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Ionization induced compression of a tightly focused laser beam

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The generation of electron sources in the MeV range and few fs durations requires the development of sub 10fs high power laser pulses [1]. However, standard Ti :sapphire lasers cannot provide pulses of duration below 20fs. In order to decrease the duration of these pulses, several schemes have been proposed, most of them based either on gas ionization in a fiber, or on compression in nonlinear plasma waves. More recently, a new self-compression method based on ionization by a tightly focused beam in a gas jet has been proposed and observed [2]. In this scheme, the pulse is blueshifted by the rapid ionization of the gas, and the ionization gradient leads to temporal compression of the pulse. We have studied under which conditions this method is suitable for generating compressed laser pulses. In particular, we characterized the influence of the gas jet on the spectral broadening, temporal compression and spatial homogeneity. We found that the generated beam properties depend strongly on the gas jet parameters, and that at best, spatially homogeneous compression down to 12fs can be produced from a 25 fs pulse.

[1] B. Beaurepaire etal, NJP, 023023 (2014)
[2] Z.-H He etal, PRL 113, 26904 (2014)

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