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Experimental evidence for Efimov quantum states[1]

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Three interacting particles form a system which is well known for its complex physical behavior. A landmark theoretical result in few-body quantum physics is Efimov's prediction of a universal set of weakly bound trimer states appearing for three identical bosons with a resonant two-body interaction [1]. Surprisingly, these states even exist in the absence of a corresponding two-body bound state and their precise nature is largely independent of the concrete type of the two-body interaction potential. Efimov's scenario has attracted great interest in many areas of physics; an experimental test however has not been achieved. We report the observation of an Efimov resonance in an ultracold thermal gas of cesium atoms [2]. The resonance occurs in the range of large negative two-body scattering lengths and arises from the coupling of three free atoms to an Efimov trimer. We observe its signature as a giant three-body recombination loss when the strength of the two-body interaction is varied near a Feshbach resonance. We also report on a minimum in the recombination loss for positive scattering lengths, indicating destructive interference of decay pathways. Our results confirm central theoretical predictions of Efimov physics and represent a starting point with which to explore the universal properties of resonantly interacting few-body systems.
[1] V. Efimov, Phys. Lett. 33B, 563 (1970). [2] T. Kraemer, M. Mark, P. Waldburger, J. G. Danzl, C. Chin, B. Engeser, A. D. Lange, K. Pilch, A. Jaakkola, H.-C. Nägerl, R. Grimm, accepted for publication in Nature, cond-mat/0512394.

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