MTW Rod Amplifier Overview

The rod amplifier (RA) is a two-pass amplification system. The amplifying medium is a 1-in.-diam, four-flashlamp-pumped, 240-mm-long Nd:glass rod. The small-signal gain in the rod is significantly different for a broadband input signal (about 8 nm) from the optical parametric chirped-pulse amplification and for a narrowband signal from an YLF amplifier. Because neodymium-doped phosphate glass has a relatively narrow spectrum of amplification, broadband gain is lower than a narrowband one. While the narrowband gain reaches 85, the broadband does not exceed 70 [Fig. 1(a)] at the same RA voltage of 2.4 kV. In practice, lamps are fired at voltages of 2.0 kV, corresponding to a narrowband small-signal gain of 40 in order to achieve the desired output energy with less distortion of the spatial beam profile. The image of the programmable spatial light modulator (PSLIM) is relayed to a flat folding mirror after the RA (Fig. 2). The quarter-wave plate ($\lambda/4$) in front of the RA produces circular polarization, increasing the safe level of energy inside the rod. It also rotates the linear polarization after two passes so that the thin-film polarizer passes the beam to the next vacuum spatial filter. The finite extinction of polarizers and wave plates can allow a cavity to form between the folding mirror behind the RA and the PSLIM, which can result in parasitic lasing. A slight intentional misalignment of the folding mirror introduces a small amount of walk-off per pass, which has little effect on the beam, but introduces enough loss for multiple passes to inhibit parasitic lasing. The gain nonuniformity of the RA can be precompensated by the PSLIM. Figure 3(a) shows the profile of the RA output beam while the PSLIM is bypassed. Figure 3(b) shows that PSLIM can correct it to a flat uniform beam profile. The high performance in the uniformity is the result of closed-loop operation of the PSLIM algorithm.

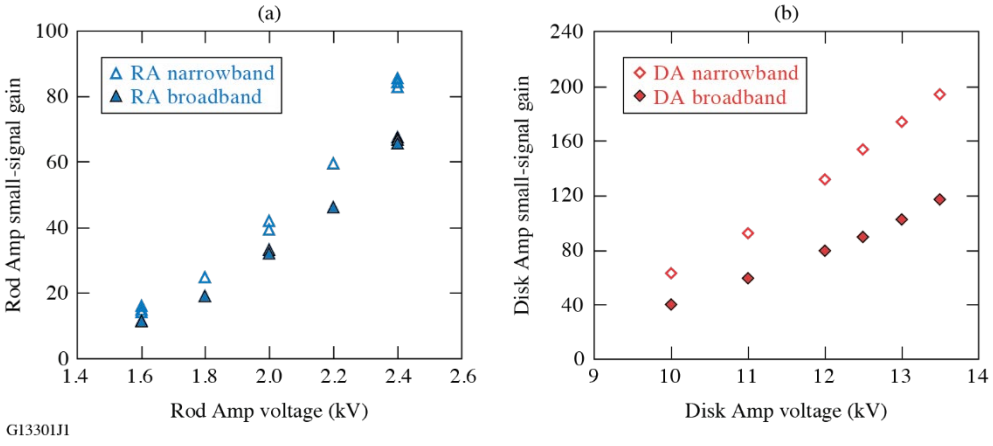

Fig. 1. Small-signal gain of (a) the double-pass RA and (b) the four-pass disk amplifier for narrowband (open symbols) and broadband (solid symbols) signals.

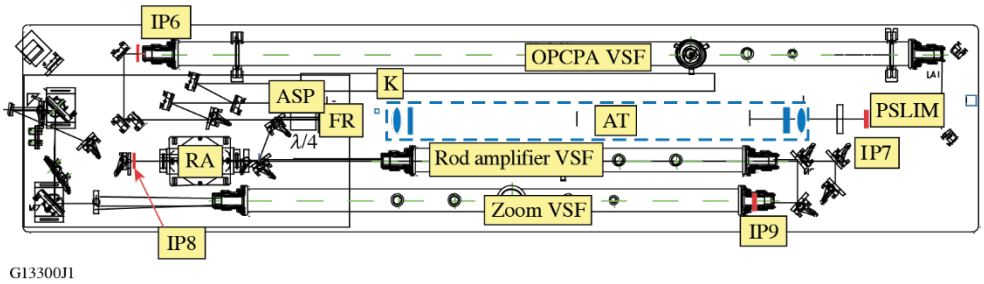

Fig. 2. Table layout. VSF: vacuum spatial filter; IP: image plane; ASP: alignment sensor package, K: calorimeter; FR: Faraday rotator; and AT: anamorphic image-relay telescope.

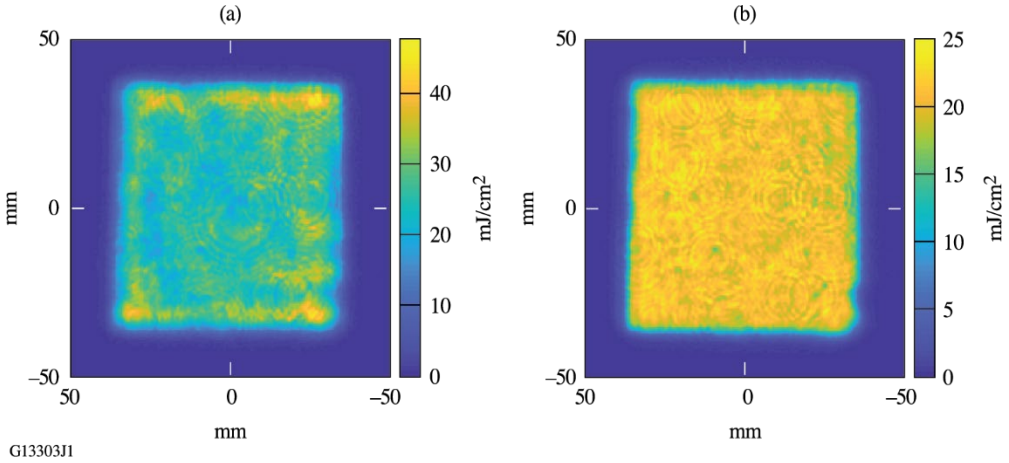

Fig. 3. Rod amplifier beam profiles measured at the G4 equivalent plane (a) without and (b) with PSLIM correction.