AGATA Demonstrator at LNL:
the Coupling with the PRISMA Magnetic Spectrometer

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INTRODUCTION

The AGATA [1] spectrometer, which has been developed during the last few years by a large European collaboration, is based on the gamma-ray tracking principle. According to detailed and realistic Monte Carlo simulations, the performance of AGATA will be orders of magnitude better than achieved with escape-suppressed germanium arrays [2].

The first implementation of AGATA is the so-called AGATA Demonstrator which has just started operation at the Laboratori Nazionali di Legnaro where it will run for an experimental campaign of about 18 months. The goal of the campaign is to check the performance of the gamma-ray tracking principle in real physics experiments. Starting about one year ago with the first delivered triple cluster, the Demonstrator has been operated in several commissioning experiments of increasing complexity and with different ancillary detectors.

In the present contribution, preliminary results from the commissioning runs of the AGATA Demonstrator coupled with the PRISMA magnetic spectrometer [3] are given.

AGATA-PRISMA SETUP

PRISMA is a large acceptance magnetic spectrometer design to work in grazing reactions with the heavy-ion beams provided by the LNL accelerator complex. The basic characteristics of PRISMA are described in ref. [3] and for the following discussion it is relevant to mention that PRISMA uses ion-tracking position-sensitive detectors to achieve good mass resolution. The tracking detectors provide the basic information to obtain the trajectory and velocity of the reaction products. According to the Monte Carlo simulations, up to velocities of approximately 10% the intrinsic AGATA detector resolution is almost fully recovered if the recoil velocity is measured with a relative precision better than 1%, and if the recoil velocity direction is measured with a precision better than 1° [4].

The AGATA Demonstrator and the PRISMA spectrometer are coupled mechanically onto a platform which can rotate from 0° to 130°. Both devices are fixed on the platform and are located face-to-face in such a way that, independently of the spectrometer angle selected for an experiment, the recoils that enter into the PRISMA spectrometer will have a forward trajectory with respect to the AGATA Demonstrator, see fig. 1. The AGATA-PRISMA electronics coupling is obtained via a VME adapter module, namely AGAVA [5], which is an interface to the AGATA synchronization unit, the GTS card [6].

THE COMMISSIONING RUNS

Two in-beam commissioning experiments have been performed in order to test the coupling of the AGATA to the PRISMA magnetic spectrometer via the AGAVA interface. Both of these test experiments used the same beam-and-target combination: a 58Ni beam at 235 MeV incident upon a thin 90Zr target. Following multi-nucleon transfer reactions at the target position, the beam like products were transported to the focal plane of PRISMA where they were identified by Z and A. The first of these tests took place in November 2009 (Week 46). The set-up consisted in two triple clusters plus a DANTE MCP and the PRISMA magnetic spectrometer both acquired via standard VME electronics and coupled through the AGAVA interface.

Fig. 1. Picture showing the AGATA Demonstrator (left) coupled to PRISMA magnetic spectrometer (right).
The experiment in week 46 suffered from several technical problems, resulting in only a small amount of useful data. However, the data collected were sufficient to demonstrate that the coupling of AGA TA to PRISMA through the AGAV interface is working. The synchronization between AGA TA and the ancillary branch, both PRISMA and DANTE, was indeed achieved.

The second in-beam test with the PRISMA spectrometer was carried out in December 2009 (Week 49). The reaction and experimental set-up used, was the same as for the Week-46 experiment. The purpose of the second experiment was the optimization of the on line PRISMA analysis, and to collect more data to investigate the performance of the AGATA-PRISMA coupling. The time difference spectra for AGATA-DANTE and AGATA-PRISMA are shown in Fig 2.

One of the major improvements in the Week-49 experiment was that it was possible to carry out the full PRISMA reconstruction on line. It was possible to process the PRISMA information and track the ions entering the spectrometer via a dedicated library, which was loaded into the ancillary filter actor of the DAQ system [7], see fig. 3.

The on line velocity, obtained after the full trajectory reconstruction, has been used for a real time Doppler correction of the gamma-tracked spectrum, as can be seen fig. 4.

**SUMMARY AND CONCLUSIONS**

In summary two test experiments have been carried out, in the commissioning campaign of the AGATA Demonstrator. The experiments were devoted to the coupling of two AGATA triple clusters with the PRISMA magnetic spectrometer. The ancillary signals from PRISMA have been plugged into VME electronics and synchronized to the AGATA clock via the AGAVA interface. Hence, the acquired signals have been processed via a standalone library loaded at the preprocessing level of the DAQ. Such a library allows fundamental information like the velocity and trajectory of the ion to be extracted, from the incoming PRISMA data, and therefore to perform event-by-event the on line Doppler correction of the tracked gamma rays. In conclusion the coupling of the AGATA Demonstrator with the PRISMA magnetic spectrometer has been successfully achieved. This opens the way for the next Physics campaign, which will be mainly focused on the investigation of the spectroscopy and lifetimes in the neutron-rich side of the nuclide chart via grazing reactions performed at the AGATA-PRISMA setup.

[2] E. Farnea et al., NIMA, under publication
[4] A. Gadea et al., NIMA, under submission