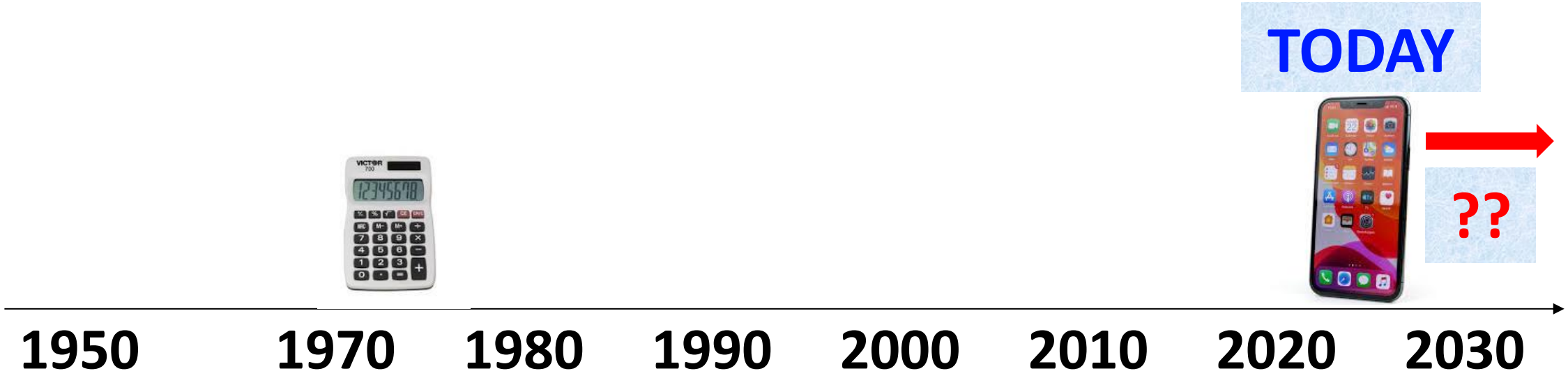


From Calculators to Smartphones

Presentation to Board of Trustees

December 13, 2024

PURDUE UNIVERSITY

Supriyo Datta

TODAY

??

1950 1970 1980 1990 2000 2010 2020 2030

Joined Purdue Electrical Engineering

Completed 40 years at Purdue

TODAY

??

1950 1970 1980 1990 2000 2010 2020 2030

Joined Purdue Electrical Engineering

Disclaimer at the end of an email

“ No trees were harmed to send this message, *however,*

PURDUE UNIVERSITY

TODAY

??

1950 1970 1980 1990 2000 2010 2020 2030

Joined Purdue Electrical Engineering

Disclaimer at the end of an email

" No trees were harmed to send this message, *however,*

a large number of electrons were terribly inconvenienced "

PURDUE UNIVERSITY

Transistor invented

TODAY

??

1950 1970 1980 1990 2000 2010 2020 2030

TRANSISTOR:

Key device for

"inconveniencing" electrons

Disclaimer at the end of an email

" No trees were harmed to send this message, *however,*

a large number of electrons were terribly inconvenienced "

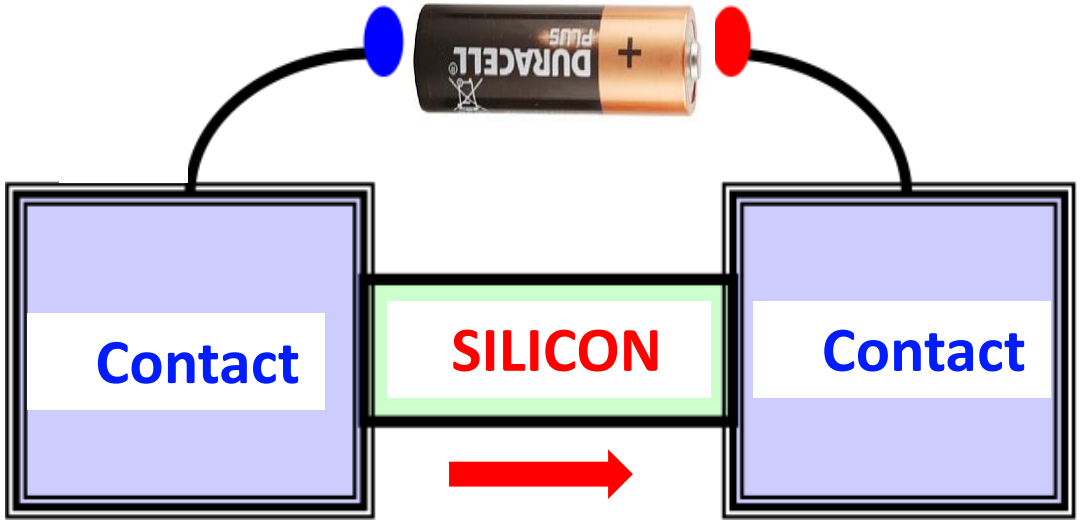
PURDUE UNIVERSITY

Transistor invented

1950

TRANSISTOR:

Key device for "inconveniencing" electrons



Billions of electrons per second

PURDUE UNIVERSITY

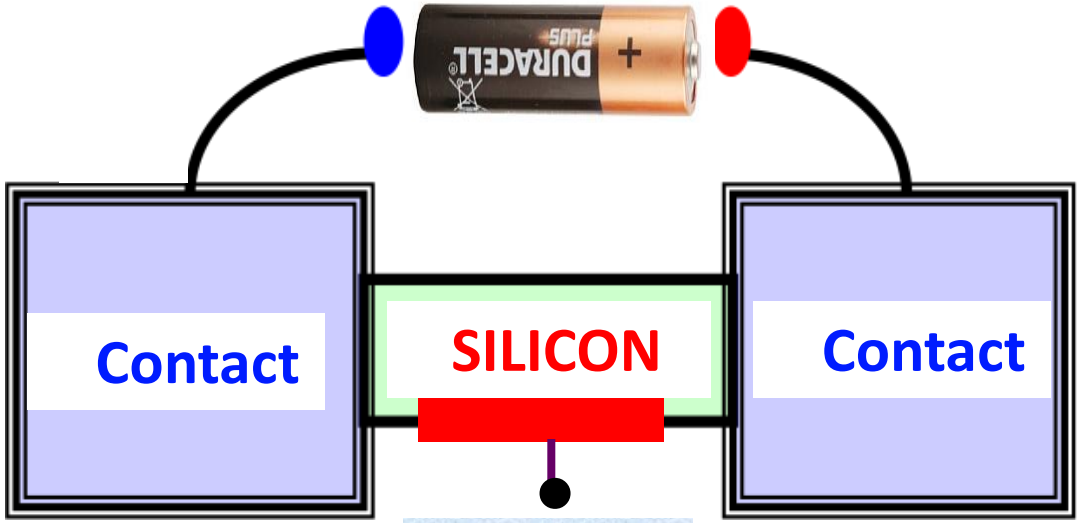
Transistor invented

1950

TRANSISTOR:

Key device for

"inconveniencing" electrons



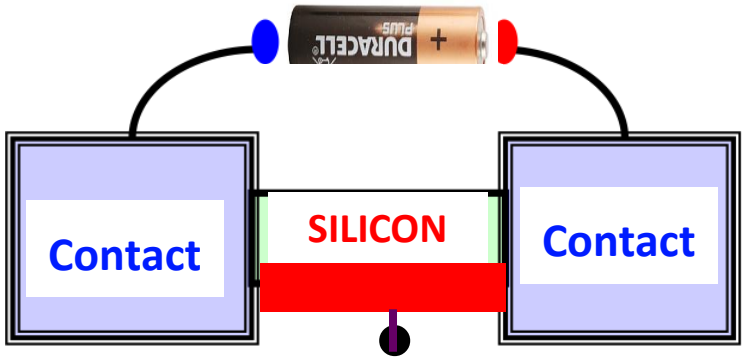
Billions of electrons per second

PURDUE UNIVERSITY

Transistor invented

1950 1970 1980 1990 2000 2010 2020 2030

TRANSISTOR:
A Switch



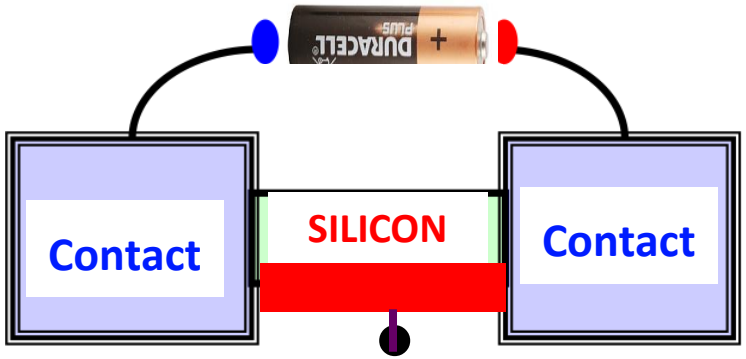
Transistor invented

1950 1970 1980 1990 2000 2010 2020 2030

~ 10,000 transistors

~ 10 billion transistors

TRANSISTOR: A Switch



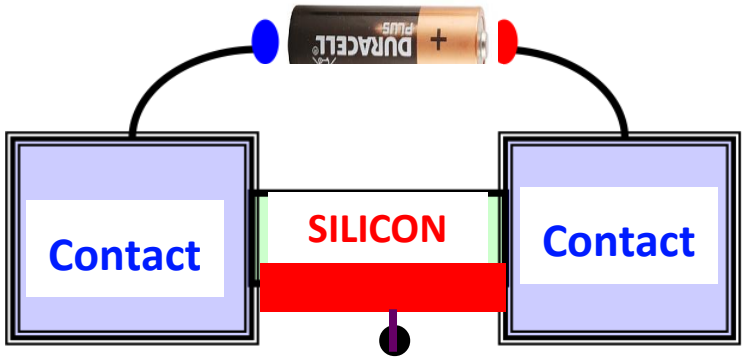
Transistor invented

1950 1970 1980 1990 2000 2010 2020 2030

~ 10,000 transistors

~ 10 billion transistors

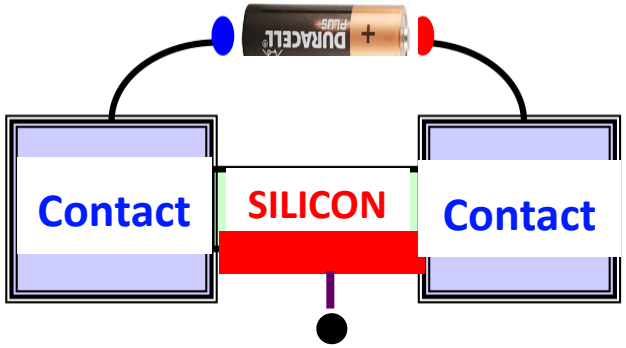
TRANSISTOR: A Switch



More transistors in the world than ants

Transistor invented

1950 1970 1980 1990 2000 2010 2020 2030



~ 10,000 transistors

~ 10 billion transistors

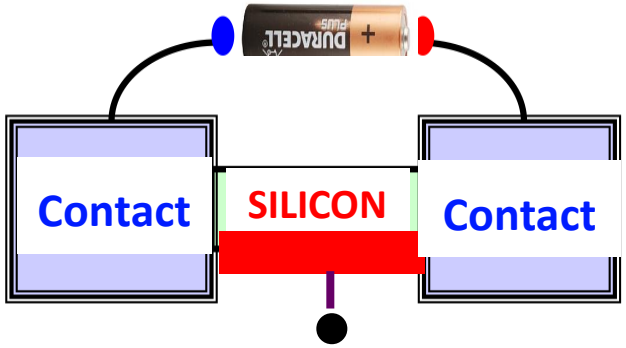
Transistors got smaller

0.1 mm
x 0.1 mm

0.0001 mm
x 0.0001 mm

Transistor invented

1950 1970 1980 1990 2000 2010 2020 2030



300 atoms

Transistors got smaller

0.1 mm
x 0.1 mm

→

0.0001 mm
x 0.0001 mm

300 atoms
x 300 atoms

Transistor invented

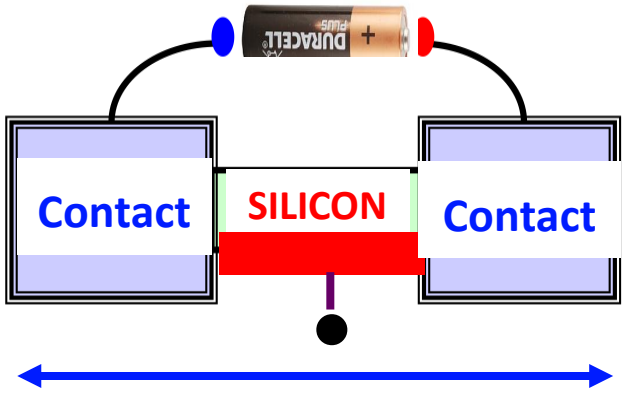
Micro electronics

Nano electronics

1950 1970 1980 1990 2000 2010 2020 2030

CLASSICAL Physics

QUANTUM Physics



300 atoms

Transistors got smaller

0.1 mm
x 0.1 mm

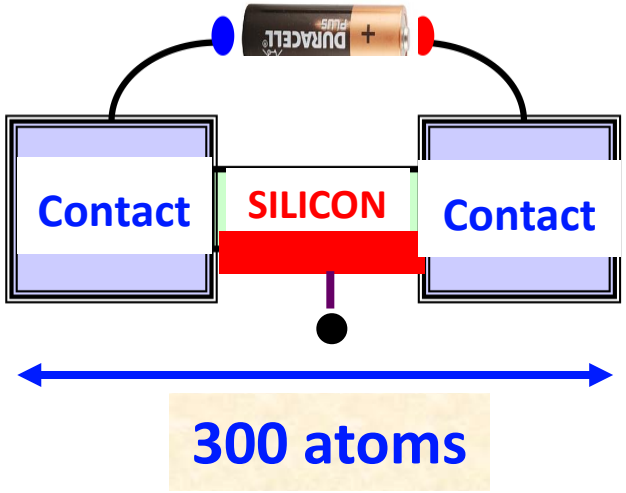
0.0001 mm
x 0.0001 mm

300 atoms
x 300 atoms

Transistor invented

Quantum models for nanoscale transistor design

1950 1970 1980 1990 2000 2010 2020 2030

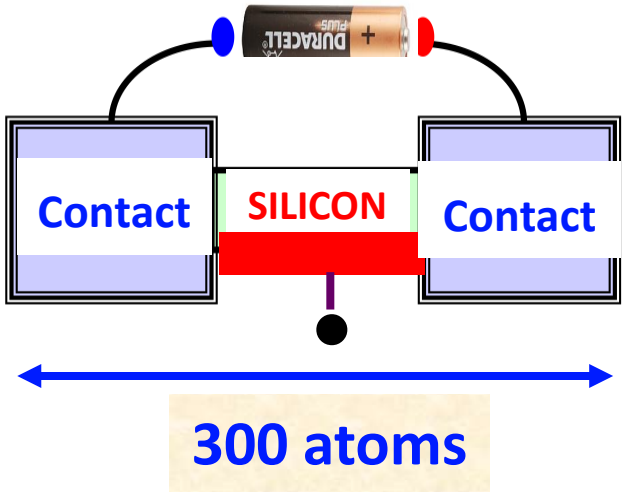


300 atoms

Transistor invented

Quantum models for nanoscale transistor design

1950 1970 1980 1990 2000 2010 2020 2030



COLLABORATOR

Mark Lundstrom

Connecting to industry

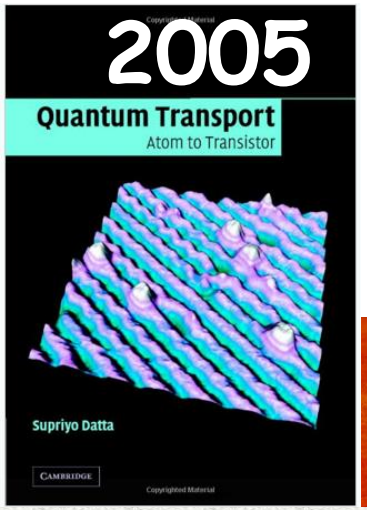
Gerhard Klimeck

Tillmann Kubis

Transistor invented

Quantum models for nanoscale transistor design

1950 1970 1980 1990 2000 2010 2020 2030

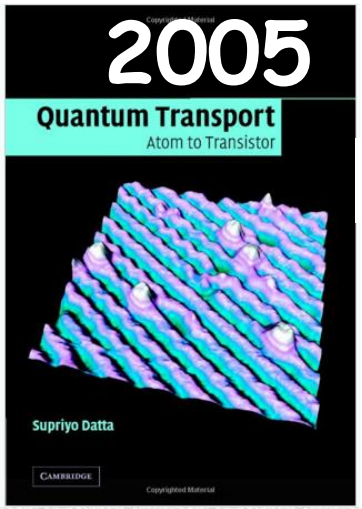


Professionals
PhD students

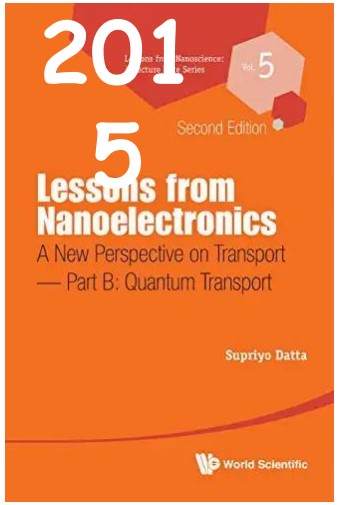
Transistor invented

Quantum models for nanoscale transistor design

1950 1970 1980 1990 2000 2010 2020 2030



nanoHUB



Professionals
PhD students

(Under) graduate course taken by > 300 students / year

Transistor invented

Quantum models for nanoscale transistor design

1950 1970 1980 1990 2000 2010 2020 2030

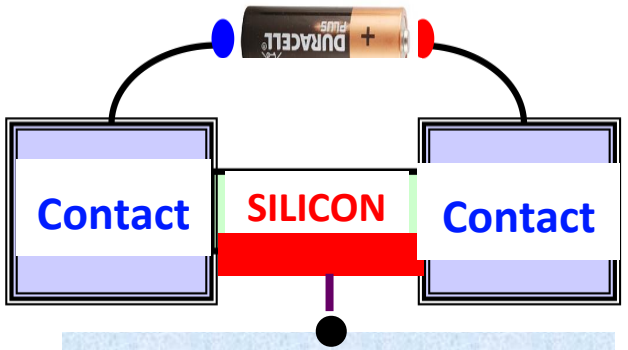
CURRENT CHALLENGE

Reducing energy cost of computation

Quantum models for nanoscale transistor design

1990 2000 2010 2020 2030

CURRENT CHALLENGE



Reducing energy cost of computation

Billions of electrons per second

Generates HEAT

Transistor invented

Joined Purdue Electrical Engineering

Quantum models for nanoscale transistor design

1950 1970 1980 1990 2000 2010 2020 2030

CURRENT CHALLENGE

Reducing energy cost of computation

- ❑ OUTSTANDING STUDENTS
- ❑ INSPIRING COLLEAGUES

PURDUE UNIVERSITY

THANK YOU !!