Building Photonic Qubits with quantum dot based single-photon sources

Dr. Valérian Giesz

Co-founder & CEO

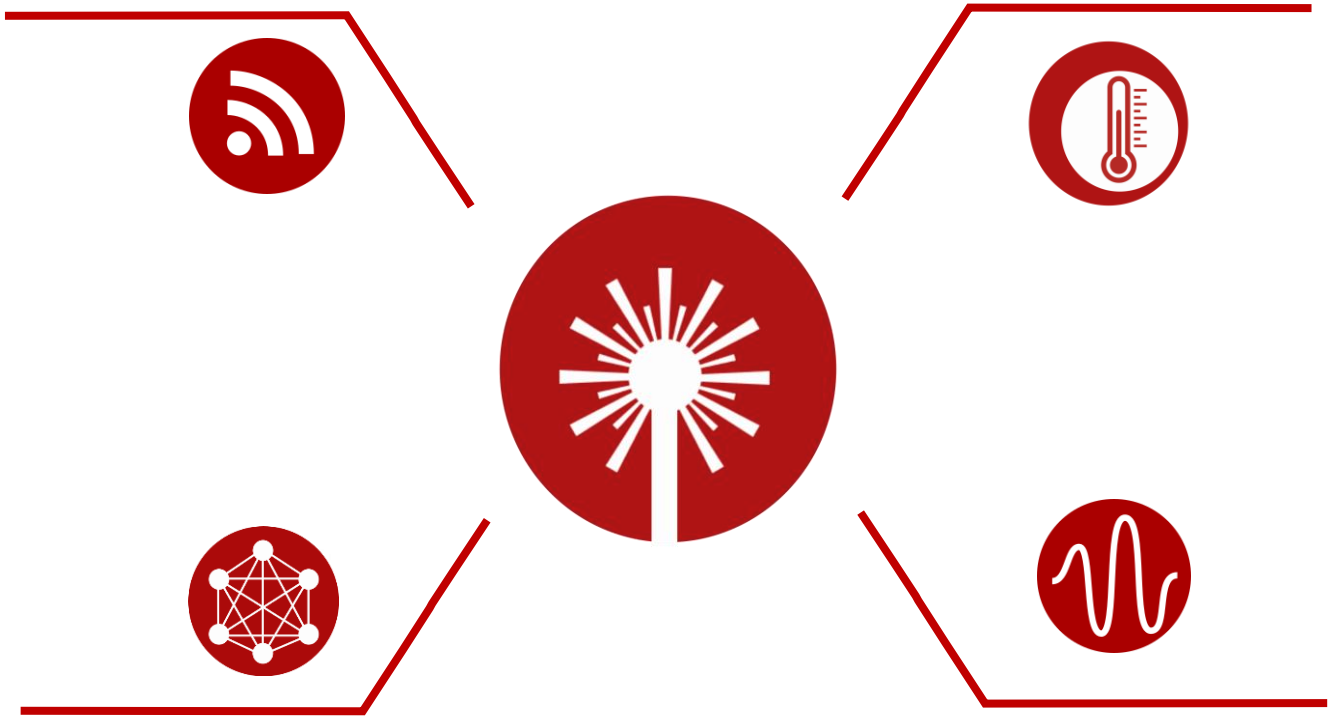
valerian.giesz@Quandela.com

May 19th 2020

Photonics is at the heart of the Quantum Revolution

Flying Qbits (communications)
- Quantum Internet

Manipulation of Qubits at room temperature and no vacuum.
Modular design



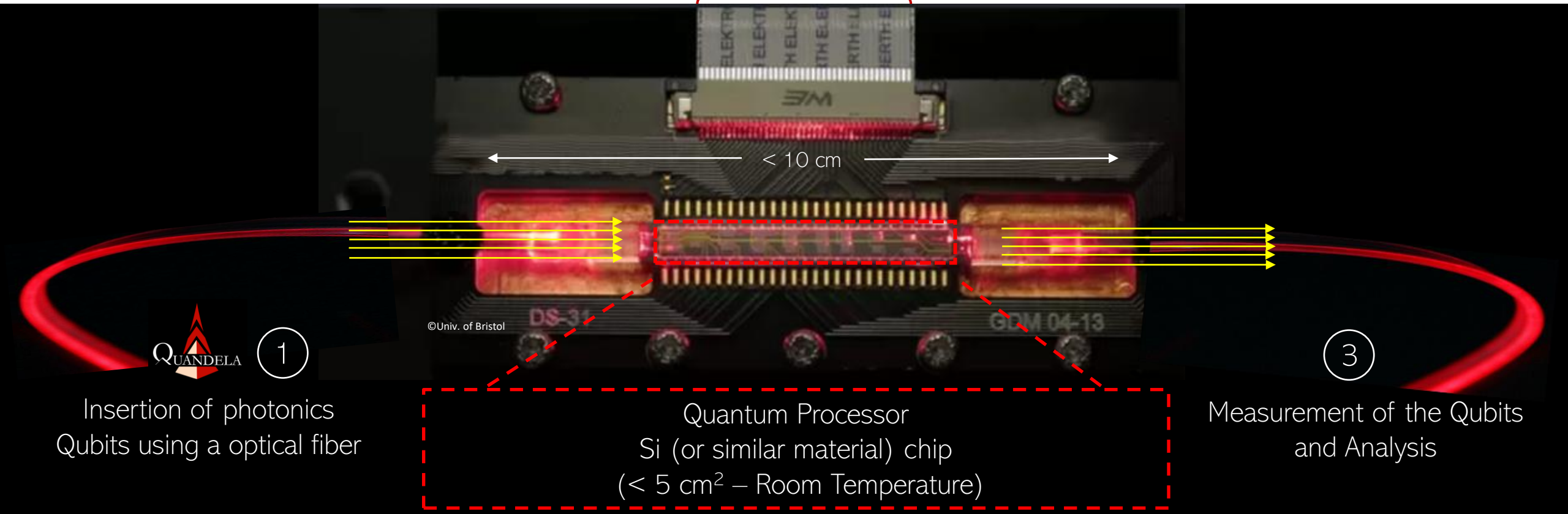
Protocol flexibility.
Generation of cluster states for universal Q computing

Long coherence time
Support high clock rates

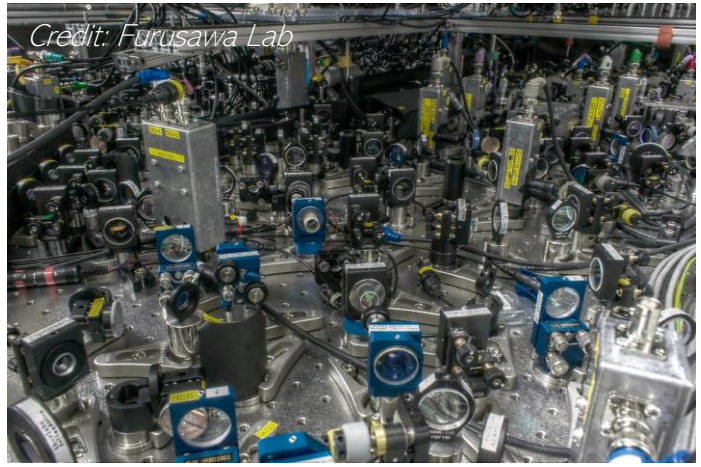
BCG BOSTON CONSULTING GROUP

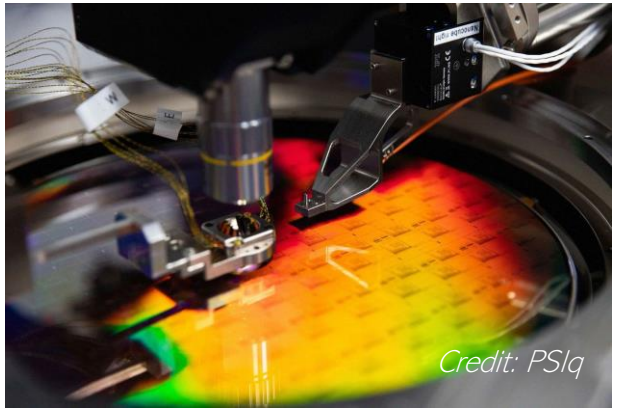
"Photons [...] could have an advantage in terms of handling because they operate at room temperature and chip design can leverage known silicon technology."

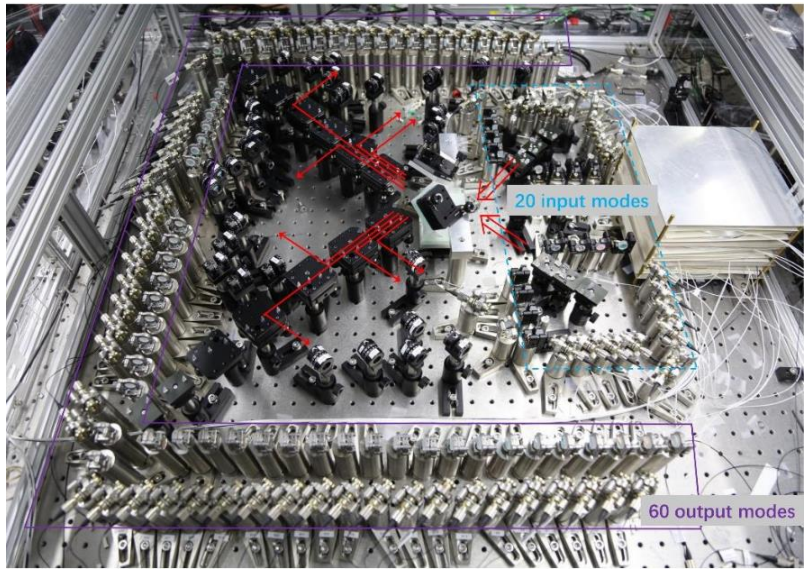
Quantum Optical Processor

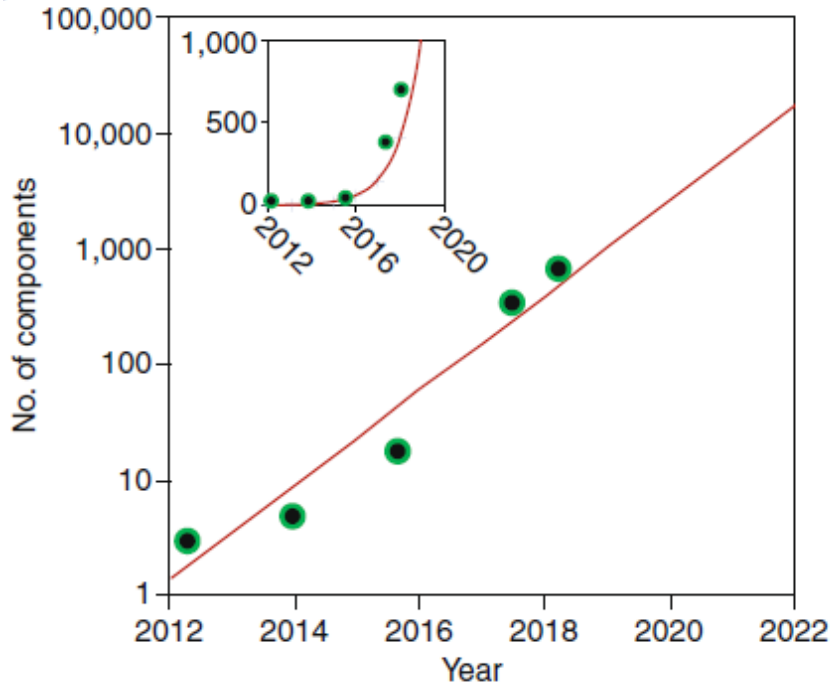


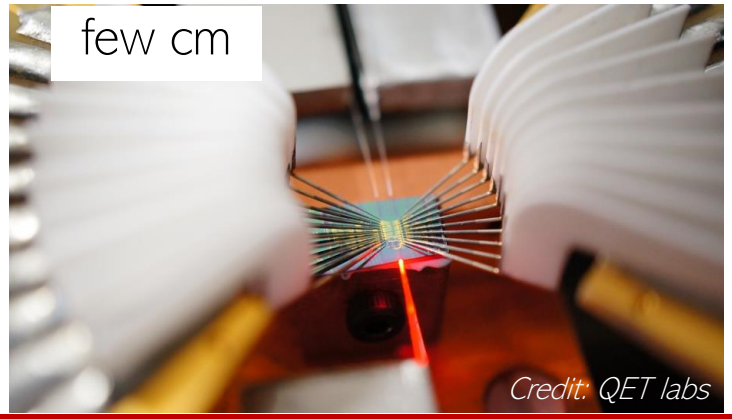
Quantum Optical Processor

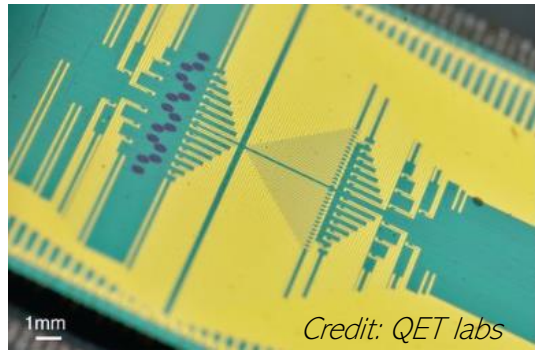












XANADU

PsiQ

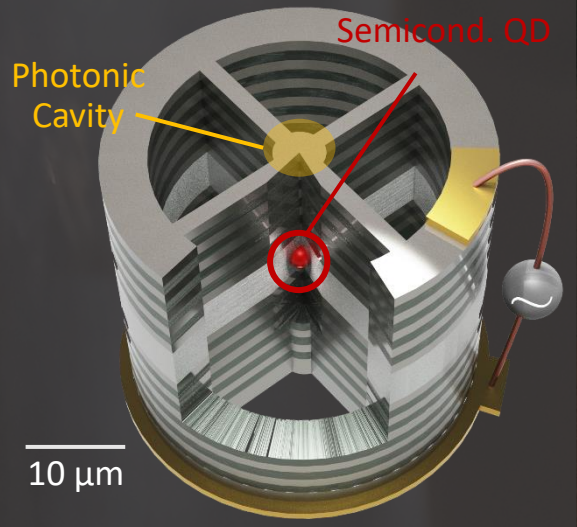
ORCA Computing

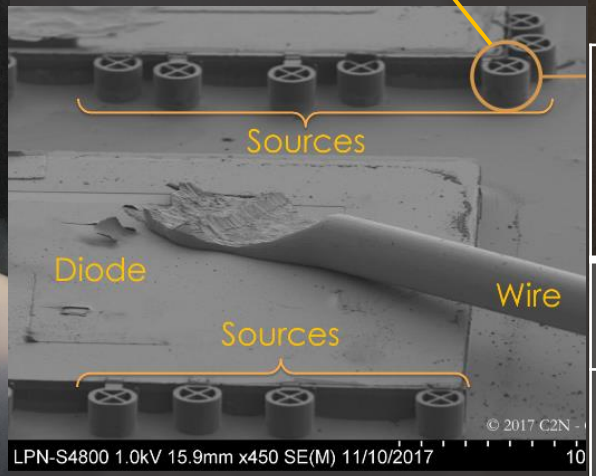
QUANDELA

QUIX

NTT

Micron size integrated source of photons





	State-of-the-art laser source (Optica Vol.5, issue 5, p. 514-517 – 2018) HOM = 90%	Quandela HOM > 92%	Speed-up
Rate: 1 photon - qubit	1.3 MHz	> 25 MHz	x 20
Rate: 3 photons - qubits	55 Hz	9 kHz	X 160
Rate: 8 photons - qubits	10^{-8} Hz	0.5 mHz	X 50000

Ollivier et al. doi.org/10.1021/acsphotonics.9b01805. ACS photonics (2020)

Key Features:

Purity
> 97 %

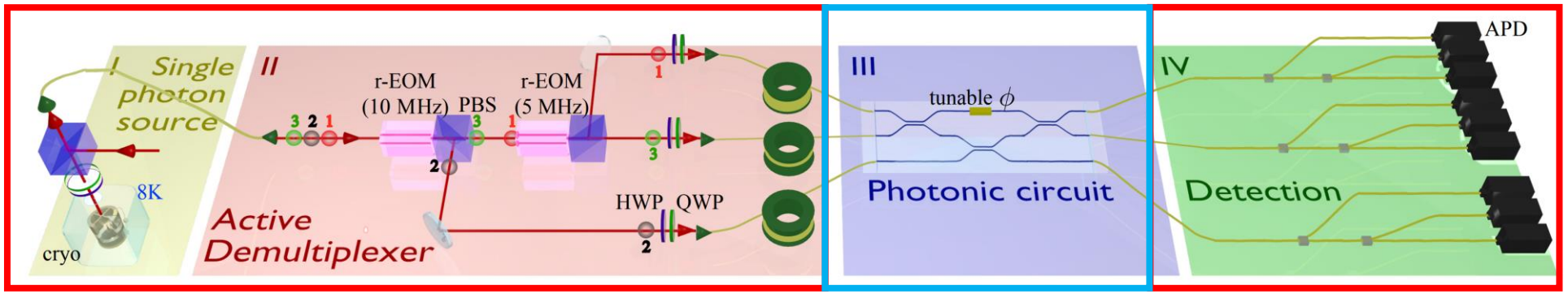
Photon-photon Interference
> 92 %

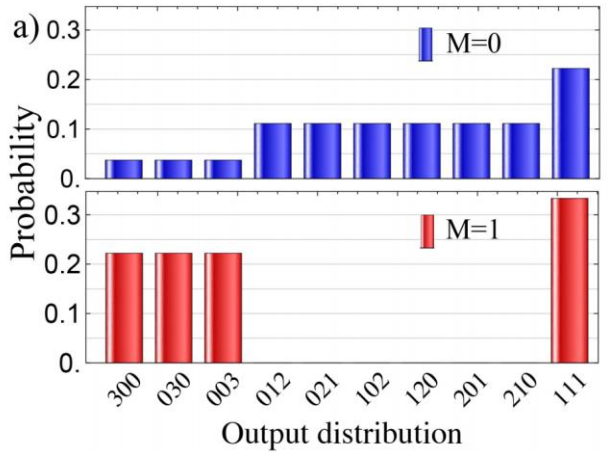
Brightness
> 20 % (several MHz)
> 50 % (end 2020)

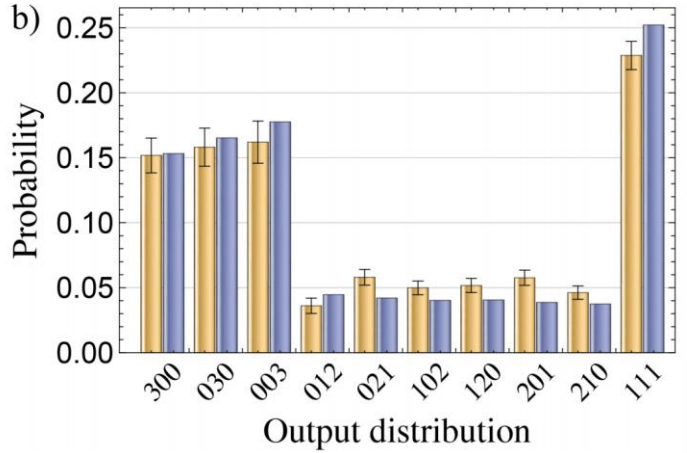
Multi-photons interference on chip

Collaboration:

Prof. P. Senellart – Quandela - Prof. R. Osellame – Prof F. Sciarrino







3 phot. rate

Laser 43 Hz

eDelight 3.8 kHz

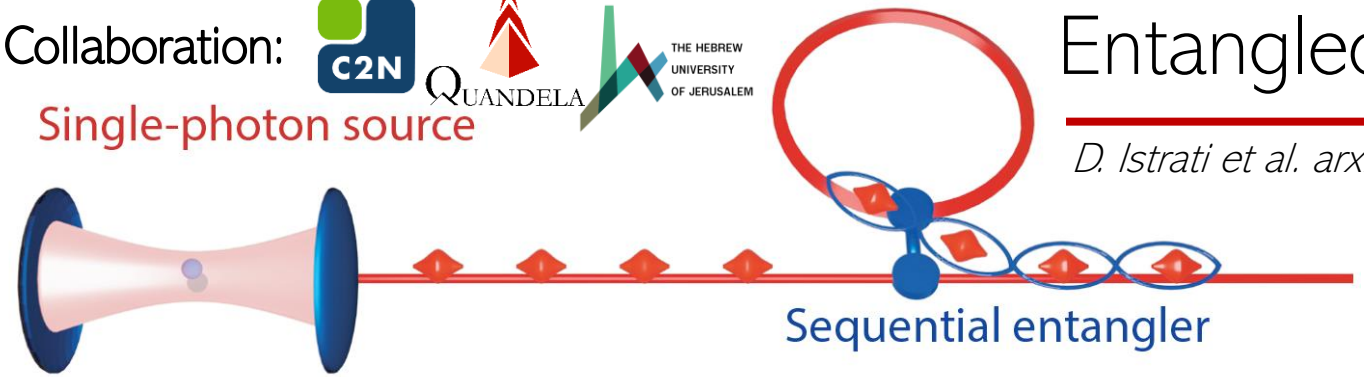
x 88 brighter

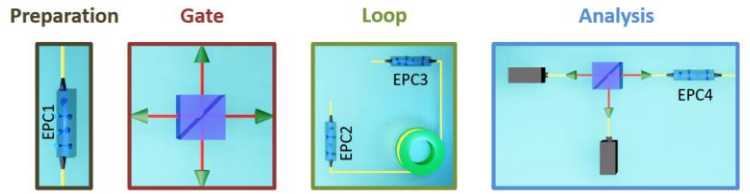
C Anton et al., vol. 6, 1471, Optica (2019)

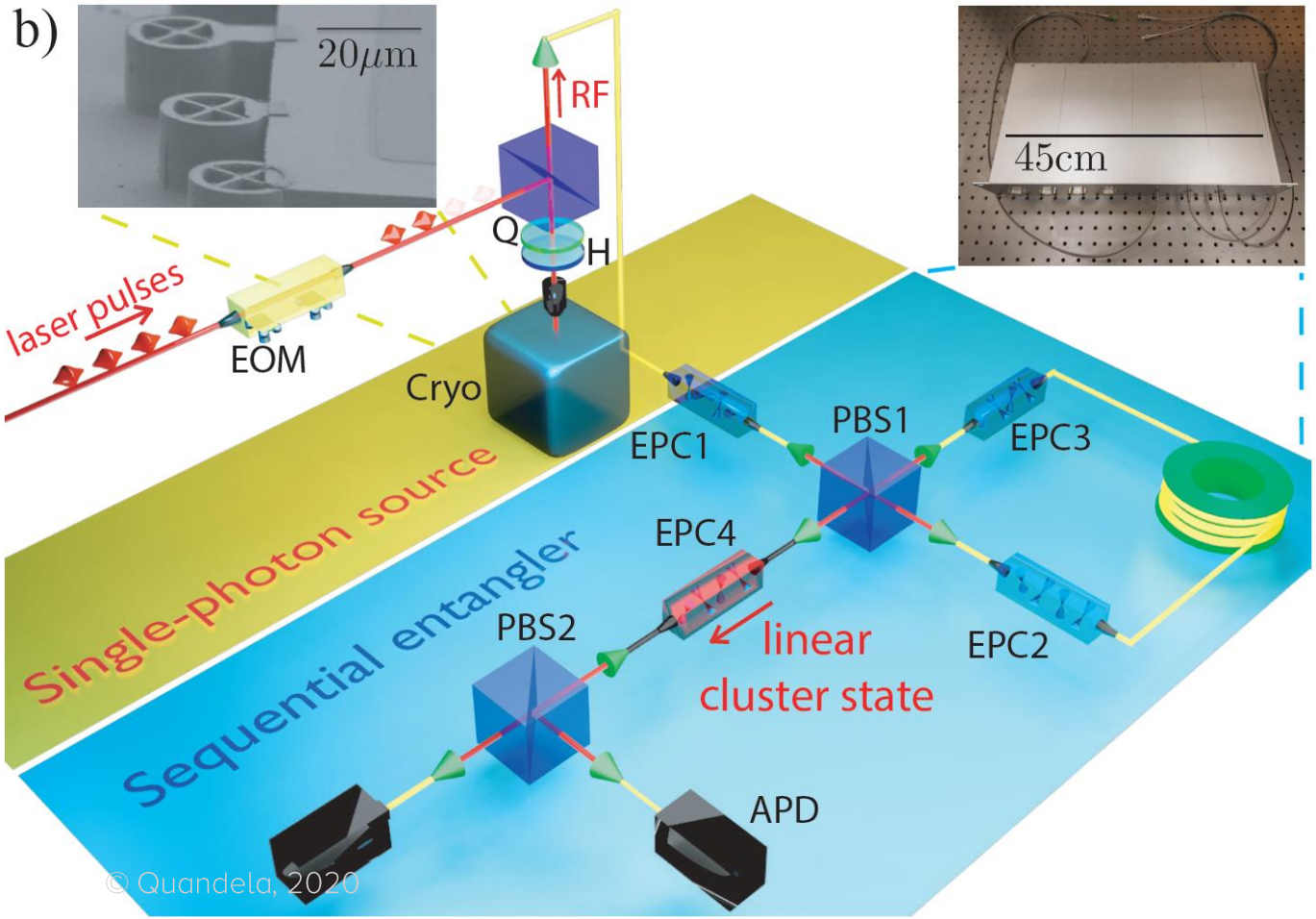
Collaboration: C2N QUANDELA THE HEBREW UNIVERSITY OF JERUSALEM

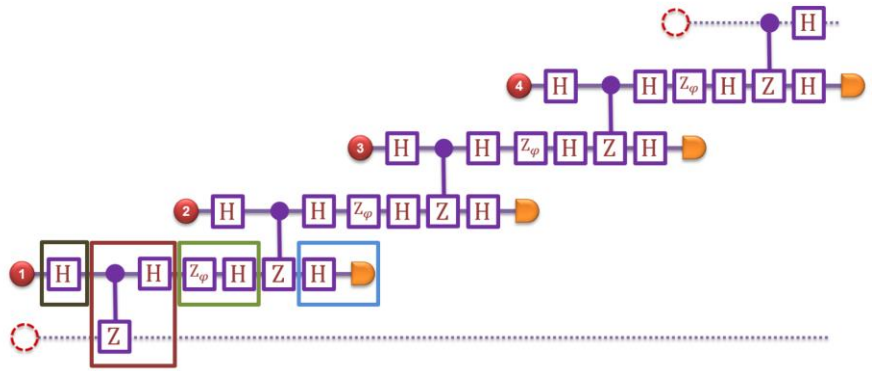
Entangled photons cluster state generation

D. Istrati et al. arxiv:1912.04375 (2020)









3 Laser qubits – 34 hours

3 Quandela qubits – 11 minutes

x 185 speed-up

4 Laser qubits – 1 year
(estimated)

4 Quandela Qubits– 1 hour

First Plug-and-Play Photonic Qubit emitter worldwide (end 2020)

Quandela provides solid-state emitters of photonic qubits

Need to collaborate more with

- Photonic Integrated Circuits manufacturers
- Efficient Optical Filters
- Fibered devices

Grants 817021, 861097

a laboratory of

and of