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Sausage to kink instability transition-induced fast magnetic reconnection resulting in a magnetized plasma disruption BYONGHOON SEO, PAKORN WONGWAITAYAKORNKUL, MAGNUS A. HAW, RYAN S. MARSHALL, PAUL M. BELLAN, Caltech, HUI LI, Los Alamos National Lab — We present observations and a model of a sausage-kink sequence that causes a fast magnetic reconnection which results in plasma jet disruption and breaking off from the originating electrode at the Caltech laboratory experiment. The sausage instability occurs first and pinches a fat, short magnetized jet to become a thin, long magnetized jet. The thin, long jet then becomes kink unstable. The incompressible kink further lengthens and thins the jet. When the jet radius becomes comparable to the ion-skin depth and so satisfies the condition for magnetic reconnection, the jet disrupts. The observed sausage-kink sequence is consistent with the theoretical stability criteria predicted by the MHD energy principle. X-ray bursts and waves are observed when the plasma jet breaks off from the electrode. The results of a three-dimensional ideal MHD numerical simulation are consistent with both the experiment and the analytic model. The observations and associated analytic and numerical models provide not only a multi-scale cascade path for fast magnetic reconnection but also a plausible underlying mechanism for impulsive natural phenomena such as quasi-periodic pulsations and solar X-ray jet eruptions and for fusion relevant phenomena such as spheromak formation and tokamak instabilities.

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