MS 13: New Developments and Techniques

Time: Thursday 15:00–16:15 Location: f128

Invited Talk MS 13.1 Thu 15:00 f128

The Multi Ion Reflection Apparatus for Collinear Laser Spectroscopy and its potential for fast and highly selective mass separation — •Stephan Malbrunot-Ettenauer for the MIRACLS collaboration — CERN, ISOLDE, Experimental Physics Department, CH-1211 Geneva 23, Switzerland

Collinear laser spectroscopy (CLS) is a powerful tool to access nuclear ground state properties of short-lived radionuclides such as spin, charge radius, and electromagnetic moments. Conventional CLS is based on the detection of fluorescence from laser-excited ions or atoms. It is limited to radioactive ion beams with yields of more than 100 to 10,000 ions/s, depending on the specific case and spectroscopic transition. To reach radionuclides with lower production yields, we are developing the Multi Ion Reflection Apparatus for Collinear Laser Spectroscopy (MIRACLS) [1]. It is based on a Multi Reflection Time of Flight (MR-ToF) device in which ions bounce back and forth between electrostatic mirrors. The trapped ions are probed by the laser during each revolution inside the MR-ToF device which largely enhances the sensitivity of CLS. In order to preserve the high resolution of CLS, MIRACLS's MR-ToF device will operate at unprecedented ion beam energies of 30 keV. This also opens new possibilities for fast and highly selective mass separation beneficial for a wide range of applications. This talk will present the MIRACLS concept and its first experimental highlights.

[1] S. Sels et al., Nucl. Instr. Meth. Phys. Res. B, in press (2019)

MS 13.2 Thu 15:30 f128

A new gas-jet setup for laser spectroscopy of transfermium elements — •Steven Nothhelfer[1,2,3], Michael Block[1,2,3], Premaditya Chhetri[1,5], Rafael Ferrer[4], Sandro Kraemer[4], Mustapha Laatiaoui[2,3], Sebastian Raeder[1,2], Fabian Schneider[2,3], Piet Van Duppen[4], Matthias Verlinde[4], Elise Verstraelen[4], and Thomas Walther[5] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, DE — [2]Helmholtz-Institut Mainz, DE — [3]Universität Mainz, DE — [4]Instituut voor Kern- en Stralingsfysica, KU Leuven, BEL — [5]TU Darmstadt, DE

Experimental data on the hyperfine structure splittings of spectral lines in transfermium elements reveal valuable information about their nuclear structure. In addition, the atomic properties of transfermium elements are of special interest due to strong relativistic effects. Therefore, a new experimental online setup is under development aiming at precise investigations of atomic states in transfermium elements by laser spectroscopy in a supersonic gas-jet. During the experiment the fusion evaporation residues are stopped in a buffer gas cell after their production and separation at SHIP at GSI, Darmstadt. Subsequently, the fusion products are extracted in a supersonic gas-jet created by a de Laval-nozzle. Laser spectroscopy in this jet enables a higher spectral resolution compared to the previous RADRIS setup, granting access to nuclear moments and spins which are derived from the hyperfine structure and isotope shifts. This talk will summarize the current status of the experiment together with first results.

MS 13.3 Thu 15:45 f128

MELISSA: First Laser Ions and Recent Achievements — •Vadim Gadelshin[1,2], Thomas E. Cocolios[3], Kristof Dockx[3], Charlotte Duchemin[3,4], Valentin Fedosseev[4], Roberto Formento Cavaier[5], Ferid Haddad[6,7], Laura Lambert[4], Bruce Marsh[4], Joao Pedro Ramos[3,4], Annie Ringvall Moberg[4,8], Thierry Stora[4], Dominik Studer[1], Felix Weber[1], Shane Wilkins[4], and Klaus Wendt[1] — [1]Johannes Gutenberg University Mainz — [2]Ural Federal University, Russia — [3]KU Leuven, Belgium — [4]CERN, Switzerland — [5]Advanced Accelerator Applications, A Novartis Company, Italy — [6]GIP ARRONAX, France — [7]SUBATECH, Nantes University, France — [8]Gothenburg University, Sweden

In April 2019 the MEDICIS Laser Ion Source for Separator Assembly (MELISSA) was launched. It was designed and constructed to provide the highly purified isotope yield and to boost it at the CERN-MEDICIS facility, aimed for routine operation with regular collection of typically 500 MBq batches of non-conventional medical radionuclides. Meanwhile MELISSA became the major ion source in use for all collections in this operational year. Several production cycles of different rare-earth radioisotopes with high specific activity were accomplished, demonstrating their yield enhancement, improved isotopic purity, and opening an access to them for users.

In the talk, a report on the first MELISSA operation period is presented. Recent achievements and difficulties, discovered during the period, are considered. Results on Er, Tb, and Yb collections, foreseen refinements and future upgrades of the laser ion source are discussed.

MS 13.4 Thu 16:00 f128

A diode pumped single frequency continuous wave Titanium:sapphire laser — •Volker Sonnenschein[1], Kato Kotaro[1], Hattori Koya[1], Hideki Tomita[1], Dominik Studer[2], Ryohei Terabayashi[1], Felix Weber[2], and Klaus Wendt[2] — [1]Nagoya University, Japan — [2]Mainz University, Germany

Pumping of Ti:sapphire using InGaN diode lasers promises a drastic reduction in cost and system size compared to traditionally employed frequency doubled Nd:YAG pump lasers. Several research groups have demonstrated diode-pumped femtosecond Ti:sapphire systems. Here we show a proof of principle for a single-frequency continuous wave (cw) Ti:sapphire system for use in high resolution spectroscopy.

The laser is pumped by three diodes providing a combined pump power of up to 8 W. A wide tuning range from 725-890 nm was realized. Frequency control and stabilization uses piezo actuators and an external reference cavity fixed on a low thermal expansion Zerodur spacer. A short-term spectral width of 500 kHz was observed using beat-note measurements with respect to a reference laser. A measurement of the hyperfine structure in the D_2 line of Rubidium yielded accurate parameters of the hyperfine coupling parameters and isotope shift, with deviations from the literature values well below 1 MHz. The full system promises a cw Ti:sapphire system at a significantly lower price point. Compared to widely utilized external cavity diode lasers a higher total output power and wider tuning range can be expected. Optimization of the pump-beam shaping and cavity geometry should further enhance these benefits.