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Creation of Rydberg polarons in a quantum Bose gas

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概要

The presence of an impurity in a medium can lead to a collective response and the formation of a quasi-particle known as a polaron. Most studies of polarons involve Fermi gases. Here, I will report the spectroscopic observation of Rydberg polarons in a Bose gas. The polarons are created by excitation of Rydberg atoms in a strontium Bose-Einstein condensate and are distinguished by occupation of large number of bound molecular states. These exotic molecules are formed due to localization of the Rydberg electron wave function in frequent scattering from the Bose atoms. The cross-over from few-body bound molecular oligomers to many-body polaron features is described with a functional determinant theory that solves an extended Froehlich Hamiltonian for an impurity in a Bose gas. Detailed analysis of the red-detuned tail of the excitation spectrum, which describes the contribution from the region of highest density in the condensate, provides a clear signature of Rydberg polarons.

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