Equilibrium and stability calculations for flux-core-spheromak configurations

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Magnetic Boozer coordinates are calculated for simply connected axisymmetric MHD plasma equilibrium, which contain a magnetic separatrix with regular X-points and vanishing rotational transform. The magnetic separatrix divides a spherical torus (ST), with closed field lines, from a screw pinch discharge (SP), which has open field lines ending upon ring electrodes. Furthermore two singular X-points are present on the symmetry axis, where the surface, with non-vanishing rotational transform , branches towards the ring electrodes. Such a configuration has been devised theoretically under the name of "flux-core-spheromak". The purpose of this talk is to analyze the equilibrium issues of such combined magnetic confinement system. In the calculation of the ideal magnetohydrodynamic (MHD) free-boundary stability of magnetoplasma equilibria, the integration of the perturbed magnetic energy in the vacuum region that can exist between the plasma edge and nearby conducting shells, is extended to axisymmetric configurations composed in part by closed and in part by open field lines. Examples of such equilibria are flux-core-spheromaks (FCS) and spherical tori with plasma central column (ST-PCC), where a magnetic separatrix divides a spherical torus – with closed field lines – from a central screw pinch discharge – with open field lines that end upon the sustaining electrodes. A 2-dimensional finite element method is used to solve both problems and an application to the experimental results of the Tokyo University Spherical Torus No. 3 (TS-3) flux-core-spheromak experiment is illustrated.

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