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Experimental evidence for the spin triplet exciton in single wall carbon nanotubes A. MOHITE, B. ALPHENAAR, University of Louisville, T. SANTOS, J. MOODERA, FRANCIS BITTER MAGNET LAB, MIT. COLLABORATION — Optical transitions in single wall carbon nanotubes (SWNTs) are dominated by the formation of excitonic states. Most excitonic states predicted for carbon nanotubes are not observable under normal conditions, including the so-called dark excitonic states and the spin triplet states. Here, we describe a photocurrent measurement technique that allows for the first observation of the spin triplet state. A thin (3 nm) semi-transparent film of Europium Sulphide (EuS) is used as a top contact to CVD grown nanotubes. EuS is a spin filtering tunnel barrier. At low temperatures, the conduction band in the EuS splits, so that the spin-up level lies 0.36 eV below the spin-down level. We monitor the nanotube photocurrent at 4.2K for magnetic fields between 0 and 50 mT. With increasing magnetic field, a low energy photocurrent peak splits off from the singlet exciton peak. No splitting is observed in the free carrier peak, but its position shifts by approximately 7 meV. From this we estimate that the EuS layer produces an effective magnetic field of 7 T. This is too small to produce observable Zeeman splitting, or for the dark exciton to be observed. We instead suggest that the EuS provides spin orbit coupling to mix the singlet and triplet states, making the triplet state optically active. Supported by ONR (No. N00014-06-1-0228) and NSF.

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