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P1.1052 Electromagnetic modelling of the reversed field pinch configuration

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A four-terminal electrical network formulation for the Reversed Field Pinch (RFP) is derived, fixing the flaws of the similar models available in the past literature [1][2]. The approach used in those papers starts from a specific plasma description, and the four electrical quantities of interest (toroidal loop voltage, plasma current, poloidal loop voltage, toroidal magnetic field) along with their governing equations are derived a posteriori. The final results, although appealing, raised a number of misleading or even wrong results and interpretations. Here the modelling takes the steps from a rather general electromagnetic formulation, independent from the specific underlying physics of the plasma considered, which has to be specified at a later stage.
This approach highlights the effective boundary condition of the RFP, which turns out to be the same used in the stability studies of the screw pinch [3]: the ratio between the toroidal and poloidal fields (Bt/Bp) at the plasma boundary (or equivalently to the edge safety factor q(a) = a/R·Bt/Bp), with the plasma current acting as a scale parameter. On the other hand the total toroidal flux becomes a "free variable", determined by the physical description used for the plasma: by the stability criteria for the mentioned case of the screw pinch or by the specific processes of the RFP (e.g. those ruled by visco-resistive or by two fluid MHD equations).
In this view the toroidal field reversal is not a property of the plasma itself, but the result of a process guided from outside the plasma by the externally imposed boundary conditions. Moreover the traditional RFP derivation with global helicity and toroidal flux conservation [4] is a particular choice among the many possible underlying plasma physics descriptions.
As a sample application of the proposed modelling approach, the correct expression of the resistive component of the toroidal loop voltage for the RFP is finally given.

[1] Sprott, J.C. Electrical circuit modeling of reversed field pinches. The Physics of fluids, 31(8), 2266-2275, (1988).
[2] Schoenberg, K.F., Gribble, R.F. and Baker, D.A. Oscillating field current drive for reversed field pinch discharges. Journal of applied physics, 56(9), 2519-2529, (1984).
[3] Glasstone, S, and Lovberg R.H. "Controlled thermonuclear reactions: an introduction to theory and experiment." pp. 493-495, D. Van Nostrand Co., Princeton NJ (1960).
[4] Taylor, J.B. Relaxation of toroidal plasma and generation of reverse magnetic fields. Physical Review Letters, 33(19), 1139 (1974).

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Presenter: CAVAZZANA, R. (EPS 2019)

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