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Characterizing spin-charge separation in ultracold atoms confined to 1D[1] TSUNG-LIN YANG, YA-TING CHANG, ZHENGHAO ZHAO, Department of Physics and Astronomy, Rice University, Houston TX, CHUNG-YOU SHIH, None, RANDALL HULET, Department of Physics and Astronomy, Rice University, Houston TX — One dimensional systems of fermions are predicted by Luttinger liquid theory to have different dispersion relations for spin and charge excitations. In the past, evidence of spin-charge separation has been seen in quantum wire tunneling experiments [2,3]. However, independent measurements for spin and charge dispersion were not realized. Ultracold atoms, however, provide a highly tunable system to directly observe this phenomenon using Bragg spectroscopy[4]. We realized such a system with fermionic ^{6}Li in a 2-D optical lattice. By measuring the momentum transfer from a Raman transition while varying the relative detuning of the two-photon transition, we can measure the dispersion relation $\omega(k)$. The two "spin" states are different hyperfine levels of the atom, and by appropriate choice of detuning, it may be possible to independently measure the spin and charge excitations. Using the tunability of interactions via a Feshbach resonance, we have measured the Bragg spectrum for the charge mode for a range of interaction strengths from the non-interacting Fermi gas to a strongly interacting one.

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[3]Y. Jompol et al., Science 325, 597 (2009).
[4]S. Hoinka et al., Phys. Rev. Lett. 109 , 050403 (2012)

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