BARBARINO, NEST, Scuola Normale Superiore Istituto Nanoscienze-CNR, LUCA TADDIA, Scuola Normale Superiore CNRIstituto Nazionale di Ottica, UOS di Firenze LENS, DAVIDE ROSSINI, NEST, Scuola Normale Superiore Istituto Nanoscienze-CNR, ROSARIO FAZIO, ICTP - International Centre for Theoretical Physics — Synthetic ladders realized with one-dimensional alkaline-earth(-like) fermionic gases and subject to a gauge field represent a promising environment for the investigation of quantum Hall physics with ultracold atoms. We unveil the existence of a hierarchy of fractional insulating and conducting states with intriguing properties by means of both analytical techniques and numerical methods. In particular, we show that the gapless phases can support helical modes, whereas the gapped states, which appear under certain conditions, are characterised both by density and magnetic order. The properties of this hierarchy of states can be experimentally studied in state-of-the-art cold-atom laboratories.

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