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Abstract for an Invited Paper
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Optical, magnetic and electronic properties of graphene quantum dots[1]

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We present a theory of optical, magnetic and electronic properties of graphene quantum dots. We demonstrate that there exists a class of triangular graphene quantum dots with zigzag edges [1-8] which combines magnetic, optical and transport properties in a single-material structure. These dots exhibit robust magnetic moment and optical transitions simultaneously in the THz, visible and UV spectral ranges due to the existence of a band of degenerate states lying at the Fermi level in the middle of the energy gap [1-6]. The magnetic and optical properties[5,7] are determined by strong electron-electron and excitonic interactions in the degenerate band, treated exactly using numerical techniques combining tight-binding, DFT, Hartree-Fock and configuration interactions methods. We show that the spin polarized degenerate band leads to quenching of the absorption spectrum at half-filling, while addition of a single electron fully depolarizes all electron spins and turns the absorption on. It is thus possible to design gate and size tunable graphene quantum dots with desired optical and magnetic properties for optoelectronic and photo-voltaic applications. Collaborators: P. Potasz, O. Voznyy, M. Korkusinski, and P. Hawrylak.

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