Contribution ID: 20

CarMa0NL modelling of halo currents on COMPASS

Tuesday 19 July 2022 11:10 (25 minutes)

During vertical displacement events (VDEs) plasma column hits the wall and scrape-off layer ("halo") currents can reach significant amplitudes [1]. Therefore, the related electromagnetic loads on plasma facing components (PFCs) should be thoroughly evaluated to guarantee their structural integrity. Modelling of halo currents for next generation tokamaks is a challenging task. For example, non-linear (3D plasma + 2D wall) MHD codes, like JOREK [2, 3], M3D [4], M3D-C1 [2, 5] and NIMROD [2, 6] are appropriate for study of the disruption physics, but might be too demanding in case one needs to analyse many scenarios and geometry configurations. Disruption-oriented (2D plasma + 3D wall) numerical tool CarMa0NL [7, 8] is more practical for design purposes, but it requires some physical insight for definition of the halo width $w_h(t)$. Such criteria is found here empirically by comparing magnetic measurements during COMPASS VDEs [3] with results of CarMa0NL modelling for a wide range of parameters.

It is shown that the halo width correlates with the value of safety factor on the last closed flux surface $q_{\lambda}(t)$. The best fit with experiment is obtained for $q_{\lambda}(t) \approx 1$, which suggests that m/n=1/1 kink instability might play a role in defining $w_h(t)$. Further, we discuss application of the findings to design of COMPASS-U tokamak [9].

References

[1] Strait E, Lao L, Luxon J and Reis E 1991 Nucl. Fusion 31 527

[2] Artola F J, Sovinec C R, Jardin S C, Hoelzl M, Krebs I and Clauser C 2021 Phys. Plasmas 28 052511

[3] Artola F J et al. 2021 Plasma Phys. Control. Fusion 63 064004

[4] Strauss H R, Paccagnella R and Breslau J 2010 Phys. Plasmas 17 082505

[5] Clauser C F, Jardin S C and Ferraro N M 2019 Nucl. Fusion 59 126037

[6] Bunkers K J and Sovinec C R 2020 Phys. Plasmas 27 112505

[7] Villone F, Barbato L, Mastrostefano S and Ventre S 2013 Plasma Phys. Controlled Fusion 55 095008

[8] Chen S L et al. 2019 Nucl. Fusion 59 106039

[9] Yanovskiy V V, Isernia N, Pustovitov V D, Scalera V, Villone F, Hromadka J, Imrisek M, Havlicek J, Hron M and Panek R 2021 Nucl. Fusion 61 096016

Speaker's title

Mr

Member State or IGO

Czech Republic

Speaker's Affiliation

Institute of Plasma Physics of the CAS, Prague

Speaker's email address

yanovskiy@ipp.cas.cz

Primary author: YANOVSKIY, Vadim (Institute of Plasma Physics of the Czech Academy of Sciences)

Co-authors: Dr CASOLARI, Andrea (IPP Prague); Dr HAVLICEK, Josef (IPP Prague); Mr IAIUNESE, Antonio (Consorzio CREATE); ISERNIA, Nicola; MATVEEVA, Ekaterina (Institute of Plasma Physics of CAS); Prof. VILLONE, Fabio (Consorzio CREATE)

Presenter: YANOVSKIY, Vadim (Institute of Plasma Physics of the Czech Academy of Sciences)

Session Classification: Disruption Consequences

Track Classification: Consequences