Helical modes induced by localized current perturbations in sawtoothing KSTAR plasmas

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Detailed 2D and quasi-3D images of sawtoothing plasmas with localized ECH have been obtained on the KSTAR tokamak, revealing the existence of multiple flux tubes (MFTs) of helicity $h=m/n=1/1$ and their complex dynamics: growth of MFTs, their coalescence into a single flux tube, and subsequent crash [1]. A systematic scan of the localized ECH deposition position showed a strong correlation between the number of flux tubes and the deposition position [2].

Theoretical investigations on possible generation mechanisms for MFTs in our experimental condition suggest that the localized ECH can induce the formation of $h=1$ flux tubes only if the q profile is nearly flat and close to 1 in the core region. Subsequently, a numerical scheme with an empirical source model for localized current using a reduced set of MHD equations has been developed [3]. A good agreement with the observation was found only for the simulations with flat q=1 profile, confirming the validity of the theoretical speculation.

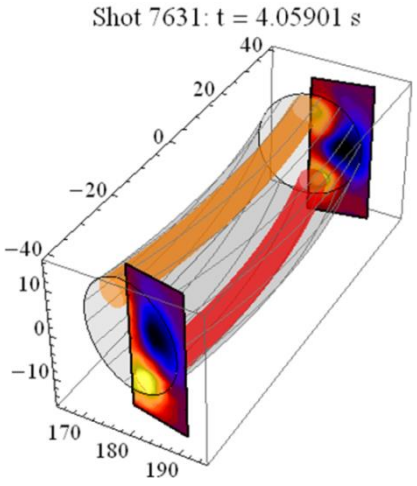

Figure 1 Dual flux tubes aligned along m/n=1/1 field line. Boxed are the observed images.

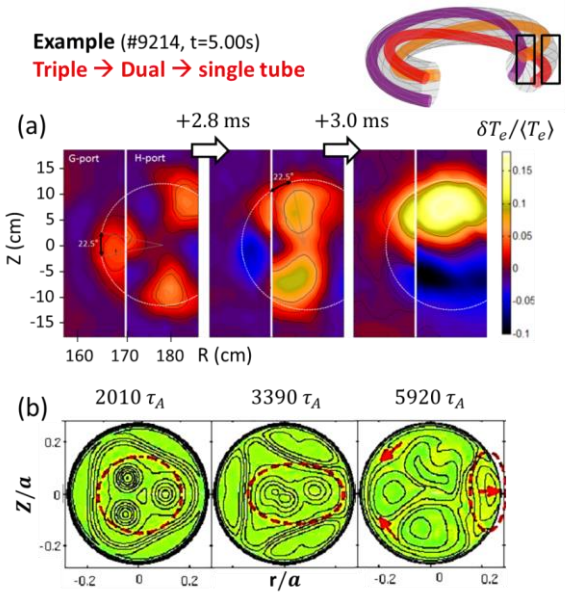

Figure 2 Merging of triple flux tubes. (a) Observation showing transformation of triple flux tubes into a dumbbell shaped dual tubes, which then merges into a single flux tubes. (b) Corresponding reduced MHD simulation result.

References:
[1] G.S. Yun et al., Phys. Rev. Lett. **109**,145003 (2012)
[2] G.H. Choe et al., submitted to Nucl. Fusion
[3] A. Bierwage et al., submitted to Nucl. Fusion