Scaling relation found in anomalous electrical transport and superconductivity of heavy fermion superconductor URu_2Si_2

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The pressure dependent electrical resistivity of URu_2Si_2 has been studied in an ultra-clean single crystal at high pressure across the first order phase boundary of P_x where the ground state switches under pressure from "hidden order" (HO) to large moment antiferromagnetic (LAFM) states. The generalized power law $\rho = \rho_0 + A_n T^n$ analysis finds that the electric transport property deviates from Fermi liquid theory in the HO phase but obeys the theory well above P_x. This suggests the quantum criticality in the HO phase of URu_2Si_2. The analysis using the polynomial in T expression $\rho = \rho_0 + \alpha_1 T + \alpha_2 T^2$ reveals the scaling relation $\alpha_1/\alpha_2 \propto T_{sc}$ in the HO phase. While the pressure dependence of α_2 is very weak, α_1 is roughly proportional to T_{sc}. This suggests a strong correlation between the anomalous quasiparticle scattering and the superconductivity and that both have a common origin, possibly rooted in the magnetic excitations $Q_0 = (0,0,1)$ observed only in the HO phase. Similar correlation between the T-linear resistivity and T_{sc} has been found in the organic superconductors, the iron pnictide superconductors and the high-T_c cuprate superconductors near quantum criticality.