(PS38)

**Heavy fermion state in the $f^2$ periodic Anderson model**

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The crystal-field levels of the $Pr^{3+}(4f^2)$ ion in $PrOs_4Sb_{12}$ are believed to be the ground state $\Gamma_1$ singlet and the first excited state $\Gamma_4^{(2)}$ triplet with the excited energy $\sim$10K. To elucidate the effect of the crystal-field levels on the heavy fermion behaviour, we study the two-orbital periodic Anderson model at half-filling where the average $f$-electron number per site is 2, using the dynamical mean-field theory combined with the exact diagonalization method[1]. We assume a semielliptic DOS for the bare conduction band with the half-bandwidth $W = 1$ and we set the $c$-$f$ hybridization $V_{\rm cf} = 0.1$.

The renormalization factor $Z$ and the local moment $\langle \vec{S}^2 \rangle$ are obtained as functions of the on-site Coulomb interaction $U$, the on-site exchange coupling $J$ and the crystal-field splitting $\Delta$. In the case of $V_{\rm cf} = 0$, the ionic ground state is singlet ($\langle \vec{S}^2 \rangle = 0$) for $\Delta > \Delta_c = 3J$, while it is triplet ($\langle \vec{S}^2 \rangle = 1$) for $\Delta < \Delta_c$. In the strong correlation regime $U \gtrsim W$, the heavy fermion state with $m^*/m = Z^{-1} \gg 1$ and $\langle \vec{S}^2 \rangle \sim 1$ is realized for $\Delta < \Delta_c$, while it is not realized for $\Delta > \Delta_c$. When the ground state singlet and the excited state triplet form a quasi-quartet ($\Delta \approx \Delta_c$), the system shows a moderate enhancement of the effective mass $m^*/m \sim 10 - 50$ and a large enhancement of the orbital fluctuation.

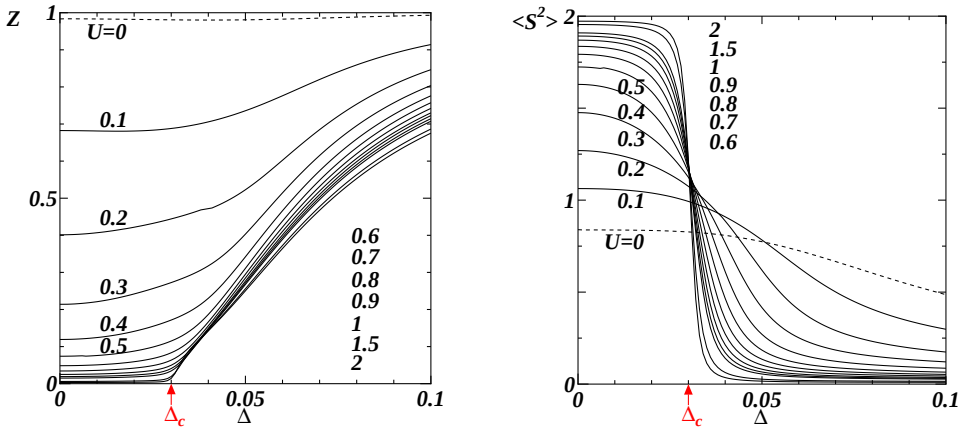


Figure 1: $Z$ and $\langle \vec{S}^2 \rangle$ as functions of $\Delta$ for several $U$ at $J = 0.01$.

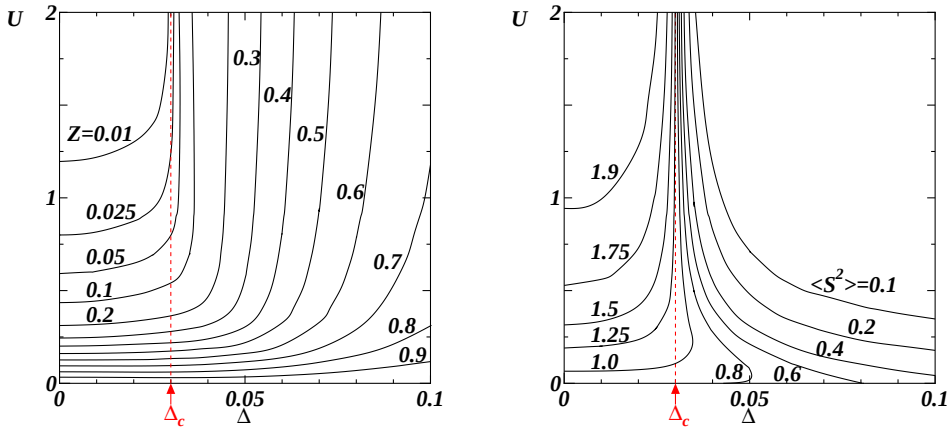


Figure 2: Contour maps for $Z$ and $\langle \vec{S}^2 \rangle$ on $\Delta - U$ plane at $J = 0.01$.

[1] Y. Ōno, M. Potthoff and R. Bulla, Phys. Rev. **B 67** (2003) 035119.