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Multiband Effects in Fe-pnictide Superconductors

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The key aspect of the newly discovered Fe-pnictide superconductors is their quasi two-dimensional multiband nature. Numerous experiments testify to the presence of a coherent, multiply connected, moderately correlated Fermi surface, and place these systems away from the Mott limit and a high local spin state of Fe dictated by the Hund's rule [1]. By relating the problem to a negative U Hubbard model and its superconducting ground state, we show that the defining instability of such a Fermi surface is the valley density-wave (VDW), a *combined* spin/charge density-wave at the wavevector connecting the electron and hole valleys [2]. As the valley parameters change by doping or pressure, the fictitious superconductor experiences "Zeeman splitting", eventually going into a non-uniform "Fulde-Ferrell-Larkin-Ovchinikov" (FFLO) state, an *itinerant* and often *incommensurate* VDW of the real world, characterized by the metallic conductivity from the ungapped remnants of the Fermi surface. When "Zeeman splitting" exceeds the "Chandrasekhar-Clogston" limit, the "FFLO" state disappears, and the VDW is destabilized. Near this point, the VDW fluctuations are an essential ingredient of high-T_c superconductivity in Fe-pnictides [2].

[1] V. Cvetković and Z. Tešanović, http://arxiv.org/abs/0804.4678.
[2] V. Cvetković and Z. Tešanović, http://arxiv.org/abs/0808.3742.