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Experimental determination of plasma detachment from the diverging magnetic nozzle of the VASIMR VX-200 Electric Thruster CHRISTOPHER OLSEN, JARED SQUIRE, BENJAMIN LONGMIER, MAXWELL BALLENGER, LEONARD CASSADY, MARK CARTER, ANDREW ILIN, Ad Astra Rocket Company, PAUL CLOUTIER, Rice University, EDGAR BERING, MATTHEW GIAMBUSSO, University of Houston, AD ASTRA ROCKET COMPANY TEAM, RICE UNIVERSITY COLLABORATION, UNIVERSITY OF HOUSTON COLLABORATION — Theories of magnetized plasma detachment in an expanding magnetic field have been lacking detailed experimental evidence. Recent experiments using a 200 kW class electric rocket (VX-200), run at 100 kW using argon and a peak magnetic field of 2 T, produced ion energies greater than 100 eV with a flux of $2x10^{22}$ ions/s in a 150 m^3 vacuum facility. Ion-neutral charge exchange effects were reduced and the resultant data show evidence of plasma detachment in a diverging magnetic field on a scale length of 2 m. The detachment is confirmed using multiple plasma diagnostics and magnetic nozzle topologies. Spatial maps of the data are compared to simulations from a particle detachment model, ParTraj, as well as MHD detachment theory. ParTraj, when compared to experiment, is shown to be more consistent in describing the data. Unless the MHD models are modified to incorporation two-fluid effects, single fluid MHD theory is inconsistent with the observations.

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