High-Field Magneto-Photoluminescence Spectroscopy of Highly-Aligned Carbon Nanotubes

J. SHAVER, J. KONO, ECE Dept., Rice University, Houston, TX, S. A. CROOKER, National High Magnetic Field Lab, Los Alamos, NM, J. A. FAGAN, E. K. HOBIE, NIST, Gaithersburg, MD — We have investigated excitons in semiconducting single-walled carbon nanotubes (SWNTs) through low-temperature magneto-photoluminescence (PL) of highly-aligned SWNT films in magnetic fields ($B$) up to 55 T. The magnetic field was generated using the 60 T long pulse magnet powered by a 1.4 GVA motor-generator at the National High Magnetic Field Lab in Los Alamos, NM. Polyacrylic acid films containing DNA suspended CoMoCAT SWNTs were stretch-aligned, and the alignment factor was analyzed by polarized Raman spectroscopy$^1$. Utilizing two well-defined measurement geometries, SWNTs $\parallel B$ and SWNTs $\perp B$, we provide unambiguous evidence that the PL from excitons in SWNTs is sensitive only to the $B$-component parallel to the tube axis. We developed a theoretical model of one-dimensional magneto-excitons, based on recently-proposed exchange-split bright and dark exciton bands with Aharonov-Bohm-phase-dependent energies, masses, and oscillator strengths, which successfully reproduces our observations$^2$.