Simulation of a fusion experiment performed on the Megajoule Laser

The Megajoule Laser (LMJ) is a key component of the Simulation programme, intended to ensure the continuation of effective deterrence after the comprehensive ending of nuclear testing. It will also make it possible to validate physical models under temperature and pressure conditions which are currently inaccessible in the laboratory.

Experimental description

Nuclear fusion is a process where two atomic nuclei combine to form one heavier nucleus. The fusion of the two lighter nuclei releases enormous quantities of energy. To attain the fusion conditions, laser beams must be directed at a target which consists of a metallic cylinder at the centre of which is placed a spherical capsule. Inside a plastic shell, this microcapsule holds the fuel, an atomic mixture of Deuterium and Tritium, two of the isotopes of hydrogen. Several tens of milligrams of deuterium and tritium are present in the form of a solidified shell at very low temperature, containing a gaseous phase.

The microcapsule has a radius similar to the thickness of a one euro-cent coin. The gold cavity has a length similar to the diameter of the same coin. And yet, up to 240 laser beams must enter and carefully cross the distance between the two plastic windows at its ends.

The experiment starts with an implosion phase of the microcapsule. To cause the deuterium and tritium to fuse, the mixture must be taken to enormously high temperatures and densities.

This is now the start of the combustion phase. The laser, which delivered the energy to produce the implosion, can now be switched off.

For further details, see: http://www-lmj.cea.fr/html/cea.htm