Criticality and phase diagram of quantum long-range systems

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Several recent experiments in atomic, molecular and optical systems motivated an huge interest in the study of quantum long-range spin systems. The goal of the talk is to present a general description of their critical behavior and phases, devising a treatment valid in d dimensions with an exponent d+σ for the power-law decay of the couplings in the presence of an O(N) symmetry. By introducing a convenient ansatz for the effective action, one can determine the phase diagram for the N-component quantum rotor model with long-range interactions, with N=1 corresponding to the Ising model. The phase diagram in the σ− dplan shows a non trivial dependence on σ. As a consequence of the fact that the model is quantum, the correlation functions are genuinely strongly anisotropic in the spatial and time coordinates for σ smaller than a critical value and in this region the isotropy is not restored even at the criticality. Results for the correlation length exponent ν & the dynamical critical exponent z and a comparison with numerical findings for them are presented.