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Magnetic field stochastization and transport process during edge pedestal collapse simulations

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A recent nonlinear reduced magnetohydrodynamic (MHD) simulation have shown a new dynamical process leading to the stochastization of magnetic fields during an edge pedestal collapse [T Rhee et. al., Nucl. Fusion **55** (2015) 032004]. In addition to the magnetic field stochastization, geodesic acoustic modes (GAM) are shown to play an important role in edge pedestal collapse, in particular, when the critical alpha (=normalized pressure gradient) is reduced near/below the ideal threshold value [H Jhang et. al. Nucl. Fusion, **57** (2017) 022006]. A strong burst of GAM activity is observed near the end of the crash and leads to secondary crashes. This phenomenon was attributed to the onset of a tertiary instability driven by the excitation of strong zonal flows. This raises a question of a dynamical mechanism which could generate such a strong zonal flow during the pedestal collapse. To address this question, we perform an analytic study of coupled zonal flow-ballooning modes. In this study, we assume that Reynolds and Maxwell stress drivers for the zonal mode are exactly cancelled (in line with observations in the simulation) and consider only the contribution from the geodesic curvature coupling drive. A simple analysis shows a possible onset of a new nonlinear instability which can induce a strong growth of zonal flows. In addition to this analysis, we perform a statistical analysis to evaluate the evolution of magnetic Kubo number during the pedestal collapse. The Kubo number is found not to exceed the unity in all the time, implying the quasi-linear diffusion model may be sufficient to study the energy loss mechanism during the collapse. Details of these analyses and their implication to experiments will be presented.