Silica final lens systems for laser fusion power plants

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The final focusing components are key elements for laser fusion power plant operation because the target compression and ignition completely depends on the laser power delivery. The major difficulty regarding the design of final focusing components stems from the hostile irradiation conditions they must face.

We have designed [1] a full conceptual final focusing system based on silica transmission lenses to operate in dry wall chambers. Neutron irradiation leads to a non-uniform steady state temperature profile along the final lenses, which in turn results in aberration with fatal consequences for the laser spots, unless a temperature control system is employed. Our design is based on a heat transfer fluid (see Figure) that keeps the temperature profile smooth and constant in all the operation phases (start up, normal operation condition and special operation conditions). In order to keep the temperature profile smooth a temperature control system based on a heat transfer fluid is used. Thus, the final lens is enclosed by two silica windows. The fluid flows in the space between lens and windows. The final focusing system is located 16 m away from the target and receives an average neutron power density of 510 kW/m3. In addition to neutron irradiation, the final system will be subjected to pulsed ion irradiation. Details on the design, figures of merit, operation scenarios, suggestions for ion mitigation strategies and other aspects such as shrapnel resistance or lifetime will be discussed.

References

[1] A. R. Páramo, F. Sordo, D. Garoz, B. Le Garrec, J. M. Perlado, A. Rivera. Nuclear Fusion 54 (2014) 123019.