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Spontaneous phase separation instabilities in nanoclusters: bottom up approach ARMEN KOCHARIAN, California State University Los Angeles, GAYANATH FERNADO, KALUM PALANDAGE, University of Connecticut, Storrs, JAMES DAVENPORT, Computational Science Center, Brookhaven Nat. Lab., Upton — Pairing instabilities and inhomogeneities found from exact diagonalization of small (4 - 8 atoms) clusters in bipartite and non-bipartite topologies provide novel insights into several mysterious many body problems in condensed matter physics and ultracold fermionic atoms. Rigorous Nagaoka type criteria are formulated for spontaneous phase separation, electron pairing and magnetism driven by interaction strength, geometrical frustration, inter-site couplings (connectivity) and transverse magnetic field. The spin-charge separation of the bare electron degrees are manifested in spin and charge density response functions under variation of electron concentration, magnetic flux and temperature. The calculated phase diagrams in low and high spin regions display level crossings, pairing and magnetic instabilities seen in assembled clusters and nanoparticles. The phase diagrams in ensemble of octahedrons and pyramids also are remarkably similar to the number of inhomogeneous paired phases, spin pseudogap, coherent and incoherent pairings found in concentrated perovskites such as high Tc superconductors, manganites, magnetoelectric multiferroic nanomaterials probed by scanning tunneling spectroscopy.

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