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

Excitation of magnetosonic solitons with high power, pulsed CO_2 laser in an overdense gas-jet target

Atul Kumar[1], Chandrasekhar Shukla[1], Ayushi Vashistha[1], and Amita Das[2]
[1] Institute for Plasma Research, HBNI, India
[2]Department of Physics, Indian Institute of Technology-Delhi, India
e-mail (speaker): atul.j1211@gmail.com

The possibility of ion heating directly with short pulse, intense lasers has gained a significant interest in recent years because of their practical applications in a variety of contexts e.g. fast ignition scheme of laser fusion, proton radiography, ion beam cancer therapy, laser triggering and controlled nuclear reaction, production of warm dense matter, injectors of ion accelerators etc. Different from X-rays, protons and light ions deliver most of their energy at the end of their path, at the so-called Bragg's peak. This property makes protons and ions very suitable for highly localized energy deposition. The recent availability of long wavelength (10 μm), pulsed CO_2 laser has enabled us to use newer targets like gas jet target for overcritical laser plasma interaction. It may simplify high repetition rate operation compared to a solid target since the latter needs to be mechanically replaced or displaced in a very short time. The excitation of magneto-sonic solitons by carrying out the 2D Particle-in-Cell simulation under OSIRIS-4.0 framework in over-dense gas jet targets has been shown with a p-polarized, pulsed CO_2 laser with an intensity $I = 7 \times 10^{17}$ W/cm^2, incident normally to the gas jet target in presence of Kilo-Tesla order of an external magnetic field. The external magnetic field are chosen so as to magnetize the electrons and ions be allowed to move. The use of CO_2 laser has also reduced the requirement of magnetic field to tens of Kilo-Tesla otherwise several hundreds of Kilo-Tesla would be required to magnetize the electrons at CO_2 laser frequency. Furthermore, it has been shown that such an excitation is independent of the polarization of the CO_2 laser. The solitary structures generated henceforth, are stable for several thousands of plasma periods. The interaction between two magneto-sonic solitons has also been studied by the generation of solitary structures with two CO_2 lasers at both ends of the system. It has also been shown that such excitations are independent of the polarization of the laser.

References

1. Atul Kumar, et. al., Plasma Phys. Control. Fusion, 2019, https://doi.org/10.1088/1361-6587/ab1408
2. Atul Kumar et. al. arXiv: 1804.02200v2 [physics-plasma-ph], 2018