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Laser-plasma amplification of short laser pulses based on ion waves

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Plasma-based laser amplification has been recently receiving much attention. Using a plasma as an amplifying medium opens new possibilities in manipulating laser light at high intensities since it overcomes solid state based technology that is limited by the damage threshold of optical components. A plasma amplifier is based on the interaction and energy exchange between a long moderate-intensity pump pulse providing the energy, and a short less energetic seed pulse that is amplified. This energy redirection is made possible due to the coupling that is fulfilled by the response of the plasma medium. A scheme based on the Brillouin Backscattering mechanism in the regime of strong coupling will be presented, with experimental demonstration that this mechanism is suited to amplify a 400 fs, few mJ seed pulse. It allows for absolute amplification in plasma, showing that such plasma amplifiers indeed hold promises. Finally, perspectives in investigating on the role of higher frequency electron modes of the plasma will be discussed as they can (especially at short seed durations) contribute to the amplification process in a mode-mixing scheme.

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