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Disruption Threshold of Error-Field-Induced Locked Mode under $n=1$ and $n=2$ Mixed Non-Axisymmetric Fields

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During 2013 KSTAR campaign, we conducted mixed non-axisymmetric (NA) field experiments to investigate the effect of overlap between differently aligned NA fields by the field error correction coils. Locking and error field (EF) penetration were induced by the torque imbalance between the intrinsic rotation and external magnetic braking. Further increase of the $n=1$ EF resulted in minor disruption. As anticipated by the magnetic braking effect, the stronger $n=2$ NA field case exhibited earlier EF penetration and locking. On the contrary to the locking phenomena, subsequent minor disruption was delayed and even avoided by the stronger $n=2$ NA field. The delay or avoidance of minor disruption has a dependence on the pitch of the $n=2$ NA field. Analysis of the locked mode amplitude revealed that the $n=2$ NA field started to hinder the growth of $n=1$ locked mode when the mode amplitude reached certain level. The starting level of the hindrance appears to rely on the $n=2$ NA field strength. More interestingly, the fast growth was recovered just before minor disruption. It seems that there exists 2nd threshold of EF penetration related to the disruption phenomena like 1st threshold in the locking phenomena. Nevertheless, the pure $n=1$ field case without $n=2$ field did not show clear change of the growth rate after locking and just exhibited gradual increase of the locked mode towards the minor disruption.

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