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Supercriticality of charge centers in graphene probed with scanning tunneling microscopy[1] YUHANG JIANG, JINHAI MAO, GUOHONG LI, Rutgers University, Department of Physics and Astronomy, 136 Frelinghuysen Road, Piscataway, NJ 08855 USA, D. MOLDOVAN, M. RAMEZANI MASIR, F. M. PEETERS, Departement Fysica, Universiteit Antwerpen Groenenborgerlaan 171, B-2020 Antwerpen, Belgium, EVA Y. ANDREI, Rutgers University, Department of Physics and Astronomy, 136 Frelinghuysen Road, Piscataway, NJ 08855 USA — The massless Dirac fermion carriers in graphene, with their effective fine structure constant,α_g, being of order unity, provide fertile ground for exploring the physics of ultra-relativistic particles in the strong coupling limit.In particulara positive charge Z embedded in graphene is expected to exhibit supercritical behavior already for $Z>Z_c = 0.5/\alpha_g$, in stark contrast to the atomic case where $Z_c \sim 170$ is experimentally inaccessible. However due to the significant screening in graphene, attaining the supercritical regime is challenging.[2] We will report on a new method to create charge centerswithin the graphene layer whose charge, Z, can be tuned to exceed the critical value. Using low temperature scanning tunneling microscopy and spectroscopy we study the evolution in the local electronic structure of graphene as a function of Z, from charge neutrality to the supercritical regime, which is identified by comparing to numerical simulations.

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[2]Y. Wang *et al*, Science, 340, 734 (2013)

Yuhang Jiang
Rutgers University, Department of Physics and Astronomy

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