Engineering progress and innovations of large optics assembly in China's SG-Ⅲ Laser Facility

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Abstract:

Thousands of optical units are used in China's large high-power laser facility, SG-III, a stadium-sized 48 beams laser constructed to create fusion conditions with controllable laboratory conditions. Hundreds of optical line-replaceable units (LRUs) are used in each 3.75 kilojoules laser beam. LRUs is design to assembly by standardized joints in laser building to form laser beams, so if one optic of the hundreds optical units suffer damage, the optic will be removed and replaced quickly, safely, and cost-effectively. ICF laser is designed so precisely that all laser beams can hit the target (～250 μm focal spot) with the accuracy better than 50 μm (Root Mean Square, RMS) from numerous directions at the almost same time. To realize these extreme specifications, thousands LRUs must be manufactured and assembled with the most stringent requirements. So, the Optics Assembly Building (OAB), a 5000 m^2 sized Class-100 (ISO Class 5) cleanroom in SG-III facility, is built and all LRUs are assembled in that building with a condition of strict cleanliness and precise alignment. However, due to the fact that stringent technical specifications for large ICF optics, there are huge challenges to realize those requirements of large ICF optics assembly and mounting. In this paper, on the basis of ten years experience, we will propose a detailed introduction on the engineering progress and our essential methodologies. In total, we attribute our success in the following key factors:

- *Multi-physical modeling and simulation is the fundamental design tool*
- *Anticipation is paramount to optimize time / budget / …*
- *Coordination / arbitration between numerous factors*
- *Automation / robotization for high assembly/operation consistence*
- *Integration reflects future maintenance*