HiPER target studies:
First steps towards the design of high gain, robust, scalable direct-drive targets
with advanced ignition schemes

Stefano Atzeni

Dipartimento SBAI, Università di Roma 'La Sapienza' and CNISM, Italy

In a laser-driven inertial confinement fusion power plant targets with energy gain (ratio of fusion energy to laser energy) about 100 will be burnt at a rate of 5-20 Hz. The laser driver will deliver accurately time- and space-shaped pulses of energy of 3-5 MJ at the above rate. Advanced ignition schemes (fast ignition and shock ignition) have the potentials to achieve such a large gain. In addition, shock ignition targets can in principle have simple structure, suitable to high rep-rate operation and the demanding reactor chamber environment.

Target studies in the frame of the HiPER project aim to design robust targets ignited by one of the previously mentioned schemes. We began by designing a very simple target which could allow for ignition demonstration with a few hundred kJ laser, and can be scaled at higher energy and gain. We have determined the requirements for fast and shock ignition, and have identified crucial issues that have to be addressed experimentally. We have also developed (and are developing) new models and codes to investigate topics such as fast electron generation and transport in fast ignition targets, and non-local electron transport in the corona of shock-ignition targets. We have also investigated irradiation schemes, target symmetry and stability issues, sensitivity to parameter changes, requirements for beam delivery and focussing for target positioning.

At present we are working along three main directions: increase target robustness (also taking into account target manufacturing and delivery issues), scale to somewhat greater laser energy (to make the design less marginal), and designing targets that might be tested on already existing facilities (NIF), or at an advanced state of construction (LMJ).