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Magnetic Properties of Carbon Nanostructures: The Role of Negative and Positive Curvature

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A Pi-orbital nearest-neighbor tight-binding Hamiltonian in conjunction with the London approximation is used to study uniform external magnetic field effects on different graphitic nanostructures with negative and positive Gaussian curvature. Ring currents and the induced magnetic moment are calculated on toroidal structures formed by coalescing C60 structures (peapod- like) and Haeckelite-tubules (structures containing heptagons, hexagons and pentagons of carbon). It is found that coalesced C60 fullerenes connected along the five-fold symmetry axes and Haeckelites tubes are metallic and exhibit large magnetic moments. These results have important implications in the magnetic properties of corrugated carbon nanotubes (coalesced peapods). The magnetism observed experimentally in rombohedral C60 is also discussed in the context of ring currents generated by the sp2 polymerization of C60. Finally, the possiblity of witnessing magnetism in interconnected graphene layers is also studied.