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Study of the halo current region resistivity on the DIII-D tokamak

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In this work we report measurements of the temperature and density of the halo current region on DIII-D during disruptions using the recently upgraded Thomson scattering diagnostic allowing low-temperature measurements down to a few eV with a sub-ms repetition rate. This is done by employing deliberate downward vertical displacement events (VDEs) and relying on the expansion of the halo current region upward, intercepting the midplane Thomson channels. Both 'hot'and 'cold'VDEs were studied using ohmic and H-mode target plasmas respectively. 'Hot'VDE, having the vertical instability growth rate greater than the current decay rate, characterizes by the electron temperature of the halo expansion region in the range of 1–10 eV increasing towards the core. While 'cold'VDE has the opposite time scale dynamics and much lower electron temperature of 1–2 eV with a flat profile. VDE of both types results in the electron density of the halo region comparable with the core plasma density and quickly decreasing to the edge. Poloidal halo currents, measured using the tile current shunts, exhibit values greater by about 20% for the 'hot'VDE cases. Modeled poloidal and toroidal halo currents, as well as modeled halo current width are also presented. Implication of the halo region resistivity on the halo current profile and JxB forces is discussed.

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