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An exact study of charge-spin separation, pairing fluctuations and pseudogaps in four-site Hubbard Nanoclusters KALUM PALANDAGE, University of Connecticut, ARMEN KOCHARIAN, California State University, GAYANATH FERNANDO, University of Connecticut, JAMES DAVENPORT, Brookhaven National Lab — An exact study is carried out by using the *analytical* eigenvalues of the four-site Hubbard Nanoclusters with the grand canonical and canonical ensemble approaches in a multidimensional parameter space of temperature (T), magnetic field (h), on-site interaction (U), chemical potential (μ) and number of electrons (N). The electron charge energy gap, with one hole off half filling, corresponds to an excitonic particle-hole pair binding instability with $\Delta^{e-h} > 0$ at $U > U_c$ and vanishes at a critical parameter $U_c = 4.584$. For $U < U_c$, particle-particle pair binding is found with (positive) pairing energy. The ground state degeneracy is lifted at $U \geq U_c$ and the Nanocluster becomes a Mott-Hubbard insulator due to the presence of energy gaps at all allowed integer numbers ($1 \leq N \leq 8$) of electrons. In contrast, for $U \leq U_c$ we find an electron pair binding instability at finite temperature near $N \approx 3$, which manifests a possible pairing mechanism. The resulting phase diagram consisting of hole-rich, hole-poor and magnetic regions in the ensemble of clusters near 1/8 filling closely resemble the phase diagrams in the family of doped high T_c cuprates.

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