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Local density probing of atomic gas via cold Li-Ca⁺ inelastic collisions in an atom-ion hybrid system RYOICHI SAITO, SHINSUKE HAZE, MUNEKAZU FUJINAGA, KAZUKI KYUNO, TAKASHI MUKAIYAMA, Institute for Laser Science, University of Electro-Communications — Ultracold atoms in a harmonic trap inevitably has an inhomogeneous density distribution, which makes an atomic gas an ensemble of atoms in different physical phases. Recent technical advances in the determination of local physical quantities in an atomic gas overcome this complexity and make it possible to directly compare experimental results with many-body theories of a homogeneous atomic gas. A laser-cooled ion can be used as a high-spatial resolution probe of physical quantities of an atomic gas. The spatial spread of an ion can be reduced to sub-microns, which is even small enough for the application of the local probe of atoms in optical lattices. In our experiment, we constructed Li and Ca⁺ ultracold hybrid system and observed inelastic collisions as a loss of ions. The inelastic collision is confirmed to be a charge-exchange process, whose rate depends linearly on the local atomic density. From the measurement of the rate of the charge-exchange, we can reproduce an atomic density profile. This is an important step toward a local probe of physical quantities of atoms with cold ions. In this presentation, we report on the observation of charge-exchange collisions between Li atom and Ca⁺ ions, and discuss the feasibility of the ions as a probe of the atoms.

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