First results of plasma central column in PROTO-SPHERA

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The PROTO-SPHERA experiment aims at replacing the metal center post of a Spherical Tokamak with a plasma central column. The plasma of the machine can be considered to be composed by three distict regions: an upper "mushroom-shaped" anode plasma, shaped by 4 constant current poloidal field (PF) coils internal to the cylindrical vacuum vessel; a lower symmetric cathode plasma; the intermediate plasma central column. The first phase of PROTO-SPHERA, in which 8 constant current shaping PF coils have been built along with their power supply, with the cathode heating and with the central column plasma power supplies, is producing (break-down voltage is 75 V in Ar, 200 V in H) the central column plasma only, with a current of 1.7 kA (8.5 kA are due): the current is limited by spurious plasma discharge paths near the vacuum vessel wall, which are driving half of the plasma current on the outboard of the main path, this problem is being cured by adding 4 further constant current PF coils, external to the vessel. The first results of PROTO-SPHERA have already removed the major concern that the central column plasma could attach itself on a restricted portion of the annular anode (both electrodes were designed with annular shape in order to handle the high plasma power and current density impinging upon them). Each PF coil inside the vacuum vessel is in principle at a floating electric potential, but can as well be connected through resistances either to the anode or to the cathode or to the vessel (ground) potential. Each PF coil is spontaneously and indipendently charged to an electric potential by the plasma discharge itself: luckily enough the ensuing electric field **E** inside the machine produces an **E∧B** drift which distributes smoothly the plasma on the annular hollow anode, with neither evidence of attachment nor of filamentation in the anode plasma region. This result is even more impressive as the plasma emerges from the directly heated annular cathode in 18 filaments, as the cathode in the first phase of PROTO-SPHERA is only partially filled with 18 groups (instead of 108) of 3 superposed Tungsten emitters, but the **E∧B** drift eliminates the filamentation just as the plasma enters the anode region.