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Measurement of the "Contact" and the Paired Fraction of Ultracold Atoms in the BEC-BCS Crossover[1] YEAN-AN LIAO, WENHUI LI, T. PAPROTTA, A.S.C. RITTNER, R.G. HULET, Department of Physics and Astronomy and Rice Quantum Institute, Rice University, Houston, TX 77005 — We use a photoassociation technique to probe small-length scale correlations of a two-spin mixture of ^{6}Li atoms as a function of interaction strength and temperature. The interaction strength is tuned from the molecular BEC regime to the BCS regime using a Feshbach resonance. The fraction of atoms that are paired is measured by photo-exciting them to a spatially small vibrational level of an electronically excited state of the Li_2 diatomic molecule[2]. The measured paired fraction is independent of of the photo-excitation laser intensity, as long as it is fast compared to the pair reformation time. At sufficiently low temperature, we find the paired fraction varies from near unity at the BEC limit, to below our limits of detectability on the BCS side. At unitarity, we observe preformed pairs above T_c, a phenomenon shared with high-temperature superconductors. The previously measured closed-channel fraction[2] is directly related to the "contact"[3], a universal thermodynamic quantity.

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[2]G. B. Partridge *et al.*, *Phys. Rev. Lett.* **95**, 020404 (2005).
[3]F. Werner, L. Tarruell, & Y. Castin, *Eur. Phys. J. B* **68**, 401 (2009).

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