Graphene Nanoribbon Turns Magnetic

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We study the electronic correlation effects in armchair graphene nanoribbon by the complimentary methods of the analytic effective field theory, non-Abelian density-matrix renormalization group and the first-principles local spin density approximation. We show that the ground state becomes ferromagnetic in the flat band regime, which arises from quantum interferences at nanoscale and the electronic correlations. It is rather remarkable that, starting from the single π-band in the nanoribbon, it generates both the flat band with intrinsic magnetic moments and the dispersive bands with itinerant carriers that mediate the exchange coupling among the magnetic moments. All three approaches we adopted here predict the same ferromagnetic ground state with quantitative agreement. The resultant ferromagnetic state with metallic conductivity is not only surprising for academic investigations, but also has potential applications in spintronics at nanoscale.