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Topological nanomagnet: Quantized magnetic moment at the edge of single-walled carbon nanotube

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One of the ultimate goals in nanotechnology is to manipulate signal processing at the molecule level. At earlier attempts in molecular electronics, the major difficulty lies in the contact problem that was recently resolved by precise oxidative cutting of a single-walled carbon nanotube (SWNT) with conducting molecules introduced to form covariant bridge over the tiny gap. The functionality of the molecular junction sensitively depends on the bridging molecule and also the edge morphology of the SWNT. Since the mutual Coulomb interaction between electrons is expected to have a crucial role at nanoscale, we are motivated to investigate the correlation effects in a semi-infinite SWNT. By both analytic and numeric approaches, we spotted a quantized magnetic moment near the edge with magnitude dictated by its topological properties but not on the detail interaction profile. Meanwhile, the edge moment only shows up in one of the sublattices, revealing an approximate supersymmetry (SUSY) in the realistic band structure. Our findings demonstrate the crucial importance of edge morphology at nanoscale due to electronic correlations. In addition, the edge moment, solely depending on the topology of the nanotube, provides an excellent candidate for nanomagnet farbrication and thus has great application potentials in spintronics devices, spin-polarized scanning tunneling microscope and other related fields.