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Mechanical Mockup of IFE Reactor Intended for the Development of Cryogenic Targets Mass Production and Rep-Rate Delivery into the Reaction Chamber

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A vital goal of inertial fusion energy (IFE) research is development of high-precision, mass production technologies for cryogenic fuel targets fabrication and their delivery to the reaction chamber at a high rate (10-20 Hz) [1].
At the Lebedev Physical Institute (LPI), a mechanical mockup of IFE reactor has been proposed [2] for developing the reactor-scaled technologies that are applicable to mass production of the cryogenic targets and their high-rep-rate delivery. The report presents an overview of the researches underlying this approach, including:
- Target mass production. Free-standing cryogenic target production using the FST-technology developed at LPI was demonstrated for cryogenic targets of 1-to-2 mm-diam. with fuel layer up to 100 um-thick.
- Target rep-rate delivery. A system for high-rep-rate assembly of the sabot and target (sabot is the target carrier during its acceleration). The report discusses the results, both theoretical and experimental, on modeling a friction-free electro-magnetic acceleration of the levitating assembly "HTSC-Sabot + Target", where HTSCs are the high temperature superconductors.
- Injected target on-line tracking. The results of computer experiments on Fourier holography for application to injected target on-line diagnostics and tracking are presented.
- Target protection. A system proposed for multiple target protection methods is based on the following principles:
1. Formation of the cryogenic layer with an isotropic ultrafine fuel structure to reduce the layer sensitivity to the external thermal and mechanical loads.
2. Use of friction-free delivery of the "HTSC-Sabot + Target" assembly to reduce the heat flux on the target.
3. Use of conical supports for a target nest in the sabot to reduce the mechanical loads arising during acceleration of the "HTSC-Sabot + Target" assembly.
4. Use of outer coatings (cryogenic, metal) in the target design to reduce risks of cryogenic layer damage as a result of target heating by thermal radiation of the hot chamber walls.
5. Co-injection of a target and a protective cover from freezing gases (D2, Xe) to reduce risks of cryogenic layer damage as a result of target heating by hot residual gases in the reaction chamber.

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