Discrete breaking of symmetry in the excitonic phase of Ta_2NiSe_5

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Ta_2NiSe_5 (TNS) is an *excitonic insulato*r candidate material. Condensation of excitons is supposed to originate from particle-hole pairs formed across valence and conduction bands which weakly overlap at the Fermi level. Yet clear cut signatures of such a phase together with its possible origins remain open questions. Here we report on the understanding of the symmetry principles underlying an instability of the excitonic type in TNS.

By means of *ab-initio* calculation we uncover a set of discrete symmetries in the high-temperature phase of TNS with significant effect to its low-energy band structure. We derive a minimal electronic model consistent with these symmetries and present evidence of an electronic phase transition related to a spontaneous breaking of these symmetries. The breaking of such discrete symmetries is intrinsically coupled to a lattice instability, which drives the high-temperature orthorhombic structure to the low-temperature triclinic one. Our results open new perspectives on the interpretation of a phase characterized by the condensation of excitons hosted by this material.