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Excitation of zonal flows and their impact on dynamics of edge pedestal collapse

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We study the role of zonal flows in edge pedestal collapse using a reduced magnetohydrodynamic (MHD) model. A dramatic change of dynamics happens when ideal ballooning modes are stabilized. A detailed analysis shows that a zonal flow driven instability is developed due to a strong excitation of zonal vorticity, resulting in secondary crashes. The presence of subsidiary bursts after a main crash increases the effective crash time and energy loss. These simulation results resemble the behavior of compound edge localized modes (ELMs). Thus, our results indicate that a complete understanding of ELM crash dynamics requires the self-consistent inclusion of nonlinear zonal flows-MHD interaction and transport physics.

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