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New Phases, Superfluid Weights, Free Carrier Densities: RG Theory of Hubbard, tJ Models A. NIHAT BERKER, Koç U. and MIT, MICHAEL HINCZEWSKI, F. Gürsey Res. Cent. and MIT — We have studied the Hubbard and tJ models in d=3 with renormalization-group theory, obtaining phase diagrams and thermodynamic properties for all temperatures, densities, and coupling strengths. In the Hubbard model, at low temperatures and around half filling, the antiferromagnetic phase is obtained. (1) At strong coupling and 30-35% doping from half filling, (2) at weak and intermediate coupling and 10-18% doping, two novel phases (τ phases) were found. In these phases, the hopping expectation value is non-zero at all length scales. The weak-intermediate coupling τ phase exhibits, as in BCS superconductivity, an excitation spectrum gap and, in the specific heat, a low-temperature exponential decay and a cusp phase transition singularity. The strong coupling τ phase exhibits, as in BEC superconductivity, in the specific heat, an $\alpha \sim -1$ phase transition singularity and a pair-formation peak above the phase transition temperature. In the tJ model, we find that the superfluid weight increases with hole doping, passes through a maximum within the τ phase at 32-37% doping, and decreases, and that the free carrier density also increases to a maximum value at 32-37% doping but remains at this value under further doping. Calculations with spatially anisotropic d=3 systems yield a chemical potential shift as a function of hole doping in good agreement with experiments. Recent results with magnetic and non-magnetic impurities will also be presented.

A. Nihat Berker
Koç U. and MIT

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