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Study of Two-fluid Effects during Magnetic Reconnection in a Laboratory Experiment M. YAMADA, H. JI, S. GERHARDT, M. INOMOTO*, R. KULSRUD, A. KURITSYN, Y. REN, Plasma Physics Laboratory, Princeton Univ. Princeton NJ 08543 — This paper highlights the most recent findings on the two-fluid dynamics in the reconnection layer of the MRX (Magnetic Reconnection Experiment) plasmas. This paper primarily addresses the two-fluids MHD physics of magnetic reconnection and the results are compared with the recent space observations. As our experimental operation regime has moved from the collisional to the collision-free regime, two-fluid effects have become more evident. The recent progress of our understanding of our experimental research based on our two-fluid MHD analysis is presented to illuminated the physics of the Hall MHD in a collision-free reconnection layer. In particular, a clear experimental verification of an out-of-plane Hall quadrupole field has been made [1] in a Harris-like neutral sheet [2], with the width comparable to the ion skin depth, during magnetic reconnection. Also high frequency fluctuations observed in the reconnection layer exhibit two fluid effects demonstrating different kinematics for electrons and ions [3]. Finally, inter-relationship between the observed fast reconnection rate, magnetic turbulence and the Hall quadrupole fields are discussed. Work supported by DoE, NSF, and NASA. [1] Y. Ren et al, Phys. Rev. Letts. August 12 issue (2005) [2] M. Yamada et al., Phys. Plasmas 7, 1781 (2000) [3] H. Ji et al., Phys. Rev. Letts. V.92, 115001 (2004) *Visiting from Osaka Univ.

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