Contribution ID: **75**

Type: **Oral**

The RIB in-flight facility EXOTIC

Friday, 23 June 2017 12:00 (20 minutes)

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\AUTHORS{Concetta Parascandolo on behalf of the EXOTIC collaboration}

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The facility EXOTIC [1], installed at the INFN-Laboratori Nazionali di Legnaro (LNL), is devoted to the in-flight production of light short-lived Radioactive Ion Beams (RIBs) in the energy range 3-5 MeV/nucleon. RIBs are produced via two-body inverse kinematics reactions induced by high-intensity heavy-ion beams, delivered by the LNL XTU-Tandem accelerator, impinging on light gas targets such as H_2, D_2, ^{3}He and ^{4}He.
The main characteristics of the facility is a large RIB acceptance of the optics elements and a maximal suppression capability of the unwanted scattered beams. The event-by-event RIB tracking is performed by means of two position sensitive Parallel Plate Avalanche Counters while the detection of reaction charged particles is achieved by means of the EXPADES array, installed in the reaction chamber at the final focal plane of the facility [2].

So far, different RIBs have been delivered at EXOTIC, like ^{17}F, ^{7}Be, ^{8}B, ^{8}Li, ^{15}O, ^{10}C and ^{11}C, while new beams are foreseen in the next future with the aim to investigate nuclear physics and nuclear astrophysics topics. Experiments with the ^{17}F, ^{7}Be, ^{8}B, ^{8}Li impinging on medium- and heavy-mass targets have been performed at Coulomb barrier energies for structure and reaction mechanism studies whereas recently, the ^{15}O and ^{11}C beams have been employed to search for α clustering phenomena in light exotic nuclei [3], using the Thick Target Inverse Kinematic scattering technique [4].

Another appealing opportunity offered by the EXOTIC RIBs is the possibility of
measuring the cross section of astrophysically important reactions.
For example, the
^{8}B beam can be employed to have an accurate knowledge of the rate of the
^{8}B(p,γ)^{9}C reaction, important in hot
pp-chains as it can provide a starting point for an alternative path across
the A = 8 mass gap.
Among the different processes of stellar nucleosynthesis forming elements heavier
than ^{9}Be, the rapid proton-capture and αp processes, occurring in
explosive astrophysical environments such as novae, x-ray bursters and type Ia
supernovae, are those than can be investigated by using the EXOTIC RIBs.
By developing a radioactive ^{18}Ne beam, the ^{18}Ne(α,p)^{21}Na reaction could be studied at astrophysical energies to provide a link between the Hot CNO cycle and the *rp*-process.
Other measurements relevant to astrophysics can be performed such as the ^{30}P(p,γ)^{31}S with a ^{30}P beam, essential for the production of heavy elements (from Si to Ca) in the explosion of O-Ne novae and in particular to explain the anomalously high ^{30}Si/^{28}Si rate measured in pre-solar grains of possible ONe novae origin.
Moreover, experiments based on the Trojan Horse Method (THM) [5] can be done. In particular, the ^{7}Be(n,α)^{4}He has been investigated at EXOTIC by applying the THM to the quasi-free reaction ^{2}H(^{7}Be,α^{4}He)p (see talk of L. Lamia).
\bigskip
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\noindent [1] V.Z.~Maidikov et al., Nucl. Phys. A 746 (2004) 389c; D.~Pierroutsakou et al., Eur. Phys. J. Special Topics 150 (2007) 47 ; F.~Farinon et al., Nucl. Instr. and Meth. B 266 (2008) 4097; M.~Mazzocco et al., Nucl. Instr. and Meth. B 266 (2008) 4665; M.~Mazzocco et al., Nucl. Instr. and Meth. B 317 (2013) 223\\
\noindent [2] D. Pierroutsakou et al., Nucl. Instr. and Meth. A 834 (2016) 46\\
\noindent [3] M. Freer, Rep. Prog. Phys. 70 (2007) 2149\\
\noindent [4] K. Artemov et al., Sov. J. Nucl. Phys. 52 (1990) 408-411\\
\noindent [5] G. Baur, Phys. Lett. B 178 (1986) 135; C. Spitaleri, Phys. of Atom. Nuc. 74, (2011) 1725; R. E. Tribble et al., Rep. Prog. Phys. 77 (2014) 106901\\

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