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IFE/P6-14: Highly Repetitive Laser Inertial fusion driver with Tiled Coherent Beam Combination Laser using Stimulated Brillouin Scattering Phase Conjugation Mirrors

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In these days, the energy problem is serious in the world. It is necessary to develop a new source of the sustainable energy. In these sustainable energy sources, fusion energy is the most promised energy source. Especially, the laser inertial fusion energy is easy to maintain and easy to increase its scale. However, there are 3 hot problems to achieve the laser inertial fusion energy. To achieve the LIFE, it is necessary to develop 2.5 kJ/10 ns @ 10 Hz laser. The Second problem is target injection with high repetition rate and high accuracy. We need to inject the fuel target to the centre of a chamber with accuracy to 20 μ m after the fusion reaction. The third problem is the target window coating due to debris from the target implosion. The first and the second problems can be resolved simply by coherent beam combination laser using Stimulated Brillouin Scattering Phase Conjugation Mirrors (SBS-PCM).

The 4-beam combination system is built to prove its feasibility to laser inertial fusion energy driver. The input energy of the each sub-beam is 1.032mJ \pm 0.027mJ, and the output energy of sub-beam is 402.3mJ \pm 1.21mJ. The standard deviations of the phase differences between the reference beam and other beams were measured to be less than $\lambda/13$, during 2,500 shots (250 s), and we will get it better than $\lambda/20$ soon.

The coherent beam combination using SBS-PCM has additional advantages in LIFE reactor system. In the fusion reaction, target injection is one of the serious problems. The repetition rate of the target injection is \sim 10Hz, and the target speed is around 400m/s. We need the accuracy of target position to 20 μ m. Because of the turbulent flow after the prior fusion reaction, it is impossible to inject the target with the accuracy to more than 20 μ m. Figure 2 shows the concept of the self-navigation technique. This method can give the accuracy to less than 1 μ m even when the turbulence exists in the reactor chamber.

In this paper, the authors introduce the tiled coherent beam combining laser using SBS-PCMs and the self-navigation techniques. With the SBS-PCMs, the authors constructed a tiled-aperture coherent beam combination laser system successfully. The 4-beam coherent combination laser shows the possibility of the practical LIFE driver with the self-navigation techniques.

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