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Characterization of plasma mirror system for ultra-high contrast PW pulse in J-KAREN-P

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With the development of chirped pulse amplification (CPA) technology invented in 1985, research using high-intensity lasers has evolved for various applications. Recently, the development of higher energy by increasing the diameter of optics and spatio-temporal control techniques has enabled the focused intensity to exceed 10^{22} W/cm^2. However, in laser-plasma experiments, pre-plasma formation owing to pre-pulse and pedestal has become a significant problem as the focused intensity increase. The sources of pre-pulse and pedestal are so intricately intertwined that it is difficult to eliminate them within the laser system alone. To solve this problem, plasma mirrors (PMs)[1] have been adopted in many experimental facilities[2]. The principle of PMs is that the main pulse is reflected by the self-generated plasma, while pre-pulse and pedestal are reflected by anti-reflective coating on the mirror substrate, which improves the temporal contrast. The PMs can improve temporal contrast by more than two orders of magnitude.

We installed the PM system on the J-KAREN-P laser at Quantum Science and Technology (QST) Kansai Photon Science Institute. we report on details of the system and its performance [2]. As Figure 1 shows, the PM system was installed after the final compressor and before the target chamber. The internal components consisted of two periscope pairs, two Off-axis parabolic mirrors, and a PM substrate. The reflectivity of a single PM exceeded 80% at ~50 kJ/cm^2. Additionally, the temporal contrast was improved to approximately ~1/100 of that of a conventional one at 1 ps before the main pulse in Figure 2. Furthermore, the spatial distribution after the PM was kept constant at <100 kJ/cm^2.

In the future, we plan to conduct experiments using high-contrast lasers (e.g., ion acceleration). Subsequently, we will upgrade to a double PM and adapt a deformable mirror after the compressor to upgrade the laser system.

References

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[2] A.Kon, *et al*, "Characterization of plasma mirror system at J-KAREN-P facility" accepted for publication in High Power Laser Science and Engineering

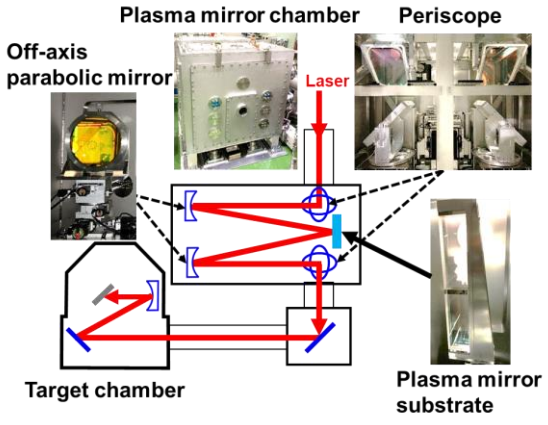

Figure.1 PM system at J-KAREN-P

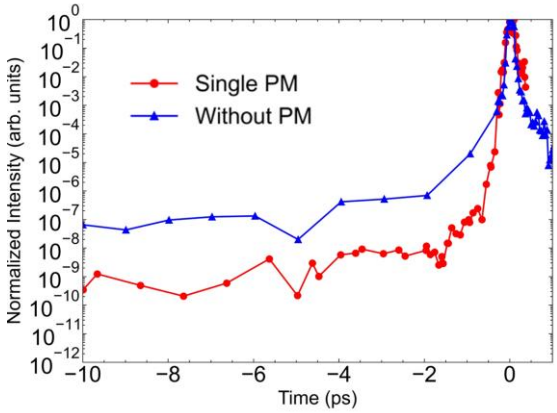

Figure 2 Temporal contrast with and without PM system