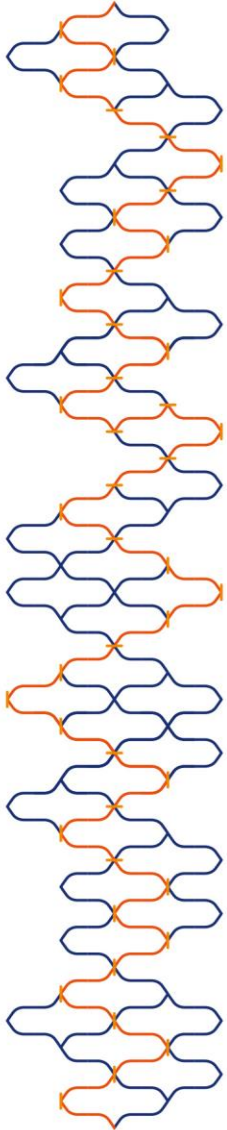




THE FASTEST WAY TO A QUANTUM FUTURE

EPIC Online Quantum Technology Meeting on Photonics for Accelerating Qubit Generation and Quantum Computing

j.p.epping@quix.nl












quix.nl

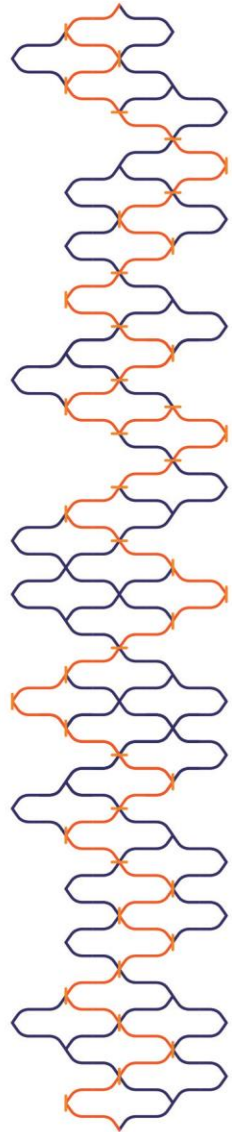
Who are we ?

Spin-off of University of Twente - January 2019



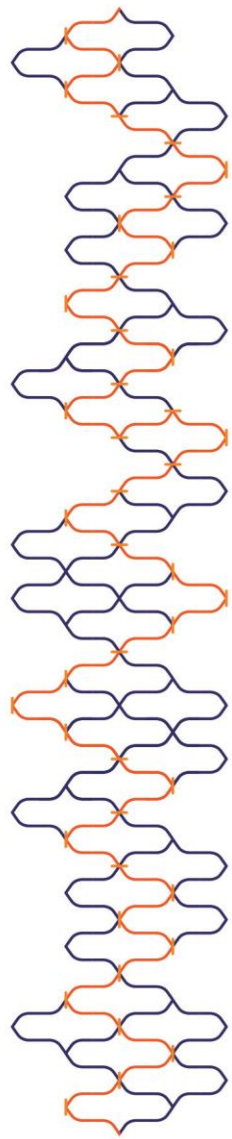
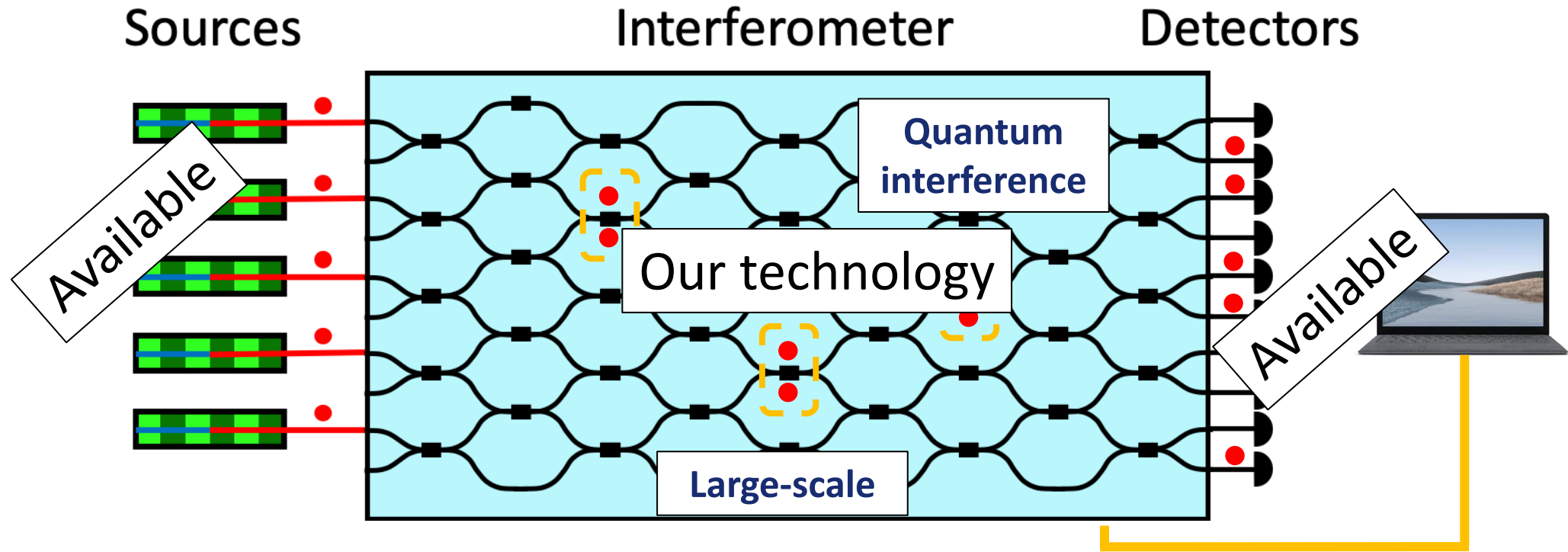
Our team

| | | | |
|---|---|---|-----------------|
|  | Hans |  | Jelmer |
|  | Caterina |  | Henk |
|  | Michiel |  | Ben |
|  | Joern |  | Pim |
| |  | | Marcella |



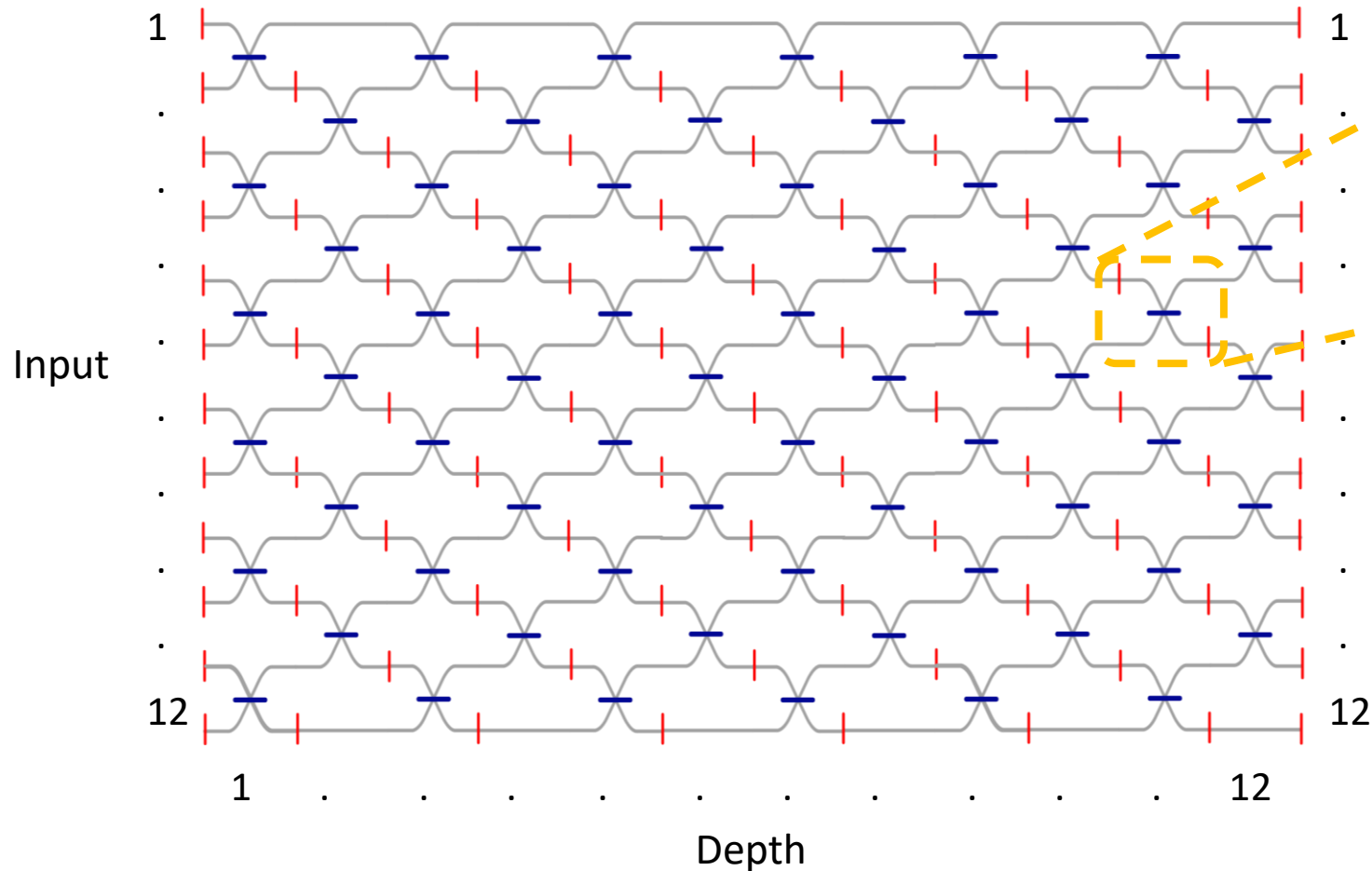
Example setup

For linear optics quantum information processing & quantum simulation

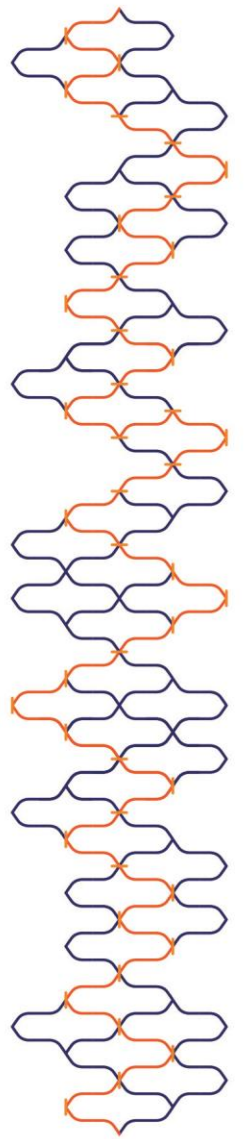
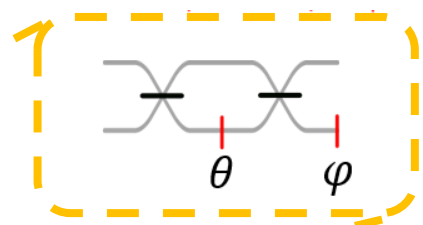


12-mode universal quantum photonic processor

66 unit cells, 156 tunable elements



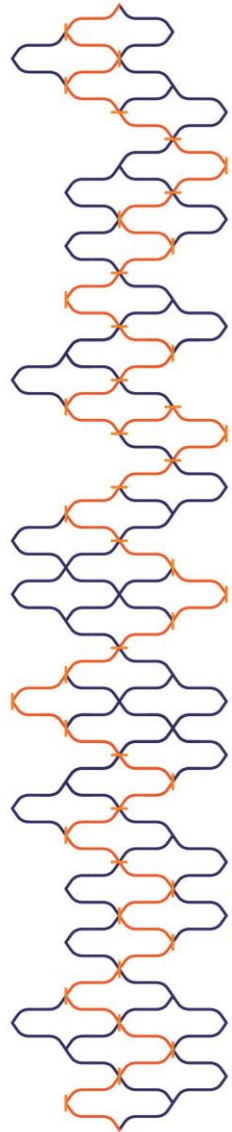
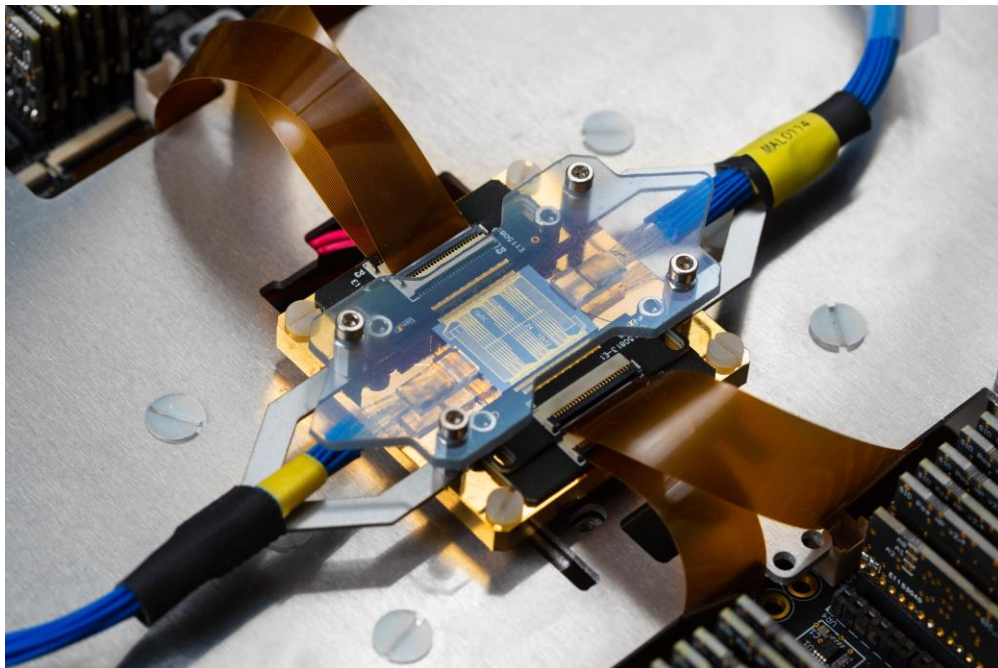
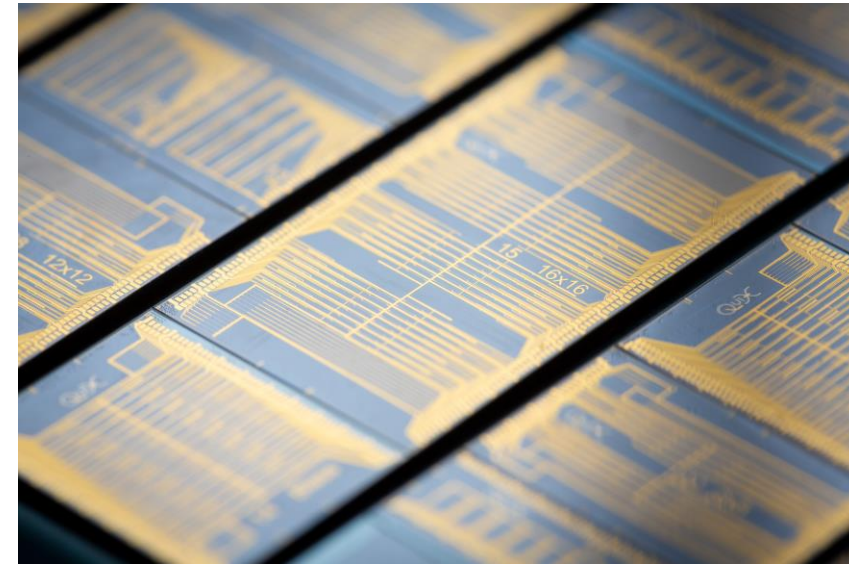
Unit cell = TBS + PS





Plug-and-play

- Silicon nitride PIC technology
- Individual control thermo-optic actuators
- Low-loss fiber interconnects (0.5 dB/facet)
- High transmission (55-60% , 2.2-2.7dB loss)

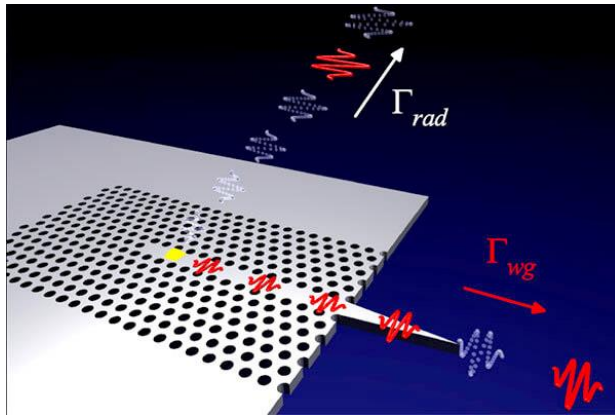




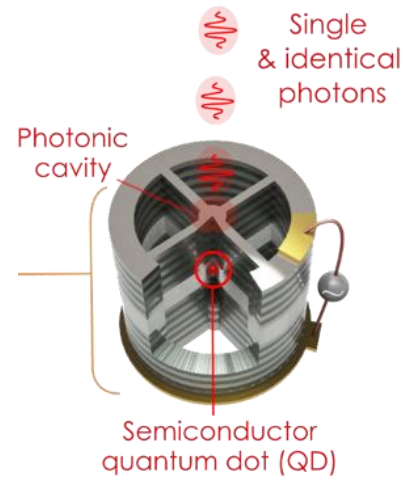
Wide transparency window

Interface with all common single photon sources!

Quantum dots

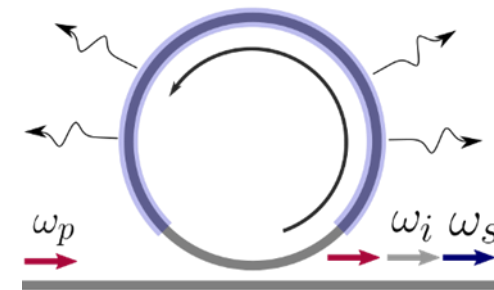


sparrowquantum.com

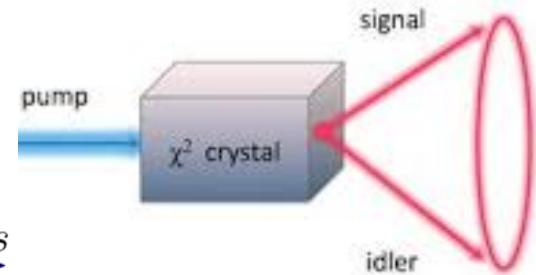


quandela.com

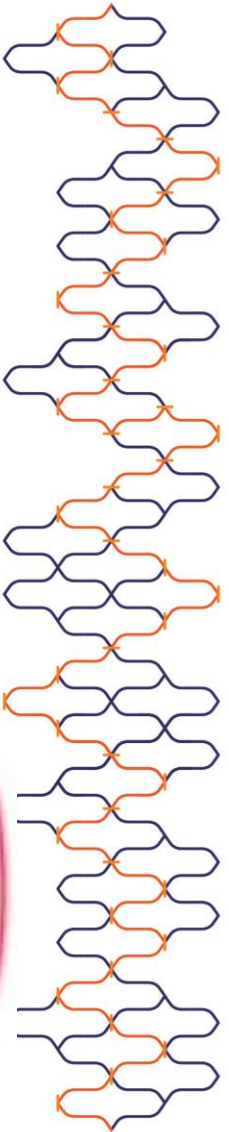
Parametric sources



SFWM[1]



SPDC

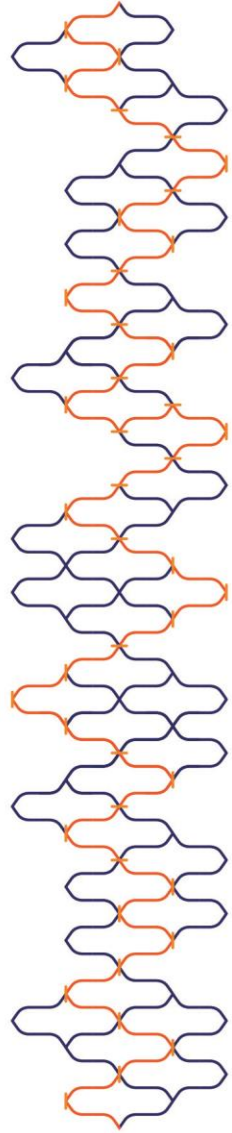
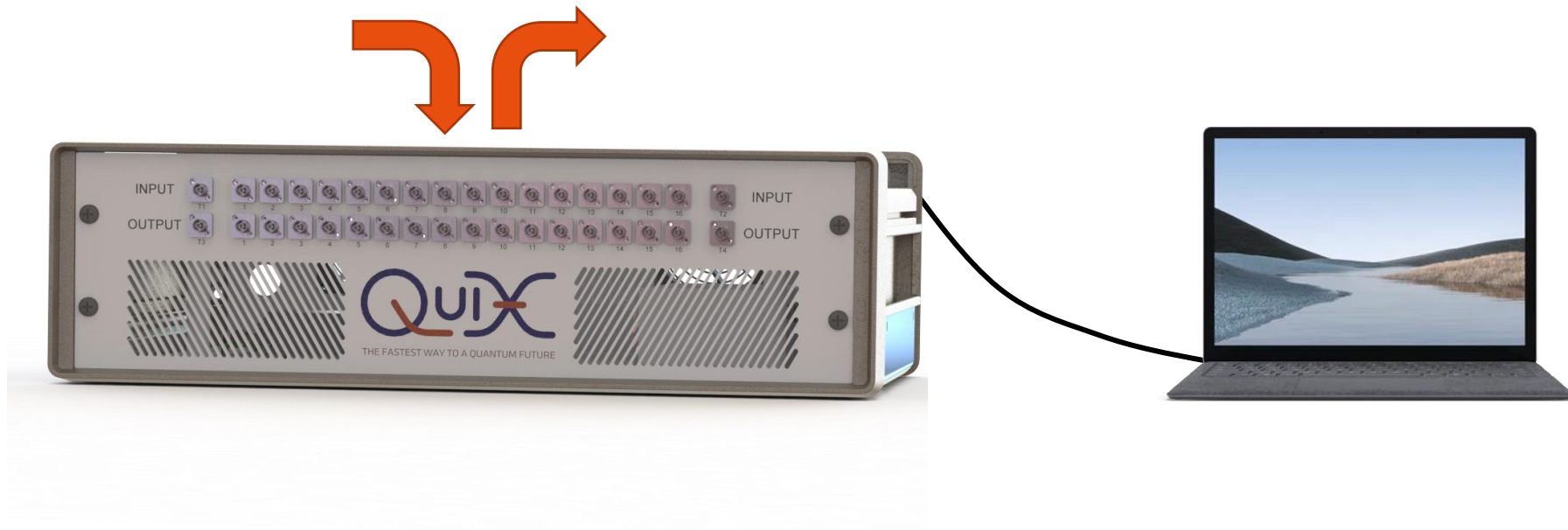


Jörn Epping

[1]Vaidya et al., Sci. Adv. 6(39), 2020.

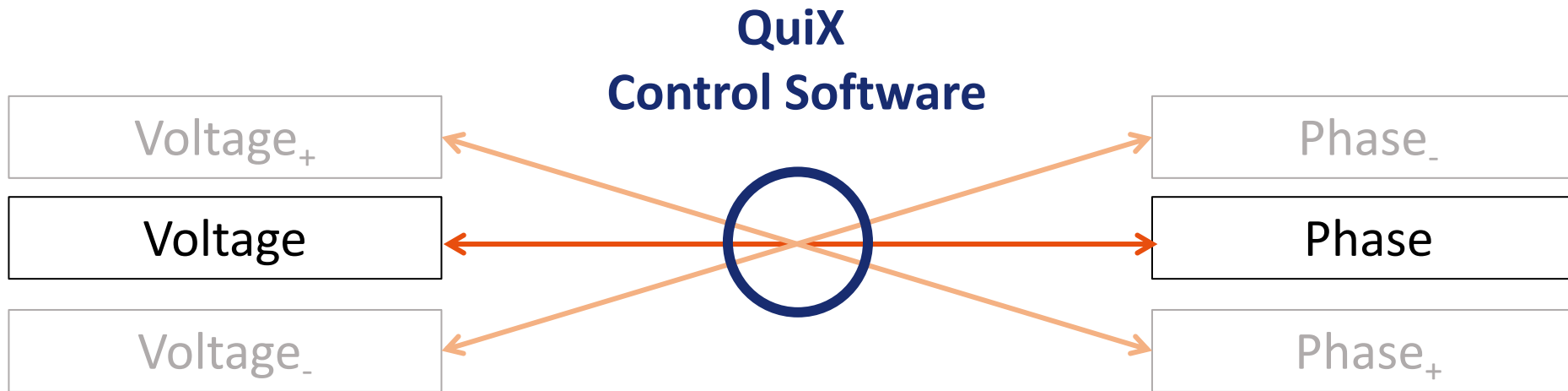
Plug-and-play

- Easy swapping processor module
- Remote control
- Software interface

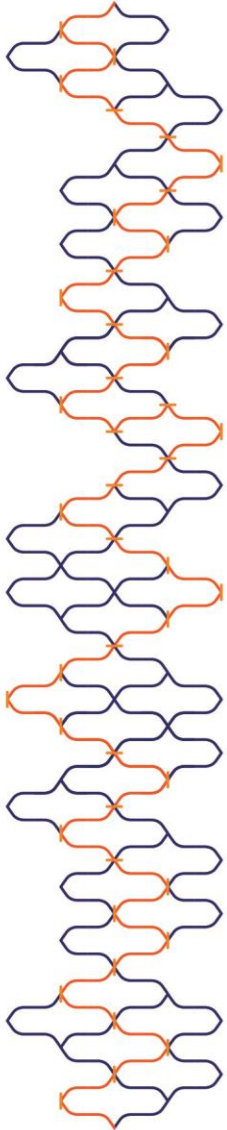


Reconfigurability

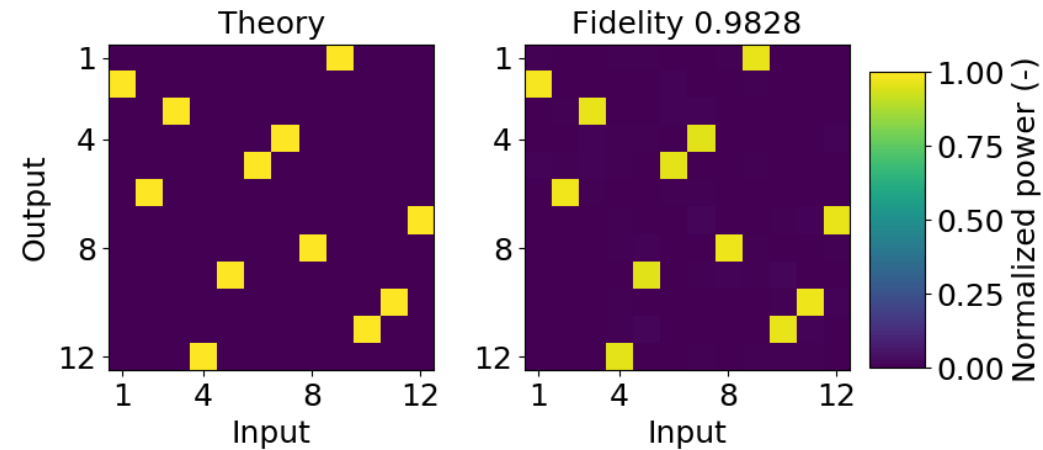
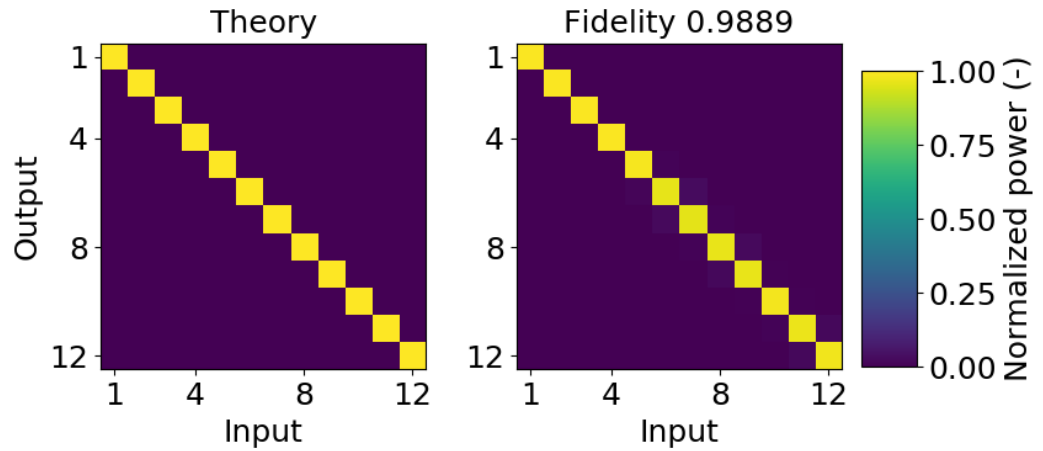
How well can we control our processor?



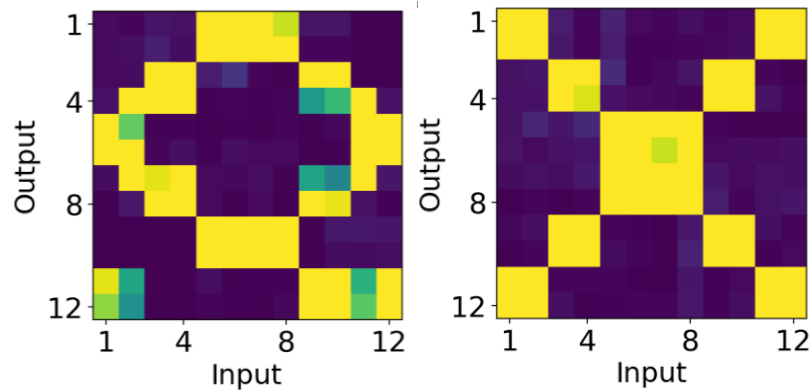
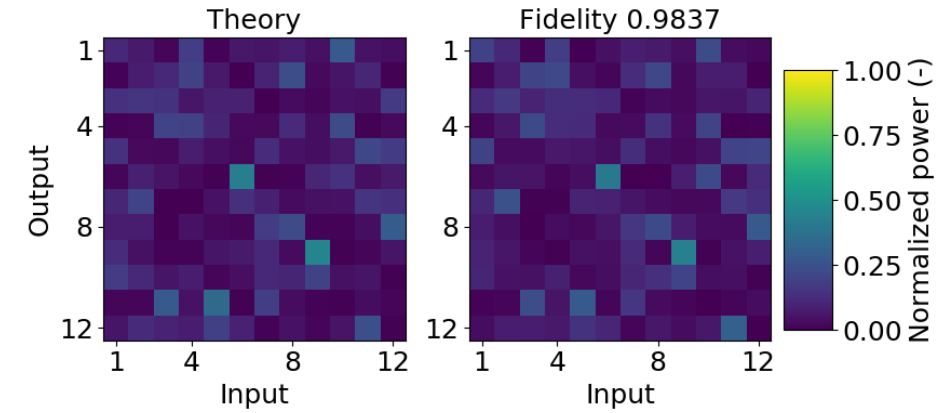
$$\mathcal{F} = \frac{1}{D} \text{Tr}(|U_{set}^\dagger| \cdot |U_{get}|)$$



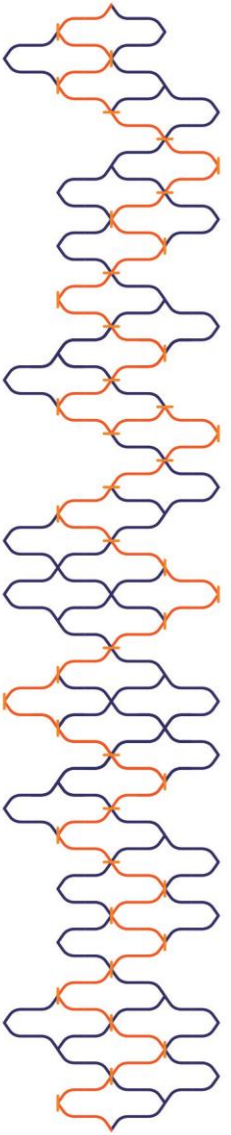
Unitary implementations



$$F_{150, \text{phase independent}} = 0.986$$

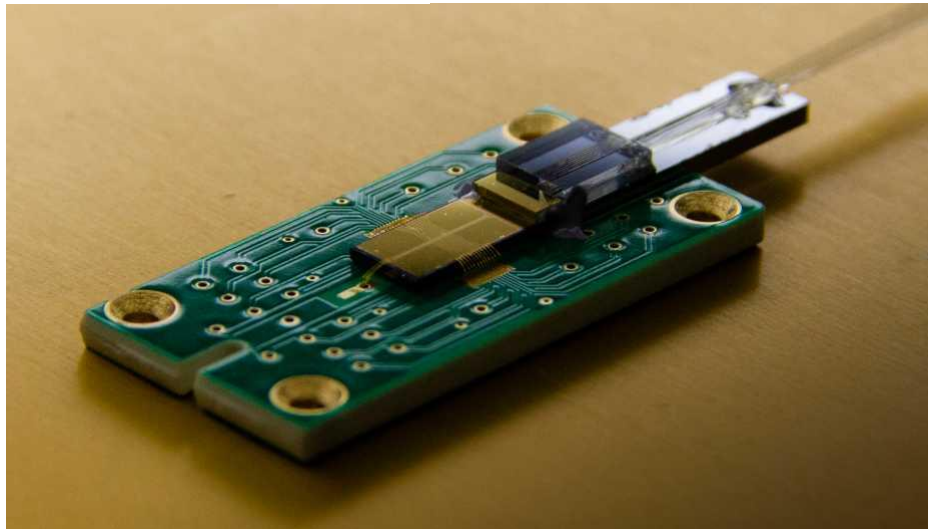


$$F_{250, \text{phase dependent}} = 0.973$$



Custom solutions

Ion-traps QC



Nature **586**, 533–537 (2020)

8

Summary of the building blocks

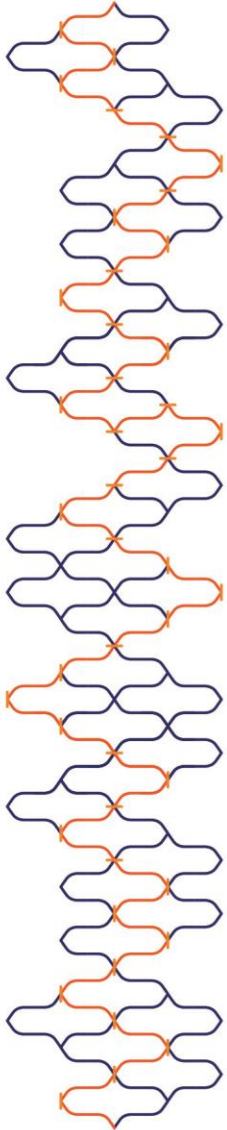
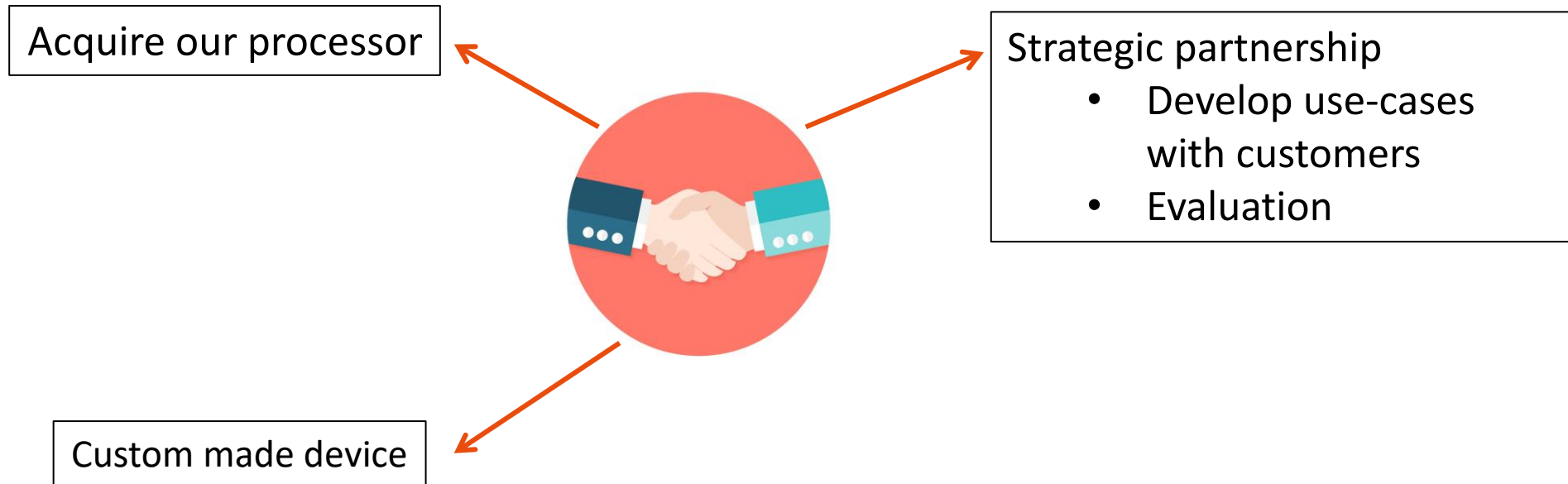
The table below summarizes the operations of all the mentioned building blocks. Combining these building blocks leads to a large range of complex operations and on-chip photonic functionality.

| Input | Building block | Output | Comment |
|-------|----------------|--------|--|
| | | | Tunable |
| | | | Here for 50/50 BS, but any fixed ratio can be designed |
| | | | Tunable |
| | | | |
| | | | For perfect coupling |
| | | | High Q, small FSR |
| | | | Broader filter bandwidth, broader FSR |



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Access to QuiX Technology



j.p.epping@quix.nl