Contribution ID: **40** Type: **Poster**

High-precision mass measurements for the rp-process at JYFLTRAP

Tuesday, 20 June 2017 19:30 (2 hours)

% Format: LaTeX2e.
%
% canete.tex
%
%
\documentstyle[11pt]{article}

\textheight=9.9in
\textwidth=6.3in
\voffset -0.85in
\hoffset -0.35in
\topmargin 0.305in
\oddsidemargin +0.35in
\evensidemargin -0.35in

\long\def\TITLE#1{{\Large{\bf#1}}}\long\def\AUTHORS#1{ #1\\[3mm]}
\long\def\AFFILIATION#1#2{[1] #2\\}
\begin{document}
{\small \it Nuclear Physics in Astrophysics 8, NPA8: 18-23 June 2017, Catania, Italy}

\vspace{12pt}

\thispagestyle{empty}

\begin{center}

\TITLE{High-precision mass measurements for the rp-process at JYFLTRAP}\\[3mm]

\AUTHORS{L. Canete[1], T. Eronen[1], A. Jokinen[1], A. Kankainen[1], I.D. Moore[1], D. Nesterenko[1], S. Rinta-Antila[1], and the IGISOL group}

%%%
{\small \it
\AFFILIATION{1}{University of Jyv\"{a}skyl\"{a}, P.O. Box 35 (YFL) FI-40014 University of Jyv\"{a}skyl\"{a}, Finland}

}
%%%
\vspace{12pt} % Do not modify

\centerline{Contact email: {\it lacanete@student.jyu.fi}}

\vspace{18pt} % Do not modify

\end{center}

The rapid proton capture process (rp) is an important reaction network that generates nuclear energy and heavier elements via rapid hydrogen burning at high temperatures [1]. The rp-process occurs e.g. in type I X-ray bursts (XRB) which consists of a neutron star coupled to a low-mass main sequence star. The gravitational

accretion of hydrogen and helium rich material from the companion star highly increases the temperature and the density at the surface of the neutron star and eventually causes a breakout from the hot CNO cycle [2]. The resulting rp-process shows a waiting point at ^{30}S for most of the nucleosynthesis flow. The continuation of the network is then fully dependent of the ratio between four processes: the β^+-decay of ^{30}S, the ^{30}S$(\alpha, p)^{33}$Cl reaction, the proton capture on ^{30}S, and the photodisintegration of ^{31}Cl. At typical XRB temperatures, the process is limitated by the long β^+-decay half-life of ^{30}S ($T_{1/2} = 1.178(5)s$) and the ratio between the proton captures on ^{30}S and photodisintegration of ^{31}Cl, which depends exponentially on the proton capture Q value i.e. on the masses of ^{31}Cl and ^{30}S. A better knowledge of the conditions where ^{30}S acts as a waiting point is also valuable in observational astrophysics as double peaks in XRB bolometrical luminosity curve have been proposed to be explained by the ^{30}S waiting point [3].

The JYFLTRAP double-Penning trap mass spectrometer at the IGISOL facility [4,5] has been successfully used to measure the mass of ^{31}Cl with high precision [6]. The new mass value, $-7034.7(34)$keV, is 15 times more precise than the value given in the Atomic Mass Evaluation 2012 [7]. The first trap called the purification trap, is filled with helium gas and is used to cool the ions and remove the contaminants. The second trap, the precision trap, is used for mass measurements via time-of-flight ion cyclotron resonance (TOF-ICR) technique [8].
The recent results from JYFLTRAP and their impact on the rp-process will be discussed in this contribution.

\bigskip
{\small

\noindent [1] R.K. Wallace and S.E. Woosley, Astrophys. J. Suppl. Ser. 45, 389 (1981);

\noindent [2] A. Parikh and al., Prog. Part. Nucl. Phys. 69, 225-253 (2013);

\noindent [3] J. L. Fisker and al., Astrophys. J. 608, L61 (2004);

\noindent [4] T. Eronen et al., Eur. Phys. J. A 48, 46 (2012);

\noindent [5] I. Moore et al., Nucl. Instrum. Methods Phys. Res., Sect. B 317, 208 (2013);

\noindent [6] A. Kankainen et al., Phys. Rev. C 93, 041304(R) (2016);

\noindent [7] M. Wang et al., Chin. Phys. C 36, 1603 (2012);

\noindent [8] M. K\"{o}nig et al., Int. J. Mass Spectrom. Ion Processes 142, 95 (1995).}

\end{document}

Primary author: Ms CANETE, Laetitia (University of Jyväskylä)

Co-author: Dr KANKAINEN, Anu (University of Jyväskylä)

Presenter: Ms CANETE, Laetitia (University of Jyväskylä)

Session Classification: Poster session

Track Classification: Tools, techniques and facilities