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Reemergence of superconductivity and pressure driven quantum criticality in iron selenide superconductors

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Superconductivity has been thought to be closely related to the quantum critical transition in many correlated electronic systems such as cuprates, heavy fermions, organic conductors and iron pnictides. The states of quantum phases are determined by the lattice, charge, orbital and spin degree of freedom in materials. These factors can be manipulated by control parameters including pressure, magnetic field, and chemical composition. Among these parameters, pressure is a clean way in tuning the lattice and the electronic properties. In this talk, I will report an experimental discovery of pressure-driven quantum criticality in the newly discovered iron-selenide superconductors $M_{0.8}Fe_xSe_2$ (M = K, Rb, Tl substituted Rb) [1]. The results of in-situ high pressure resistance and structure measurements demonstrate transitions from the metallic Fermi liquid behavior to the non-Fermi liquid behavior and from the antiferromagnetism to the paramagnetism at a critical pressure. In extended high-pressure studies on these iron selenide superconductors, we find that the system investigated enters a new superconducting state above the critical pressure after elimination of its initial superconducting phase [2]. The maximum Tc of the second superconducting phase reached 48 K, higher than the maximum Tc of the first superconducting phase. We propose that the reemerging superconductivity in the studied samples should be driven by the quantum critically.

References:

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