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Category Number and Subject:

[**X**] Theory [ ] Experiment

Momentum Model of Gas Jet Penetration in Plasma,* P.B. Parks, GA — The lack of penetration of supersonic gas jets used in recent disruption mitigation experiments is explained. In the model [1], a cold, thin, plasma halo forms over the surface of the jet, shielding the neutral gas interior. The magnetic field inside the jet is slightly less than the field outside as a result of the balance between sideways advection of magnetic field lines by jet motion, and inward diffusion across the resistive halo. The net magnetic force opposing the jet motion then balances the neutral gas ram pressure piling up as a shock wave behind the tip of the jet, resulting in an equation for the "tip speed" of the jet. The tip speed to jet speed ratio U is very sensitive to jet density and halo resistivity. An argon jet ($\gamma = 5/3$) cannot penetrate unless $U > U_{crit} = 1/4$, otherwise the backward propagating shock wave reaches the rear jet surface, causing neutral "spillage" into the vacuum region. In DIII-D experiments, the jet density ~6×10^{16} cm^{-3} was too feeble to satisfy our penetration criterion, even when the B-field was lowered 0.5 T. Indications for improving neutral particle penetration for ITER will be made.

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[ ] Oral [x] Poster