Contribution ID: **160** Type: **Poster**

Nuclear structure studies of exotic nuclei: the case of 31Ar

The ^{31}Ar nucleus is one of the most exotic β-delayed particle precursors, at the proton drip-line, with high Q-value and low proton separation energy. Therefore, different decay modes are open (β1p-β3p) [1]. The aim of the IS577 experiment performed at the ISOLDE Decay Station (IDS-CERN) [2] was to provide relevant information on the resonances of ^{31}Cl and ^{30}S, populated in the beta decay of ^{31}Ar.
The set-up used consisted of 5 Double Sided Si Strip Detectors (DSSD) backed by un-segmented Si-pad detectors in ΔE-E telescope configuration. This Si-array is located inside the new MAGISOL Si-Plugin Chamber, installed at the new permanent station IDS, devoted to β-decay measurements. In addition, there are 4 HPGe clover-detectors surrounding the chamber for gamma detection. This set-up is very compact with both high efficiency (Ω_p=45.5%) and good energy resolution (25 keV) for multi-particle emission, needed to characterize the different p-channels of ^{31}Ar.
New results will be presented here, such as the observation of new proton transitions and the identification of new excited states of ^{31}Cl thanks to the proton-gamma coincidence technique. In addition, three new levels of ^{30}S in the range from 8 up to 9 MeV of excitation energy have been observed extending the knowledge of excited state in ^{30}S to higher energies. Furthermore, we have experimentally determined for the first time the partial proton-gamma width of several states of ^{30}S located just above the proton separation energy, relevant for the astrophysical rp-process, present in certain stellar environments such as classical novae [3]. Our experimental determination of the values of partial widths can reduce the uncertainty in the values of the rate of the ^{29}P(p,γ)^{30}S reaction.
[1] G.T. Koldste et al., Phys. Rev. C 89, 064315 (2014)
[2] http://isolde-ids.web.cern.ch/isolde-ids/
[3] G.T. Koldste et al. Phys. Lett. B 737 (2014) 383-387.

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Session Classification: POSTER SESSION