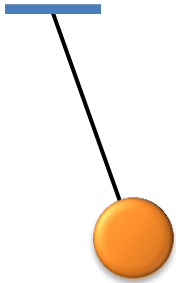
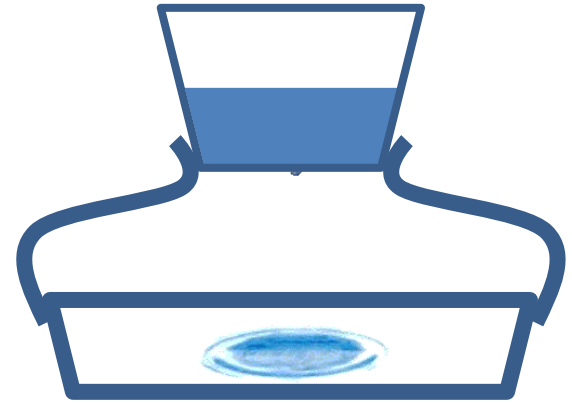
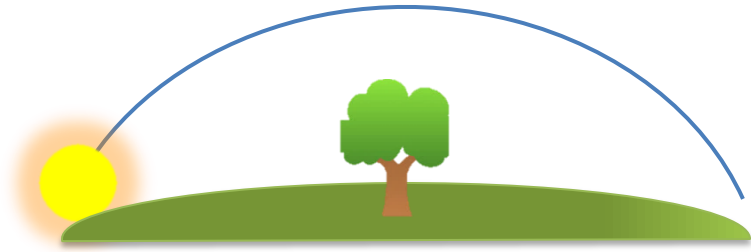


Today's science, tomorrow's device

(graphics from internet sources)



Quartz crystal

Sundial  
Egypt, 3500 BC



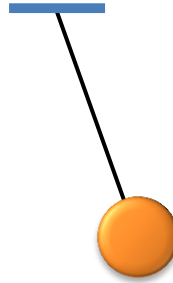
Water clock  
Mesopotamia, 1500 BC



Hourglass  
150 BC to 1600 AD



# Simple Pendulum:

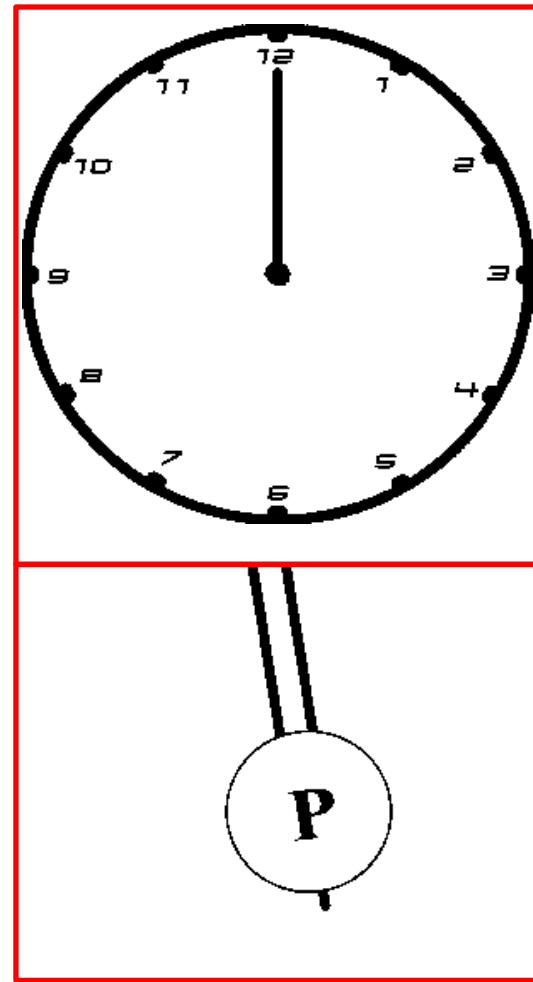
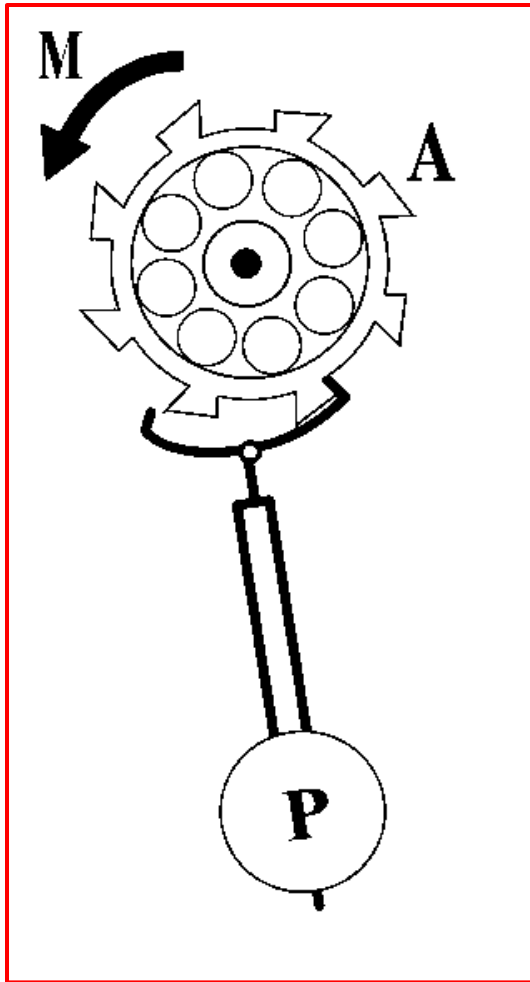


$$T \approx 2\pi \sqrt{\frac{L}{g}}$$

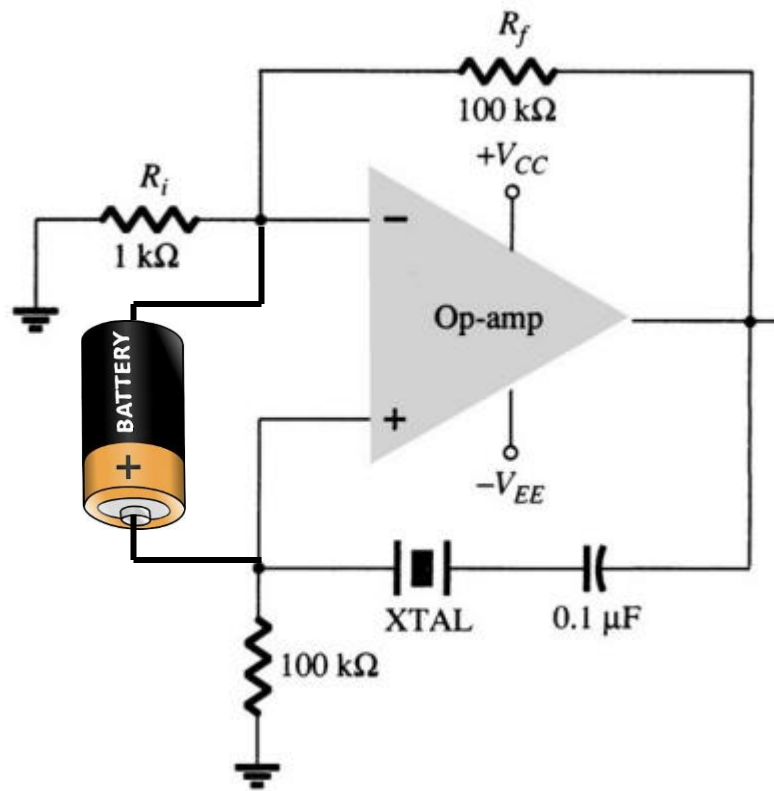
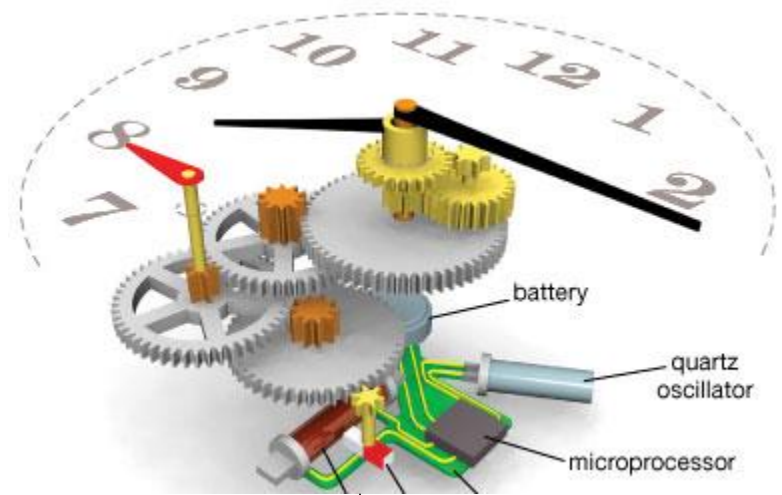
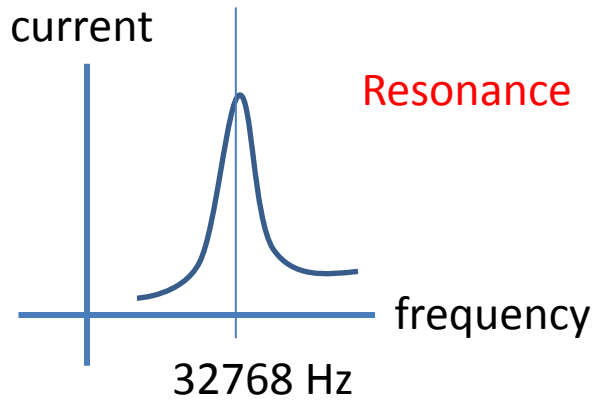
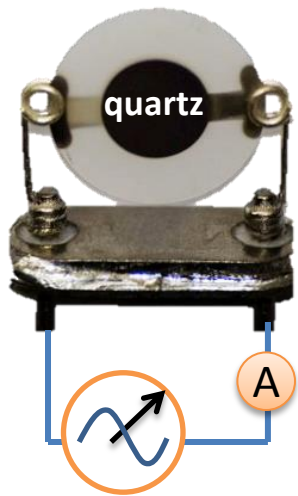
Reports of its knowledge by Chinese since 1<sup>st</sup> century

Studied in detail by 17<sup>th</sup> century Galileo Galilei  
and Christiaan Huygens  
– first to think of “TIME KEEPING DEVICES”

# Simple Pendulum to CLOCK !



Next 300 years, it monopolized time-keeping device !!



Shadow clock  
Egypt, 3500 BC



Period: 1 day  
Error: minutes per hour

Water clock  
Mesopotamia, 1500 BC



Period: ~ Minutes to hours  
Error: minutes per hour

Hourglass  
150 BC to 1600 AD



Period: Minutes to hours  
Error: seconds per hour

Pendulum clock  
1600 AD –



Period: One second  
Error: seconds per day

QUARTZ clock  
1927 –



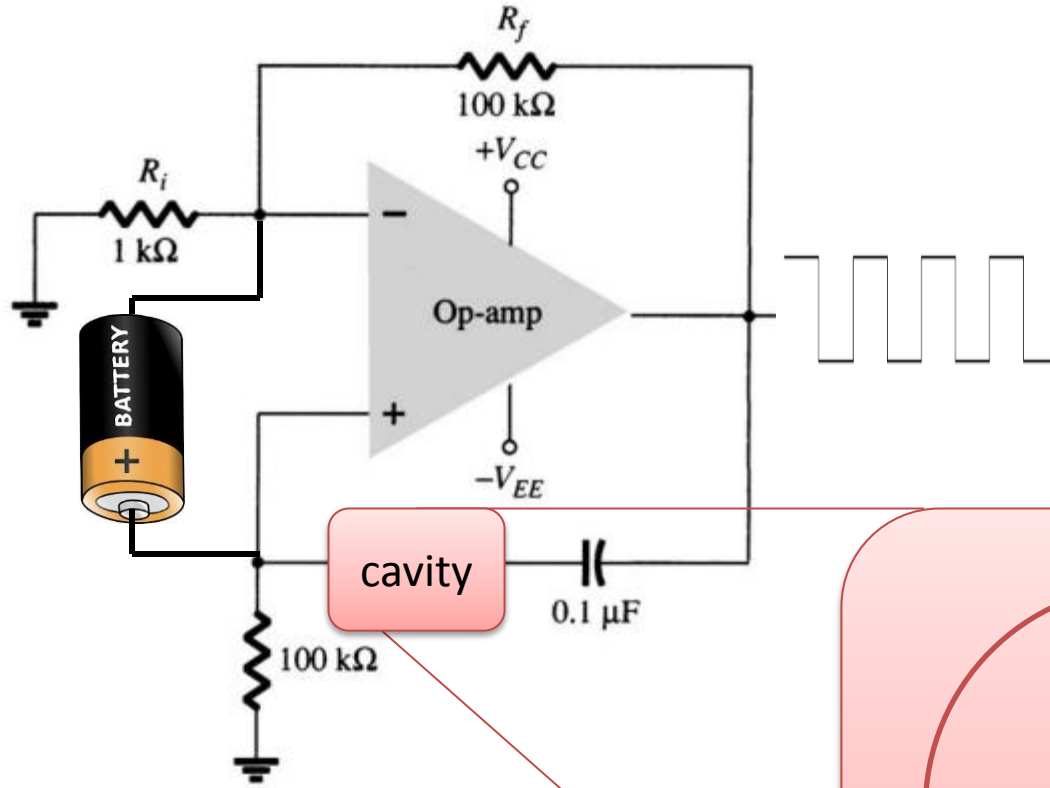
Period:  $1/32768$  s  
Error: seconds per week



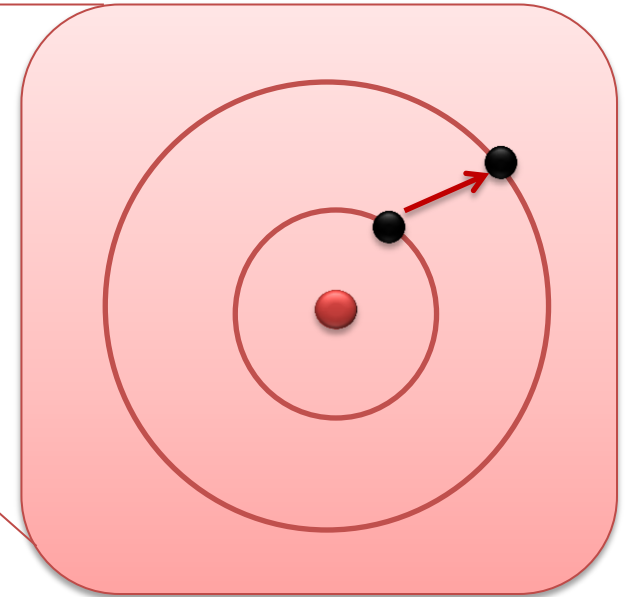
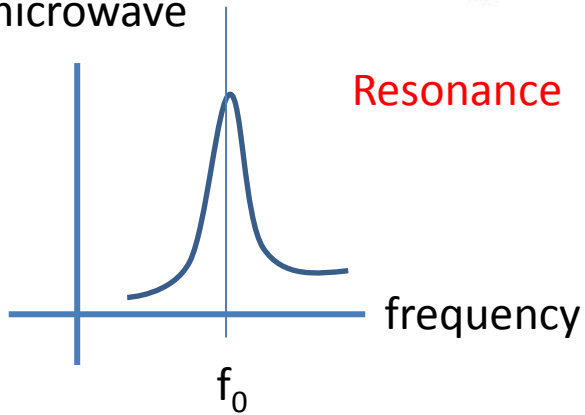
# Atomic Clock:

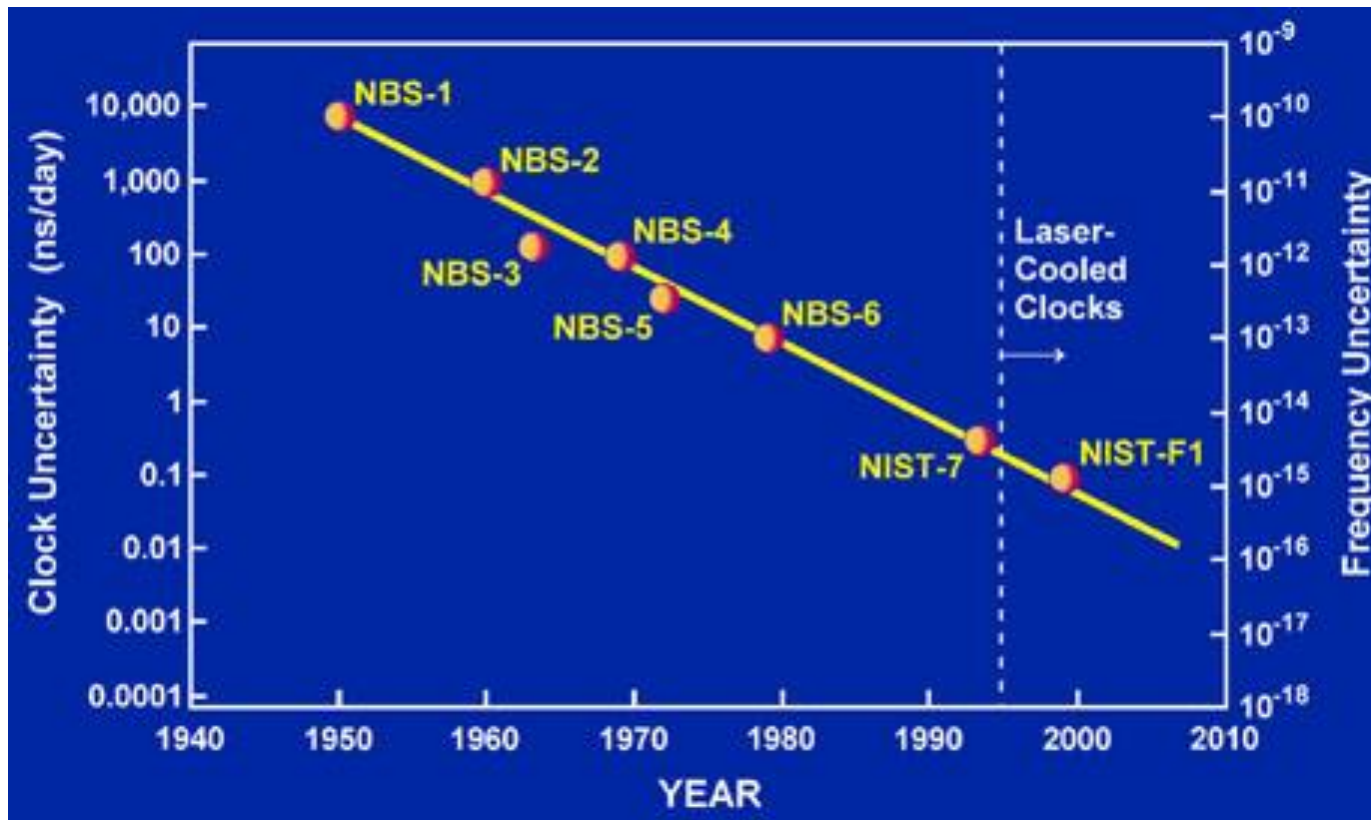
6,834,682,610.904 Hz (Rubidium)

Error: less than a nano second per day



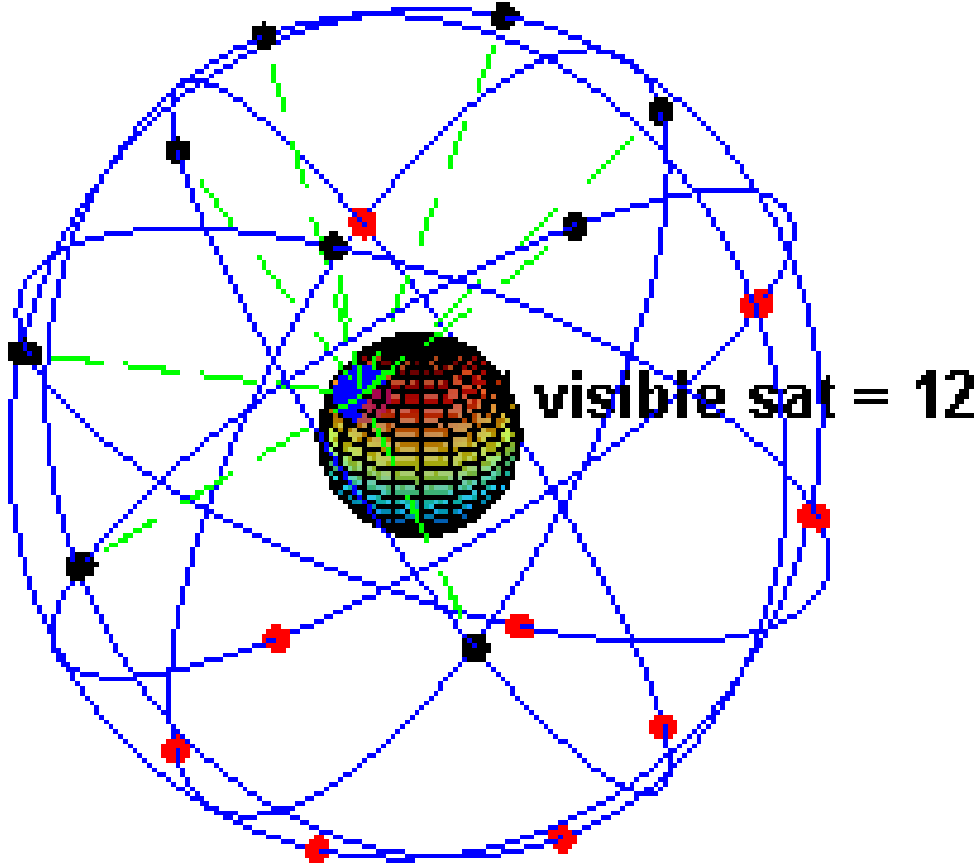
Absorption of microwave





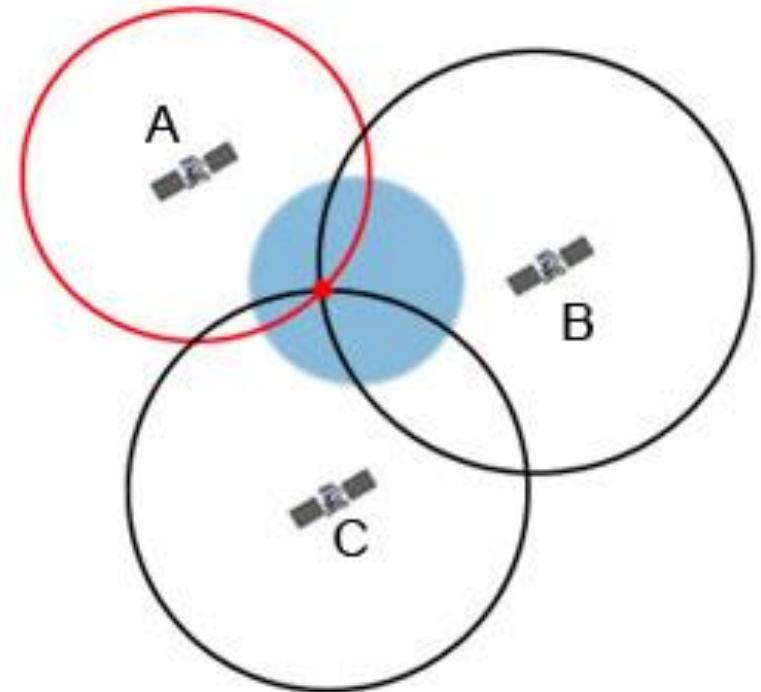
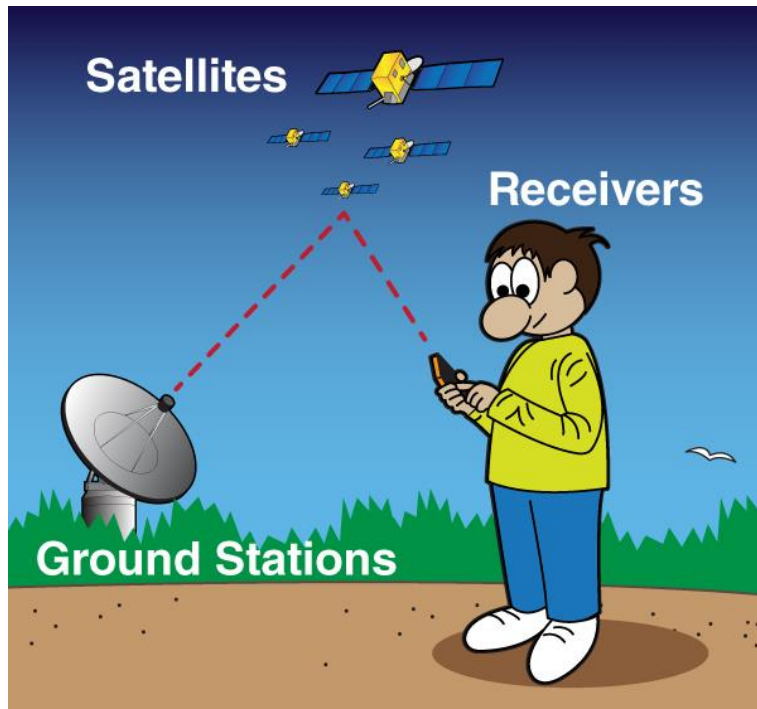
# What can we do with “precise” clocks?

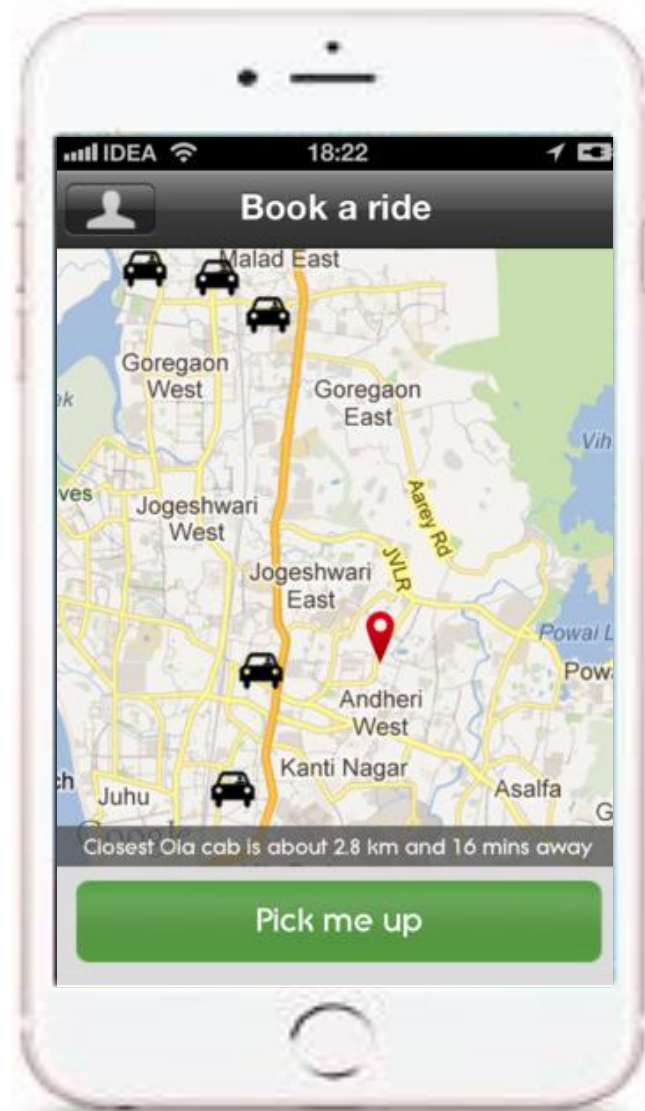
Global Positioning System (GPS):



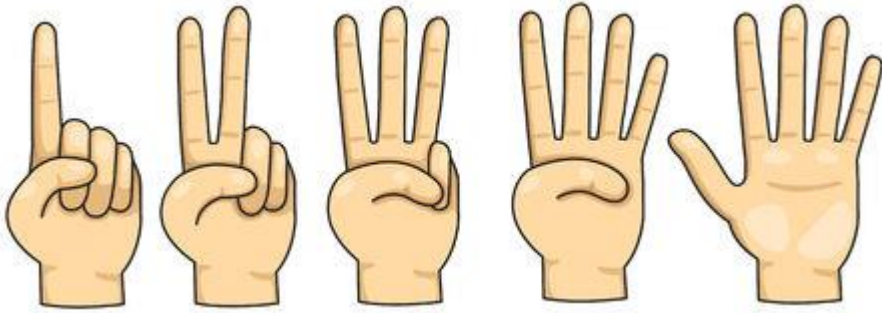
# How does it work?

- Ground stations synchronize the GPS clocks.
- GPS satellites transmit their positions.
- Receiver analyzes its distance from each of the satellites, and calculates its position on earth.





# Computing devices:



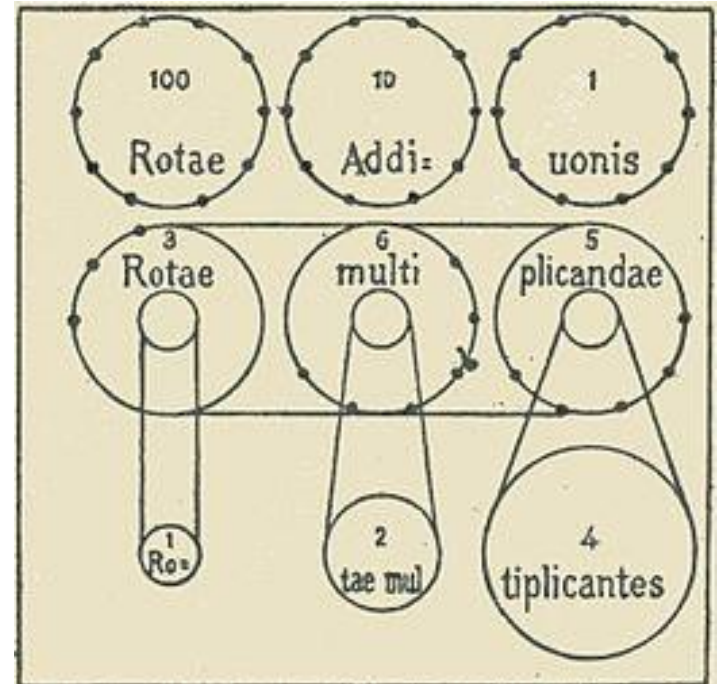
Abacus  
1000 BC





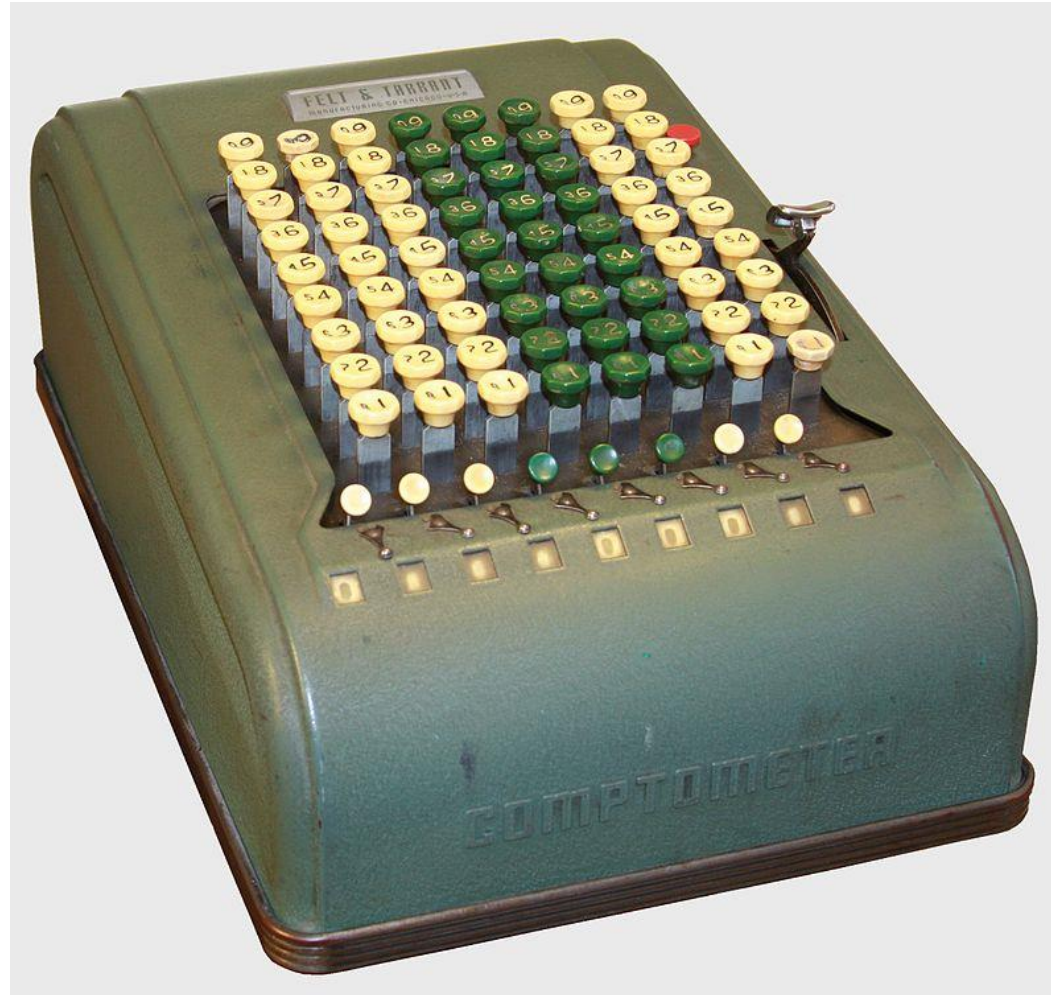
Mechanical calculators:

Pascaline, 1652



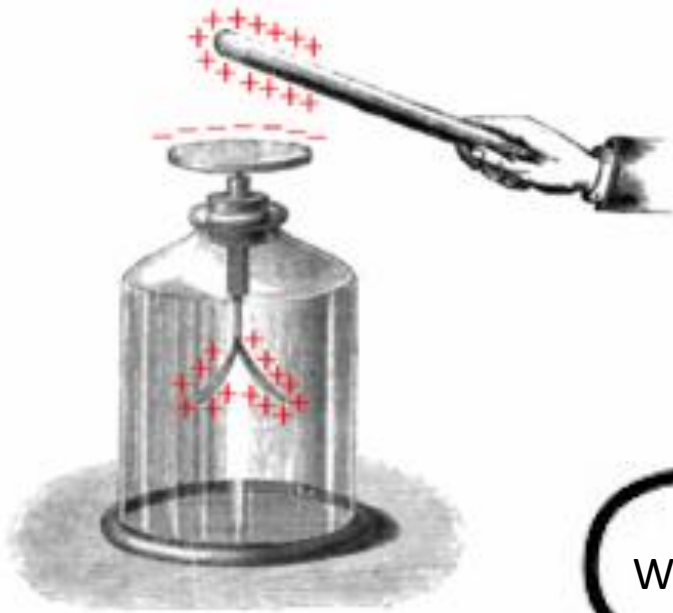
Mechanical calculators:

Comptometer: used in world war I and II

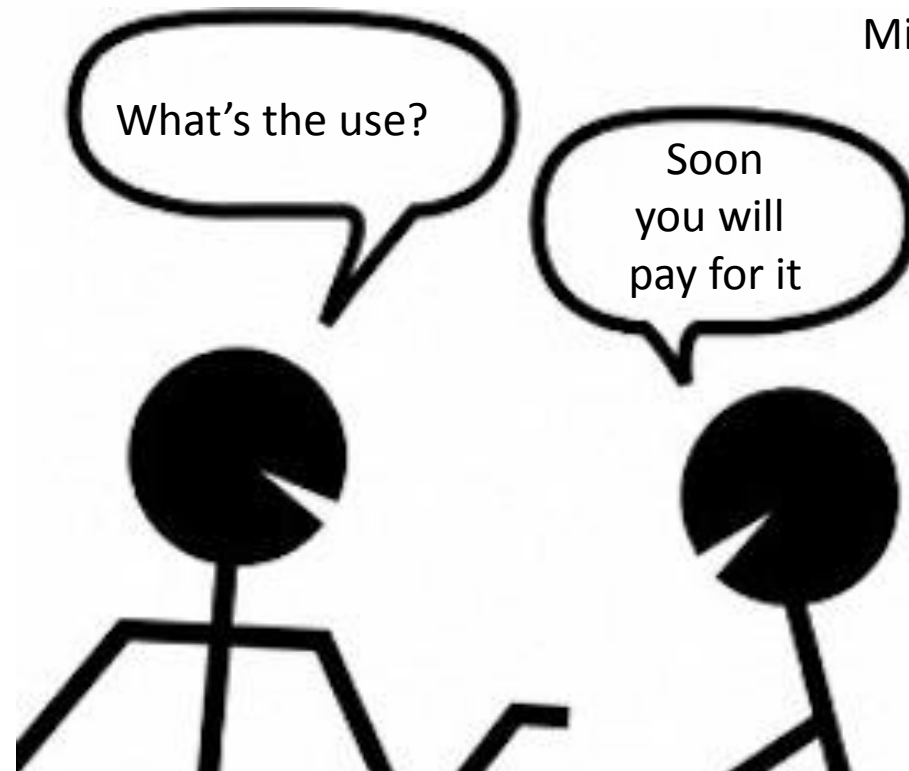


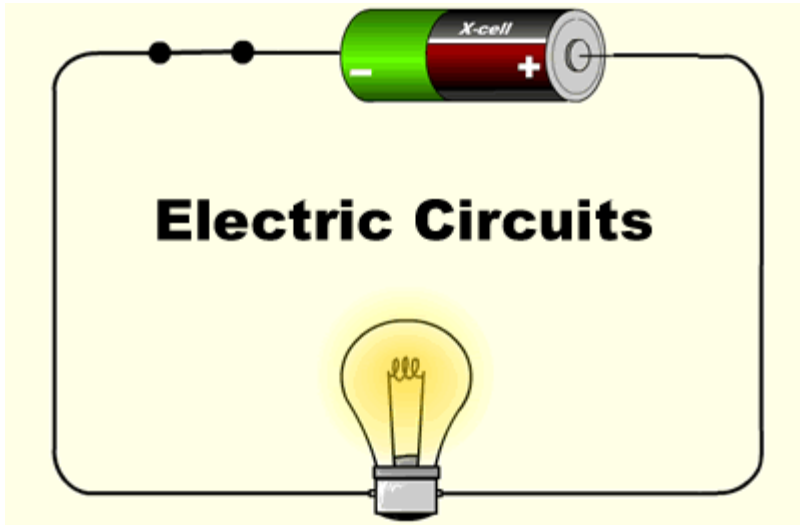


# Electric charges:



Michael Faraday:





Resistors

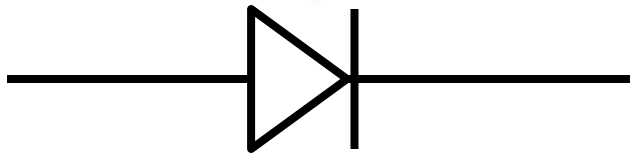
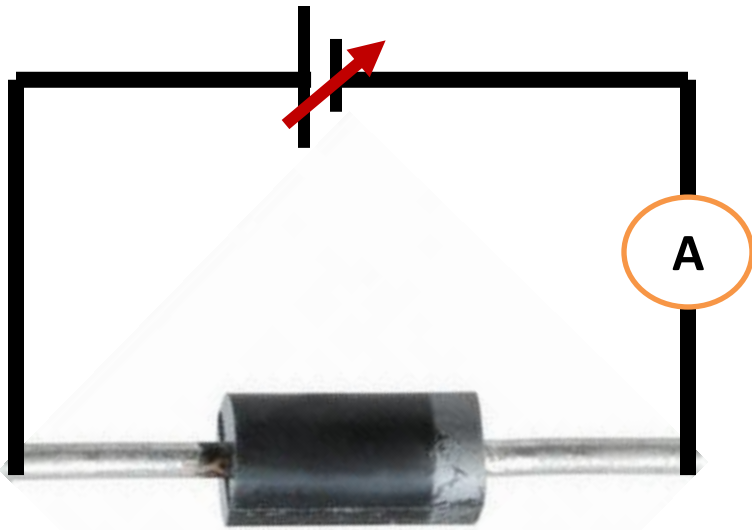


conductors

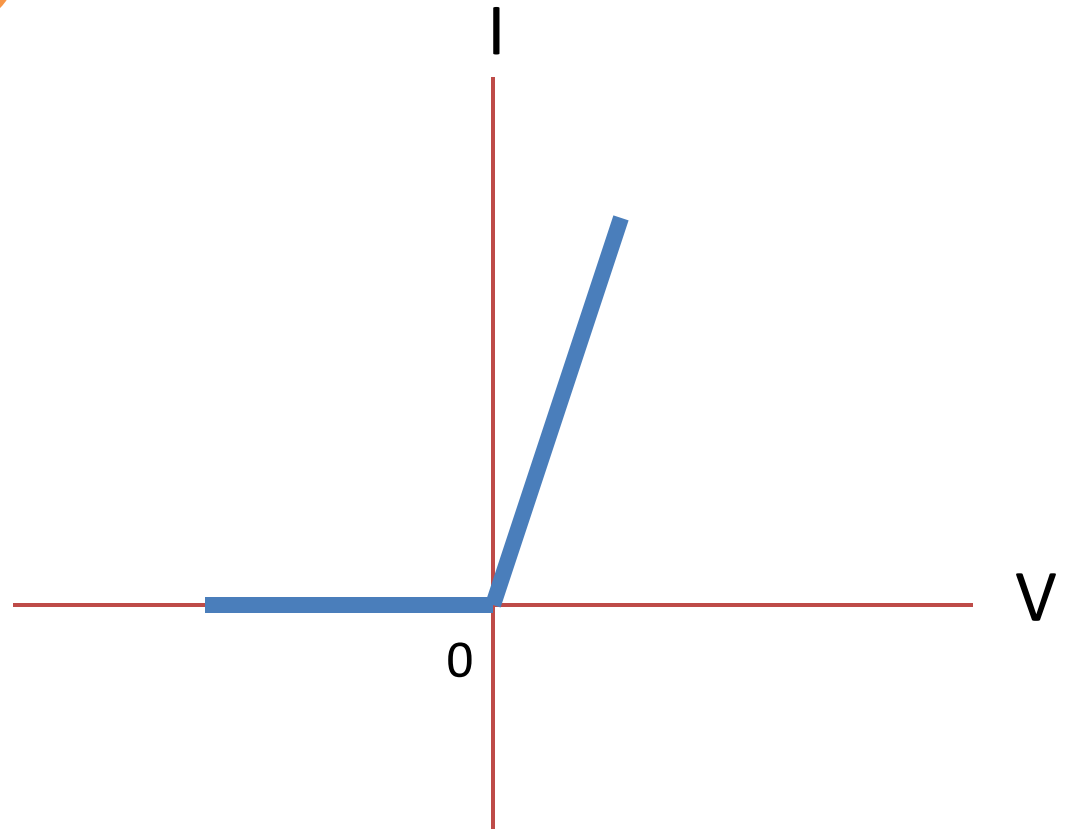


Semiconductor

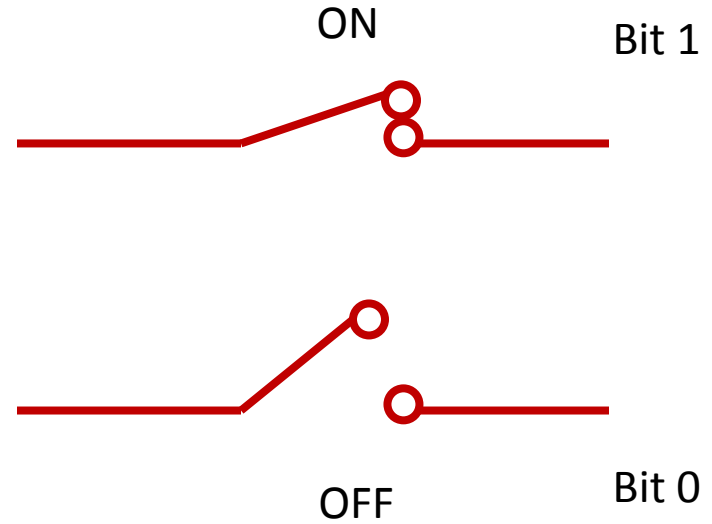
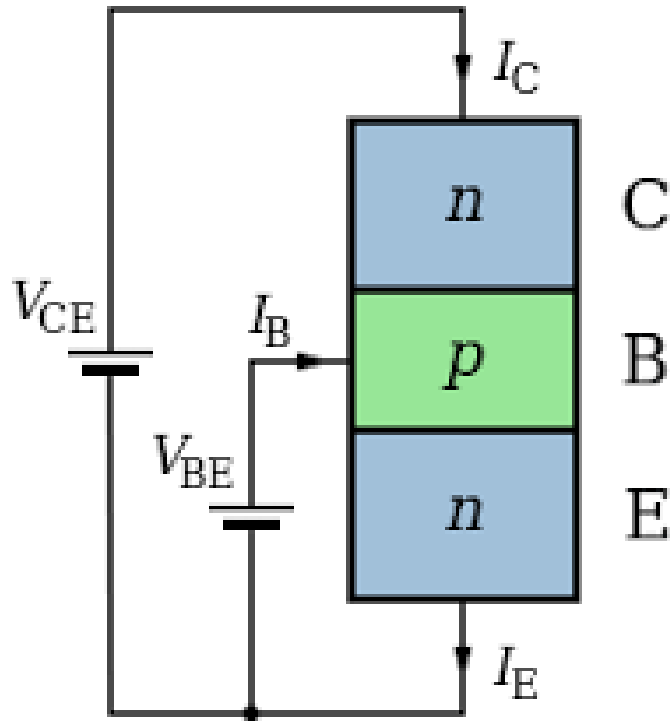
# Semiconductor diode



One-way switch

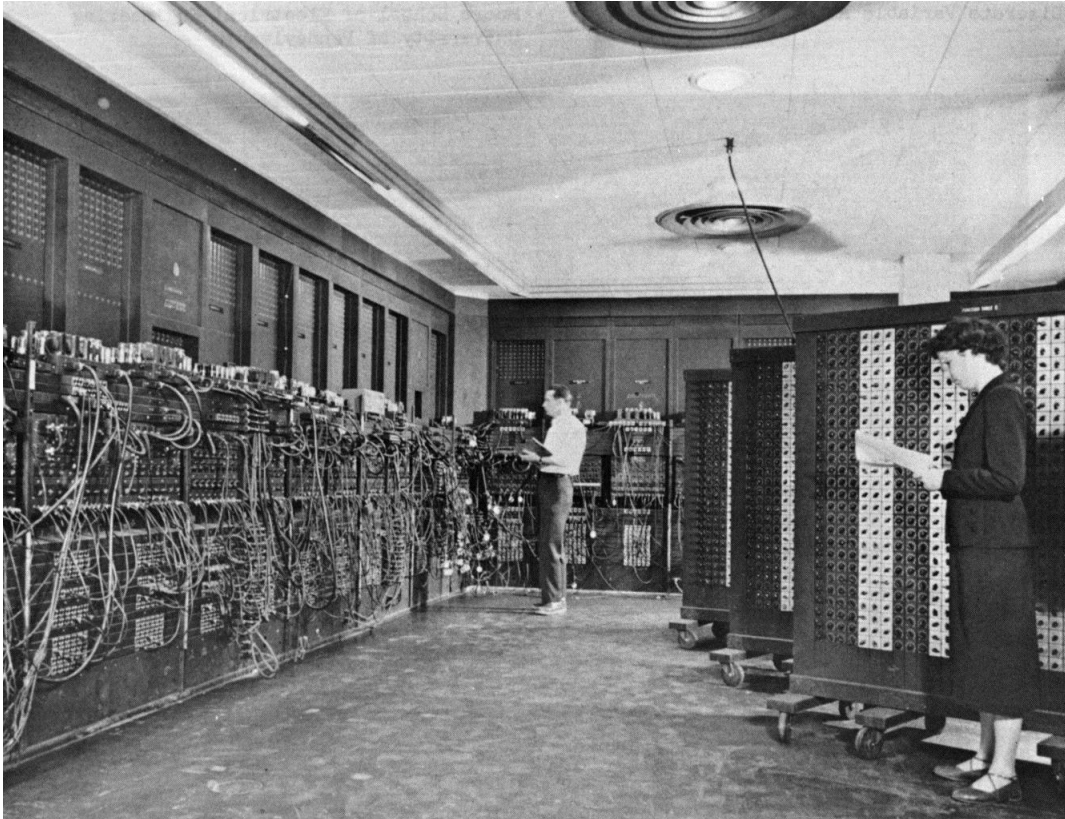


# Semiconductor Transistor



Binary logic

First digital computer  
ENIAC,  
1945

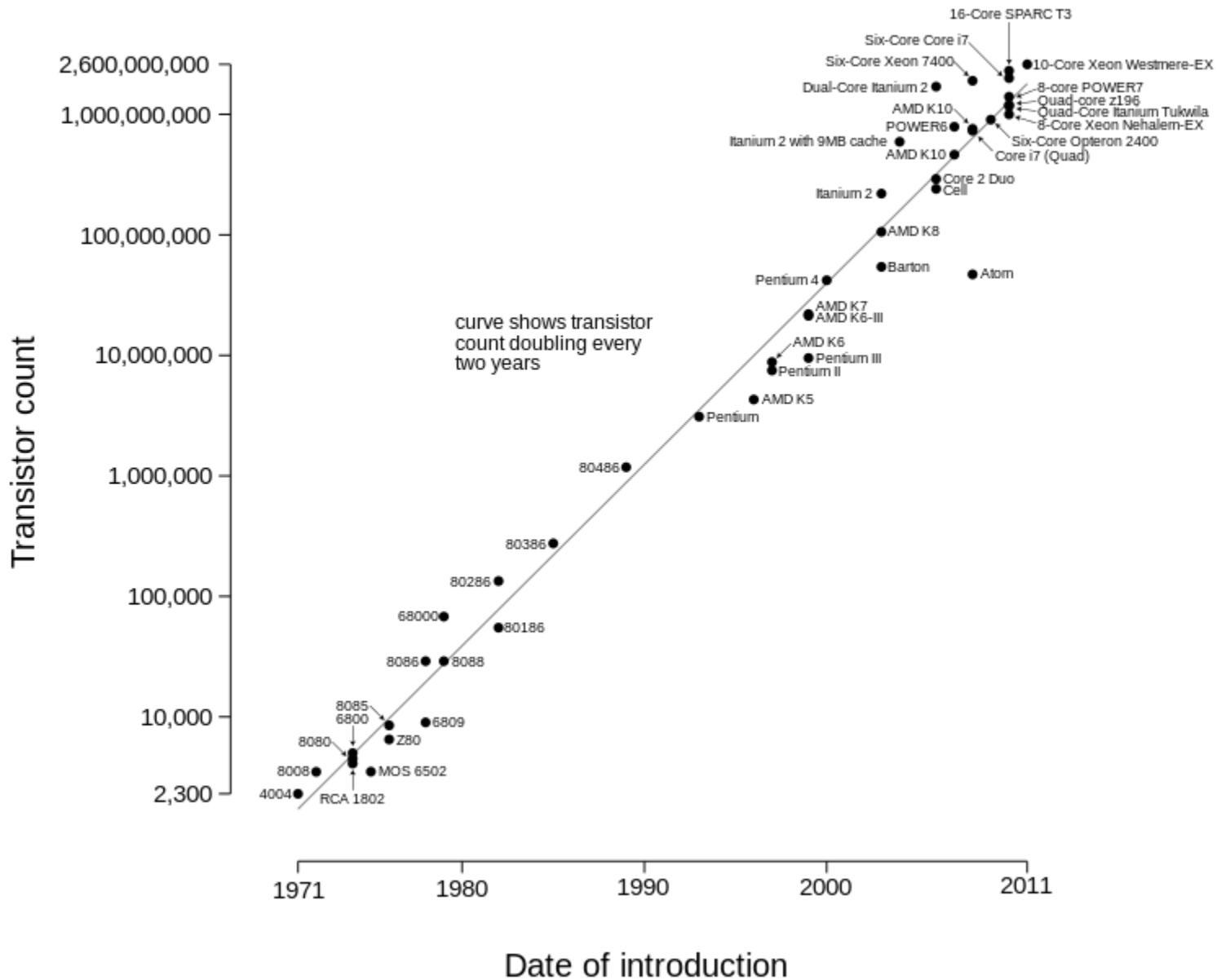


30 tons,  
20 kW power



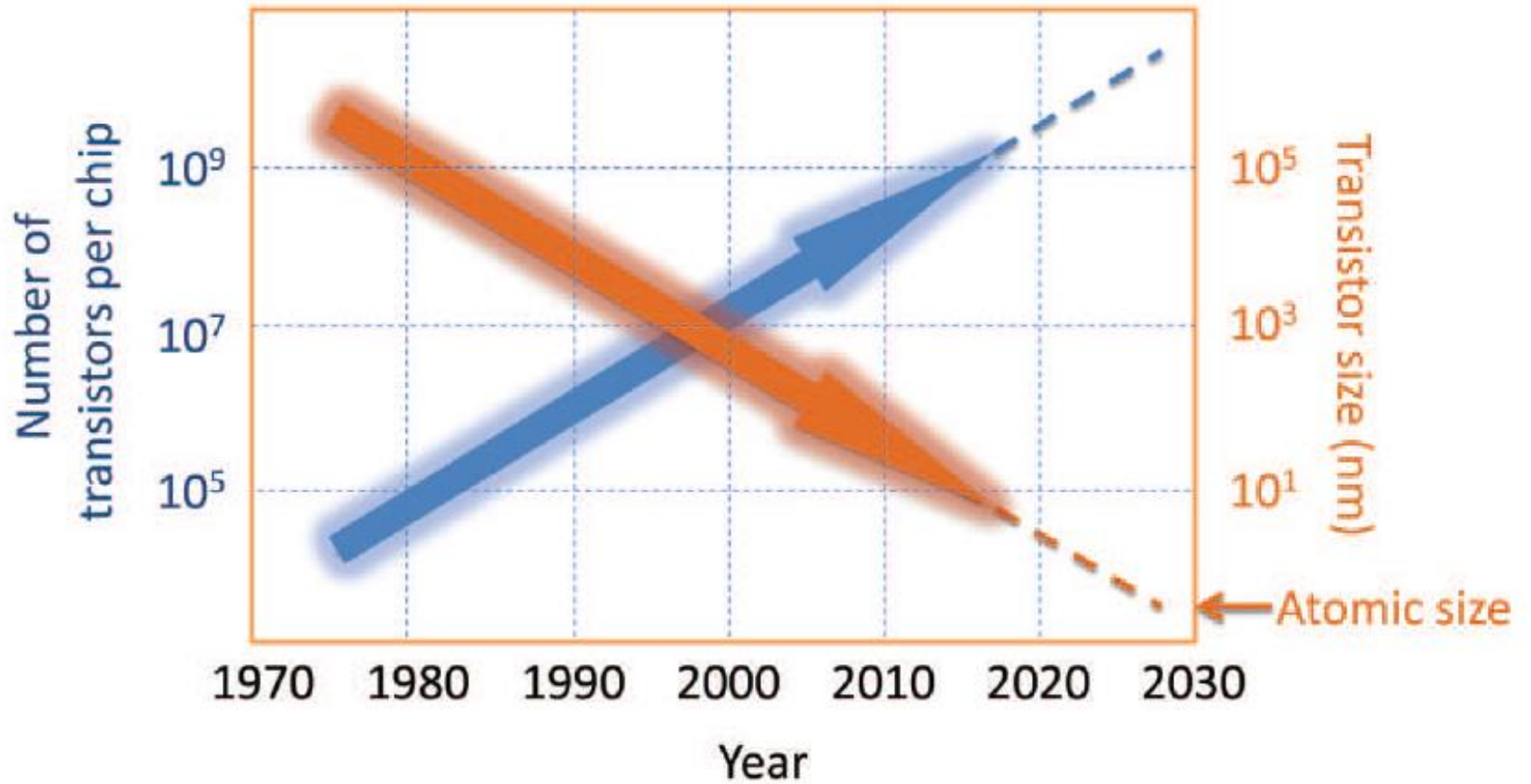
1,400,000,000 transistors !!

# Microprocessor Transistor Counts 1971-2011 & Moore's Law



Gordon E. Moore, co-founder of intel

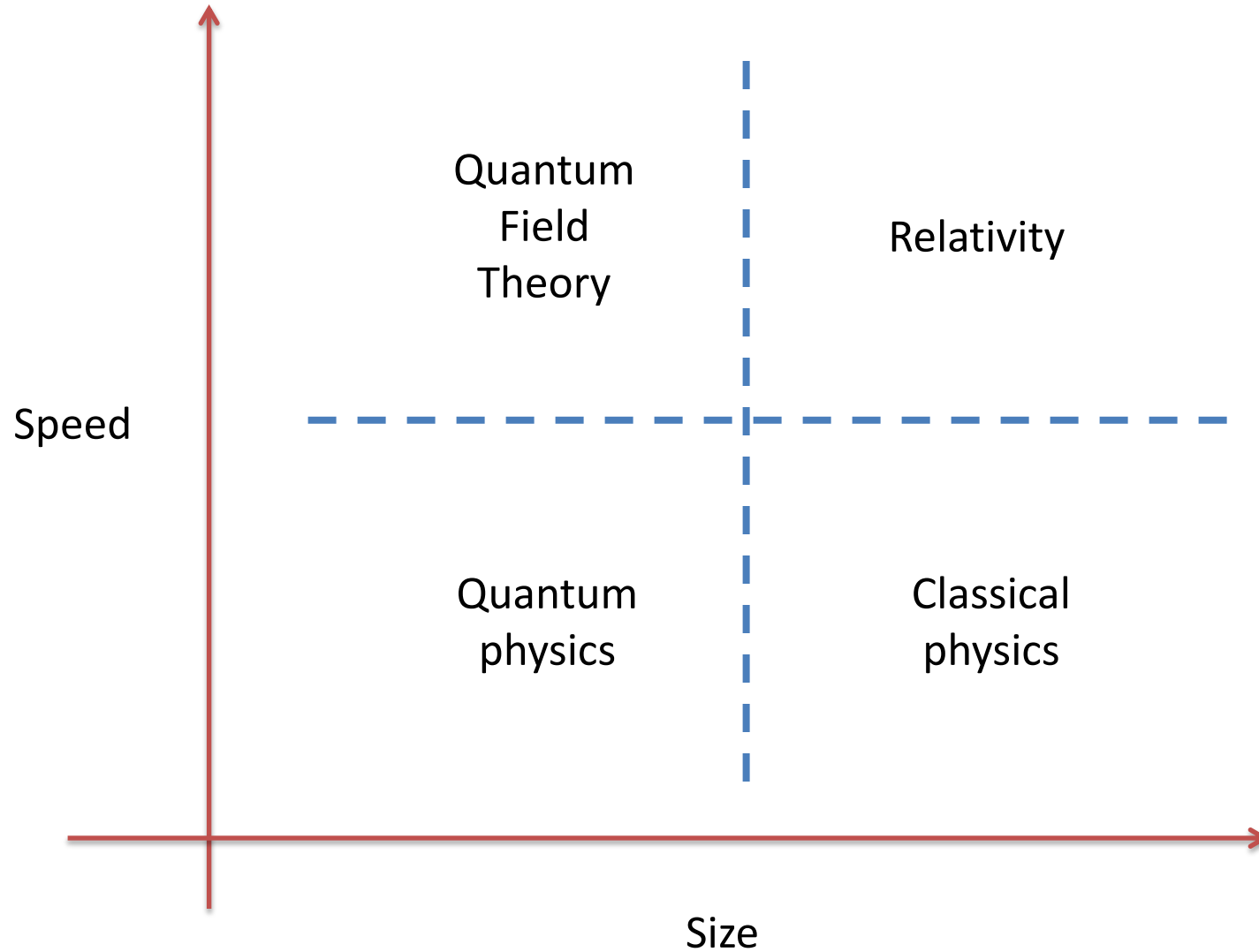
Transistor size:



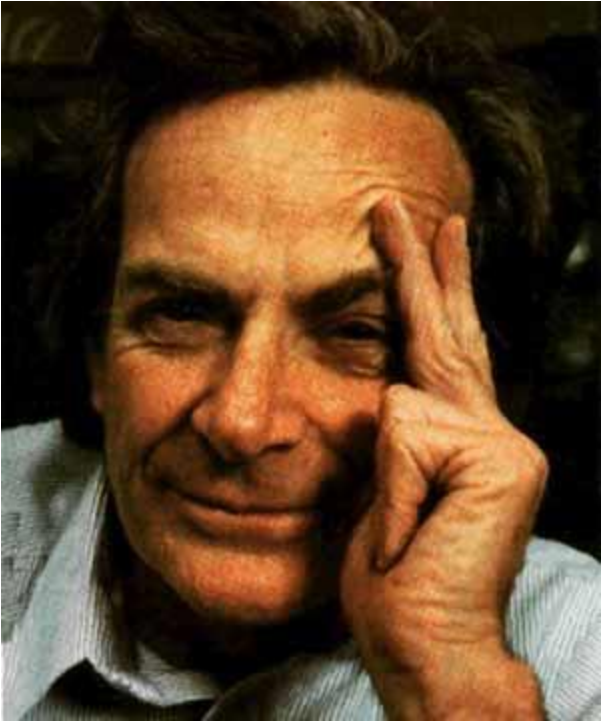
What happens when we hit atomic limit?  
Can single atoms be a transistor?



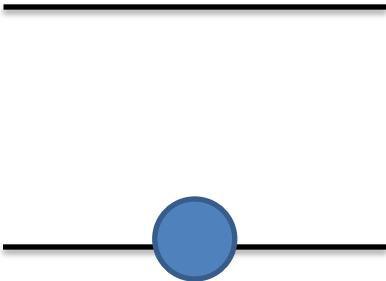
# Physics of everything:



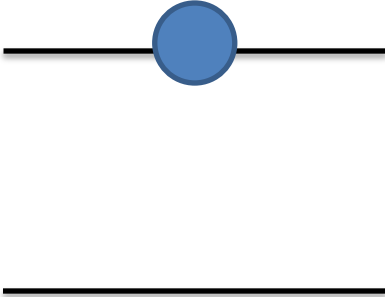
# Quantum computers !!



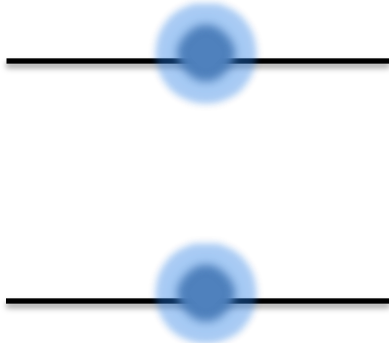
0 qubit



1 qubit



superposition qubit



Quantum world is strange !!



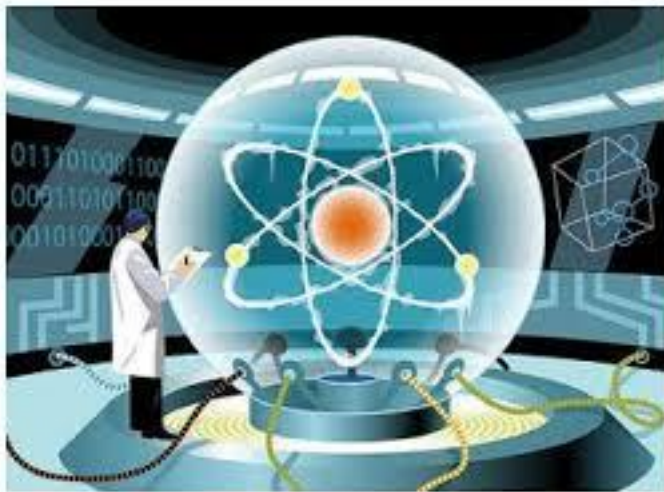
Quantum computers, if built, can be more powerful than the classical computers

For example:

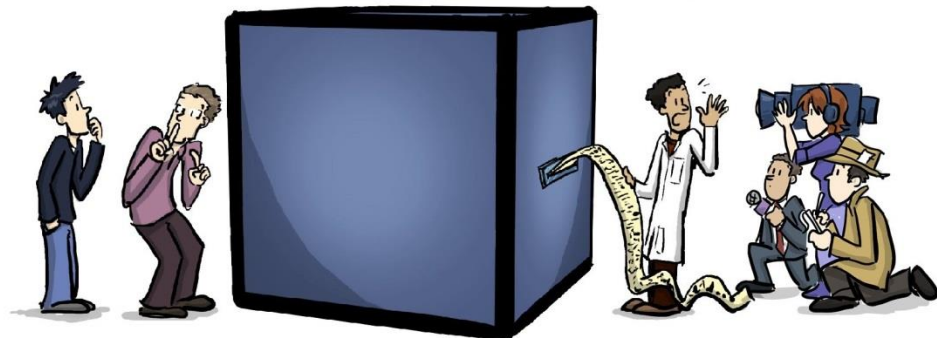
23, 29

Factoring: What are the factors of 667?

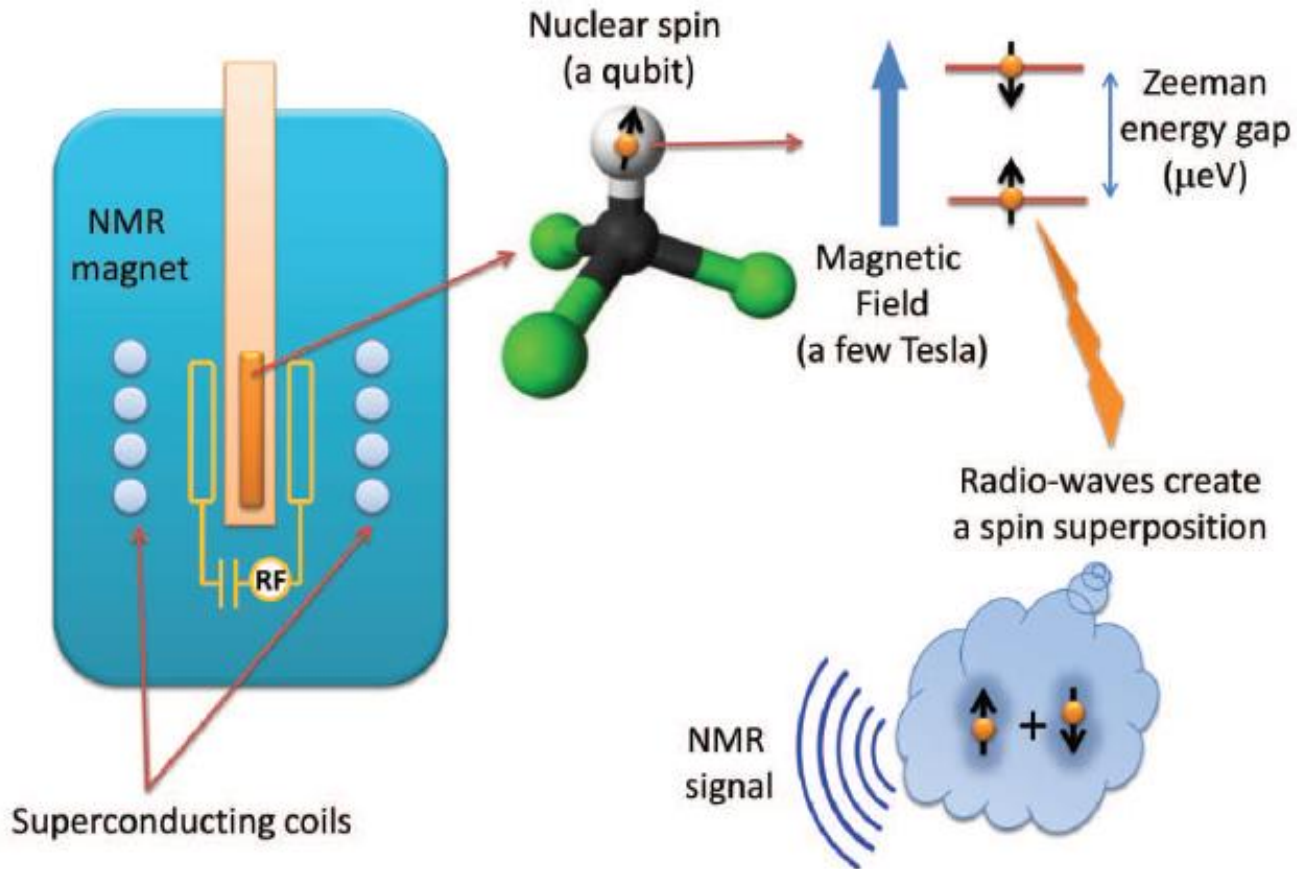
Unsorted atabase searching.



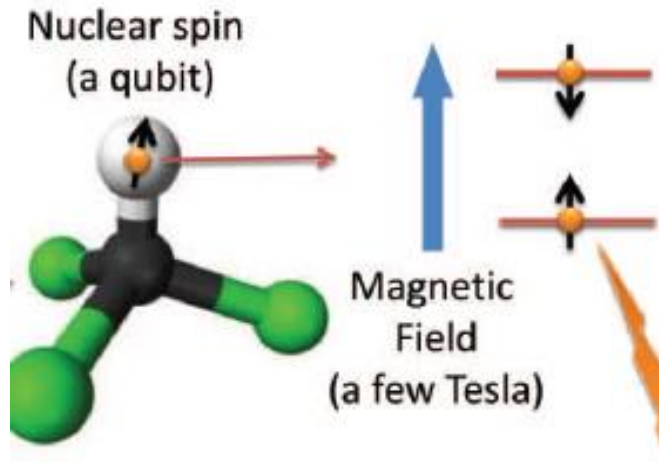
# A Quantum COMPUTER



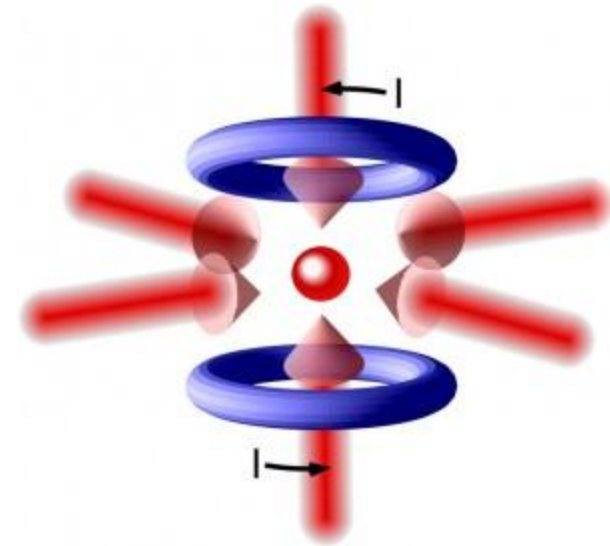
# Nucleus as a transistor:



Dr. T. S. Mahesh



Dr. Umakant Rapol



Dr. Santhanam



Dr. Rejish Nath

