

## The average charge states of heavy recoil ions in the rarefied gas

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The knowledge on the charge state distribution of heavy ions moving in gas-filled regions is an important issue of heavy-ion beam related physics. Already decades ago, many experimental and theoretical investigations have been performed on charge-exchange collisions for light and medium heavy ions in rarefied gases. As results of these works many basic aspects of the charge-exchange collisions have been established.

A renewed interest in the understanding of charge states of heavy ions in rarefied gases has been motivated by the production of heavy and superheavy elements at gas-filled separators.

Semi-empirical expressions were derived, based on a parameterization of the experimental data according to the theoretical underpinnings of charge-exchange collisions, such as an influence of the atomic shell structure of the heavy ions. However, these investigations were often performed at different, but fixed gas pressures around 1 mbar, which were individually evaluated to be optimum values for each respective facility. In turn, the influence of a variation of the gas pressure has not been included in any of the above mentioned expressions.

In this contribution, we will present the results of the average charge states of heavy ions more specifically  $^{252,254}\text{No}$  and  $^{188}\text{Pb}$ , in various rarefied gases and their mixtures at the gas-filled TransActinide Separator and Chemistry Apparatus (TASCA).

A possible semi-empirical expression for the prediction of the average charge states will be discussed.