Rapid inward impurity transport during impurity pellet injection on the DIII-D tokamak

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Abstract

Neon killer pellets are injected into the DIII–D tokamak plasma in order to quench radiatively the plasma's stored energy and mitigate disruption effects. Rapid inward transport on the time-scale of the pellet ablation results in central deposition of the neon, inside the ablation penetration radius of the pellet at a normalized radius r/a = 0.45. This results in a centrally peaked electron density profile. This result is in contrast to the radially outward deposition measured for fueling (hydrogenic) pellets injected from a tokamak's low field side. Penetration of the impurity into the central plasma allows ~90% of the plasma's kinetic energy to be lost through neon radiation in 2 milliseconds. The fraction of deposited pellet material remaining in the plasma is conservatively estimated at 73%. The observed magnitudes of magnetic fluctuations ($\delta B/B \sim 0.2\%$) are shown to be capable of causing the radial transport. Disruption mitigation and pellet fueling efficiency for reactor size plasmas could be aided by this effect.