# Atomic and Laser Physics Seminar

## Monday, 14 January

## 11.30

## Audrey Wood Seminar Room


## Dr Michal Karpinski

## Department of Physics


# *Controlling spatial properties of photon pairs generated through waveguided spontaneous parametric down conversion*


Generation of entangled photons in nonlinear waveguides opens up new promising routes to engineer characteristics required for implementing quantum information protocols. We report experimental realization of a bright pulsed source of photon pairs in the 800 nm spectral region, using type-II spontaneous parametric down-conversion in a multimode periodically poled potassium titanyl phosphate (PPKTP) waveguide. We demonstrate the use of intermodal dispersion to achieve careful control of the spatial degree of freedom of the generated photons, following the method suggested in [1,2]. This allows us to produce the twin photons in well-defined spatial modes, without any spatial filtering at the output. Spatial purity of the photons is confirmed by a direct measurement of the $M^2$ beam quality factor in the heralded regime [3].

High spatial purity of the generated photons allowed us to demonstrate generation of polarization entangled photon pairs in the Shih-Alley configuration. Generation of polarization entanglement was confirmed by detecting a violation of a Bell's inequality without performing any additional spatial filtering of the photons [4].

These results show the possibility of achieving full control over the spatial degree of freedom of waveguide generated photon pairs. They also pave the way to efficient preparation and detection of spatial mode entangled photon pairs and polarization-spatial mode hyper-entangled states.



[1] K. Banaszek, A. B. U'Ren, and I. A. Walmsley, Opt. Lett. **26,** 1367 (2001).
[2] M. Karpiński, C. Radzewicz, K. Banaszek, Appl. Phys. Lett. **94**, 181105 (2009).
[3] M. Karpiński, C. Radzewicz, K. Banaszek, Opt. Lett. **37,** 878 (2012).
[4] M. Karpiński, C. Radzewicz, K. Banaszek, arXiv:1209.5349 (2012).