The spin density wave quantum phase transition in two dimensional metals

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The mean-field theory for the onset of spin density wave order in a metal describes a quantum phase transition which reconstructs the “large” Fermi surface to small Fermi pockets. Fluctuations near this transition are described by a quantum field theory of fermions near the reconstruction points, and the bosonic order parameter. This field theory is shown to be strongly-coupled in two spatial dimensions. We find an instability near the quantum critical point to $d$-wave pairing; this is a “log-squared” instability, stronger than the familiar logarithmic BCS instability. A similar instability is also found towards a modulated bond order. We also discuss an alternative route for the onset of spin density wave order, via intermediate non-Fermi liquid phases which have small Fermi pockets but without long-range spin density wave order.

S. Sachdev, M. A. Metlitski, Y. Qi, and C. Xu, Physical Review B 80, 155129 (2009)