



量子物理学・ナノサイエンス第 295 回セミナー

Studying the fundamental properties of pions and antiprotons using lasers

- 講師** : Dr. Masaki Hori
Max-Planck-Institut für Quantenoptik,
Garching, Germany
- 日程** : 7月1日(水) 16:00-17:30
- 場所** : Zoom (registration needed)

概要

The metrological techniques of atomic physics, in particular laser spectroscopy of various atoms and molecules, have begun to determine the fundamental properties of some particles including the (anti)proton-to-electron mass ratio and the charge radii of protons and deuterons to unprecedented precision. This has attracted theoretical interest that have allowed some of these experiments to constrain possible deviations from the expectations of the Standard Model of particle physics that may arise due to a hypothetical fifth force, or interactions with exotic bosons including axion-like particles that may constitute the dark matter at the specific energy (0.1-1000 eV) and length scales (10^{-10} m) that are relevant and accessible to atomic systems.

We have recently begun to extend these studies to mesons (i.e., particles that contain a valence quark and antiquark which are bound by the strong interaction) by carrying out laser spectroscopy of so-called "metastable pionic helium atoms". These three-body exotic atoms are composed of a negatively charged pion and a 1s electron orbiting a helium nucleus. The atom is remarkable in the sense that, whereas other varieties of atoms containing pions typically have very short lifetimes of a few picoseconds or less, this particular variety of pionic helium atom survives for many nanoseconds. The extreme longevity (for a pionic atom) allowed us to excite transitions of the pion in the atom using a laser with a peak power of 10 megawatts. The experiment, which constitutes the first such laser excitation and laser spectroscopy of an atom containing a meson, was carried out using the 590 MeV ring cyclotron facility of the Paul Scherrer Institute near Zurich, Switzerland. We will also briefly describe the experiment now in preparation at the new Extra Low Energy Antiproton ring (ELENA) facility of CERN to carry out laser spectroscopy of antiprotonic helium atoms.

学内外の方々のご参加を歓迎いたします。以下の URL から事前登録をお願いいたします。

https://zoom.us/meeting/register/tJAuc--orzMtH9Vtpxnj9czZYpHp_88rwHI2

なお、参加可能人数に限りがありますため、6月24日までは学内の方を優先して承認し、人数に余裕がある場合は、25日以降学外の方の申し込みを承認する予定です。

連絡教員 物理学系 藤岡 宏之 (内線 2455)