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Quantum criticality in a cubic heavy fermion cage compound[1]

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Matter at the absolute zero in temperature may reach a highly exotic state: Where two distinctly different ground states are separated by a second order phase transition the system is far from being frozen; it is undecided in which state to be and therefore undergoes strong collective quantum fluctuations. Quantum criticality describes these fluctuations, their extension to finite temperatures, and the resulting unconventional physical properties. Heavy fermion compounds have been much investigated in the past few years as model systems. An important recent finding is that in the tetragonal compound $YbRh_2Si_2$ [1] a new energy scale vanishes at the quantum critical point and is in addition to the second-order phase transition scale that governs the behavior of conventional quantum critical points [2,3]. New theoretical scenarios can account for this finding if 2-dimensional spin fluctuations are assumed [4]. Here similar behaviour of the new heavy fermion compound $Ce_3Pd_{20}Si_6$ [5] is discussed in which the cubic crystal structure and the highly symmetric local environment of the Ce atoms in molecular "cages" makes 2-dimensional spin fluctuations rather unlikely.

[1] For a review see Gegenwart et al., Nat. Phys. 4, 186 (2008).
[2] Paschen et al., Nature 432, 881 (2004).
[3] Gegenwart et al., Science 316, 90 (2007).
[4] Si et al., Nature 413, 804 (2001).
[5] Paschen et al., J. Magn. Magn. Mater 316, 90 (2007) and Refs. herein.

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