

## P1.1058 Phase relation between phase locked (2,1) and (3,1) tearing modes in ASDEX Upgrade

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See the full abstract here:

<http://ocs.ciemat.es/EPS2019ABS/pdf/P1.1058.pdf>

Tearing modes (TMs) are a major concern for tokamak operation. Especially a ( $m = 2$ ,  $n = 1$ ) TM (with  $m$  poloidal and  $n$  toroidal mode number) can cause strong confinement reduction and also initiate a disruption. When modes with the same toroidal but different poloidal mode numbers are phase locked, the local phase relation inevitably varies in space. In a tokamak with its toroidal symmetry, coupled modes are usually observed to rotate as a rigid body in toroidal direction. Thus, the phase relation varies with poloidal angle only. A (2,1) mode is mostly coupled to a (1,1) core mode when  $q_0 < 1$ , while coupling to ( $m > 2$ ,  $n = 1$ ) TMs is not a general observation. Several publications that report on observed mode coupling or predict the phase relation between  $n = 1$  TMs indicate that the modes are in phase on the low field side (LFS). E.g. in [1] this is observed prior to a density limit disruption for the (3,1) and (2,1) TMs.

Recent observations in ASDEX Upgrade with local electron temperature measurements by electron cyclotron emission diagnostics show that (2,1) and (3,1) TMs can couple with different phase relations on the LFS, reaching up to antiphase (i.e. the O-point of one island is next to the X-point of the other). The dependence on several parameters is discussed. Especially plasma rotation and plasma beta are strongly correlated with the phase between the modes.

Knowledge of the local phase can be of importance, e.g. when an island should be stabilised by current drive in the island's O-point using modulated electron cyclotron current drive (ECCD). An important tool for detecting and analysing TMs in real time are magnetic pick-up coils, which measure the perturbation field outside the plasma. In order to determine the correct ECCD timing from magnetic measurements in case of coupled modes, the phase relation between the modes has to be considered.

### References

[1] W. Suttrop et al, Nuclear Fusion 37, 119 (1997)

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