First experimental measure of the fast change of lasers transverse energy profiles

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Abstract: We report the first experimental observation of fast dynamics (nanosecond scale) of complex two-dimensional transverse patterns in broad area lasers. The laser emission bright peaks forming the transverse patterns are observed to be aperiodically flashing in time with different growing rates.

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Large aspect ratio (usually high power) lasers tend to develop complex and irregular energy profiles in the cross-section which change very fast in time (nanosecond scale). This phenomenon, that can ruin the utility of these important lasers, had not been directly observed since to record images with an integration time and cadence of the order of nanoseconds was not yet possible [1-3]. Motivated by this great challenge, we have developed a new experimental setup that address this problem.

In this work we report the first direct experimental observation of the fast dynamics (nanosecond scale) of complex two-dimensional transverse energy profiles in large aperture lasers. A continuous creation and vanishing of filamentary-like energy structures have been found in the energy profiles. These bright peaks are aperiodically flashing in time with different growing rates. These optical filaments practically do not move along the cross-section during their lifetime which is close to 2 nanoseconds.

Figure 1 shows three representative pairs of instantaneous consecutive patterns separated by different time delays. Each pair represents the transmitted (left) and reflected (right) patterns. For the shortest delay, Fig .1(a) and (b), a great similarity between the transmitted and reflected patterns is found. At larger delay, Fig. 1(c), both patterns become clearly dissimilar and without any common filamentary structures.

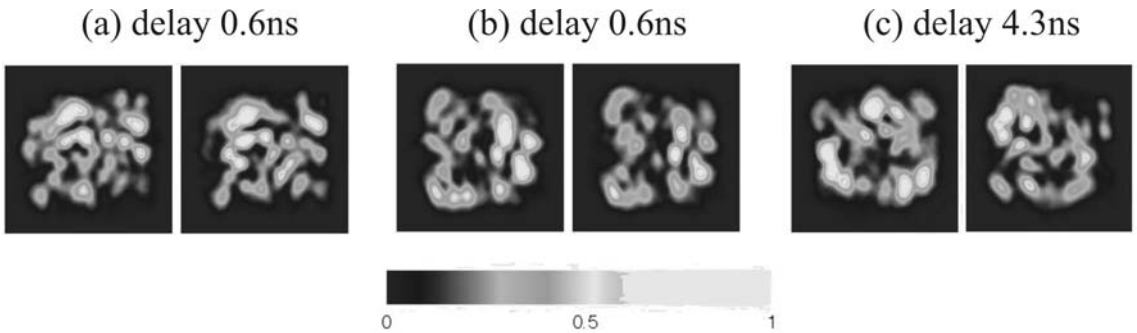

Fig. 1.Three representative pairs of instantaneous consecutive patterns separated by a time delay (a), (b) t_d=0.6 ns, and (c) t_d=4.3 ns. The transmitted pattern (left) is recorded a time t_d before than the reflected pattern (right). Experimental pattern dimension 20 X 20 mm^2.

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