Generation and control of internal-injected electron beams in plasma for cancer therapies

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The step-like plasma density profile produced by a shock wave is demonstrated to be promissing in the generation of very high-quality electron beam. This technology has been widely used in the application of Free Electron Lasers, where a 30 picocoulomb electron bunch with ~0.5% relative energy spread is required[1]. For the application of medical electron therapy for cancer one need a higher charge electron beam (~200 picocoulomb) in the range of 150-250MeV energy with low energy spread (<5% relative energy spread)[2]. In this research, the possibility to generate and control of such high-charge and high-quality beam with one-stage plasma accelrator is firstly explored. The relationship between shock profile and injected beam parameters are studied and it is understood that the beam charge and quality can be controlled and tailored by tuning shock position, shock height and the length of shock density downramps. An approximately 200 picocoulomb electron beam with over 200 MeV beam energy and less then 2% energy spread is shown to be able to obtained and applied to electron cancer therapies.

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