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High Intensity Laser hybrid guiding for electron acceleration

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Controlled guiding of laser pulses at relativistic intensities in plasmas over distances exceeding the diffraction length is a crucial requirement of a Laser Plasma Accelerator Stage (LPAS) for achieving high quality electron beams. A new hybrid guiding scheme is proposed, in which first a laser pre-pulse (I ~ 10¹⁶ W/cm²) guided through a dielectric capillary ionizes and heats the target gas. Hydrodynamic expansion of the generated plasma then results in the formation of a plasma channel. The main laser (I ~ 2-5 10¹⁸ W/cm²) focused at the entrance of this structure can be efficiently guided by the combined refraction of this channel and reflection at capillary walls. This scheme has been investigated using numerical simulations including hydrodynamic expansion of the plasma, propagation of the high intensity laser beam and acceleration of electrons in the plasma wave.

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