SEMINAR PROJEKTA #OI 171020

U četvrtak, 29.08.2013. sa početkom u 13 časova u sali "Zvonko Marić" Instituta za fiziku održaće se seminar:

"***Charged particle guiding through insulator capillaries – from discovery to application***"

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Charged particles, keeping their initial charge states, can be transmitted through an insulating capillary even if the capillary axis is tilted with respect to the incident beam axis larger than the geometrical limit. This phenomenon is called charged particle guiding. During the last decade there has been a growing interest in the study of charged particle interactions with cylindrical surfaces based on various capillary targets from nano- to macrometer size. The research is highly motivated because this effect holds the possibility of various technical applications, like beam focusing, collimation, and deflection without external electrical fields, living cell irradiation, micro manipulation on surfaces.

According to our recent knowledge for the case of slow highly charged ions (HCI), the phenomenon is based on the self-organized formation of charge patches on the inner surface of the sample, producing a guiding electric field. Guiding sets in when these charge patches reach a dynamical equilibrium, i.e. the arriving and leaving ions result in a constant amount of charge on the inner wall of the capillary. Arriving ions come from the incident beam, while the charge decreases by the transport into the bulk of the wall material, or along the surface towards the capillary exit. Most of the experiments and simulations focus on the transmission of HCIs through randomly distributed or ordered arrays of nanocapillaries. Systematic measurements of collisions between slow HCIs and a macroscopic glass capillary with large aspect ratio and with cylindrical shape has also been performed. The results prove that the guiding effect known from nanocapillaries is also valid up to a few hundreds of µm diameter

When electrons, instead of HCIs, are used to test the guiding conditions for various targets, this simple and straightforward explanation, however, fails for several reasons. It was found experimentally that a dominant fraction of electrons escaping from the capillary have smaller energies than the incident energy. This is in sharp contrast with the HCI transmission when the particles pass through the capillary with almost loss free transmission. Since electrons do not change their charge state a clear distinction between transmission of the original projectiles (primaries) and secondary electrons generated with the interaction of primaries with the capillary inner surface, is impossible. Furthermore, secondary electron production also implies that the inner capillary surfaces can be either positively charged (the secondary electron emission coefficient larger than 1) thereby attracting rather than deflecting subsequently arriving electrons or negatively charged (the secondary electron emission coefficient smaller than 1) generating the same conditions as

obtained for HCI. We note here, that the velocities of the light particles in the measurements so far are much larger than that of the particle velocity in the HCI experiments

During the talk I will give a short overview of the investigations performed during the last years in the field of capillary physics. The presentation will cover the following topics: a) general problem – interaction of slow highly charged ions with capillaries, b) electron/positron transmission through capillaries, c) and finally as a unique feature, proton microbeam transmission through insulator single capillary and plates.