Orbital fluctuation mediated superconductivity and structure transition in iron-based superconductors
HIROSHI KONTANI, Nagoya University — The main features in Fe-based superconductors are summarized as (i) orthorhombic transition accompanied by remarkable softening of the shear modulus $C_{66}$, (ii) high-$T_c$ superconductivity close to the orthorhombic phase, and (iii) stripe-type magnetic order induced by orthorhombicity. To understand them, we analyze the multiorbital Hubbard-Holstein model with Fe-ion optical phonons. In the random-phase-approximation (RPA), a small electron-phonon coupling constant ($\lambda \sim 0.2$) is enough to produce large orbital (=charge quadrupole) fluctuations. The most divergent susceptibility is the $O_{xz}$-antiferro-quadrupole (AFQ) susceptibility, which causes the $s$-wave superconductivity without sign reversal ($s^{++}$-wave state). $^1$ The $s^{++}$-wave state is robust against impurities, $^2$ consistently with experimental observations. At the same time, divergent development of $O_{x^2-y^2}$-ferro-quadrupole (FQ) susceptibility is brought by the “two-orbiton process” with respect to the AFQ fluctuations.


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