RIMS Workshop



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Fundamental laser spectroscopy and laser ion source development at the LARISSA laboratory of the University of Mainz –from 6-Lithium to 255-Fermium

Thursday 28 March 2024 09:05 (30 minutes)

The LARISSA laboratory at the Institute of Physics of Johannes Gutenberg University was founded in 1988 shortly after the Chornobyl nuclear reactor accident to develop laser mass spectrometric techniques for the sensitive and selective determination of lowest-level contaminations of specific radiotoxic isotopes of relevance, as e.g. 41-Ca, 90-Sr, 236-U. In the past 35 years, R&D activities have been widely broadened by addressing the advancement of multi-step resonance ionization mass spectrometry (RIMS) and its application to numerous exotic elements and isotopes. For this purpose, the 30 keV RISIKO off-line radioactive ion beam (RIB) facility and the MABU quadrupole mass spectrometer were equipped with dedicated laser ion sources in combination with highly specialized solid-state lasers. A multitude of applications aside from the original goal of ultra-trace analytics, cover direct laser spectroscopic studies on the atomic and nuclear structures of rare isotopes complementing the identification of efficient and selective laser ionization schemes for use at on-line RIB production plants and in analytics. On top of this, ion beam purification and isotope selection for distinct fundamental studies are performed. This wide spectrum of applications addresses species from almost the entire periodic table of elements, for which two basic prerequisites are imperative: (1) the access to and the handling permission for altogether about 100 radioisotopes up to the German exemption limit including 47 isotopes out of 12 actinide elements and (2) the steadily ongoing refinement and adaptation of the laser systems. Optimized laser systems at present allow for (1) maintenance-free, stable long-term utilization, (2) fast automated access as well as wide-range continuous tuning of wavelengths or, alternatively, (3) narrow bandwidth operation for high-resolution spectroscopy. Today, more than 100 of these dedicated Ti:Sa laser types are in use worldwide, predominantly at large-scale research centers. A presentation of the Larissa lab together with recent results shall be given, highlighting the relevance of the work for the sensitive and selective ultra-trace analysis of radioisotopes by using conventional RIMS as well as resonant laser secondary neutrals mass spectrometry.

Workshop Themes

Instrument capabilities

Author: WENDT, Klaus Presenter: WENDT, Klaus Session Classification: Thursday Session 1