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IFE/P6-15: Overview and Latest Proposals in SBS PCM Based IFE Technology Featuring Self-navigation of Lasers on Injected Direct Drive Pellets

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The current status will be reviewed of a recently proposed novel approach to inertial fusion energy (IFE) technology, where phase conjugating mirrors (PCM) generated by stimulated Brillouin scattering (SBS) are employed in combination with a special target displacement compensation system to implement an automatic self-navigation of every individual laser beam onto injected IFE pellets. This novel technology is of a particular importance to the direct drive schemes of pellet irradiation, which is the basis of a number of IFE project (e.g. HiPER). If successful in its full scale realization, this aiming scheme would greatly reduce the technical challenges of adjusting large and heavy optical elements during each shot in an IFE reactor, where a typical repetition rates are several Hertz. Featuring no moving parts, this technology would allow for a high number of laser drivers to be employed. Operating with lower energies (< 1 kJ –thus avoiding the optics damage caused by perpendicular SBS) such laser drivers would be easier to design for the required repetition rate. The latest achievement in the gradual step-by-step development of this technology is a conceptual design for the removal of the unconverted basic laser harmonic. This is needed since, the corresponding schemes already developed to deal with this issue, e.g., for Laser MegaJoule (LMJ - France) or National Ignition Facility (NIF - USA) are not applicable in the SBS PCM IFE technology, so a special Faraday isolator is proposed. For the basic harmonic propagating in both directions (to be removed during its second pass) it will work in its classical configuration. The higher harmonic (propagating only in the backward direction) will be allowed to pass through. Having the unconverted harmonic removal problem solved, a serious development of the SBS PCM based laser driver can be started to establish an upper limit of energy at which the required laser beam parameters would be still acceptable. This energy limit comes from the use of SBS PCMs to self-navigation steering of the laser beams to the target, which means that spatial filtering cannot be employed to take care of the laser beam quality. The value of the upper energy level obtained would determine the number of laser drivers needed for a direct drive fusion facility working in the expected 5-10 Hz repetition regime of an IFE power plant.

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