IBM Research

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Felix Eltes
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IBM Research – Zurich

World Class Global Capability: 3,000 Scientists


Six Nobel Laureates


Ten Medals of Technology


Five National Medals of Science


Three Kavli Laureates


Six Turing Awards

69 Members

123 IEEE Fellows

28 ACM Fellows

99 Active IBM Fellows

Ireland
Zurich
Almaden
Watson
Austin
Haifa
China
Tokyo
India
Kenya
IBM invested $ 5.7B on R&D in 2016
Brazil
South Africa
Australia

IBM Research – Zurich

Established in 1956

45+ different nationalities

Two Nobel Prizes:

- 1986: Nobel Prize in Physics for the invention of the scanning tunneling microscope
- 1987: Nobel Prize in Physics for the discovery of high-temperature superconductivity

Open Collaboration:

- Horizon2020: 50+ funded projects and 500+ partners

7 European Research Council Grants

Scientific Departments

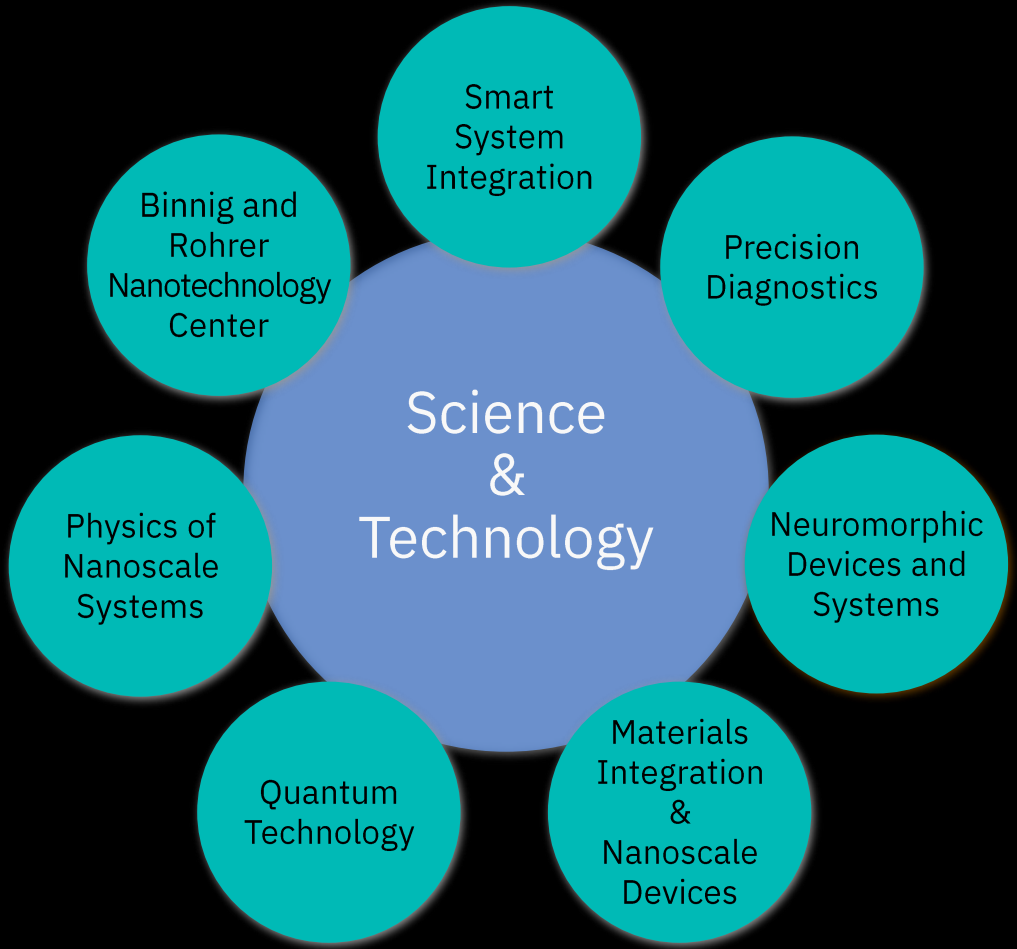
Cognitive Computing & Industry Solutions

Cloud & Computing Infrastructure

Science & Technology

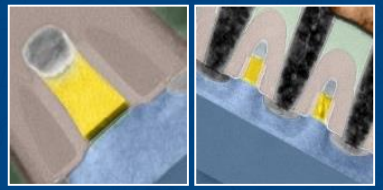
Big Data Analytics

Atoms


Smart System Integration
Precision Diagnostics
Neuromorphic Devices and Systems
Materials Integration & Nanoscale Devices
Quantum Technology
Physics of Nanoscale Systems
Binnig and Rohrer Nanotechnology Center
Science & Technology

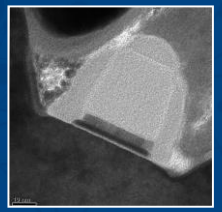
We are pushing the limits of chip technology

Conventional scaling efforts



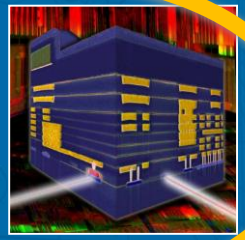
Scaling:
22, 14, 10, 7, 5 nanometer nodes

III/V Devices

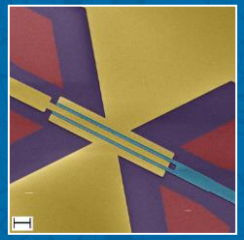


New materials and devices to extend core logic, memory and I/O technology roadmaps

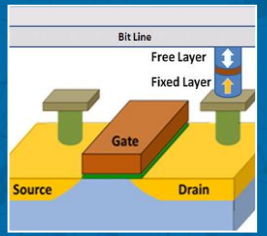
Silicon Photonics



Carbon Devices

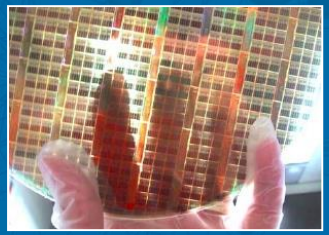


MRAM

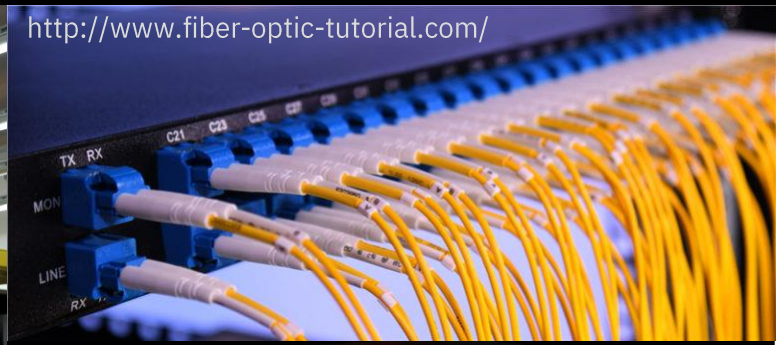


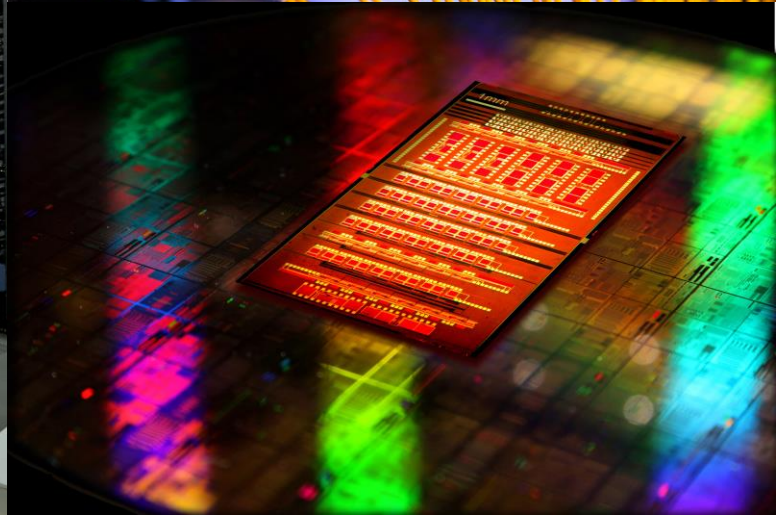
Phase-change materials

3D



Silicon photonics for communications

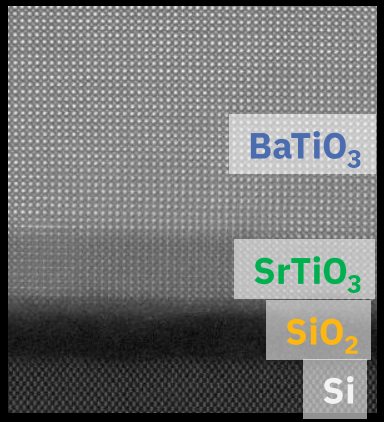


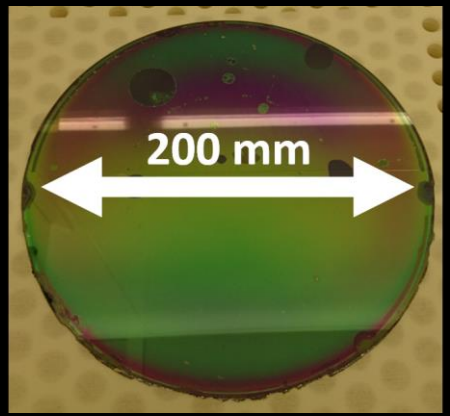


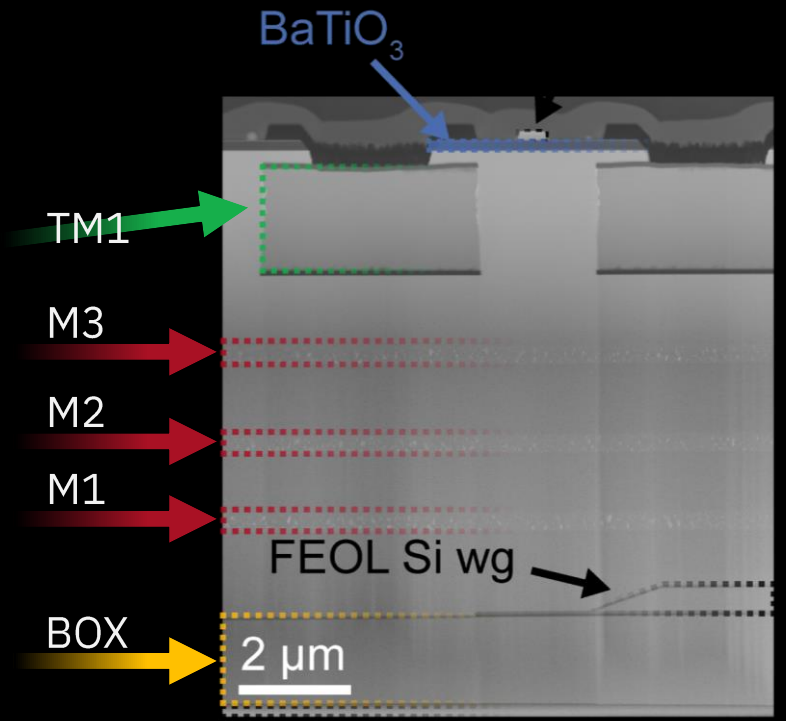
3D integration of barium titanate for next generation modulators

Pockels modulators in Si photonics
- Not possible with existing technologies

Integration through wafer bonding
- PIC compatible technology







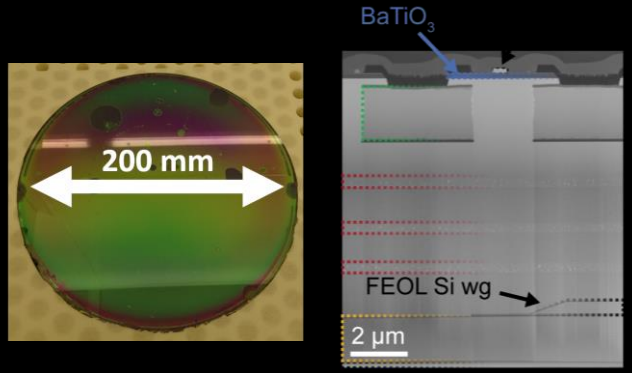
Eltes *et al.*, JLT, 2019
Abel *et al.*, Nat. Materials, 2019

3D integration of barium titanate for next generation modulators

Pockels modulators in Si photonics
- Not possible with existing technologies

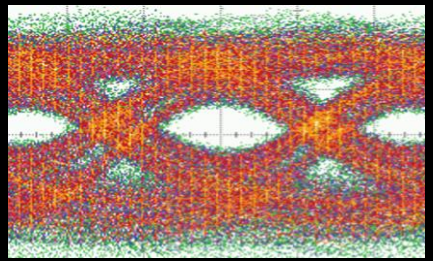
Integration through wafer bonding
- PIC compatible technology

High-speed modulators demonstrated

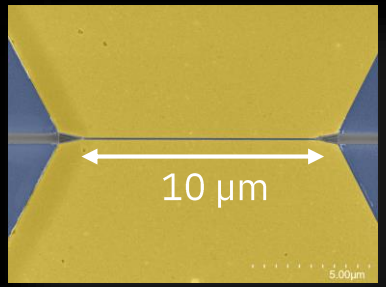


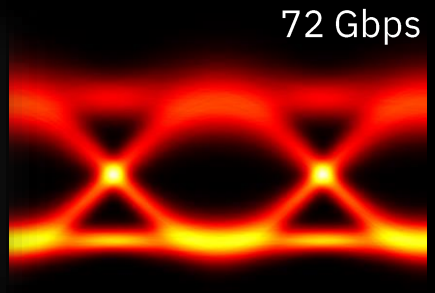
Eltes *et al.*, JLT, 2019

40 Gbps



Abel *et al.*, Nat. Materials, 2019



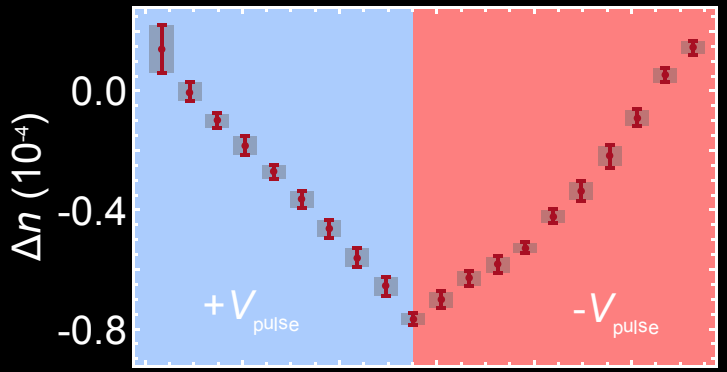


Messner, Eltes *et al.*, OFC Post Deadline Paper, 2017

Novel properties → novel applications!

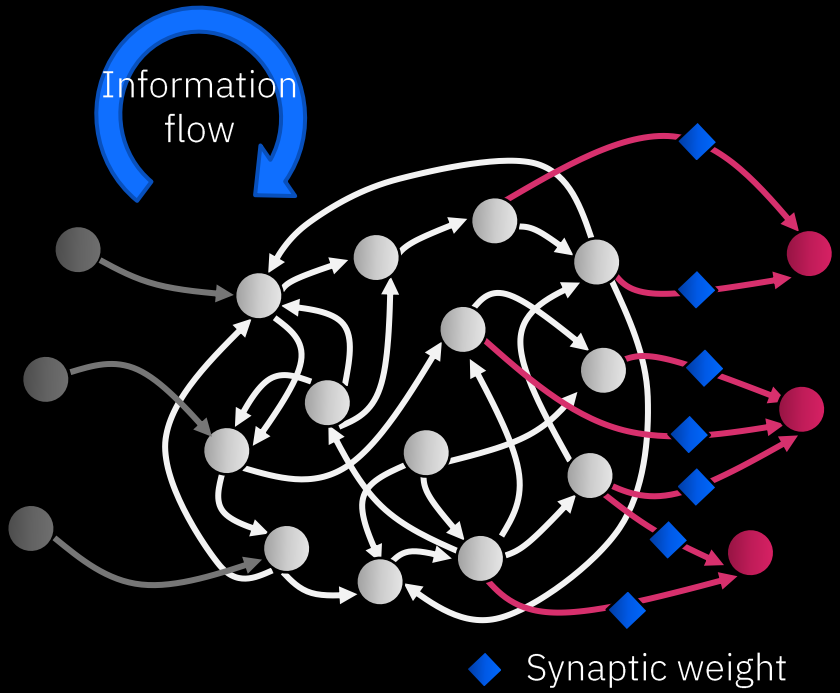
Non-volatile switching for neuromorphic photonics

- Photonic reservoir computing
- Non-volatile optical weights



Geler-Kremer *et al.*, ISAF, 2019

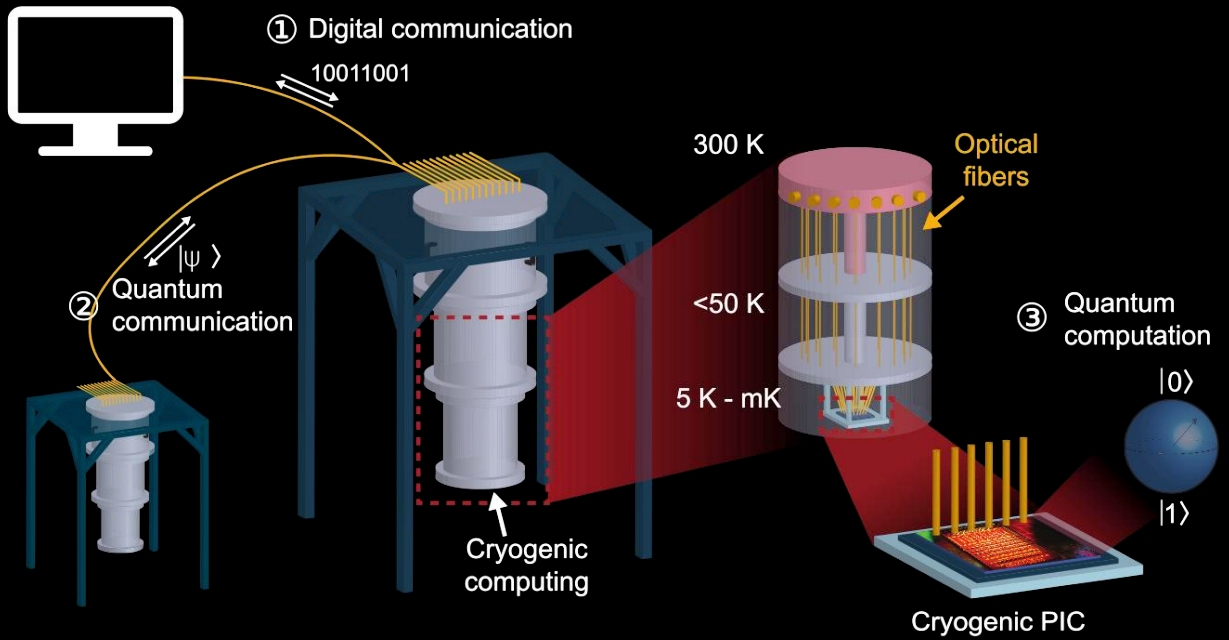
Recurrent neural network



Cryogenic photonics – with University of Bristol

Explore potential for cryogenic applications

- Cryogenic interconnects
- Quantum interconnects



University of BRISTOL

EPSRC
Engineering and Physical Sciences Research Council

Eltes *et al.*, IEDM, 2018
Eltes *et al.*, arXiv:1904.10902

Cryogenic photonics – with University of Bristol

Explore potential for cryogenic applications

- Cryogenic interconnects
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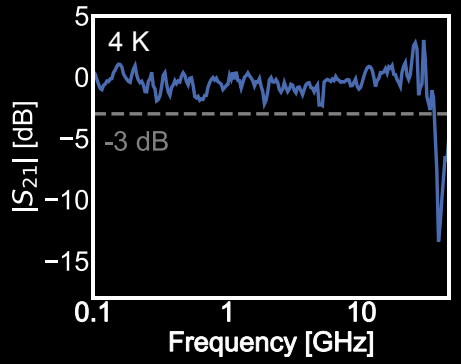
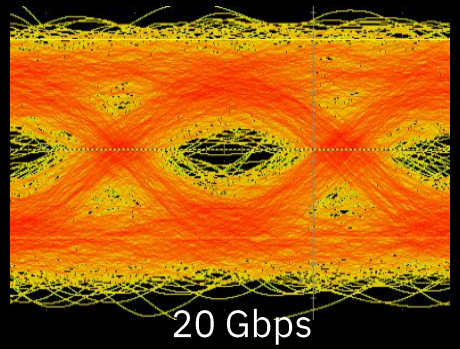
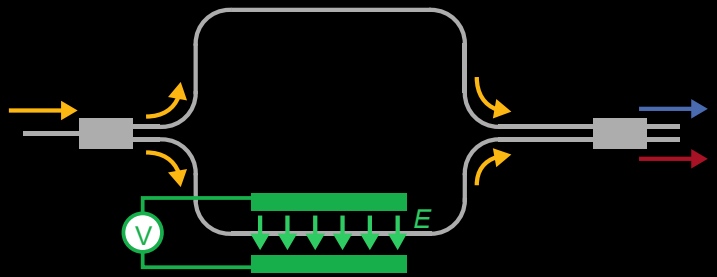
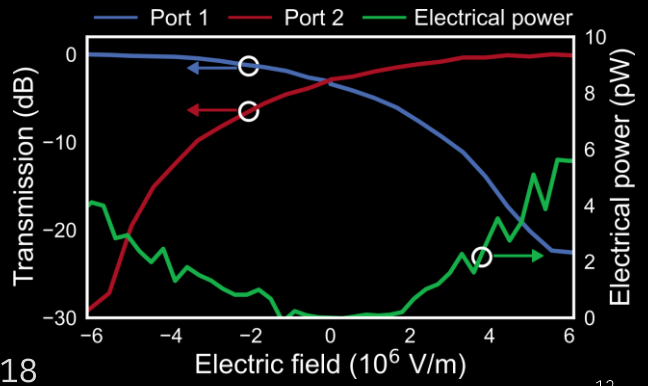
High-speed modulation





Low power switching





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Eltes *et al.*, IEDM, 2018
Eltes *et al.*, arXiv:1904.10902

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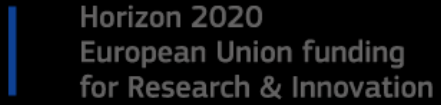

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