QUANTUM SUPER-RESOLVED IMAGING WITH SPAD ARRAYS

G. Lubin,[1] R. Tenne,[1] I.M. Antolovic[2], U. Rossman[1], E. Charbon[2], C. Bruschini[2] and D. Oron[1]

[1]Weizmann Institute of Science, Department of Physics of Complex Systems, Rehovot 7610001, Israel

[2]École Polytechnique Fédérale de Lausanne (EPFL), School of Engineering, Neuchâtel 2002, Switzerland

E-mail : gur.lubin@weizmann.ac.il

KEY WORDS: Quantum imaging, Super-resolution, SPAD array detectors, Temporal photon correlations

Super-resolution microscopy techniques are now readily available, surpassing Abbe's diffraction limit by relaxing one or more of the assumptions it's based on. As the limit is implicitly derived for classical light, an exciting avenue for new super-resolution methods is through the use of quantum properties light. A non-classical light source is already present in many life-science imaging scenarios, a result of photon antibunching, the tendency of fluorophores to emit one photon at a time. Moreover, harnessing advances in single photon avalanche diode (SPAD) array technology enables simple and elegant realizations of quantum imaging modalities.

We experimentally demonstrate a quantum enabled super resolution technique, Quantum Image Scanning Microscopy (Q-ISM) [1]. The method is based on imaging coincidental photon pairs in an image scanning microscope setup, the contrast stemming from photon antibunching.

We further demonstrate the recent realization of this technique and other photon correlation measurements with novel on-chip SPAD array detectors [2]. This approach leads to a simple and cost-effective realization, promoting widespread use of quantum sensing. The inherent scalability of this new approach has the potential to enable widefield quantum imaging, overcoming one of the main obstacles to the implementation of quantum technologies in life-science imaging.

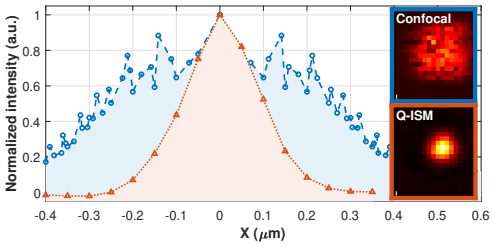

Fig 1. Q-ISM super-resolution demonstrated with a SPAD array microscope

References

[1] R. Tenne et al. *Nat. Photonics*, **13**, 116-122, 2019

[2] G. Lubin et al. *Opt. Express*, **27**, 32863-32882, 2019