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Proximity superconductivity in ballistic graphene at high magnetic fields J. R. PRANCE, Department of Physics, University of Lancaster, Lancaster, UK, M. BEN SHALOM, M. J. ZHU, V. I. FALKO, A. MISHCHENKO, A. V. KRETININ, K. S. NOVOSELOV, C. R. WOODS, School of Physics and Astronomy, University of Manchester, Oxford Road, M13 9PL Manchester, UK, K. WATANABE, T. TANIGUCHI, National Institute for Materials Science, 1-1 Namiki, Tsukuba, 305-0044 Japan, A. K. GEIM, School of Physics and Astronomy, University of Manchester, Oxford Road, M13 9PL Manchester, UK — We present measurements of the superconducting proximity effect in graphene-based Josephson junctions with a mean free path of several microns, which exceeds the junctions' length [1]. The junctions exhibit low contact resistance and large supercurrents. We observe Fabry-Pérot oscillations in the normal-state resistance and the critical current of the junctions. The proximity effect is mostly suppressed in magnetic fields of <10 mT showing the conventional Fraunhofer interference pattern; however, unexpectedly, a weak proximity effect survives in magnetic fields as high as 1 T. Superconducting states randomly appear and disappear as a function of field and carrier concentration, and each exhibits a supercurrent carrying capacity close to the universal limit of $e\Delta/h$ where Δ is the superconducting gap of the contacts. We attribute the high-field supercurrent to mesoscopic Andreev states that persist near graphene edges. Our work reveals new proximity regimes that can be controlled by quantum confinement and cyclotron motion. [1] Ben Shalom et al., arXiv:1504.03286 (2015)

Jonathan Prance
Department of Physics, University of Lancaster, Lancaster, UK

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