detector system was used tp record the optical emission after a delay of 500ns. Electron density was measured using Stark broadening of the atomic lines, while the intensity ratio of two atomic lines of the same species was utilized for temperature measurement. Ratio of neutral and ionic lines is used for the investigation of ionic temperature.

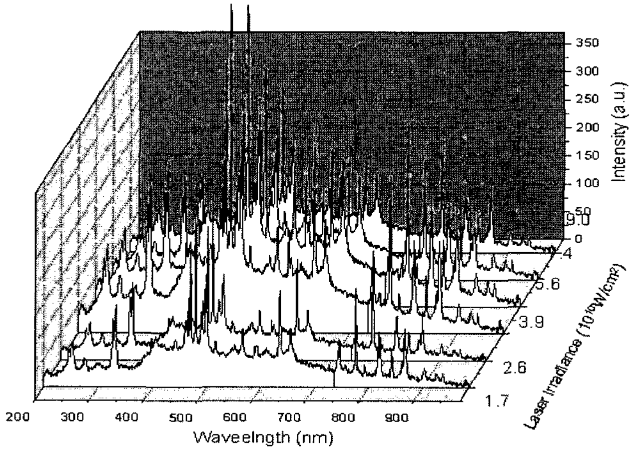

Fig.1 Optical emission spectra from the zinc plasma produced by laser ablation of zinc rod in air using 1064 nm of Nd:YAG laser at different laser irradiances

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FST-formation of cryogenic layer inside spherical shells of HiPER-class: results of mathematical modeling and mock-ups testing

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Current stage in the IFE research has passed to a closing stage: creation of the experimental reactor and realization of electric power generation. HiPER is a proposed European **H**igh **P**ower laser **E**nergy **R**esearch facility dedicated to demonstrating the feasibility of laser driven fusion for IFE reactor. The HiPER facility operation requires the formation and delivery of spherical shock ignition cryogenic targets with a rate of several Hz. The targets must be free-standing, or un-mounted. At the Lebedev Physical Institute (LPI), significant progress has been made in the technology development based on rapid fuel layering inside moving free-standing targets which refers to as FST layering method. It allows one to form cryogenic targets with a required rate.
In this report, we present the results of a feasibility study on high rep-rate formation of HiPER-class targets by FST. We consider two types of the baseline target for shock ignition. The first one (BT-2) is a 2.094-mm diameter compact polymer shell with a 3-µm thick wall. The solid layer thickness is 211 µm. The second (BT-2a) consists of a 2.046-mm diameter compact polymer shell (3-µm thick also) having a DT-filled CH foam (70 µm) on its inner surface, and then a 120 µm-thick solid layer of pure DT. The work addresses the physical concept, and the modeling results of the major stages of FST technologies for different shell materials:

- Filling stage optimization (computation): optimal filling of a target batch up to ~ 1000 atm at 300 K requires minimizing the diffusion fill time due to using the ramp filling method for both BT-2 and BT-2a.
- Depressurization stage optimization (computation and experiments): it requires providing the shell container leak proofness during the process of its cooling down to a depressurization temperature. This allows one to fulfill the technical requirements on the risks minimization associated with the damage of the HiPER-class targets.
- Layering stage optimization (computation and experiments): 1-st step requires (a) choosing an optimal temperature of target input into the layering channel, (b) analyzing the "liquid- vapor" interface behavior at different cooling rates, and (c) computation of the FST layering time.
- A preliminary consept of the FST-layering module for HiPER-class targets (including the interface unit for target-and-sabot assembly) is presented. The results of the mock-ups testing are disscussed, namely:

(a) FST layering channels (LC) of different geometry have been created and the time of target residence inside LC has been measured for 2 mm diam. targets of different weight and material, including a HiPER-class surrogate target. This allows determining the requirements on the LC manufacturing.

(b) Mock-up of target positioning device has been constructed and tested. It was found that the device ensures a comprehensive look at the target for the time less than 1 sec.

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Fast electron transport in shaped solid targets

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The scheme of fast ignition fusion energy relies on the ultra-intense ultra-short (UIUS) laser energy transport into the compressed core plasma. One solution is to insert a hollow cone in the fuel shell to block the UIUS laser from the coronal plasma, thus allowing it to reach the core plasma. The cone not only can guide the UIUS laser to its tip, but can play important roles in the specific cone-in-shell target designed for FI. It was found in a PIC simulation that the cone can guide the fast electrons generated at the inner wall to propagate along the wall surface toward its tip, which would increase the energy density at the tip and might enhance the heating of the core plasma. Surface guiding of fast electrons with planar foil targets has been demonstrated experimentally. However, the guided fast electrons will mix the electrons generated ahead by the laser light with a planar target, and hence one cannot experimentally quantitatively validate the guide of the fast electrons.

We investigate the cone guiding of fast electrons with an inverse cone target. We found a novel surface current of fast electrons propagating along the cone wall. The fast electrons generated at the planar outer tip of the inverse cone are guided and confined to propagate along the inverse cone wall to form a surface current by induced transient electric and magnetic fields associated with the current itself. Once departing from the source at the outer tip, this surface current of fast electrons is "clean", neither experiencing the interacting laser light nor mixing fast electrons ahead, unlike those in cone or planar targets. This surface current in the inverse cone may explicitly give the capability of the guide of fast electron energy by the cone wall. The guiding and confinement of fast electrons is of importance for fast ignition in inertial confinement fusion and several applications in high energy density science.