Eoin Murray MPhil corrections changelog.

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Caption improvements

Figure 1.1

Previously

Electronic structure of a quantum dot. (a) An exciton e-h pair. (b) A biexciton with two e-h pairs. (c) An exciton with an extra hole making a positively charged exciton.

Now

Electronic structure of a quantum dot. (a) An e-h pair is referred to as an exciton. (b) Two e-h pairs is referred to as a biexciton. (c) An exciton with an extra hole (electron) is a positively (negatively) charged exciton.

Figure 1.2

Previously

Single photon emission process in a quantum dot.

Now

A single photon emission process in a quantum dot. A photon (γ in the image) excites an electron from the Valence band to the Conduction band, this creates an exciton. This exciton can relax into the quantum dot and after some time τ it will recombine and emit another photon. Since the quantum dot energy leves are discrete, and only accept a fixed number of carriers and after photon emission there is a finite time which must pass before more carriers can be captured, true single photon emission is possible.

Figure 1.3

Previously

Light ray propagation in a planar dielectric waveguide.

Now

Light ray propagation in a planar dielectric waveguide. The unguided ray impinges on the boundary at angle larger than θ_c and therefore some of the light refracts, losing power at each reflection causing the ray to gradually disappear. The guided ray impinges at an angle less than θ_c and reflects fully propagating long the core without any loss of power.

Figure 1.4

Previously

Graphical solution of Equation **??**. The black line is the LHS of the equation and the red line is the RHS. Each LHS segment corresponds to a mode in the waveguide.

Now

Graphical solution of to the transcendental equation **??**. The black line is the LHS of the equation and the red line is the RHS. Each LHS segment corresponds to a mode in the waveguide.

Figure 1.7

Previously

Example NOON state sensor using a single photon source and a photonic circuit. In this case the temperature of the heater is being sensed.

Now

A single photon is emitted and impinges on the 50:50 beamsplitter, where one is delayed. The two photons will then interfere at the first DC, generating a NOON state. The state travels down paths 1 and 2, gathering a phase due to the presence of the heater on path 1. The phase of the MZI, and thus the temperature of the heater, can be determined accurately from analysing how output coincidences change with temperature.

Figure 2.1

Previously

Schematic of waveguide characterisation experiment.

Now

Schematic of waveguide characterisation experiment. Two PM V-groove arrays are aligned to the side of the waveguide chip. One of the V-groove channels injects laser light into port 1. The light is split by the DC and then collected from port 3 and 4 by another (generally multimode) V-groove array and sent to a power meter. The power ratios of of port 3 and 4 are used to calculate the coupling ratio of the DC.

Figure 2.3

Previously

Typical micro-Photoluminescence setup to excite the QD sample with a laser and collect the QD light. The orange light is the laser and the red light is the path the QD light takes.

Now

Typical micro-Photoluminescence setup to excite the QD sample with a laser and collect the QD light. The orange light is the laser and the red light is the path the QD light takes. The QD light travels in free space through two 92/8 beamsplitters, with 92% transmission. With the two beamsplitters; the laser, LED and CCD elements can be placed in the optical path of the QD light, while minimising the amount of QD light lost. The QD light is collected by a fibre coupled collimator and sent to a spectrometer equipped with a, liquid nitrogen cooled, silicon charged coupled device.

Figure 2.5

Previously

Schematic of a hybrid device. A III-V chip with embedded quantum dots is bonded to an SiON waveguide chip such that the single photons from the QDs are routed through the waveguides.

Now

Schematic of a hybrid device. A III-V chip with embedded quantum dots is bonded to an SiON waveguide chip such that the single photons from the QDs are routed through the waveguides. The other end of the waveguide is bonded to a V-groove array to collect the light and send it to a spectrometer.

Figure 2.6

Previously

Schematic of HBT experiment taking place on the Hybrid chip.

Now

Schematic of HBT experiment taking place on the Hybrid chip. The light from ports 1 and 2 of the hybrid chip is collected by the V-groove array and sent towards transmission gratings in order to spectrally isolate the QD light. The light in both channels then impinge on APDs. The APD clicks are then correlated on a timing card.

Figure 3.1

Previously

Finite difference time domain simulation of a QD dipole emitting in a cavity and the emission being guided by the SiON core.

Now

Finite difference time domain simulation of a QD dipole emitting in a cavity and the emission being guided by the SiON core. The $\hat{z}$ component of the electro-magnetic field is clearly seen to propagate along the waveguide core.

Figure 3.5

Previously

Photograph of an example bonded device.

Now

Photograph of an example bonded device. The III-V chip is bonded orthogonally to the SiON chip (top-right) which is in turn bonded to a six channel V-groove array (bottom-left of chip). The nichrome channels allow a phase-varying heating current to be applied to the MZ's. The structure is glued to a copper block is placed in a cryostat for the duration of experiments.

Figure 3.6

Previously

Schematic of the experiment.

Now

Schematic of the experiment. The laser light travels from port 3 (highlighted in orange) exciting QDs in the III-V chip. The QD light (path highlighted in red) enters a heater tuned MZI. The QD light is collected by V-grooves and sent through transmission gratings towards APDs in order to do correlations.

Figure 3.9

Previously

Counts measured as a function of time over 12 hours.

Now

Counts measured as a function of time over 12 hours. The hybrid chip is stable over long periods of time and needs no drifting correction.

Figure 3.11

Previously

The outputs a MZI arm is shown by the black triangles, the solid black line is a fit to the data. The red line is the calculated phase as a function of voltage.

Now

The output of a MZI arm is shown by the black triangles, the solid black line is a fit to the data. The red line is the calculated phase as a function of voltage.

Change units of some graphs

I was to check with Toshiba the possibility that I can add more details to the axis graphs (changing to arbitrary units to an actual count rate).I have spoken to David Ellis and Toshiba will not allow me to include count rates.

New references

Added original 'Quantum Dot Single-Photon Turnstile Device' citation on page 8.

Added HBT referent to experimental section documenting the HBT experiment, page 26.

Added 'Manipulation of multiphoton entanglement in waveguide quantum circuits' justification for waveguide characterisation experiments on page 20.