Beam Spatio-Temporal Multiplexing Approach for Improving Control Accuracy of High Contrast Pulse

Authors : Ping Li, Bing Feng, Junpu Zhao, Xudong Xie, Dangpeng Xu, Kuixing Zheng, Qihua Zhu, Xiaofeng Wei

Abstract : In laser driven inertial confinement fusion (ICF), the control of the temporal shape of the laser pulse is a key point to ensure an optimal interaction of laser-target. One of the main difficulties in controlling the temporal shape is the foot part control accuracy of high contrast pulse. Based on the analysis of pulse perturbation in the process of amplification and frequency conversion in high power lasers, an approach of beam spatio-temporal multiplexing is proposed to improve the control precision of high contrast pulse. In the approach, the foot and peak part of high contrast pulse are controlled independently, which propagate separately in the near field, and combine together in the far field to form the required pulse shape. For high contrast pulse, the beam area ratio of the two parts is optimized, and then beam fluence and intensity of the foot part are increased, which brings great convenience to the control of pulse. Meanwhile, the near field distribution of the two parts is also carefully designed to make sure their F-numbers are the same, which is another important parameter for laser-target interaction. The integrated calculation results show that for a pulse with a contrast of up to 500, the deviation of foot part can be improved from 20% to 5% by using beam spatio-temporal multiplexing approach with beam area ratio of 1/20, which is almost the same as that of peak part. The research results are expected to bring a breakthrough in power balance of high power laser facility.

Keywords : inertial confinement fusion, laser pulse control, beam spatio-temporal multiplexing, power balance

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