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Experimental study on the velocity limits of magnetized rotating plasmas CATALIN TEODORESCU, RYAN CLARY, RICHARD ELLIS, ADIL HASSAM, ILKER UZUN-KAYMAK, University of Maryland — An experimental study on the physical limits of the rotation velocity of magnetized plasmas is presented. A comprehensive campaign has been carried out on the MCX, a mirror magnetic field plasma rotating azimuthally, to ascertain what physical effects limit attempts to externally boost the velocity. The externally applied parameters that control the plasma characteristics – applied voltage, external magnetic field and fill pressure – are scanned across the entire available range of values. It is found that the plasma rotation velocity does not exceed the Alfven velocity, in complete agreement with the equilibrium requirements of magnetically confined plasmas. As the velocity approaches the average Alfven speed, further applied force does not result in an increase past this critical speed. Diamagnetic loop measurements show that the diamagnetically excluded flux increases as the square of the Alfven Mach number, as predicted by equilibrium MHD theory. Measured rotation velocities are also found to stay below the critical ionization velocity in hydrogen, a limit suggested by Alfven. However, an approach to a definite limit has not been proven yet largely because of voltage and magnetic field upper bounds dictated by the available experimental hardware.

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