Silicon is to Physics what Carbon is to Life

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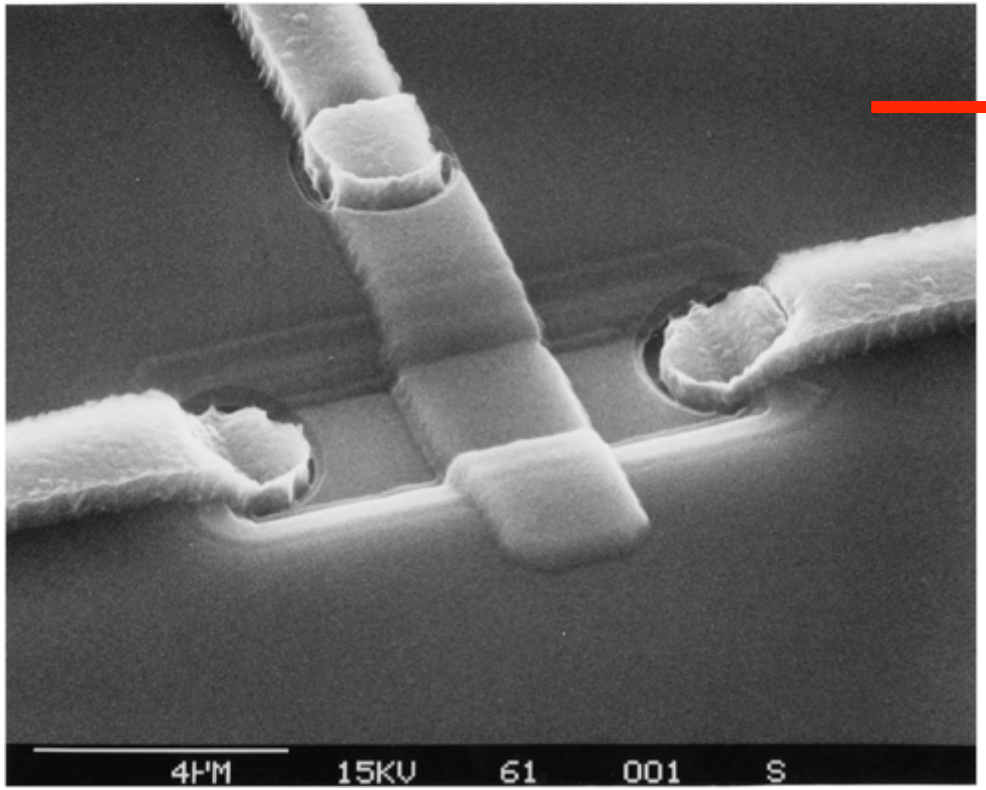
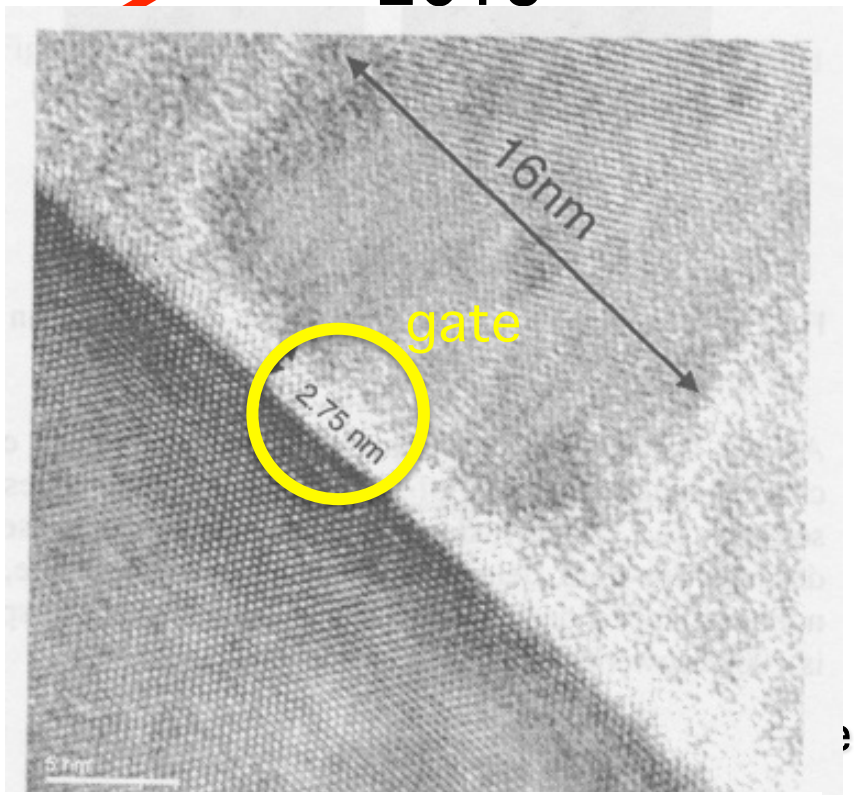
Integrated electronics is key: silicon MOS transistor



continuous scaling/miniaturization

2015



2 μm TECHNOLOGY

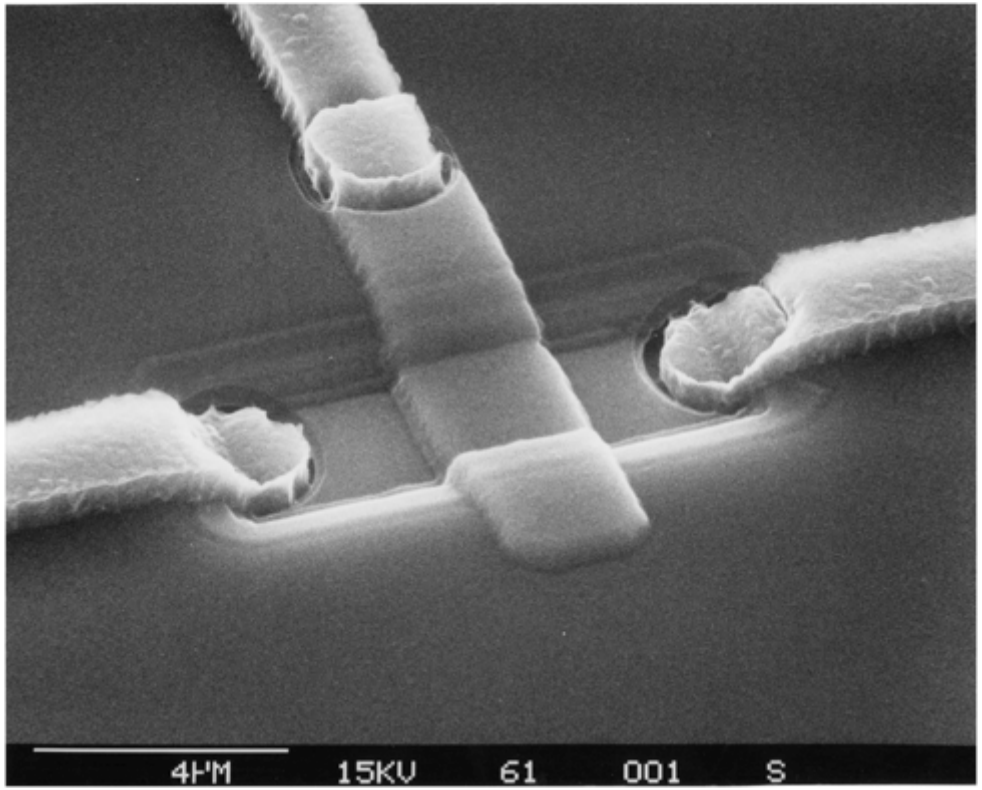
1985

HEP was 2 generations behind industry

gate length .016 μm

SiO_2 gate thickness 2.75 nm

Integrated electronics is key: silicon MOS transistor



continuous scaling/miniaturization

2015

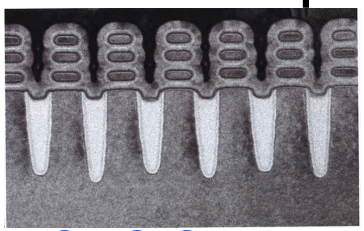
same scale

gate length .016 μm

SiO_2 gate thickness 2.75 nm

thin gate usually radhard

2017 development at IBM



gate-all-around source IBM

not same scale

2 μm TECHNOLOGY

1985

HEP was 2 generations behind industry

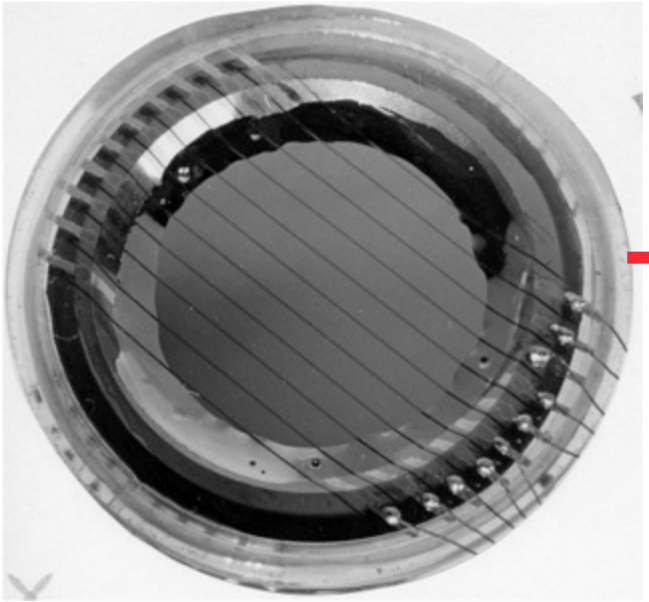
0.005 μm

2017

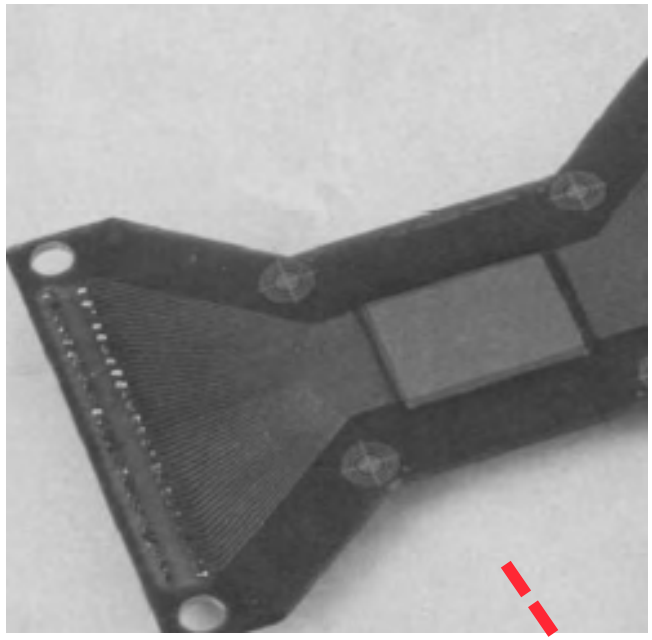
now HEP is 8 generations behind

Segmented silicon detectors

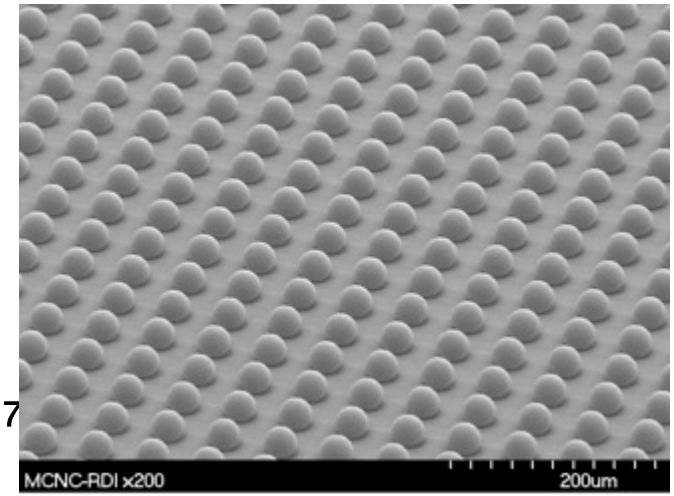
Thanks to Educators, Collaborators and Supporters



~1965
PHILIPS-Amsterdam
100 x 1370μm x 1370μm
Ammerlaan, van Dantzig, Visschers



1980 CERN / ENERTEC Strasbourg
100 x 4000μm x 200μm
Jarron, Burger, CSEM, Kemmer



1989-2000
Pixel detectors developed at CERN
smallest pixel side ~50μm
Campbell, Snoeys, LAA, IMEC, ETHZ, EPFL, RD19, Omega, Medipix

Physics experiments should begin to use recent industrial Si technology (<20nm) and achieve:

- lower power for same functions
- ps timing
- more on-chip memory
- multilayer information processing
- economy of scale
- ....
- higher rates, better data
- new physics?

Future experiments will rely on newest electronics
need timely R&D efforts, expertise and resources
worldwide collaboration & tens of millions to do it right

Thank You