Michigan Institute for Plasma Science and Engineering Seminar

REACTOR ENGINEERING ISSUES FOR MAGNETIZED TARGET FUSION

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Abstract

Magnetized target fusion (MTF) is a pulsed high energy density approach to fusion using a hybrid of inertial compression and magnetic confinement. It is a subset of magneto-inertial fusion. MTF is based on a plasma target approaching fusion conditions with a slower driver and weaker compression than conventional inertial confinement fusion by employing embedded magnetic fields to reduce thermal losses. A wide choice of drivers and targets can be considered. This talk focuses on the engineering needs of MTF compared to conventional fusion reactor scenarios. MTF requires megabar (or higher) pressures at multi-keV temperatures with densities between magnetic fusion energy (MFE) and conventional inertial fusion energy (IFE). Generally, MTF gain scales weakly with driver energy and so designs tend towards larger, but less frequent implosions than in IFE systems (e.g., multi-GJ yields once every 10 s with a thick liquid-walled chamber). This has the advantage of more time to clear the chamber between pulses. By starting with a warm plasma (~100 eV) with compression ratios of 10-20, one can relax the symmetry requirements needed for high convergence (~30) IFE capsules. By using multi-MG magnetic fields, thermal losses are slowed (compared to IFE) so that driver systems can deliver MJ's of energy in μs instead of ns timescales. The efficiency of MTF liner drivers are high, 30-70%, so even lower gains associated with efficient batch burn concepts can be tolerated. Key concerns with a pulsed reactor system involve reliably handling millions of shots per year while switching high currents with large energy storage. Concepts for stand-off coupling to the liner and dynamic assembly of the liner will be described, as will some of the economics of MTF for electrical power generation. This work is supported DOE Office of Fusion Energy Sciences and DOE/LANL contract DE-AC52-06NA25396.

About the Speaker: Dr. Glen Wurden leads the Fusion Energy Sciences team in the P-24 Plasma Physics group and is Fusion Energy Sciences program manager at Los Alamos National Laboratory. His research interests include implementing fusion plasma diagnostics as presently used on the Alcator C-Mod tokamak, the U. Washington Field Reversed Configuration experiments and the MTF project with LANL and AFRL. He has worked on a wide variety of plasma confinement concepts including the TFTR, ASDEX and JT-60U tokamaks. He is a member of Phi Beta Kappa, APS, AAAS, and IEEE (Senior Member). He has more than 150 publications and is on the board of directors of the Fusion Power Associates. He held both NSF and Oppenheimer Fellowships. Dr. Wurden earned the BS (Physics, Chemistry, and Mathematics) summa cum laude from the U. Washington, and the M.A. and Ph.D. in Astrophysical Sciences from Princeton University.