AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE

PROTO-SPHERA produces its First Torus-&-Divertor Configurations

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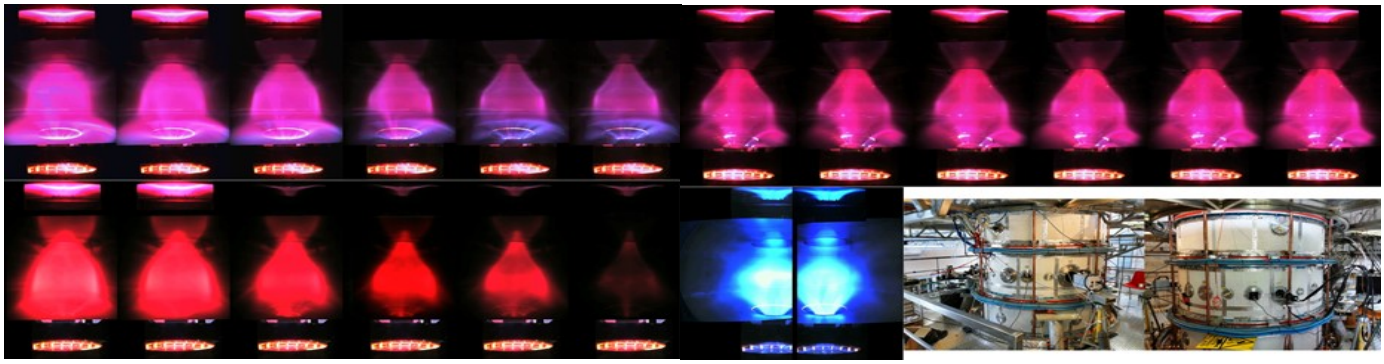
The Phase-1 PROTO-SPHERA experiment, with 4 additional PF coils wound on the outboard of its cylindrical Aluminum vacuum vessel and with a new Super-Capacitor power supply, has produced around its Plasma Centerpost the first Plasma Tori, in Argon and in Hydrogen. The Plasma Centerpost carries a longitudinal current I_{PC}=10 kA; its line-averaged electron density on the midplane increases linearly with I_{PC}: at I_{PC}=10 kA $\langle n_e \rangle = 4 \cdot 10^{20}$ m^{-3} in Ar, $\langle n_e \rangle = 1.5 \cdot 10^{20}$ m^{-3} in H, densities which are on a par with high-field Tokamaks. The Tori carry a toroidal current I_{ST}=5 kA in Ar and I_{ST}>5 kA in H.



Left: Switch-off of H-Torus - top visible light, bottom Hα light **Right - top Break-down of H-plasma, bottom Ar Divertor fans**

The Plasma Centerpost assumes the expected spherical shape but the additional PF coils are too faraway from the Centerpost outboard region: their vertical field can carve from it thin Tori only, with aspect ratio R/a>7 & elongation b/a>3. The Tori can be sustained as long as the Plasma Centerpost longitudinal current is maintained (up to 0.5 sec now); the Tori are limited by a magnetic separatrix with 2 conical Divertor fans. Already in Ar the lower (cathodic) Divertor fan is dominant but the H Torus has a very naughty cathodic fan: it is forcing now the urgent insertion of a metal lower Divertor plate. The total power delivered to the whole plasma already exceeds 3 MW but disruptions never occur. Therefore the Magnetic-Reconnection Current Drive, which will sustain with DC voltage PROTO-SPHERA in Phase-2, has already been demonstrated at low currents (but high densities) in Phase-1. The major surprise is that the Torus forms even in presence of a static vertical field: this feature will significantly ease the plasma operations of future Phase-2, where new internal PF coils will produce Spherical Tori with I_{ST}=1/4 MA.

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