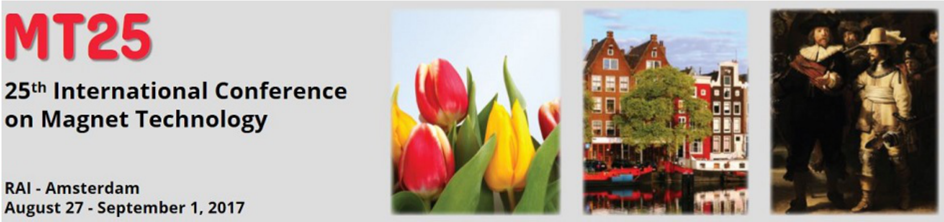

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Design of a laser-driven kiloTesla magnetic bottle

Wednesday, 30 August 2017 15:30 (15 minutes)

The possibility to trigger the proton-boron nuclear fusion reaction (p + 11B $\longrightarrow$ 8.5 MeV + 3a) by using a nsec class laser has been recently demonstrated. This is of high interest since such reaction does not produce any neutrons but just three alpha-particles, which could be used for applications in different fields. The possibility to confine the plasma fuel generated during laser-target interaction through an ultra-intense magnetic field would allow to enhance the rate of the generated alpha-particles. In last decades it has been experimentally proved that a small coil-target energized with a long pulse (nsec-class), high energy (several hundreds of J) laser can produce a quasi-static (over one nsec) magnetic field of the order of 1 kT. The combination of several laser beams with the dual purpose of producing a plasma responsible of the fusion reaction and, using a proper synchronization, energizing two multiturn coils would enhance the alpha particle rate by confining ions up to few MeV/u in a small region (less than 1mm^2 in diameter). We propose the design of an innovative magnetic bottle-like trap made of two multiturn coil targets able to produce a magnitude field of several kT, which is ideal to confine the plasma for a relatively long time (few nsec), thus increasing the number of p-B collisions and, hence, the fusion reaction rate. A complete study of the trap is here reported including magnetic field analysis, electric, thermal and mechanic behavior and also the confinement efficiency using particle tracking code simulations. A preliminary experimental setup will also be proposed.

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