3rd Asia-Pacific Conference on Plasma Physics, 4-8,11.2019, Hefei, China

Excitation of Plasma Wakefields by Relativistic Proton Beam

Mithun Karmakar[1], Nikhil Chakrabarti[2], and Sudip Sengupta[1]

[1]Institute for Plasma Research, Bhat, 382428 Gandhinagar, India
[2]Saha Institute of Nuclear Physics, 1/AF Bidhannagar, Kolkata-700064, India
e-mail (speaker): mithun.karmakar@ipr.res.in

We report an exact analytical travelling wave solution for nonlinear relativistic electron plasma wave excited by an intense proton beam. [1] The structures of the excited wake wave electric field and the perturbed plasma electron fluid density are obtained by considering a rectangular proton beam source. [1,2] This theoretical investigation is related to the proposed AWAKE (Advanced Wake Field Acceleration) experimental programme on proton beam driven plasma wake field accelerator (PDPWFA) at CERN.

The stationary wave solution for the wake wave excited by single proton beam as well as equi-spaced train of small proton bunches with the inclusion of the non-relativistic plasma ion dynamics shows some interesting features. The effect of an external magnetic field on wake field structures are also considered. It is found that the transformer ratio (the ratio of energy gain to the drive beam energy) which determine the energy efficiency in the acceleration process is modified due to presence of such external magnetic field. The trapping physics of test electrons in such wake field is also investigated to estimate the energy gain in such wakefield acceleration process.

References

[1] T. Tajima and J. M. Dawson, Phys. Rev. Lett. 43, 267 (1979).

[2] J. B. Rosenzweig, Phys. Rev. Lett. 58, 555 (1987).