- IFSA2025 –

Implosion design using a multi-objective optimization method for fast ignition

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The fast ignition is one of the alternative ignition schemes for laser fusion. There are two main processes, implosion and heating. The physical mechanism of the latter heating process has not been fully elucidated, and the optimal heating method has not been established. Since this process can significantly change the assumptions of the implosion process, it is necessary to include various possibilities here and consider the overall dependencies.

For example, solid sphere targets and shell target designs have been considered for the fast ignition. The initial radius of the solid spherical target is smaller than that of the shell target, which results in higher laser intensity for implosion, which is expected to cause various side effects. However, the solid spherical target is robust against the hydrodynamic instabilities during the acceleration phase. Optimizing the parameters, such as the maximum density, the maximum areal density, the cone opening angle of the cone, the density scale length around the critical density, with/without a gold cone for guiding the heating laser, and so on. These may conflict with each other, so trade-offs must be considered through multi-objective optimization.

In the parameter survey study, we perform optimization by combining 1D and 2D radiation hydrodynamic simulation codes. We will show the optimum solid spherical target and shell target with/without guiding cone for fast ignition experiments at ILE Osaka. The multi-objective optimization method will also be introduced in this presentation.

References

[1] H. Nagatomo *et al.*, *Nucl. Fusion* **61** 126032 (2019)
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Acknowledgment
This work was supported by JSPS KAKENHI Grant No. JP20H01886, JP22K03567, JP24H00204.