TASISpec - A new twist on spectroscopy of superheavy elements.

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A new nuclear spectroscopy set-up called TASISpec (*TA*sca *S*mall *I*mage mode *Spec*troscopy) has been designed and commissioned. It exploits TASCA's specific small image focal mode, i.e. the fact that superheavy elements (SHE) produced in fusion-evaporation reactions can be focused into an area of less than 3 cm in diameter. This provides the world-unique possibility to pack composite Ge-detectors in very close geometry, resulting in an unprecedented, highly efficient detection of γ-rays and X-rays in coincidence with implanted SHE.

The test set-up as used in 2008 is illustrated in Fig. 1. It comprised four single sided silicon strip detectors (SSSD), one double sided silicon strip detector (DSSSD) and two Ge detectors; one cluster (7 crystals) downstream and a large VEGA clover (4 crystals) on one side. The final set-up foresees additional three clover detectors, while their implementation requires a dedicated holding structure to be built in 2009.

Conversion electron, γ-ray, and α sources as well as parasitic beams inducing the reactions ^{206}Pb(^{48}Ca, $2n$)^{252}No, ^{207}Pb(^{48}Ca, $2n$)^{253}No, ^{244}Pu(^{48}Ca, $4n$)^{288}114, and ^{150}Nd(^{64}Ni, xn)$^{214-x}$Ra, ^{154}Sm(^{64}Ni, yn)$^{218-y}$Th, ^{nat}Gd(^{64}Ni, zn)$^{224-z}$U, have been used to start to characterise the performance of TASISpec. Detection efficiencies amount to some measured 80% for emitted α particles and extrapolated more than 40% (absolute scale) for γ rays at an energy around 250 keV. In addition, energy thresholds of particle- and γ-ray detectors, dead times, and data rates of a first combined VME (up to 224 channels for Si-strip detector processing) and XIA-DGF (11 channels sampling the Ge-detector signals) data acquisition system were successfully tested as well as TASCA-SIM transmissions determined at different magnet settings.

In 2009 it is planned to establish the extraordinary $\gamma\gamma$-, γ-EC-, EC-EC, or even $\gamma\gamma$-EC-, multi-coincidence capabilities of the both segmented and compact TASISpec set-up by settling the decay scheme of K-isomeric states in ^{253}No [1, 2, 3, 4]. Despite of the underlying amount of data many question marks still remain regarding the structure of ^{253}No.

Following upon this ideal starting point to show the proof-of-principle of TASISpec, K isomers expected in neutron-rich SHE around ^{270}Hs [5] will be stepwise approached via, e.g., spectroscopic studies of ^{255,257}No, ^{261}Rf, and ^{265}Sg. Such a programme employs also the unique facets of both high UNILAC beam intensities, use of radioactive actinide targets, and high transmission of TASCA for rather asymmetric reactions. Last but not least, the unprecedented γ-efficiency of TASISpec may allow to discriminate SHE by means of characteristic X-rays.

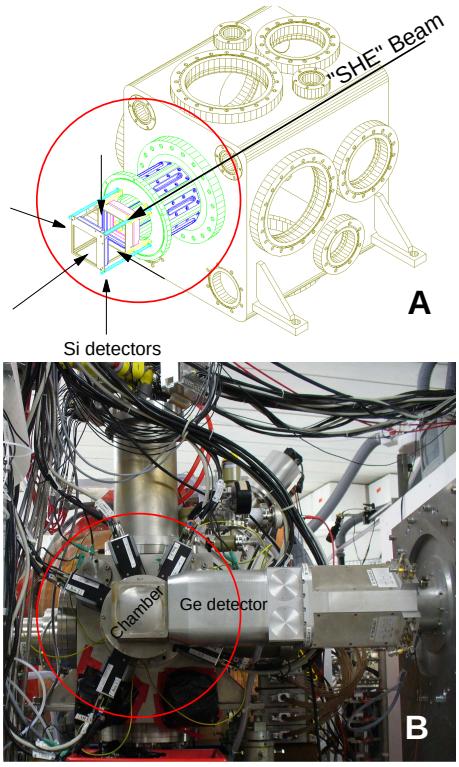

Figure 1: The TASISpec set-up installed at the focal plane of TASCA. Panel (A) illustrates a drawing of the end of the TASCA separator. The TASISpec structure is encircled. Five silicon strip detectors are placed in a cube-like shape. Panel (B) shows a photograph of the commissioning set-up. To the right a Ge-VEGA-clover detector is placed.

References

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