MTW Programmable Spatial Light Modulator

The optical parametric chirped-pulse–amplification (OPCPA) output beam is shaped by a programmable spatial light modulator (PSLIM) and amplified in Nd:glass rod and disk amplifiers. PSLIM is a beam-shaping system consisting of a high-resolution spatial light modulator (SLM) (Hamamatsu LCOS-SLM X10468) and a beam-shaping algorithm. The algorithm creates a high-frequency spatial-phase modulation on the SLM, where the depth of the modulation controls the amount of the zeroth-order diffraction that is transmitted. The higher-order diffraction terms are lost outside the field of view of the system image relays. Additional phase correction, although limited to about one wave peak-to-valley, can be achieved by low-frequency modulation in the SLM. The PSLIM and rod amplifier (RA) with associated diagnostics are located on the rod amplifier table, shown in Fig. 1. The OPCPA output beam is up-collimated (2×) and spatially filtered in the OPCPA vacuum spatial filter. PSLIM modulates the beam intensity and phase to both correct the incoming beam and to pre-compensate for gain nonuniformity in the RA afterward. It is located in the middle line of RA table, after the 20-mm ceramic Faraday rotator (FR) and the anamorphic image-relay telescope (AT), shown in Fig. 1 as the dashed box.

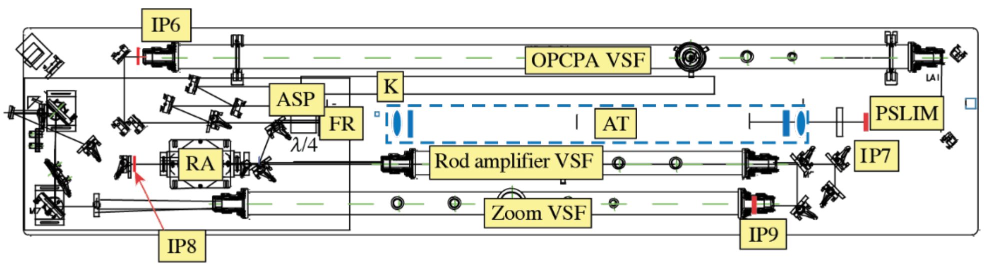

Fig. 1. Table layout. VSF: vacuum spatial filter; IP: image plane; ASP: alignment sensor package, K: calorimeter; FR: faraday rotator; and AT: anamorphic image-relay telescope.

The FR and the half-wave plate protect upstream optics from back-reflections. Due to the relatively low damage threshold of the PSLIM (230 mJ/cm^2 with 2.5-ns pulses at 5 Hz), an AT is used to image the PowerAmp to the spatial light modulator and to change the square OPCPA beam profile (12.8-mm FWHM) to a rectangular SLM area [15.7-mm (H) × 11.8-mm (V) beam size over 16-mm (H) × 12-mm (V) of SLM]. That better fills the PSLIM active area, thereby maximizing the utilization of the area and reducing average fluence on the device. The outer horizontal cylindrical lens pair images the horizontal dimension, whereas the inner pair images vertical dimension independently. Another benefit of an AT is that it has separate focal lines between the lens pairs (horizontal and vertical) instead of the usual focal spot of a conventional telescope. As a result, the maximum intensity is below the air-ionization level and a vacuum tube between the lenses is not necessary.

The PSLIM requires an exact and stable position of the beam on the modulator, which is set using an input alignment sensor package and the energy is checked using an input energy calorimeter. The Shack–Hartmann wavefront sensor looks at the output image plane of the RA. PSLIM can be bypassed, if necessary, by inserting a pair of mirrors in front of it. After PSLIM, the spatially modulated beam is polarization switched using the FR to the RA.