

PROGRESS AND PLANS OF THE PROTO-SPHERA PROGRAM

S. Papastergiou, F. Alladio, A. Cucchiaro, A. Mancuso, P. Micozzi
Associazione Euratom-ENEA sulla Fusione, CR Frascati C.P. 65, Rome, Italy
papastergiou@frascati.enea.it

PROTO-SPHERA is a proposed spherical torus (ST) where a Hydrogen plasma arc, in a form of a Screw Pinch (SP), fed by electrodes, replaces the central rod of the standard ST experiments. This machine, with a longitudinal pinch current $I_e=60$ kA, will produce an ST of diameter $2R_{sph}=75$ cm, aspect ratio $A=1.2-1.3$, carrying a toroidal current $I_p=120-240$ kA. The plasma will be magnetically shaped as a disk near each modular annular electrode. Theoretical calculations (using a 3D ideal MHD stability code) show that such a configuration should be ideally stable up to a total beta ranging between 15-25%, depending upon the ratio I_p/I_e . The ST toroidal current should be sustained by Helicity Injection from the Screw Pinch.

In order to demonstrate the feasibility of the SP discharge and the basic electrode characteristics, a preliminary linear electrode test bed, Proto-Pinch, has been built and operated successfully.

The detail mechanical engineering design of PROTO-SPHERA has now been completed. The machine design philosophy, basic geometry and operating conditions with the major components like the vacuum vessel (vv), coils, electrodes, protection components and divertor will be analysed. The thermal and electromagnetic behaviour as well as the predicted and permitted heat stresses will be discussed in order to demonstrate that the design, construction and reliable operation of the machine are feasible.

Reference will also be made to the proposed Multi-Pinch experiment using the START vv to demonstrate the feasibility and stability of the PROTO-SPHERA configuration. The START vv has now been transported and disassembled in ENEA-Frascati. The detailed design of Multi-Pinch, initial phase of PROTO-SPHERA, has also been completed and the first contract related to the PF coils is about to be placed.