The heavy-ion magnetic spectrometer PRISMA

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PRISMA is the magnetic spectrometer [1] recently installed for experiments with the A=100-200, E = 5-10 MeV$\times$A heavy-ion beams of the XTU Tandem-ALPI-PIAVE accelerator complex and for the use with the proposed radioactive beam facility SPES. The spectrometer has a very large solid angle (80 msr) and momentum acceptance ($\pm 10\%$), good mass resolution (1/300) via TOF measurement, energy resolution up to 1/1000, and can rotate around the target in a wide angular range - 20^o to 130^o. PRISMA has a simple quadrupole-dipole magnet configuration. The ion tracks are reconstructed event by event, via software, using the position, time and energy signals from the entrance micro-channel plate detector[2], and from the array of focal plane detectors[3].

PRISMA was designed for high-efficiency studies of elastic and inelastic scattering, and of few- and multi-nucleon transfer reactions induced by very heavy ions. Heavy-ion collisions at energies near the Coulomb barrier are an interesting research area where reaction dynamics and nuclear structure influence each other to a large extent. They are also a valid tool for the population of neutron-rich exotic nuclei where new structure effects are expected to show up. The γ-ray detector array CLARA [4] with 25 Clover detectors from the Euroball collaboration, is presently associated to PRISMA (see Fig. 1, left). Future experiments involving radioactive nuclear beams will take great advantage from the large efficiency and high mass, Z and energy resolutions of the spectrometer.

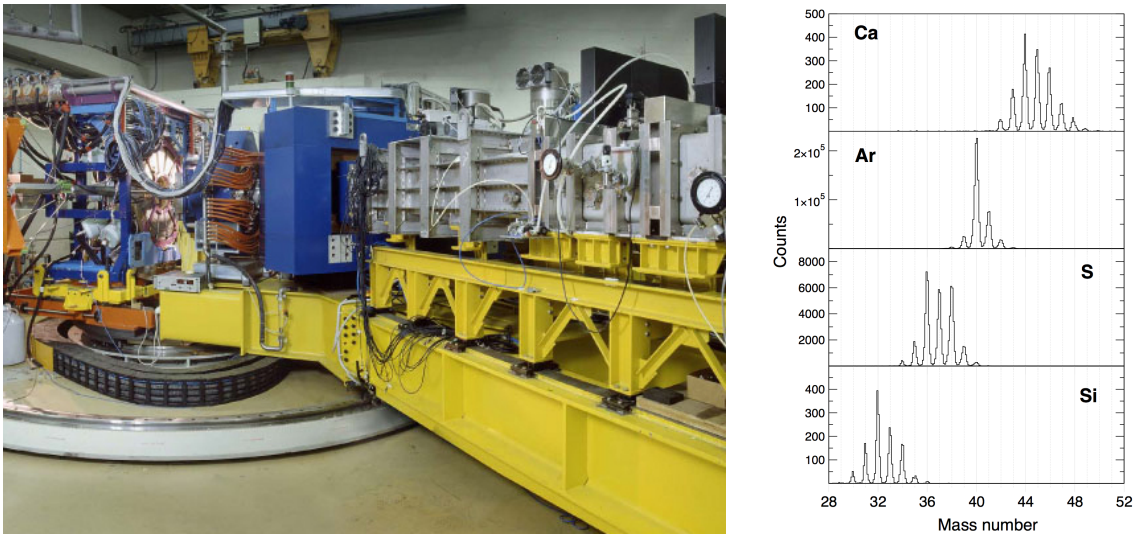

FIG. 1: *The PRISMA spectrometer and the array CLARA (left). Mass spectra measured in the reaction $^{40}Ar + ^{208}Pb$ (right).*

A preliminary run was recently performed using the $^{40}Ar^{9+}$ beam produced by the new ECR source - positive ion injector (PIAVE) feeding the ions into the superconductive Linac ALPI for final acceleration. The beam energy on the target was 252 MeV and its intensity was 8 pnA. The target was a 300μg/cm^2 evaporation (a 2 mm strip) of ^{208}Pb onto a 15 μg/cm^2 carbon foil. PRISMA was placed at θ_{lab}=66^o, close to the grazing angle. These experimental conditions allowed the acquisition of very clean events, and the obtained Z and mass spectra are of excellent quality (see a few examples in Fig. 1, right). Several neutron-rich nuclei, like for instance ^{50}Ca, ^{41}S, ^{36}Si, ^{33}Al and ^{29}Mg, are populated by multi-nucleon transfer.

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[2] G.Montagnoli et al., Nucl. Instr. & Meth. in Phys. Res. A547 (2005) 455
[3] S.Beghini et al., Nucl. Instr. & Meth. in Phys. Res. A551 (2005) 364
[4] A.Gadea et al., Eur.Phys.J. A20 (2004) 193