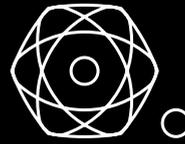


C L Y D E
S P A C E



QUANTIC

The UK Quantum Technology Hub
in Quantum Enhanced Imaging



**Few-photon satellite
communications using LEDs**



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Clusters of nanosatellites can communicate in space using LED-based transceivers developed by QuantIC. They benefit from ultra-low power consumption, small footprint and high resilience to background noise.

Satellite technology is vital for a wide range of terrestrial applications, from communications and weather systems tracking to navigation and Earth observation. Furthermore, new technological advances show clear opportunities for distributed swarms or constellations of small satellites that will provide new functionality using innovative, cost-effective units in flexible arrangements. Such constellations require self-alignment and communication systems without greatly increasing the power consumption of the satellite unit. The market for nanosatellites is rapidly growing and estimated to reach \$30.1 billion USD (~£22.7 billion GBP) in the next 10 years.

QuantIC's researchers are working with Clyde Space, world leading innovator and supplier of CubeSats and small satellite systems, and the Scottish Centre of Excellence in Satellite Applications to develop a low light level communications and positioning system that operates at the few-photon level, close to the

quantum limit. This technology will allow constellations of satellites to identify their own position relative to other units and to communicate with each other, all at ultra-low power levels, and with form factors compatible with current CubeSat standards. QuantIC's LED emitter technology and single photon receivers crucially enable this performance. It also offers a high level of resilience against both DC and AC background noise. Transmitter and receiver are both conveniently interfaced with CMOS digital electronics.

"As the market continues to rapidly develop, there are ever increasing applications of nanosatellite constellations - systems of nanosatellites working together to solve a particular problem. QuantIC's novel optical communications technology coupled with Clyde Space's extensive experience in spacecraft design ensures that key commercial constellations missions can be met with system-optimised solutions which are not only responsive to market demand but pioneer industry innovations."
- Andrew Strain, Chief Engineer, Clyde Space.

Application area	Ultra low light navigation and communications
Estimated Component Cost	Laboratory demonstrator: £3.5k/transceiver Small volume FPGA based product: ~£200 (using off-the-shelf SPAD modules) High volume ASIC based product: ~£20 (digital logic, LED driver, and SPAD detector in one ASIC)
Present Performance Specs	100 kBit/s data rate, 30 photons/bit received power (10 pW), resilient to DC and AC noise from 0-10 MHz, 4.5 W power consumption (Scope to reduce to 1.5 W)
Latest Publications	Herrnsdorf et al., Positioning and Space-Division Multiple Access Enabled by Structured Illumination With Light-Emitting Diodes, J. Lightwave Technol. 35, 2339 (2017)

For more information, please contact:

Dr Michael Fletcher
QuantIC Business Development Manager
michael.fletcher@glasgow.ac.uk

Dr Michael Strain
Project Technology Lead
michael.strain@strath.ac.uk



www.quantific.ac.uk
 @QuantIC_QTHub