

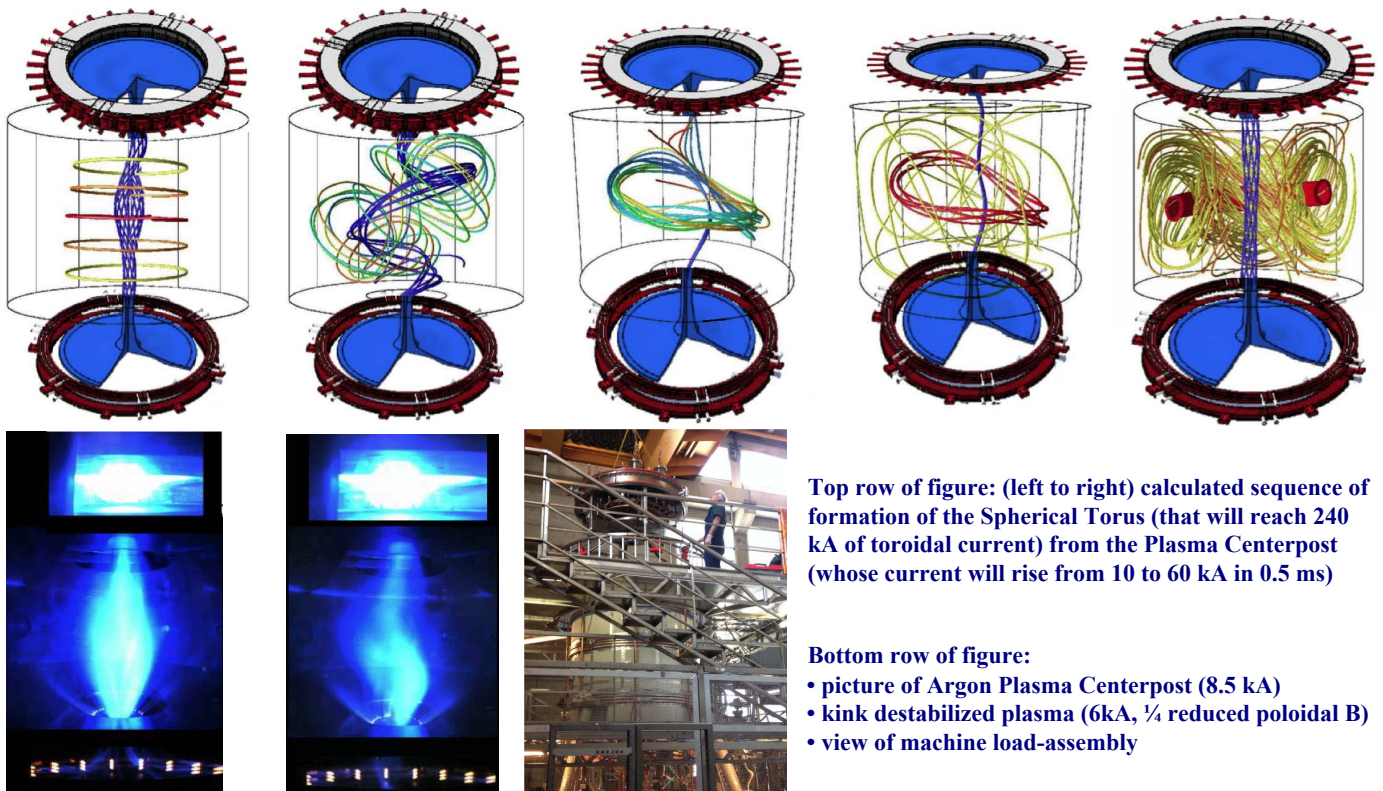
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## The PROTO-SPHERA experiment, an innovative magnetic confinement scheme

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PROTO-SPHERA is an innovative Magnetic Confinement plasma experiment for Controlled Thermonuclear Fusion research, whose aim is to form a Spherical Torus confining plasma not around a metal centerpost (as in Tokamaks), but around a Plasma Centerpost. The PROTO-SPHERA experiment is producing plasma since 2 years and has reached in Argon discharges its Phase-1 target current of 8.5 kA in the Plasma Centerpost. In future (at 60 kA plasma current) magnetic plasma instabilities will kink the Plasma Centerpost to a point such as to shed a Spherical Torus around it. The experiment can at the moment produce the Plasma Centerpost only, but it is already exploring the initial phases of the kink instability, as shown in the following pictures.



**Top row of figure: (left to right) calculated sequence of formation of the Spherical Torus (that will reach 240 kA of toroidal current) from the Plasma Centerpost (whose current will rise from 10 to 60 kA in 0.5 ms)**

**Bottom row of figure:**

- picture of Argon Plasma Centerpost (8.5 kA)
- kink destabilized plasma (6kA,  $\frac{1}{4}$  reduced poloidal B)
- view of machine load-assembly

This confinement scheme, if successful, will have advantages over Tokamaks: cylindrical and not toroidal geometry of the vacuum vessel (easing access and repairs), undefined sustainment of the toroidal current within the Torus, by DC voltage applied to the Plasma Centerpost (allowed by mixed magnetic and electrostatic plasma confinement and plasma mass motion), spontaneous re-forming of the Torus in case of 'plasma disruption' and finally high plasma beta (unitary ratio between plasma pressure and magnetic confinement pressure, which in Tokamaks is only a few %), that could minimize the size of a future Fusion reactor.