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A Self-Consistent Mechanism for Incomplete Reconnection in Sawteeth MATTHEW BEIDLER, PAUL CASSAK, West Virginia University — A prevailing impediment to core confinement in fusion devices is the occurrence of large sawtooth events. Experiments show that the crash phase often ends before all available magnetic flux is reconnected, i.e., reconnection is incomplete, but this is inconsistent with the Kadomtsev model. We present a model for incomplete, or partial, reconnection in sawtooth crashes [1]. The reconnection inflow self-consistently convects the high pressure core and low pressure edge of a tokamak toward the m=n=1 rational surface, thereby increasing the pressure gradient at the reconnection site. If the pressure gradient at the rational surface exceeds a threshold, incomplete reconnection will occur. We show that predictions of this model are borne out in large-scale simulations of reconnection. The predictions are also consistent with data from the Mega Ampere Spherical Tokamak. Physically, we attribute the suppression to the interaction of the exterior pressure gradient with the pressure quadrupole that inherently occurs during collisionless (Hall) reconnection with a strong guide-field. The results should apply across tokamaks, including ITER.

[1] M. T. Beidler and P. A. Cassak, Phys. Rev. Lett., 107, 255002 (2011)

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