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Elastic Solitons and Vortices in Bilayer Graphene JOSEPHINE YU, Montgomery Blair High School, HARSH MATHUR, Case Western Reserve University — Using electron microscopy Alden et al [PNAS 110, 11256 (2013)] find that in strained bilayer graphene regions of stable AB and BA stacking are separated by domain walls. Vortex-like defects are also observed at the intersections of three domain walls; scanning transmission electron microscopy reveals that the vortex cores have an unstable AA stacking. We develop a continuum elasticity model that describes the relative displacement of the two layers of graphene. In addition to the usual gradient energy cost we posit a nonlinear potential for the displacement field that favors AB and BA stackings and disfavors the AA stacking. In our model the domain walls appear as soliton solutions to a double sine-Gordon equation. We find that the ratio of the width of domain walls with tensile strain to those with shear strain is $\sim$1.63, in excellent agreement with observations. We study the stability and oscillatory modes of the domain walls motivated by experimental observations that show the domain walls undergoing damped oscillations. Estimates of the vortex core size based on our model are in agreement with the experiment. A homotopy analysis of bilayer graphene vortices shows that they carry non-abelian topological charge.

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