JOINT ENGINEERING/ACCELERATOR SEMINAR

"Thermonuclear Fusion, ITER and Superconductivity"

Ettore Salpietro,

Advisor to the European Joint Undertaking Fusion for Energy (F43) and European Fusion Development Agreement (EFDA – Retired)

The thermonuclear fusion reaction is the source of energy of the sun and the universe. The fusion of the deuterium and tritium nuclei generates energy, which is carried by the alpha particle and the neutron generated by the reaction. The neutron will be slowed down in the blanket surrounding the plasma and it will generate the tritium, which is needed to sustain the reaction. The alpha particle will heat the plasma to maintain the very high temperature needed for the nuclear reaction to occur.

Many approaches have been tried to achieve, on earth, what is realised in nature with big dimensions. The most successful approach is the tokamak. The first tokamak has been built in Russia, about 40 years ago; the present ITER is based on the tokamak concept. In the tokamak, the magnetic fields confine and shape the plasma. The ITER magnetic fields system is all superconducting, the coils with maximum field of about 6 Tesla and below are made of niobium titanium superconducting strand; for higher field the Nb3Sn strands are used. The superconducting cables, used in the ITER coils need to carry very high current, in the order of several tens of k amps, nuclear and eddy current generated heat that must be removed from the coils. The cable in conduit concept has been proved to be the most favourable for the operating conditions of a tokamak. An extensive research and development programme has been carried out to demonstrate the ITER coil feasibility; critical issues, which have been addressed by the programme are: strain sensitivity of Nb3Sn strand, manufacturing of strand with high current and limited hysteretic losses, current distribution in the cable, thermal hydraulic analysis of the cable, cable stability and the structural material for the cable jacket.

Dr. Salpietro's talk will start with a short introduction of fusion power and devices, which have been built up to now; continue with the description of ITER device, fusion reactor concept, safety and environmental impact of fusion reactor; and finally, the critical issues of the ITER superconducting coils will be presented.

Thursday, July 1, 2010

10:00 a.m. – 11:30 a.m.

CEBAF Center Auditorium

Coffee before seminar begins at 9:30 a.m.

Jefferson Lab

For further info, please contact Alex Bogacz at x5784 or Anne-Marie Valente at x6073