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Electron-electron interaction effects on the photophysics of metallic single-walled carbon nanotubes[1] SUMIT MAZUMDAR, University of Arizona, DEMETRA PSIACHOS, ZHENDONG WANG, ROBERTO BADILLA, University of Arizona — Within a molecular Hamiltonian appropriate for correlated π-electron systems, we show that optical excitations polarized parallel to the nanotube axes in the so-called metallic single-walled carbon nanotubes are to excitons. Our calculated absolute exciton energies in twelve different metallic single-walled carbon nanotubes, with diameters in the range 0.8 - 1.4 nm, are in nearly quantitative agreement with experimental results. We have also calculated the absorption spectrum for the (21,21) single-walled carbon nanotube in the E_{22} region. Our calculated spectrum gives an excellent fit to the experimental absorption spectrum. In all cases our calculated exciton binding energies are only slightly smaller than those of semiconducting nanotubes with comparable diameters. As in the semiconducting nanotubes we predict in the metallic nanotubes a two-photon exciton above the lowest longitudinally polarized exciton that can be detected by ultrafast pump-probe spectroscopy. We also predict a subgap absorption polarized perpendicular to the nanotube axes below the lowest longitudinal exciton, blueshifted from the exact midgap by electron-electron interactions.

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