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Instability of three-band Luttinger liquids: renormalization group analysis and possible application to $K_2Cr_3As_3$ JIAN-JIAN MIAO, FU-CHUN ZHANG, YI ZHOU, Zhejiang Univ — Motivated by recently discovered quasi-one-dimensional superconductor $K_2Cr_3As_3$ with D_{3h} lattice symmetry, we study one-dimensional three-orbital Hubbard models with generic electron repulsive interaction described by intra-orbital repulsion U, inter-orbital repulsionU', and Hund's coupling J. As extracted from density functional theory calculation, two of the three atomic orbitals are degenerate and the third one is non-degenerate, and the system is presumed to be at incommensurate filling. With the help of bosonization, we have usual three-band Luttinger liquids in the normal state. Possible charge density wave (CDW), spin density wave (SDW) and superconducting instabilities are analyzed by one-loop renormalization group. The ground state depends on the ratio J/U. For the physical relevant parameter region, $0 < J/U < 1/2$, the ground states are superconducting states. When $0 < J/U < 1/3$, spin singlet superconducting state is favored. While spin triplet superconductor will be favored when $1/3 < J/U < 1/2$. The spin density wave state can be achieved only in the unphysical parameter region $J/U > 1/2$.

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