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Orbital Nematic Instability in Two-Orbital Hubbard Model: A Renormalization-Group Study

MASAHISA TSUCHIIIZU, Department of Physics, Nagoya University, Japan, SEIICHIRO ONARI, Department of Applied Physics, Nagoya University, Japan, HIROSHI KONTANI, Department of Physics, Nagoya University, Japan — Motivated by the nematic electronic fluid phase in Sr$_3$Ru$_2$O$_7$, we analyze the ($d_{xz}$, $d_{yz}$)-orbital Hubbard model by the one-loop renormalization-group method [1]. We find that, in the weak-interaction case, the $q=0$ component of the orbital susceptibility $\chi^q(q)$ is critically enhanced by the Aslamazov-Larkin (AL) type vertex correction due to the superconducting fluctuations. In the strong-interaction case, we also find the development of $\chi^q(q)$ driven by the AL-type vertex correction due to spin fluctuations, consistently with the perturbation analysis [2]. Thus the strong orbital nematic fluctuation, i.e., orbital Pomeranchuk instability, emerges near the magnetic or superconducting quantum criticality. This mechanism of orbital nematic order presents a natural explanation for the nematic order in Sr$_3$Ru$_2$O$_7$, and is expected to be realized in various multi-orbital systems, such as Fe-based superconductors [3].


Masahisa Tsuchiiizu
Department of Physics, Nagoya University, Japan

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