Perspectives of Ion Acceleration with PW-lasers

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Experiments on ion acceleration driven by high intensity lasers over the past ~15 years have demonstrated the generation of proton and ion beams with remarkable. Nowadays accessible intensities, beyond 10^{21} W/cm^2, have provided for the first time the opportunity to access new ion acceleration regimes and to extend scaling laws for the acceleration process. It will be discussed the recent experimental findings on ion acceleration obtained on PW laser.

In most laser-driven ion acceleration studies the sheath field established by relativistic electrons at target surface accelerates ions, via the so-called Target Normal Sheath Acceleration (TNSA). Newly found scenario at PW laser power offers more favorable proton energy scaling with laser intensity than "ordinary" TNSA, the ions are accelerated in the electrostatic field of charged cavity created by relativistic laser pulse at the target front and in the enhanced sheath field at the target rear. A separate mechanism, Radiation Pressure Acceleration (RPA), where Radiation pressure is exerted via laser ponderomotive force on a foil surface, which results in local electron-ion displacement, and ion acceleration via the ensuing space-charge field.

These phenomena will be discussed by careful study of complex dynamics of laser-plasma processes through characteristics of the ion source and accelerated beam properties.

This presentation is closely related to recent development or imminently anticipated development of laser technology to bring the existing laser power to a multi-PW level to study relativistic plasma phenomena and for application, e.g., ion acceleration. The findings pave a way to achieving an ion source and beam desire parameters and they encourage further activities for optimisation of laser plasma-based accelerators.