The 13th International Conference on Stopping and Manipulation of Ions and related topics (SMI-2019)

Contribution ID : **17** Type : **not specified**

Characterization of supersonic jets for in-gas-jet laser ionization spectroscopy at the IGLIS laboratory and of gas flow inside the ion guide at the IGISOL-4 facility

Thursday, 18 July 2019 14:00 (20)

Noble gases such as argon and helium are utilized within the In-Gas Laser Ionization and Spectroscopy (IGLIS) [1] and Ion Guide Isotope Separation On-Line (IGISOL) [2] techniques to thermalize and transport nuclear reaction products, which often have short lifetimes and small production yields. To facilitate the spectroscopic studies of the properties of nuclear reaction products, thorough understanding and characterization of utilized gas flows are essential. Characterization was performed experimentally at both the IGLIS and IGISOL-4 laboratories and numerically using the Computational Fluid Dynamics (CFD) Module of COMSOL Multiphysics.

With the in-gas-jet method, an extension of the IGLIS technique, the spectral resolution is improved by more than one order of magnitude in comparison to in-gas-cell laser ionization spectroscopy [3], while maintaining a high efficiency. This allows the determination of nuclear properties with higher precision. The flow parameters of such supersonic gas jets were characterized at the IGLIS laboratory at KU Leuven using Planar Laser Induced Fluorescence (PLIF) and will be discussed in the first part of this talk. The projected temperature associated (Doppler) broadening, which can be attained with an upgraded in-gas-jet method, was estimated to be about 140 MHz for the No isotopes. Moreover, the numerical calculations were performed to obtain temperature, velocity and Mach number profiles of supersonic jets formed by a de Laval nozzle. The experimental and numerical in-gas-jet results agreed reasonably well for a range of coordinates after the nozzle's exit [4].

Extraction efficiencies and delay times of subsonic helium and argon flows inside a fission ion guide are being characterized at the IGISOL-4 facility at the University of Jyvaskyla using a radioactive ^{223}Ra α-recoil source ($T_{1/2}$=11.4 d). The status of these measurements will be discussed in the second part of this talk. This characterization defines lower limits of production yields and lifetimes of the nuclear reaction products to be studied using gas cells.

[1] Yu. Kudryavtsev et al., Beams of short lived nuclei produced by selective laser ionization in a gas cell, Nucl. Instrum. Meth. Phys. Res. B, 114, 350 (1996)

[2] I. D. Moore, P. Dendooven, and J. Ärje, The IGISOL technique—three decades of developments. In: Äystö J., Eronen T., Jokinen A., Kankainen A., Moore I.D., Penttilä H., Three decades of research using IGISOL technique at the University of Jyväskylä. Springer, Dordrecht (2013)

[3] R. Ferrer et al., Towards high-resolution laser ionization spectroscopy of the heaviest elements in supersonic gas jet expansion, Nat. Commun. 8, 14520 (2017)

[4] A. Zadvornaya et al., Characterization of Supersonic Gas Jets for High Resolution Laser Ionization Spectroscopy of Heavy Elements, Phys. Rev. X, 8, 041008 (2018)

Primary author(s) : ZADVORNAYA, ALEXANDRA (University of Jyväskylä)

Co-author(s) : Dr KANKAINEN, Anu (University of Jyvaskyla); Dr MOORE, Iain (University of Jyvaskyla); POHJALAINEN, Ilkka (University of Jyväskylä)

Presenter(s) : ZADVORNAYA, ALEXANDRA (University of Jyväskylä)