Contribution ID: **49** Type: **Invited talk**

Penning-trap mass spectrometry for neutrino physics

Friday, 12 June 2015 11:50 (30 minutes)

The discovery of neutrino oscillations has proven neutrinos are massive particles. However, this does not provide information on the type of the neutrino and its mass. An answer to these questions lies in a study of beta transitions, i.e., beta- and double-beta- decays as well as electron and double-electron captures. A crucial parameter in this study is the Q-value of the beta transitions, which has to be measured with an accuracy of 100 eV in the case of the determination of the neutrino type and better than 1 eV if the neutrino mass is concerned. Tremendous progress in Penning traps has finally allowed such high precision Q-value measurements.
This contribution will be an overview of the results of the measurements performed with the Penning-trap mass spectrometer SHIPTRAP and present a physical program for the next generation Penning-trap mass spectrometer PENTATRAP, which is under construction at Max-Planck Institute for Nuclear Physics/Germany.
The contribution can be divided into two parts.
The first part comprises the results of our search for the nuclide with the largest probability for neutrinoless double-electron capture. We have determined the Q-values of a large number of potentially suitable nuclides with SHIPTRAP by Penning-trap mass-ratio measurements. So far two interesting transitions have been discovered. The double-electron capture in 152Gd has been determined to have the smallest half-life of about 1e27 years for a 1 eV neutrino mass among all known double-electron-capture transitions, which makes 152Gd the most suitable candidate for the search for neutrinoless double-electron capture. In 156Dy a multiple resonant enhancement of neutrinoless double-electron-capture transitions to four nuclear excited states has been discovered, which may open a way to a weighting of contributions of different mechanisms to this process.
Recently, the novel mass-measurement technique PI-ICR developed at SHIPTRAP has been successfully employed to measure, for instance, the Q-values of 187Re beta-decay and of electron capture in 163Ho with a relative uncertainty of about 2e-10.
The second part - the culmination of our activity - is a creation of the Penning trap mass spectrometer PENTATRAP for measurements of the Q-values of 187Re beta-decay and of electron capture in 163Ho with an uncertainty below 1 eV for a determination of (anti)neutrino mass.

Primary author: Dr ELISEEV, Sergey (Max-Planck Institut für Kernphysik, Heidelberg)

Co-authors: Mr RISCHKA, Alexander (Max-Planck Institut für Kernphysik, Heidelberg, Germany); Dr DÖRR, Andreas (Max-Planck Institut für Kernphysik, Heidelberg, Germany); Dr BÖHM, Christine (Max-Planck Institut für Kernphysik, Heidelberg, Germany); Dr NESTERENKO, Dmitriy (Petersburg Nuclear Physics Institute, St. Petersburg, Russia); Dr MINAYA RAMIREZ, Enrique (Max-Planck Institut für Kernphysik, Heidelberg, Germany); Prof. BLAUM, Klaus (Max-Planck-Institut für Kernphysik); Prof. SCHWEIKHARD, Lutz (Ernst-Moritz-Arndt University Greifswald); BLOCK, Michael (GSI, Darmstadt); Dr GONCHAROV, Mikhail (Max-Planck Institut für Kernphysik, Heidelberg, Germany); Mr FILIANIN, Pavel (Petersburg Nuclear Physics Institute, St. Petersburg, Russia); Prof. NOVIKOV, Yuri (Petersburg Nuclear Physics Institute, St. Petersburg, Russia)

Presenter: Dr ELISEEV, Sergey (Max-Planck Institut für Kernphysik, Heidelberg)

Session Classification: Instrumentation and Fundamental interactions

Track Classification: Fundamental interactions