A new TASCA focal plane detector*

A. Yakushev[1#], R. Graeger[1], A. Gorshkov[1], A. Türler[1], D. Ackermann[2], Ch. E. Düllmann[2], E. Jäger[2], F.P. Heßberger[2], J. Khuyagbaatar[2], J. Krier[2], M. Schädel[2], B. Schausten[2], E. Schimpf[2], D. Rudolph[3], J. Even[4], J.V. Kratz[4], N. Wiehl[4], V. Chepigin[5], A. Fomichev[5], V. Gorshkov[5], S. Krupko[5], J. Bar[6], P. Grabiec[6], A. Panas[6], M. Wegrzecki[6], J. Dvorak[7], A. Semchenkov[8], J. Uusitalo[9]

[1]Technical University München, D-85748 Garching, Germany; [2] GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt, Germany; [3] Lund University, S-22100 Lund, Sweden; [4]University of Mainz, D-55128 Mainz, Germany; [5]FLNR, 141980 Dubna, Russia; [6]ITE, 02-668 Warsaw, Poland; [7]LBNL, Berkeley, CA 94720, U.S.A.; [8] University of Oslo, 0315 Oslo, Norway, [9]University of Jyväskylä, Jyväskylä, Finland

The new, highly efficient, gas-filled TransActinide Separator and Chemistry Apparatus (TASCA) has been recently put into operation at GSI with the aim to study chemical and physical properties of superheavy elements with Z≥104. Based on the results of magnetic field model calculations of the dipole and the quadrupoles, two modes of operation of TASCA, the "High Transmission Mode" and the "Small Image Mode" have been realized [1]. Two types of focal plane detector setups (FPD) were used during the TASCA commissioning phase: a (80 x 36) mm^2 16-strip position-sensitive silicon detector (PSD) and a (58 x 58) mm^2 double-sided silicon strip detector (DSSSD) as a prototype for a new TASCA focal plane detector. The test experiments showed that the image size in the HTM is larger than the detector size of both detector types, as it was expected according to ion transport calculations and Monte-Carlo simulations [1,2]. The nominal vertical position resolution of the PSD is ± 0.2 mm. However, a search for position correlated decay chain members usually occurs within ± 1 mm limits, corresponding to a pixel size area of (5 x 2) mm^2. The relatively large pixel size of the PSD negatively affects search limits for rare decay chains from long-lived isotopes of superheavy elements. The TASCA FPD working group has decided to build a detector setup based on a DSSSD as a stop detector and a backward array consisting of single-sided silicon strip detectors (SSSD). A *veto* detector for light fast ions that penetrate the DSSSD will be mounted behind the stop detector. The new setup will feature a (144 x 489 mm^2 large detector, which will accept > 90% of all evaporation residues reaching the focal plane. The geometrical detection efficiency for α-particles emitted from implanted nuclei will be > 70%. As compromise between a pixel size as small as possible and the number of spectrometric electronic channels as small as possible, a pitch width of 1 mm on the front and back side of the DSSSD has been chosen. To reduce the necessary number of ADCs the number of strips on each side of the DSSSD and on the SSSD should be a multiple of 8 when using 32-channel preamplifiers and 8 or 16-channel amplifiers with integrated multiplexers. A DSSSD structure with an active area of (72 x 48) mm^2 has 72 strips on the front side and 48 strips on the back side. The strip width and the interstrip distance on the both sides of the DSSSD are 900 µm and 100 µm, respectively. Two adjacent DSSSDs form the stop detector with an active area of (144 x 48) mm^2. A SSSD structure with an area of (72 x 48) mm^2 has 8 strips, which are 72 mm long. The strip width and the interstrip distance of the DSSSD are 5.65 mm and 100 µm, respectively. 8 SSSD detectors form the backward array with a depth of 72 mm. Two similar SSSD detectors are used as *veto* detector. Silicon wafer thicknesses of 300 µm and 500 µm have been chosen for the DSSSDs and SSSDs, respectively. These thicknesses will allow for the detection of conversion electrons in the backward array. A schematic design of the new TASCA detector array and first results from source measurements are shown in Fig. 1.

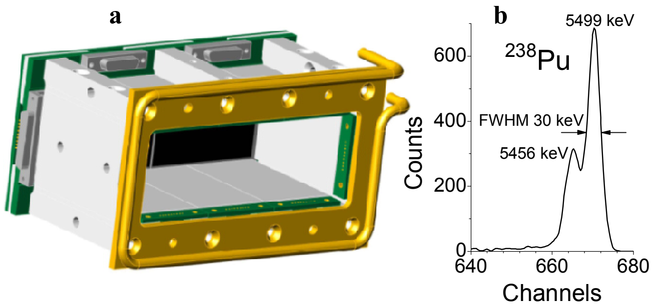

Figure 1: A drawing of the new TASCA FPD array (a) and an alpha particle spectrum from a DSSSD strip (b).

In total, the new TASCA detector array has to process the signals of 320 strips. The necessary spectrometric and data readout electronics, which are compatible with TASISpec [3], as well as the associated software, should be ready for experiments in spring 2009.

References

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#Alexander.Yakushev@radiochemie.de