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Effect of Pre-Plasma Potential on Laser Ion Acceleration

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Abstract : In this work, the role of the preformed plasma created on the front face of a target, irradiated by a high intensity short pulse laser, in the framework of ion acceleration process, modeled by Target Normal Sheath Acceleration (TNSA) mechanism, is studied. This plasma is composed of cold ions governed by fluid equations and non-thermal & trapped with densities represented by a "Cairns-Gurevich" equation. The self-similar solution of the equations shows that electronic trapping and the presence of non-thermal electrons in the pre-plasma are both responsible in ion acceleration as long as the proportion of energetic electrons is not too high. In the case where the majority of electrons are energetic, the electrons are accelerated directly by the ponderomotive force of the laser without the intermediate of an accelerating plasma wave.

Keywords : Cairns-Gurevich Equation, ion acceleration, plasma expansion, pre-plasma
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