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Observation of quantum-critical breakdown of the Bose Polaron ZOE YAN, YIQI NI, ALEXANDER CHUANG, CARSTEN ROBENS, MARTIN ZWIERLEIN, Massachusetts Institute of Technology — Strongly-coupled Bose polarons are created in equilibrium by immersing 40K impurities in a 23Na Bose-Einstein condensate (BEC). We perform locally-resolved radiofrequency ejection spectroscopy by transferring the impurities from a strongly-interacting into a non-interacting internal state. Our spectra reveal the energy, lifetime, and short-range correlations of the strongly-coupled impurity state as a function of temperature, from low temperatures in which the polaronic quasiparticle is well-defined to the regime near the BEC phase transition. At low temperatures, the impurity behaves as a localized Bose polaron with its spatial extent given by the interboson distance. Approaching the critical BEC temperature, the impurity's spectral width increases to several times the measured binding energy, signaling a breakdown of a simple quasiparticle picture in the vicinity of the quantum-critical point.

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