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Introduction

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Introduction

In 2003, a 2-day workshop on single photon detectors was held at NIST (the National Institute of Standards and Technology, USA) to ascertain the needs of the user, development, and measurement communities. A snapshot of the research at that time was published in a special issue of the *Journal of Modern Optics* in 2004 [1].

The discussions highlighted key requirements for photon counting detectors: high quantum efficiency, low dark count rates, high dynamic range, spectral selectivity, IR sensitivity, solar blindness, photon number resolution, low dead-time, low jitter, low after-pulsing, ease of use and low cost.

Since then, quantum information processing (QIP) research has grown at a steady rate with papers appearing in *Nature* on a fortnightly basis. An updated log-plot (figure 1) of the number of papers published on single photon detectors and sources shows that the steady growth continues in tandem with quantum cryptography. (Even though a change in abstracting methods by the database changed the overall numbers somewhat since the single photon issue of 2004, the growth trend is clear.) Quantum cryptography and quantum computing continue to be the main drivers for this community, while researchers in astronomy, biomedical and nuclear physics, who have a long history in photon detection, are also pushing photon counting detector development.

In October 2005, a two and a half day follow-up workshop, 'Single photon: sources, detectors, applications and measurement methods', was held at NPL (National Physical Laboratory, UK). This workshop focused on the key developments since the previous workshop and brought together the QIP source and detector communities, with the detector communities from the biomedical, nuclear and astrophysics fields. Figure 2 shows the breakdown of the 82 international delegates.

The presentations at the 2005 workshop clearly showed that the issues and potential roadblocks highlighted in 2003 were being addressed. It was recognized that the wide variety of applications prevents a 'one size fits all' detector. A few highlights of the developments are efforts in photon counting detectors operating at telecom wavelengths using InGaAs/InP photodiodes. New commercial detectors now emphasize improvements in size, portability, USB interfacing, lower jitter, lower afterpulsing, and now single photon avalanche photodiode arrays are becoming commercially available. Combining the QIP community with the biomedical, nuclear, and astrophysics communities widens the commercial market, addressing a concern expressed by all.

One session of the workshop was dedicated to researchers developing single photon sources, mainly for the purposes of QIP. Key issues are: producing single

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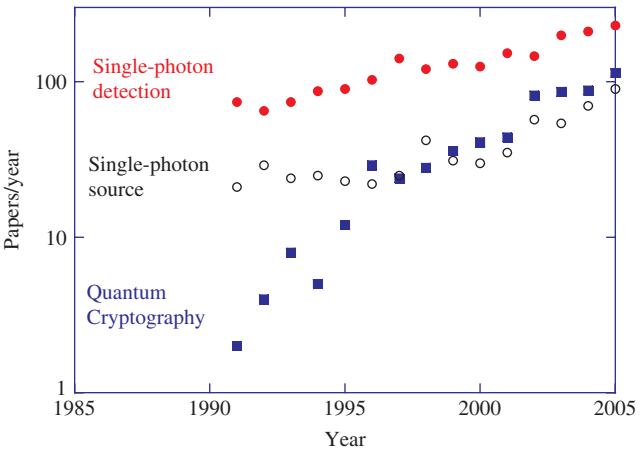

Figure 1. Growth of photon-counting detector related papers as indicated by numbers of papers each year, along with single photon source, and quantum cryptography papers for comparison as found in the Web of Science database. (The colour version of this figure is included in the online version of the journal.)

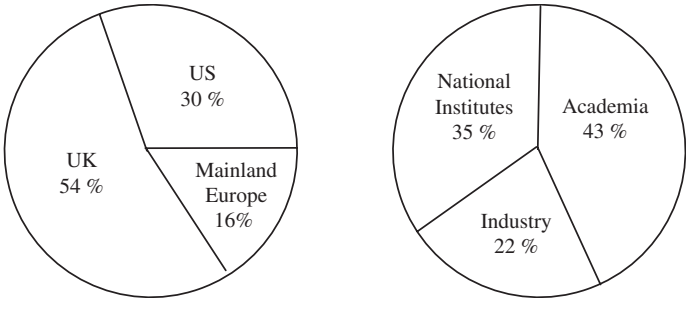

Figure 2. Breakdown of the SPW2005 participants from different parts of the world and research communities.

photons on demand, demonstrating the 'single photonness', controlling properties such as wavelength, polarization and degree of photon indistinguishability.

The presentations from the workshop are available on the web at http://www.photoncount.com, a new site created specifically to maintain communication in the single photon community between meetings. The site currently has over 100 participants.

This issue captures a snapshot of photon counting research from a wide variety of photon-counting disciplines, in the 2 years following the 2003 workshop. This volume contains 23 papers originating from the workshop presentations, as well as including relevant papers from researchers who did not attend. It was agreed at the 2005 workshop that developments are occurring rapidly enough that the community should meet every 2 years.

The guest editors thank NPL for hosting and providing funds for the workshop, industrial sponsors, Hewlett Packard, IdQuantique, SensL, Spectrolab and Toshiba, and also the US Army European Research Organisation.

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Reference

[1] A. Migdall and J.P. Dowling, J. Mod. Opt. **51** 1265 (2004).