Charging and discharging of nano-capillaries during ion-guiding of multiply charged projectiles

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EXPERIMENTAL SETUP

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ABSTRACT

Efficient guiding of slow (typ. keV) highly charged ions (Ne\textsuperscript{7+}) through insulating nano-capillaries has been observed even if the capillaries were tilted by up to 20° with respect to the incoming ion beam direction \cite{1}. Surprisingly, the majority of the projectile ions was found to survive the transition through the insulating capillary in their initial charge state. Measured 1-dim. scattering distributions of the transmitted particles indicated propagation of the projectile ions along the capillary axis. As reason for this “guiding effect” a charging-up of the inner walls of the capillaries in a self-organized way due to impact of preceding projectile ions has been proposed \cite{1-4}.

Theoretical modelling of the experimental observations has so far proven to be a challenging task \cite{1-4}. Difficulties arise especially due to the different characteristic times observed in the experiment for capillary-wall charging and discharging \cite{3, 4}.

To gain more insight into this interesting phenomenon we have measured the 2-dim. scattering distribution of transmitted projectiles during the charging-up process.

EQUIPMENT

The capillary target for these experiments consisted of a 10 µm thick PET (polyethylene terephthalate) foil from HMI-Berlin. It was characterized with AFM at TU Wien (mean capillary diameter: 180 nm ± 25%, capillaries per unit area: 4x10\textsuperscript{6} cm\textsuperscript{-2}).

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