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Possible competing ground states in high mobility electron-hole bilayers K. DAS GUPTA, A.F. CROXALL, C.A. NICOLL, M. THANGARAJ, H.E. BEERE, I. FARRER, D.A. RITCHIE, M. PEPPER, Cavendish Laboratory, University of Cambridge — Recently it has become possible to fabricate independently contacted high mobility electron-hole bilayers (EHBL) with densities $< 5 \times 10^{10}\text{cm}^{-2}$ and a separation 10-20 nm in a GaAs/AlGaAs system. In these EHBLs the interlayer interaction can be stronger than the intralayer interactions. Excitonic superfluidity in such EHBLs was first predicted almost forty years ago. Since then theoretical works have indicated the possibility of a very rich phase diagram, containing a superfluid, charge density waves, Wigner crystals and a BCS-BEC crossover. However this system has been extremely difficult to fabricate in practice. Very recent experiments have revealed novel features in the interlayer scattering (Coulomb drag) below $\sim$ 1K. The Coulomb drag shows strong non-monotonic deviations from a $\sim T^2$ behaviour expected for Fermi-liquids at low temperatures. Simultaneously an insulating behaviour in the single layer resistances also appears in both layers inspite of electron mobilities $> 10^6\text{cm}^2\text{V}^{-1}\text{s}^{-1}$ and hole mobilities $> 10^5\text{cm}^2\text{V}^{-1}\text{s}^{-1}$. The experimental results may indicate a competition between an excitonic ground state and charge-density- waves. [J. Keogh *et al* APL, 87,202104 (2005). A.F.Croxall *et al* arXiv:0807.0117 (to appear in JAP), A.F. Croxall *et al* arXiv:0807.0134v3 (to appear in PRL)]

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