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Plasma block acceleration by intense laser fields

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Acceleration of charged particles by intense laser fields has been under intensive theoretical and experimental investigations in the past two decades. A lot of acceleration mechanisms in both vacuum and plasmas have been put forward,aiming to produce energetic electrons or ions with high beam quality and peak energy, which can find direct applications in many fields,such as nuclear physics,medical therapy and laser-driven fusion. Recently, due to the rapid progress in proton-boron fusions driven by petawatt,picosecond lasers, the plasma block acceleration begins to attract people's attention [1]. Different from the traditional laser accelerations of either electrons or ions, the plasma block acceleration focuses upon the energy transfer to a neutral plasma block, which can efficiently drive the proton-boron fusion nonthermally, as shown by Hora et al.[2].In this talk,I will show two ways to realize the plasma block acceleration through PIC simulations. One is by the implosion mechanism when the laser intensity I is less than 10^18W/cm^2 [3] as shown in Fig. 1 and another is by a double-target scheme for I~10^22 W/cm^2 [4], as shown in Fig. 2 and Fig. 3. It has been demonstrated that the plasma block acceleration can have an energy transfer efficiency as high as 60% in the double-target scheme. These results will have critical applications not only in the block igintion of laser-driven proton-boron fusions, but also in generating energetic particle with very high beam quality.

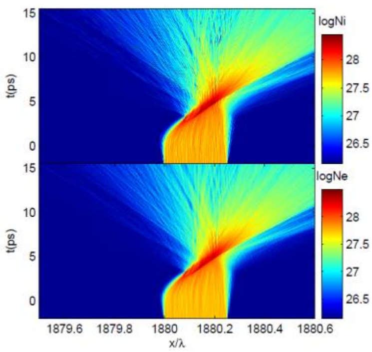

Fig. 1 Plasma block acceleration by implosion as as an intense ps laser with I=10^{15}W/cm^2 impact upon a solid-density plasma[3].

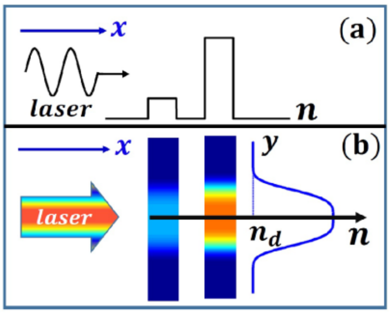

Fig. 2 Scheme of plasma block acceleration by a double-target scheme[4].

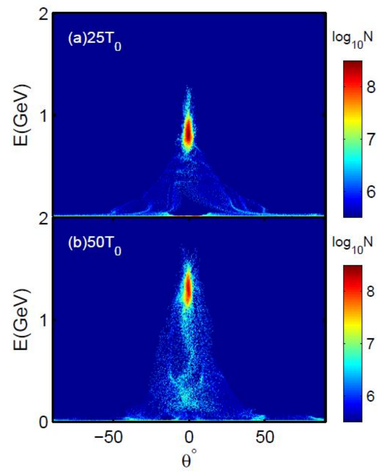

Fig. 3 Propagation of a plasma block in the double-target scheme with laser intensity I=10^{22}W/cm^2. [4]

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