ENERGY DEPOSITION AND WAKEFIELD EXCITATION IN CASE OF ION BEAM PASSING THROUGH A PLASMA TARGET

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Recently our team investigated the energy deposition and excitation of wakefield in case of hundreds keV proton/helium ion beams passing a gas-discharged plasma target. The experiments were performed at the HV-ECR platform at IMP (see details in ref [1-3]).

Figure 1 (left) shows the experimental result of the energy loss for 400keV helium beam penetrating the hydrogen gas-discharge plasma target (with initial gas pressure of 3mbar, and discharging high-Voltage of 3kV) in terms of time after discharging, the energy loss calculated with different models were shown as well. As we can see in the figure that, the measurements of energy loss in plasma were much lower that the theoretical predicts. Moreover, there were quite a few fraction of He^{1+} after the He^{2+} ion beam passing though the plasma, so that the effective charge state should be lower than the nuclear charge taken for theoretical calculations.

We also found that, the proton beam was strongly focused after passing through the plasma target, and the energy of the focused proton beam were uniform (Figure 1 right). It means that the proton beam can passing though the plasma target without strong Coulomb collisions. Simulation shows that the wake-field could strongly influence the distribution and revolution of the free electrons and form a self-modulated, periodic, focusing, and collision-less tunnel in plasma.

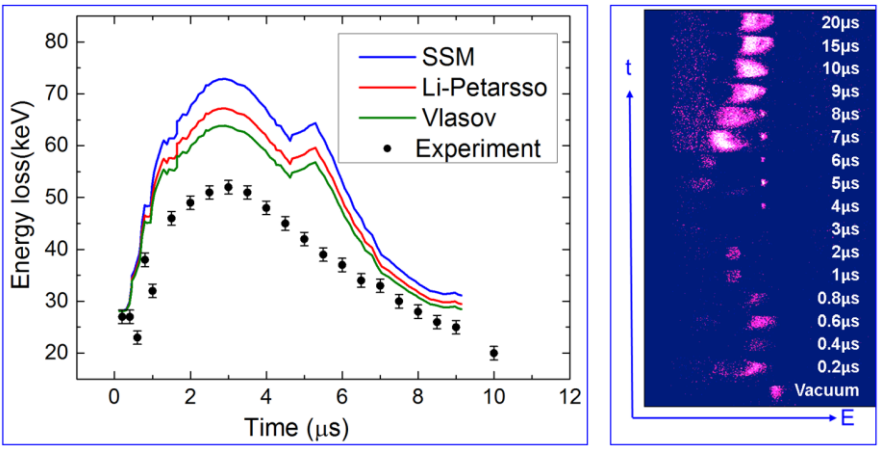

Fig.1 Left: Energy loss for 400keV helium ion beam penetrating the plasma target; Right: the measured beam after 100keV proton beam penetrating the plasma target.

References

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[2] Cheng R. et al. 2013 Phys. Scr. T156 014074
[3] Y. Zhao, et al, 2014 High Power Laser Science and Engineering, 2, e39. doi:10.1017/hpl.2014.44