A new TASCA focal plane detector setup and DAQ system*

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During the TASCA commissioning phase competitive tests of two types of focal plane detectors for TASCA – a Position Sensitive Silicon Stripe Detector (PSSSD) and a Double Sided Silicon Strip Detector (DSSSD) - have been performed. The DSSSD proved to be more reliable and more sensitive for the detection of decay chains due to the high granularity of the DSSSD; moreover the position resolution of the DSSSD is independent of implantation position and deposited energy [1, 2]. The new TASCA focal plane detector setup consists of a Multi Wire Proportional Counter (MWPC) and a Focal Plane Detector Box (FPDB). The implantation detector of the FPDB consists of two side-by-side mounted 300 µm-thick DSSSDs with an active size of 72x48 mm² each mounted on a PCB frame. Eight 500 µm-thick Single Sided Silicon Strip Detectors (SSSSD) of the same size form a backward array – a four-sided box with an open side of 144x48 mm² and a depth of 72 mm (Fig. 1) [3]. The DSSSD comprises 144 vertical strips on the front side and 48 horizontal strips on the back side, each with 1 mm pitch size. Spectrometric signals are read out from the front and back sides. They provide implantation and decay energies and (x,y) coordinates with a position resolution of 1 mm. While the registration efficiency from the back side is almost 100%, the one from the front side is about 90% due to a gap of 100 µm between the strips. Each SSSSD has 8 strips with an active area 5.7x72 mm² without position resolution. The energy resolution in the DSSSD was ≤25 keV (FWHM) for 8.1 MeV α-particles measured with implanted 252Cf No depositing their full energy in the DSSSD and 170 keV for reconstructed α-particles that deposited a fraction of their energy inside the DSSSD and the remainder in the SSSSD. The average detection efficiency of the FPDB for α-particles emitted from a nucleus implanted in the active area of the DSSSD is 72%. Two additional SSSSDs are mounted behind the implantation detector and serve as a punch-through veto detector for light fast ions. The punch-through detector together with the MWPC serves for discriminating between ions recoiling from the target, radioactive decays of implanted species, and fast light ions. A cluster Ge-detector consisting of seven crystals was installed ~30 mm behind the FPDB for γ-ray measurements in coincidence with α- or SF decays.

In total 640 spectrometric channels (320 for the α-particle branch and 320 for the SF branch) are required to readout the FPDB. To minimize the total number of ADC channels, 8-channel dual-range amplifiers with integrated multiplexers were built. 40 analog output signals from the α-particle branch and 40 ones from the SF branch are connected to inputs of three V785 32-channel peak sensing ADCs (CAEN). 40 digital 3-bit outputs from the amplifiers with address codes of the fired strips are stored in four SIS 3820-3600 32-channel I/O VME registers (Struck GmbH). Analog signals from Ge-detectors are digitized in the SIS 3302 8-channel 100 MS/s 16-bit flash ADC (Struck GmbH). The amplifiers have a logical trigger output with adjustable discriminator level. All trigger outputs from the amplifiers are collected by”OR” in a CAMAC Common Trigger module. When a processed common trigger signal is accepted by a VME trigger module TRIVA5, the amplitudes of all fired ADC channels, the status of all registers, and time stamps are read out by a RIO4 (CES) frontend VME controller using the MBS software package. The total readout dead time was about 50 µs; a shorter dead time of ~30 µs was measured without Ge-detectors reading. Visualization as well as on-line and off-line analysis was performed using the software package GO4 [4].

The new detector setup and new DAQ system have been successfully used during the experiment on the synthesis of element 114 performed at TASCA in 2009 [5].

References