Contribution ID: **3639** Type: **not specified**

P5.1099 From Lawson to burning plasmas: a multi-fluid analysis

Friday, 12 July 2019 14:00 (2 hours)

See the full abstract here http://ocs.ciemat.es/EPS2019ABS/pdf/P5.1099.pdf

A standard figure of merit for magnetic-confinement nuclear fusion experiments is expressed through the Lawson criterion [1]. The criterion gives the value for the "triple product" of plasma density, temperature and energy confinement time that must be reached in order for the plasma to ignite, i.e. to continue producing fusion power without any input heating power. Experimental parameters can easily be compared with Lawson's value. However, this evaluation of plasma performance is inaccurate because of the extreme simplifying assumptions made in the derivation of the Lawson criterion, namely, the 0D geometry and the single-fluid plasma model. The Lawson criterion was improved in recent work, where one-dimensional geometry and multifluid (ions, electrons and alphas) physics were included in the model, accounting for physical equilibration times and different energy confinement times between species [2]. Both steadystate (Lawson-like) and time-dependent calculations were considered, with particular emphasis on the heating power needed to bootstrap a plasma to ignition. A further drawback of the Lawson criterion is that it expresses performance in terms of ignition. A much more meaningful measure for the performance of current and future experiment is expressed in terms of the gain factor Q (ratio between total fusion power and external heating power, with the burning plasma state corresponding to Q=5). Of particular interest for the next generation of experiments is the introduction of no-alpha parameters, which give a formal, physics-based procedure to compare pure deuterium plasma discharges with future deuterium-tritium discharges [3].

References

[1] J. D. Lawson, Proc. Phys. Soc. London Sect. B 70, 6 (1957)

[2] L. Guazzotto and R. Betti, Tokamak Two-Fluid Ignition Conditions, Phys. Plasmas 24, 082504 (2017)

[3] L. Guazzotto and R. Betti, Two-Fluid Burning-Plasma Analysis for Magnetic Confinement Fusion Devices, submitted for publication

pppo

Presenter: GUAZZOTTO, L. (EPS 2019)

Session Classification: Poster P5