We have also found that this dissipative light-bullet tends to be spontaneously formed in the filamentary dynamics in media with anomalous dispersion. Figure 1(b) shows the peak intensity, the total energy and losses of a pulse that undergoes self-focusing and filamentation in an ideal medium with only Kerr nonlinearity and multi-photon absorption. This simple model reproduces the particularly long filament "segments" and the "burst" observed in experiments and in more accurate simulations. [1,2] The peak intensity in the filament is identical to that of the dissipative light-bullet with maximum dissipation, and the initial Gaussian radial profile is seen to transform gradually [Fig. 1(c)] into that of the dissipative light-bullet of maximum dissipation.

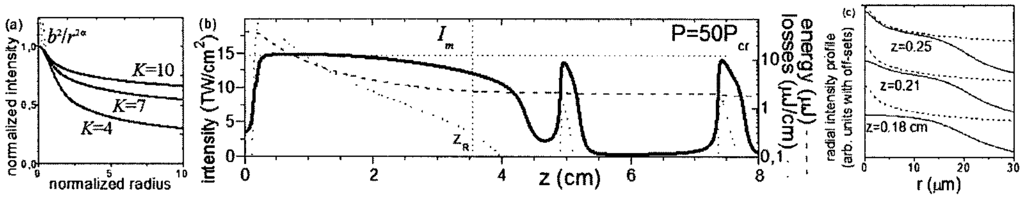

Fig. 1 (a) Spatiotemporal radial profiles of the most dissipative light-bullets in media with K-photon absorption. (b) Peak intensity (solid curve), energy (dashed curve) and losses (dotted curve) upon self-focusing of a Gaussian pulse of width 0.011 cm (duration 44.5 fs) at 1550 nm and with 50 times the critical power for self-focusing in fused silica, modelled as a medium with only Kerr nonlinearity and nonlinear losses (K=10). (c) Radial intensity profiles of the pulse (solid) approaching the radial profile of the most dissipative light-bullet (dotted) upon self-focusing.

Dissipative light-bullets then provide an alternative explanation to filament dynamics in media with anomalous dispersion and relevant nonlinear losses, which does not involve the problematic concepts of multidimensional solitons or of conical waves.

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Effects of external magnetic field on harmonics generated in laser interaction with underdense plasma

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Generation of harmonic radiation is an important subject of laser plasma interaction and attracts great attention due to a wide range of applications [1]. It has been seen that intense electromagnetic and quasi-static transverse magnetic fields are generated in laser plasma interaction [2]. An extremely intense magnetic field (up to hundreds of MG) has been observed by experimental measurements in interaction of short laser pulses with plasma [3]. These self-generated or applied magnetic fields affect the propagation of the laser pulses [4].
In most laser interactions with homogeneous plasma, odd harmonics of laser frequency are generated [5]. In this paper, we point out the possibility of even harmonics generation when a linearly polarized laser beam propagates in homogeneous plasma in the presence of a transverse magnetic field. It is shown that applying external field induces a transverse current density oscillating twice of the laser field which leds to generation of second harmonic radiation. This current density is derived using the perturbation method, and the steady state amplitude of the second harmonic obtained by solution of the wave equation. By the same procedure the current density and then the steady state amplitude of higher order harmonics are calculated. The efficiency of

harmonic generation (the ratio of harmonic power to incident power) is a drastically function of the strength of external magnetic field. It is found that the efficiency of even harmonics is zero in the absence of magnetic field and increases as the magnetic field is increased. For odd harmonics, applying the external magnetic field enhances the generated harmonics as well. The conversion efficiency also increases with increase in plasma density and intensity of the laser beam.

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Independent control of arbitrary orders of dispersion at the high power end of CPA lasers

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One of the most crucial issues in chirped pulse amplification (CPA) systems is the precise temporal recompression of the pulses hitting the target. In case of few cycle high intensity lasers, the stabilization of the carrier-envelope phase (CEP) of the pulses is also required. An acousto-optical programmable dispersion filter can satisfy both aims, providing dispersion (pre)compensation up to the fourth order of dispersion and make the CEP shift stable [1,2]. Its use is, however, limited to a pulse intensity of 100 MW/cm^2, hence its application is restricted to the front end of the (OP)CPA laser systems. A simple optical arrangement consisting of wedges with different materials and different apex angles was proposed recently for isochronic control of CEP of a pulse train [3]. In this paper we show that assembly of wedges can be specifically designed to tune only one of the dispersion coefficients, while all the others, including CEP, remain practically unchanged. Wedge pairs changing solely the zeroth (CEP) and second order (group delay) dispersion (GDD) are experimentally presented along with a triplet of wedges tuning the third order dispersion (TOD) only.
The experiment was carried out with the use of spectrally resolved interferometry (SRI). A Michelson-interferometer was illuminated by 100 nm bandwidth laser pulses of a Ti:Sapphire oscillator. The sample arm of the interferometer contained the wedge assembly, set to near Brewster-angle incidence at each surfaces, designed for tuning the required order of dispersion. At the output of the interferometer the spectral interference between the pulses from the sample and reference arms was resolved with a spectrograph. The dispersion was tuned by perpendicular shift of the entire wedge assembly to the laser beam. In the measurements spectral interferograms were recorded and evaluated at each spatial position of the assembly. Three different wedge combinations, two doublets and a triplet were designed and examined carefully. The first doublet consisted of an N-PK51 and a Lithosil-Q1E193 wedge and was designed to CEP tuning, the second one from N-SSK2 and N-LaK7 aimed to change the GDD only. The measured tuning slopes were 1.66 rad/mm and 3.6 fs^2/mm, respectively. The triplet compiled of N-LaK7, N-LaSF46 and NSF57 wedges was made for TOD tuning: 130 fs^3/mm was measured. All wedge assemblies only changed the selected spectral phase derivative while keeping the others practically zero. The residual angular dis-persion was also measured [4], and found to be well below the detection limit of 0.2 μrad/nm.
We have proved that a combination of optical wedges is capable to control the required order of dispersion, including CEP, independently to all the other orders. Since the loss is negligible and the (bulk) damage threshold is high, we believe that such specially designed wedge combinations can significantly contribute to the fine tuning of dispersion and CEP just prior to the compressor of high power laser systems like Petawatt Field Syntheser (PFS), Extreme Light Infrastructure (ELI), but also of smaller scale laboratory few cycle systems.