# *Physics of $t_{2g}$ electrons in transition metal oxides* +

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Our recent activity on transition metal oxide physics at Tokyo & RIKEN will be presented. Among a variety of subjects, in this talk, we would like to focus on two $t_{2g}$ electron systems where low energy spectroscopy shall be extremely powerful to explore the physics.

(1) Local physics of doped bi-layer ruthenate $Sr_3Ru_2O_7$

$Sr_3Ru_2O_7$ is a paramagnet located very close to a magnetic critical point. By introducing a small amount of Mn impurities (~2 %), a long-range antiferromagnetic ordering, likely accompanied by orbital ordering, is induced. This doping induced phase transition was investigated in real space by STM/STS. In the pure $Sr_3Ru_2O_7$, the atomic image of squared lattice was observed for the first time. The topographic image did not show any noticeable bias voltage dependence. In contrast, antiferromagnetic Mn 5% doped $Sr_3Ru_2O_7$ showed a drastic change of topographic images as a function bias voltage. We argue that this strong bias voltage dependence in the doped ruthenate originates from the orbital states inherent to $Ru^{4+}$ compound. Besides, Mn impurities were clearly identified in the images and a strong resonance of impurity states was found at a bias voltage of 800mV.

(2) Heavy femion oxide $LiV_2O_4$ spinel

$LiV_2O_4$ is known as the first heavy fermion oxides with an extremely large g of ~400mJ/molK$^2$. The origin of heavy quasi-particle mass, whether Kondo coupling or a geometrical frustration, has been a subject of long standing debate. Recently we have performed high field measurement on the unique spinel oxide and found a metamagnetic transition to a magnetization plateau state with M ~ 1.2 $\mu_B$/unit formula This transition is accompanied with a peak in the magnet resistance, which can be viewed as an increase of quasi-particle scattering due to critical fluctuations at the transition. We observed well defined metamagnetic transition only at very low temperatures below 4 K, where coherent quasi-particles is formed. These behaviors are strikingly in parallel with those of dense Kondo systems such as $CeRu_2Si_2$ and strongly suggest low energy density of states singularity near the Fermi level. It may be worthy for exploring such anomaly in quasi-particle density of states by low energy spectroscopy.

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