Measurements of impurity and heat dynamics during noble gas jet-initiated fast plasma shutdown for disruption mitigation in DIII-D

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Abstract. Impurity deposition and mixing during gas jet-initiated plasma shutdown is studied using a rapid (~2ms), massive (~10^{22} particles) injection of neon or argon into stationary DIII-D H-mode discharges. Fast-gated camera images indicate that the neutral deposition remains fairly localized near the injection port and does not penetrate far into the plasma pedestal. Nevertheless, fast bolometry indicates that high (50%-100%) thermal quench radiated power fractions are achieved; this appears to be facilitated through a combination of fast ion mixing and fast heat transport, both driven by large-scale magnetohydrodynamic activity. These experiments suggest that massive gas injection could be viable for disruption mitigation in future tokamaks even if core penetration of jet neutrals is not achieved.