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A laser ablation carbon cluster ion source for high accuracy mass measurements with an MR-TOF-MS

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At the FRS Ion Catcher (FRS-IC) at GSI Darmstadt, Germany, short-lived nuclei produced with the fragment separator FRS are thermalized in a cryogenic stopping cell (CSC) and measured with a high-resolution multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS).

The MR-TOF-MS at the FRS-IC has been used for mass-measurement with resolving powers of up to 1,000,000 (FWHM) and accuracies down to 2×10^{-8} . To further improve the mass measurement accuracy, calibrants over a broad mass range are needed for systematic error studies on the 10^{-9} level with the MR-TOF-MS. Furthermore, calibrants with a mass close to the mass of the ion of interest are advantageous. For these purposes, a laser ablation carbon cluster ion source (LACCI) has been built and commissioned, capable of providing calibrant ions in the mass range of 36 u to 240 u. LACCI uses a laser with a repetition rate of up to 100 Hz (532 nm diode pumped solid state laser) in order to match the needs of the MR-TOF-MS. This repetition rate is two orders of magnitude larger than the one of existing systems and requires special designs to ensure stable long-term (week) operation.

A study of the repetition rates, laser optics (laser spot size, laser energy), target movement and ion optics (ion transfer efficiency) has been carried out. The development of LACCI and the commissioning results of LACCI coupled with a quadrupole mass filter and the MR-TOF-MS for long-term operation will be reported in this contribution.

Primary authors: YU, Jiajun (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany; Jinan University, Guangzhou, China); HORNUNG, Christine (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany); BECK, Soenke (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany); DICKEL, Timo (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany); JLU Gießen, Germany); GE, Zhuang (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany); GEISSEL, Hans (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany; JLU Gießen, Germany); GROEF, Lizzy (JLU Gießen, Germany); KRIPKO-KONCZ, Gabriella (JLU Gießen, Germany); NARANG, Meetika (JLU Gießen, Germany); PLASS, Wolfgang (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany; JLU Gießen, Germany); SCHEIDENBERGER, Christoph (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany; JLU Gießen, Germany)

Co-author: COLLABORATION, FRS Ion Catcher

Presenter: YU, Jiajun (GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany; Jinan University, Guangzhou, China)

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