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Superconductivity at the Two-dimensional Limit

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Superconductivity in the extreme two-dimensional limit is studied on ultra-thin lead (Pb) films down to two atomic layers, where only a single channel of quantum well states exist. Scanning tunneling spectroscopy reveals that local superconducting order remains robust until two atomic layers, where the transition temperature abruptly plunges to lower values depending sensitively on the exact atomic structure of the film. Our result shows that Cooper pairs can still form in the last two dimensional channel of electron states, although their binding are strongly affected by the substrate [1]. In this presentation, I will also discuss this new result in comparison with several recent experimental results on ultra-thin metallic films performed using local STS probes and macroscopic transport measurements.

[1] "Superconductivity at the Two-dimensional Limit," Shengyong Qin, Jungdae Kim, Qian Niu and Chih-Kang Shih, Science 324, 1314 (2009).