Electrically detected exciton photo-absorption
in semiconductor double quantum dot

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Quantum transports of semiconductor quantum dots so far are mostly treat the conduction band electrons. Trapping an electron from conduction electron reservoir into the dot, and electrically detect their current or charge, enables us to control a single charge, a single spin, as well as tiny numbers of nuclear spins around it. [1] Semiconductor devices on the other hands are well known to be excellent photo-detectors/emitters, and the interaction of photons, conduction band and valence band electrons in such devices are well understood. In this paper, motivated by recent quantum media conversion proposals from a single photon to a single photo-created electron spin [2,3], we report a quantum transport measurement of semiconductor double quantum dots under monochromatic light irradiation which can cause an interband photo-absorption in quantum dots.

We measured a dc transport current $I_D$ of the vertical double dot composed of AlGaAs barrier, InGaAs wells and n-GaAs electrodes at temperature ~ 0.23K with monochromatic light illuminations of wavelength 850nm -1100nm. Under large source drain bias voltage $V_S$ near pinch-off gate voltage $V_G$, Photo-absorption with minimum photon energy occurs as an indirect exciton, i.e. creation of an electron on one quantum well and a hole on the other. (Fig.1) [4] Photon energy needed to create such an indirect exciton depends linearly on the electric field applied to the triple barrier structure and thus can be tuned by $V_S$ (Fig. 2.). This onset $V_S$ is consistent with the amount of the photon energy decrease estimated from $V_S$ deference of two quantum wells (dotted line).
Reference


**Fig. 1** Schematics of the device and the indirect exciton.  
**Fig. 2** Onset $V_S$ of photo absorption vs. photon energy.