MOUNTING, ALIGNMENT AND INTEGRATION OF LARGE OPITCS IN CHINA'S HIGH POWER LASER FACILITY

Zhao Xiong[1], Xiaodong Yuan[1]
[1]Research Center of Laser Fusion, China Academy of Engineering Physics, Mianyang, China, 621900
Contact Author: xiong_022111@163.com

SG-III, the large high-power laser facility at China Academy of Engineering Physics, is constructed to create fusion conditions with controlled laboratory conditions[1]. Its 1053 nm output of 48 beams is frequency converted to produce 0.18 MJ energy and physical experiments require the ability to precisely align and focus pulses with single-beam energy up to 3.75 KJ onto a millimeter-sized target with a precision of 30 μm (RMS). Arrayed along each beampath, hundreds of optics must be positioned to stringent tolerances which put a huge technical challenge on the installment and integration of optics for SG-III engineers.

As National Ignition Facility (NIF) and Laser MégaJoule, SG-III share a similar schematic design where many laser beams are generated, amplified, purified, transferred and finally focused on one target[2,3]. Stringent specifications of optics mounting must be maintained even though the design and requirements of the optics in SG-III facility have been pushed to extremes of state-of-the-art engineering technologies. Hundreds of line-replaceable units (LRUs) are used as independent subsystems in each beampath, which represent a success of the philosophy of modularity: large optics are packaged into LRUs which can be installed by standardized joints in laser building to form laser beamline. The assembly and installment of LRUs include two stages. The first stage is "offline" assembly in the Optics Assembly Building (OAB). Optical components are assembled into LRUs with strict specifications of cleanliness, alignment, and wavefront. The focus is the surface distortion problem of large aperture optics during LRU assembly. Considering LRUs assembly structure, mounting design and operational procedures, opto-mechanical analysis methods are applied to model and evaluate the mounting performance of large optics. The second stage is "online" assembly in Laser Building and Target Area, where we focus on how to keep the LRUs precise alignment and extremely stable from external excitations, including thermal shift, mechanical vibrations, and etc. The alignment requirements of LRUs were driven primarily by ignition target performance including a specification of ±30μm RMS pointing at target center[4]. The target specification is translated into alignment requirements for various LRUs, both mirrors (±3mm), and other steering optics (±1mm). All supporting structures in SG-III buildings also should be controlled to varying levels of precision so they would precisely hold the optics at design locations. Meeting those ambitious requirements has cost a ten-year-long hard work. The presentation will provide an overview of the facilities, equipment and processes used to realize the precise mounting, alignment and integration of large opitcs in china's high power laser facility.

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