The Performance of TASCA in the ^{48}Ca+^{206,207,208}Pb Reactions

J. Khuyagbaatar[1], M. Schädel[1], D. Ackermann[1], Ch.E. Düllmann[1], E. Jäger[1], F.P. Heßberger[1], A. Semchenkov[1,2], A. Gorshkov[2], R. Graeger[2], A. Türler[2], A. Yakushev[2], K. Eberhardt[3], J. Even[3], J.V. Kratz[3], L.-L. Andersson[4], D. Rudolph[4] for the TASCA Collaboration

[1]GSI, Darmstadt, Germany; [2]Technical University München, Garching, Germany; [3]University of Mainz, Mainz, Germany; [4]Lund University, Lund, Sweden

The gas-filled recoil separator TASCA (**T**rans**A**ctinide **S**eparator and **C**hemistry **A**pparatus) was installed in a dipole-quadrupole-quadrupole configuration (DQQ) at the UNILAC at GSI [1-3]. An extensive commissioning program [4] was carried out at TASCA studying a large number of experimental parameters and nuclear reactions.
Depending on the polarity of the quadrupole magnets TASCA can be operated in two modes: the so called High Transmission Mode (HTM) and the Small Image Mode (SIM). Dispersion values of 9 and 1 mm per one percent change of $B\rho$ were calculated for the HTM and SIM, respectively [3]. Ion optical calculations of the HTM and SIM were performed using Monte-Carlo simulations [5].
Important characteristics of TASCA in both modes were investigated using ^{48}Ca+Pb reactions and a 16-strip 80x35 mm^2 large position-sensitive silicon-strip detector based focal plane detector (FPD). Optimal magnetic settings and gas pressures were established by centering spatial distributions of α-decaying evaporation residues in the FPD. Transmission measurements were performed with targets of well determined thicknesses.

HTM:

Measured spatial distributions of ^{254}No ions are shown in Fig. 1 for different helium gas pressures and a constant dipole magnet setting of $B\rho$=2.08 Tm. Solid curves show the calculated [5] distribution of ^{254}No ions in the FPD of TASCA at different gas pressures. Well centered distributions were observed in the range of 0.8 to 1.0 mbar pressure range. These distributions are in very good agreement with the calculated ones. However, at lower and higher gas pressures the ^{254}No distributions are horizontally shifted off-center. This means that the deflection angle of ^{254}No in the dipole magnet is changing. This is related to a change of average charge of ^{254}No ions. Such an effect was observed also at the Dubna gas-filled separator and it was explained with so-called "density effect" [6].
An average value of (57±5) % for the transmission of No isotopes synthesized in ^{48}Ca on $^{206-208}$Pb reactions was deduced using the cross-section data for fusion-evaporation reactions from [7]. This value is in good agreement with the calculated value of about 52 % for the HTM of TASCA.

SIM:

To find optimal settings for the quadrupole magnets in the SIM is more difficult than for the HTM. Various settings for the quadrupole focusing were tested to obtain best values. A 40-mm diameter image size was taken as a "reference" best value. Again, deviations between this optimized result, which is in agreement with theoretical calculations, and distributions obtained at pressures lower than the optimal He pressures were observed.
A transmission of (35±5) % was deduced at optimized SIM settings for the reaction ^{48}Ca+^{208}Pb. This value is in good agreement with calculated values.

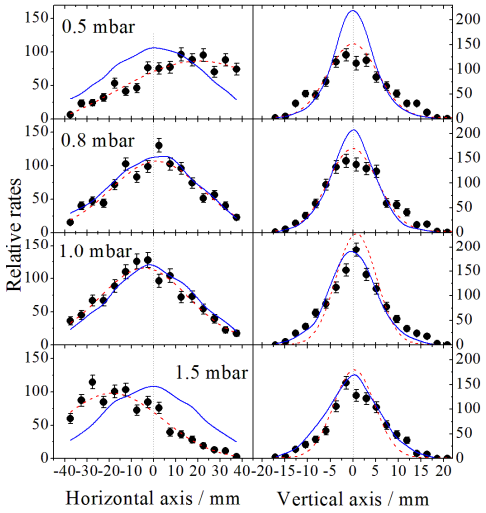

Fig 1: Spatial distributions of ^{254}No ions in the FPD at different pressures of the He filling-gas. TASCA was operated in HTM. Dashed lines show the Gaussian fit.

Pure hydrogen and He-H_2-mixtures were used as filling gases in both modes as well. The optimal magnetic settings and gas pressures were investigated and the corresponding average charges of nobelium ions were determined. Within a 10% uncertainty, the measured transmissions for He, H_2 and mixtures of both gases were identical. When pure H_2 and a mixture of He and H_2 were used, we observed a better background suppression of target-like ions as compared with pure helium.
More detailed information on the TASCA performance in ^{48}Ca+Pb reactions and average charges of the nobelium ions in various gases will be given in [8].

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