Light charged particle detector EUCLIDES for the GALILEO campaign.


1INFN, Laboratori Nazionali di Legnaro, Legnaro (Padova), Italy.
2INFN, Sezione di Padova, Padova, Italy.
6Dipartimento di Fisica dell’Università di Padova, Padova, Italy
3Dipartimento di Fisica dell’Universit`a a Milano e Sezione INFN, Milano, Italy.

INTRODUCTION

The GALILEO project at LNL Legnaro National aims at the investigations of the nuclear structure at extreme conditions. Currently, neutron deficient nuclei of interest can be produced using fusion-evaporation nuclear reactions at the high-intensity stable beams delivered by the Tandem-ALPI-PIAVE accelerator. Meantime, radioactive beams provided by SPES facility will open an outstanding opportunity for further research. GALILEO [1] represents a 4π high-efficiency germanium array coupled to different ancillary devices such as EUCLIDES [2], Neutron Wall [3], Neda [4], etc. In the present paper we report on the current status of the high-efficiency light-charged particles detector EUCLIDES.

The EUCLIDES providing channel selection is one of the key ancillary detectors of the GALILEO project. It consists of 55 dE/E Si telescopes of different shapes with the angle coverage close to 4π. It reassures about 60% efficiency for single proton detection and 35% for single α-particles. It was used in numerous experiments at LNL in coincidence with the GASP detector. The status of each segment was already checked off-line using α-sources and reported previously [5]. The major benchmark today in preparation of EUCLIDES for future physical GALILEO campaigns is the status of the detectors and validation of new fully-digitized read out chain.

Two-day commissioning test of EUCLIDES coupled to 6 germanium detectors placed at the GALILEO structure was performed in December 2014 and is reported in Ref. [1]. Although, in this test only 6 dE/E telescopes were used, it provided an α-particle selection for 110Te produced in the α2p evaporation channel (see Fig. 3 in Ref [1]) of the fusion-evaporation reaction 58Ni+58Ni (E_{lab}=145MeV). An important step towards further progress was the development of new 16-channel preamplifiers for EUCLIDES by the INFN Milano, Fig. 1. Overall 7 pre-amplifiers were produced. The new preamplifiers provide a rise time of less than 10 ns and an ENC of 20keV+20eV/pF.

Thanks to implementation of new fully-digitized electronics the 3rd commissioning run was performed in March 2015 with 9 germanium of GALILEO coupled to full configuration of Si detectors of EUCLIDES using newly built preamplifiers. A 105 MeV 32S beam was delivered to a 1 mg/cm³ 58Ni target. The preliminary results on this experiment currently include data only from 6 Si telescope. On the recorded dE-E matrix, Fig. 2, one can clearly separate 1p, 2p and α channels as an example in Fig. 3a and 3b are plotted Doppler corrected a Doppler corrected γ-ray spectrum gated by 2p and a γ-ray spectrum gated by α. As is shown in Fig. 3a the strongest peaks were attributed to de-excitation of excited states in 80Nb by 58Ni(2S,3p)80Nb; and to de-excitation of low-lying states to 82Zr produced by 58Ni(2S,α)p82Zr, Fig. 3b . Although, the analysis is now in progress, considerable progresses have been achieved in comparison to the previous tests.
**CONCLUSION**

The 3rd commissioning test of high-efficiency germanium array GALILEO coupled to the high efficiency $4\pi$ Si array of light particles is reported. In the preliminary analysis it was possible to separate 3p and $\alpha$p reaction channels. The corresponded $\gamma$-ray transitions in $^{87}$Nb and $^{84}$Zr were observed. It is foreseen to perform the next steps to improve selectivity of the setup. Thus, all the 55 Si EUCLIDES detectors will be deployed to be coupled to 25 singles germanium detectors, inserted into the GALILEO structure, and to the Neutron Wall. This will be an important step towards future physical campaigns at INFN Legnaro to populated excited states of neutron-deficient nuclei via fusion-evaporation reactions with both stable and radioactive (provided by SPES facility in the future) beams.

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