Abstract Submitted
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Lengthy logarithms and graphene's Debye-Waller factor[1] B.C. REGAN, BRIAN SHEVITSKI, WILLIAM A. HUBBARD, E.R. WHITE, UCLA Department of Physics and Astronomy & CNSI, BEN DAWSON, M.S. LODGE, MASA ISHIGAMI, UCF Department of Physics & NTC, MATTHEW MECKLENBURG, UCLA Department of Physics and Astronomy & CNSI — In an infinite, two-dimensional crystal, long wavelength thermal phonons create a divergence in the mean-square displacement u_p^2 of atoms from their ideal lattice positions, which has led some to infer that the existence of graphene might depend on the stabilizing influence of ripples in the third dimension. Using the Debye model to approximate graphene's phonon band structure, we calculate u_p^2 and the resulting Debye-Waller suppression of high order peaks in graphene's electron diffraction pattern. We find that at room temperature in a 10 μm sample $\sqrt{u_p^2}$ is less than 5% of the carbon-carbon bond length, well below the Lindemann melting threshold. Our TEM measurements of the Debye-Waller factor in suspended, exfoliated graphene agree with the calculation. Finite size effects are sufficient to explain graphene's evident stability at room temperature. Surprisingly, in the case of graphene even 6×10^{23} carbon atoms, representing a sheet 126 m on a side, are not enough to approximate an infinitely large crystal.

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B. C. Regan
UCLA Department of Physics and Astronomy & CNSI

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