PHOTON PAIR SOURCES FOR QUANTUM OPTICAL COHERENCE TOMOGRAPHY

Z. IBARRA-BORJA[1], R. RAMÍREZ-ALARCÓN[1], D. LOPEZ-MAGO[2].

[1]QUANTUM PHOTONICS LABORATORY, CENTRO DE INVESTIGACIONES EN ÓPTICA, LEÓN C.P. 37150, MÉXICO.
[2]PHOTONICS AND MATHEMATICAL OPTICS GROUP, TECNOLÓGICO DE MONTERREY, MONTERREY 64849, MÉXICO

ABSTRACT

We have implemented two different configurations of QOCT, using the Hong-Ou-Mandel (HOM) interferometer. The HOM interferogram graphs the coincidences of the signal (s) and idler (i) photons, generated in spontaneous parametric down conversion (SPDC), versus their optical paht difference, showing no coincidence detection, this phenomenon is called HOM dip. Both implemented QOCT configurations use the HOM interference but employing two different configurations of SPDC: Type I in non-collinear and Type II in collinear propagation. The maximum axial resolution reached in this work was 4.08 μm, obtained using SPDC Type I in non-collinear propagation and a cube beam splitter.

RESULTS

EXPERIMENTAL SETUP

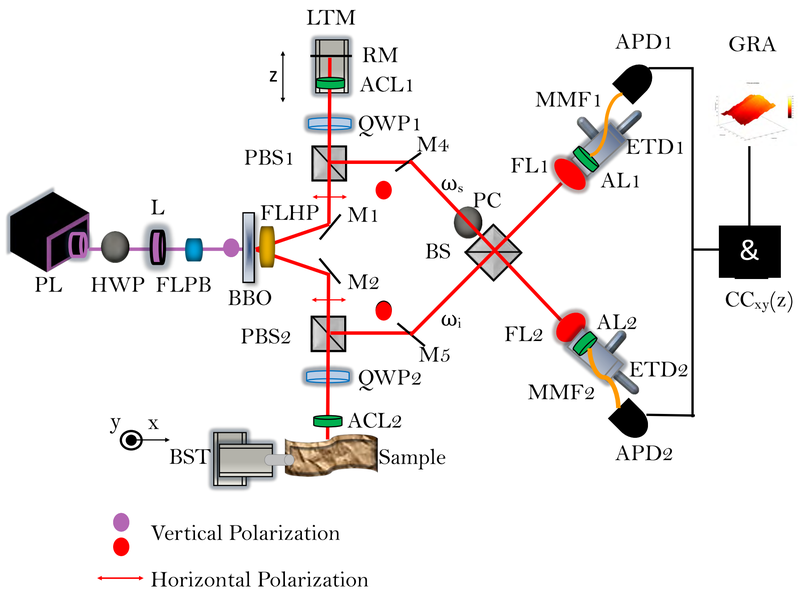


Fig. 1: Experimental arrangement for quantum optical coherence tomography (QOCT) using SPDC Type I in non-collinear propagation

HOM INTERFERENCE

$$N_c = \frac{1}{2}\left\{1 - V\left[f(\delta\tau)\cos(\delta\omega\delta\tau)\cos(\theta)\right]\right\}$$

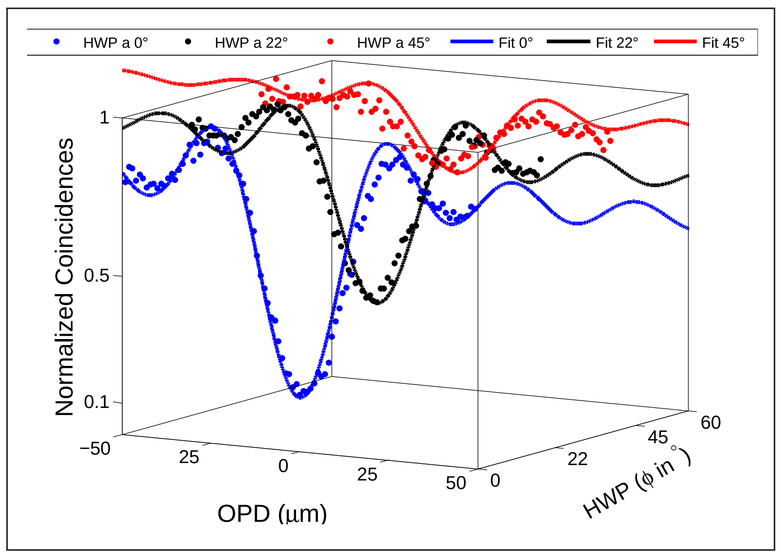
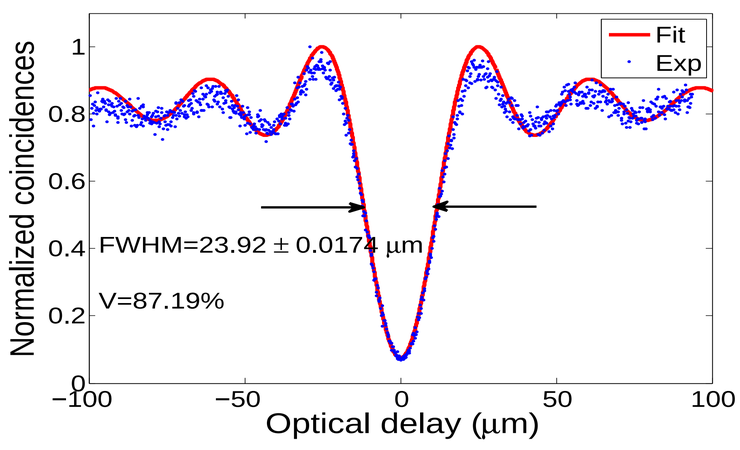
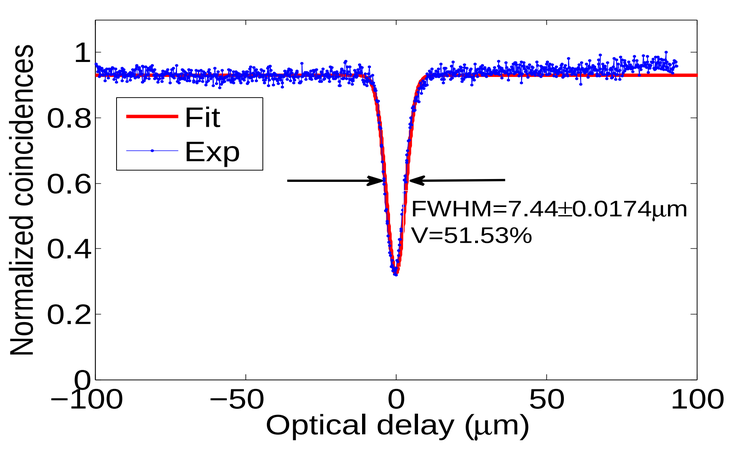


Fig. 2: Interference dip in coincidence rate for three wave plate orientations.

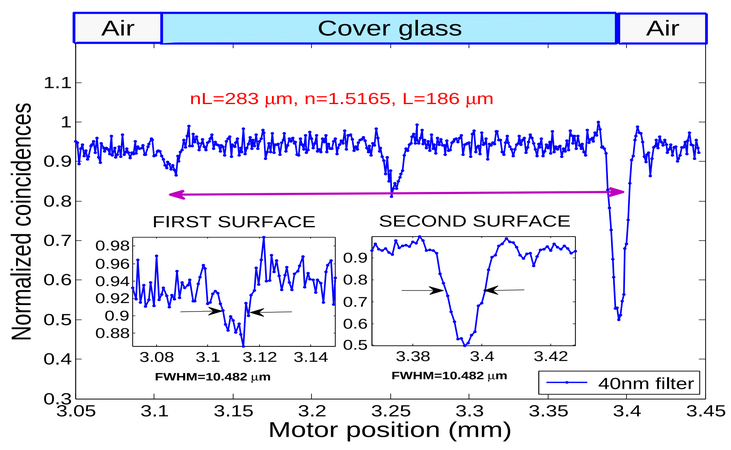
QOCT USING SPDC TYPE I



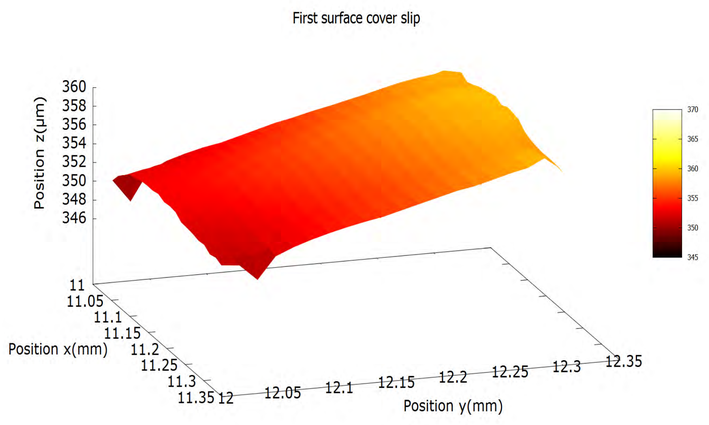
(a) HOM Interferogram for a single layer using a filter FWHM=10 nm.



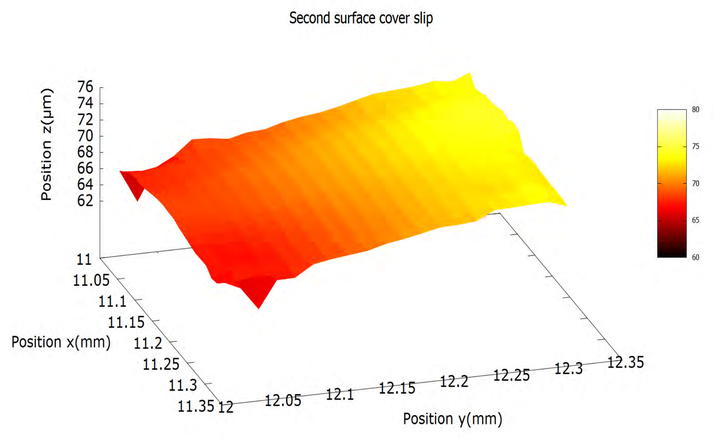
(b) HOM Interferogram for a single layer without filters.



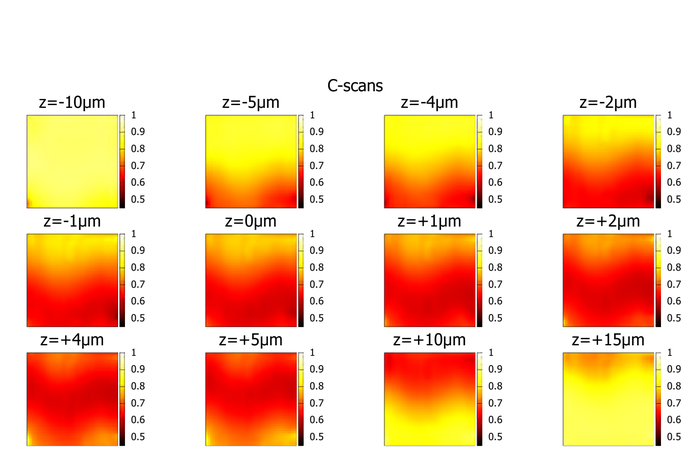
(c) Coincidence rate for QOCT (A-scans) using a cover slip. We deposit a thin layer of copper on each surface of the cover slip.



(d) Three-dimensional image of the first surface constructed from the collection of all A-Scans.



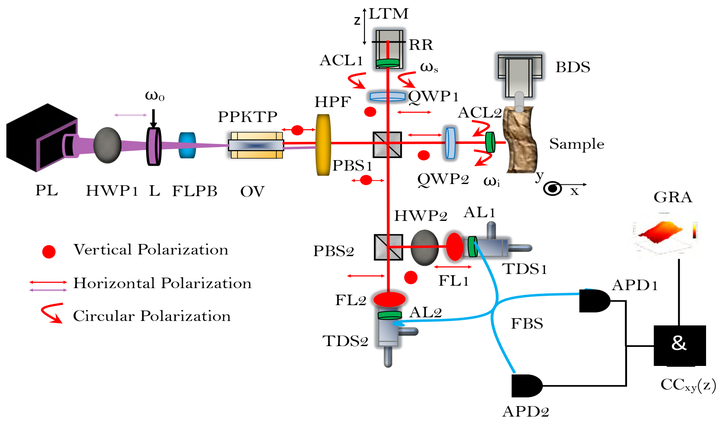
(e) Three-dimensional image of the second surface constructed from the collection of all A-Scans.



(f) Two-dimensional transverse (xy) QOCT sections (C-scans) of the first surface of cover slip at different axial depths z.

Fig. 3: QOCT

QOCT USING SPDC TYPE II



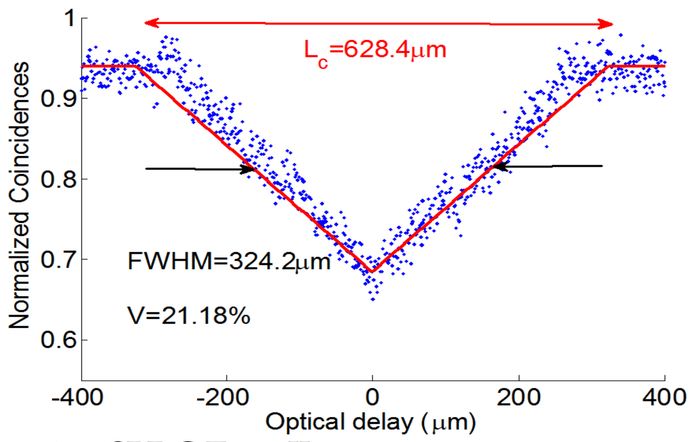


Figure 4: QOCT results using SPDC Type II

CONCLUSIONS

QOCT's system has been implemented using a Hong-Ou-Mandel interfence, which led us to obtaining an axial maximum resolution of 7.44 ± 0.0174 μm, this using an arrangement where we work with a fiber beam splitter and SPDC Type I non-collineal

REFERENCES

[1] M. B. Nasr, D. P. Goode, N. Nguyen, G. Rong, L. Yang, B. M. Reinhard, B. E. A. Saleh, and M. C. Teich. *Quantum optical coherence tomography of a biological sample* Optics Communicaations, 282(6):1154-1159, 2008