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Casimir Interactions Between Scatterers on Carbon Nanotubes
DINA ZHABINSKAYA, University of Pennsylvania, JESSE KINDER, Cornell University, E. J. MELE, University of Pennsylvania — We study the interactions between two short-range scatterers in metallic carbon nanotubes as a Casimir problem. In the massless Dirac Hamiltonian for the electrons, a defect can be represented by a scattering potential with a pseudospin polarization. Sublattice-asymmetric and bond-centered potentials may lead to small momentum backscattering, depending on the chiral angle of the nanotube. Quasibound states formed between two defects determine the forces at the boundaries. We develop a force operator approach within the Dirac model to calculate the forces on two square well potentials of finite width, and take the limit of sharp and strong scatterers to study the Casimir forces mediated by the fermions. For the special case of two identical scatterers we recover the conventional one-dimensional attractive Casimir force. For the general problem with inequivalent scatterers we find that the magnitude and sign of this force depends on the relative pseudospin polarizations of the two defect potentials. We will also discuss the effects intervalley scattering on the Casimir interactions between defects.

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