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Collective dynamics and transport in extremely magnetized dusty plasmas[1]

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We have built an experimental setup to realize and observe rotating dusty plasmas in a co-rotating frame. Based on the Larmor theorem, the "RotoDust" setup is able to create effective magnetizations, mimicked by the Coriolis inertial force, in strongly coupled dusty plasmas that are impossible to approach with superconducting magnets. At the highest rotation speed, we have achieved effective magnetic fields of 3200 T [1]. The effective magnetization $\beta = \omega_c/\omega_p$ (ratio of cyclotron to plasma frequency) reaches 0.76 which is typical for many strongly magnetized and strongly correlated plasmas in compact astrophysical objects [2]. The analysis of the wave spectra as observed in_the rotating frame clearly shows the equivalence of_the rotating dust cloud and a magnetized plasma._Further, the analysis of the mean square displacement (MSD) and the velocity autocorrelation function (VAC) revealed the transport parameters diffusion and viscosity, which are in reasonable agreement with numerical predictions for magnetized 2D Yukawa systems. Small degree of super-diffusion is observed. [1] P.Hartmann, Z.Donko_, T.Ott, H.Ka_hlert, M.Bonitz, Phys.Rev.Lett. 111, 155002 (2013) [2] H. Ka_hlert, J. Carstensen, M. Bonitz, H. Lo_wen, F. Greiner, and A. Piel, Phys. Rev. Lett. 109, 155003 (2012) [3] T. Ott and M. Bonitz, Phys. Rev. Lett. 107, 135003 (2011)

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