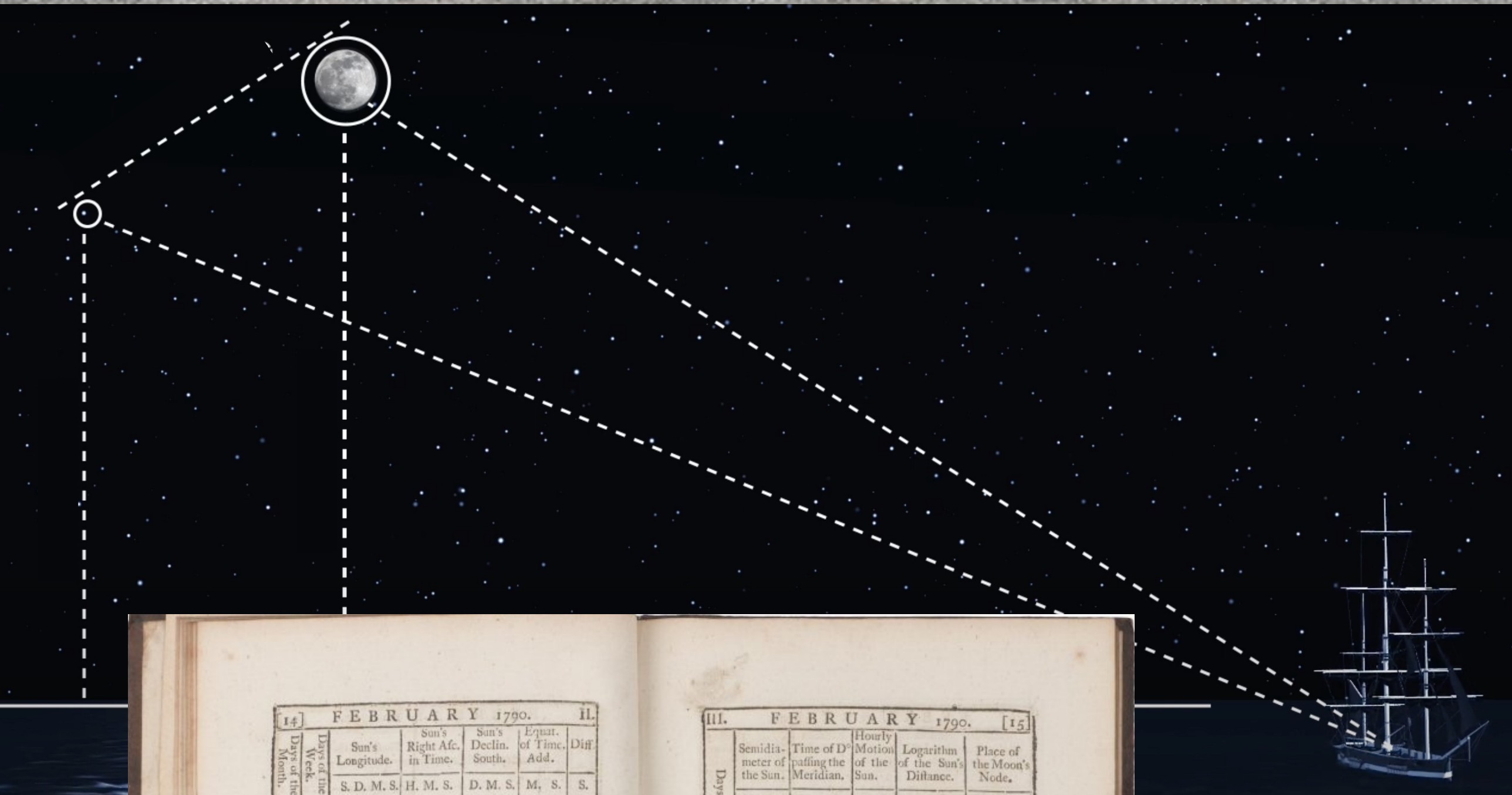


Tech for Impact 2025: Democratising Quantum

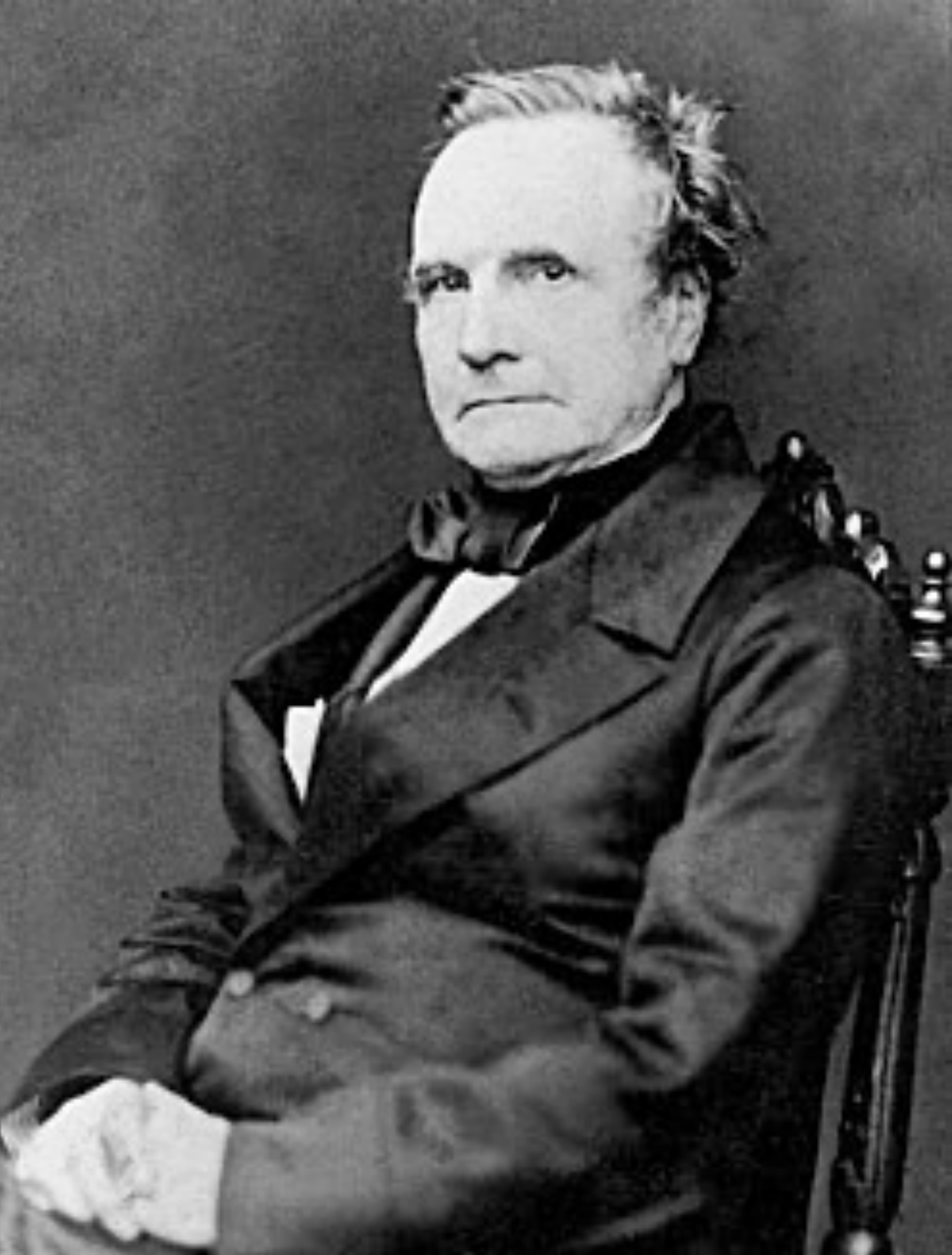
Anasua Chatterjee
Assistant Professor
QuTech and Kavli Institute of Nanoscience,
TU Delft, Netherlands



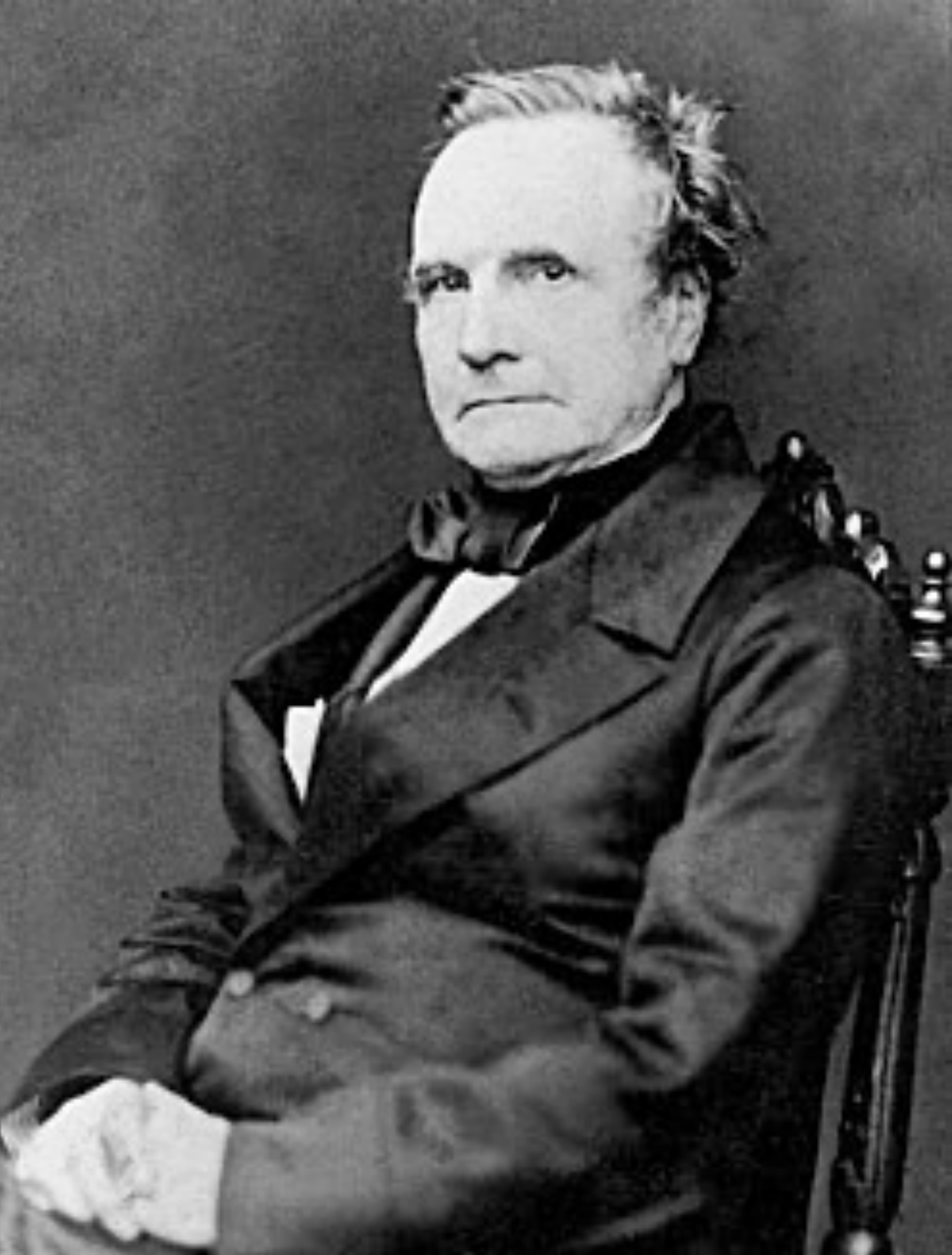


FEBRUARY 1790.									
Days of the Month.	Days of the Week.	Sun's Longitude.	Sun's Right Asc. in Time.	Sun's Declin. South.	Equat. of Time.	Diff.			
1	M.	10. 12.55.57	21. 1.36.8	16.56.59	14. 5.9	6.9			
2	Tu.	10. 13.56.45	21. 5.40.3	16.39.35	14. 12.8	6.1			
3	W.	10. 14.57.32	21. 9.42.9	16.21.54	14. 18.9	5.2			
4	Th.	10. 15.58.18	21.13.44.7	16. 3.57	14. 24.1	4.4			
5	F.	10. 16.59. 3	21.17.45.7	15.45.42	14. 28.5	3.7			
6	Sa.	10. 17.59.47	21.21.45.9	15.27.12	14. 32.2	2.9			
7	Su.	10. 19. 0.30	21.25.45.4	15. 8.26	14. 35.1	2.1			
8	M.	10. 20. 1.12	21.29.44.1	14.49.34	14. 37.2	1.4			
9	Tu.	10. 21. 1.53	21.33.42.0	14.30. 8	14. 38.6	0.6			
10	W.	10. 22. 2.33	21.37.39.2	14.10.37	14. 39.2	0.2			
11	Th.	10. 23. 3.11	21.41.35.5	13.50.51	14. 39.6	1.0			
12	F.	10. 24. 3.48	21.45.31.1	13.32.51	14. 38.0	1.7			
13	Sa.	10. 25. 4.24	21.49.26.0	13.10.39	14. 36.3	2.4			
14	Su.	10. 26. 4.58	21.53.20.1	12.50.14	14. 33.9	3.1			
15	M.	10. 27. 5.31	21.57.13.5	12.29.36	14. 30.8	3.9			
16	Tu.	10. 28. 6. 2	22. 1. 6.1	12. 8.47	14. 26.6	4.7			
17	W.	10. 29. 6.31	22. 4.58.0	11.47.46	14. 22.2	5.4			
18	Th.	11. 1. 6.58	22. 8.49.2	11.26.34	14. 16.8	6.0			
19	F.	11. 1. 7.24	22.12.39.7	11. 5.11	14. 10.8	6.7			
20	Sa.	11. 2. 7.48	22.16.29.5	10.43.38	14. 4.1	7.4			
21	Su.	11. 3. 8.10	22.20.18.7	10.21.56	13. 56.5	8.0			
22	M.	11. 4. 8.29	22.24. 7.2	10. 6. 4	13.48.7	8.7			
23	Tu.	11. 5. 8.46	22.27.55.1	9.38. 4	13.40.6	9.3			
24	W.	11. 6. 9. 122.31.42.3	9.15.53	13.30.7	10.0	10.6			
25	Th.	11. 7. 9.14	22.35.28.9	8.53.30	13. 20.7	11.1			
26	F.	11. 8. 9.25	22.39.14.8	8.31.11	13. 10.1	11.7			
27	Sa.	11. 9. 9.34	22.43. 0.2	8. 8.38	12.59.0	12.4			
28	Su.	11.10. 9.41	22.46.45.1	7.45.58	12.47.2	13.1			

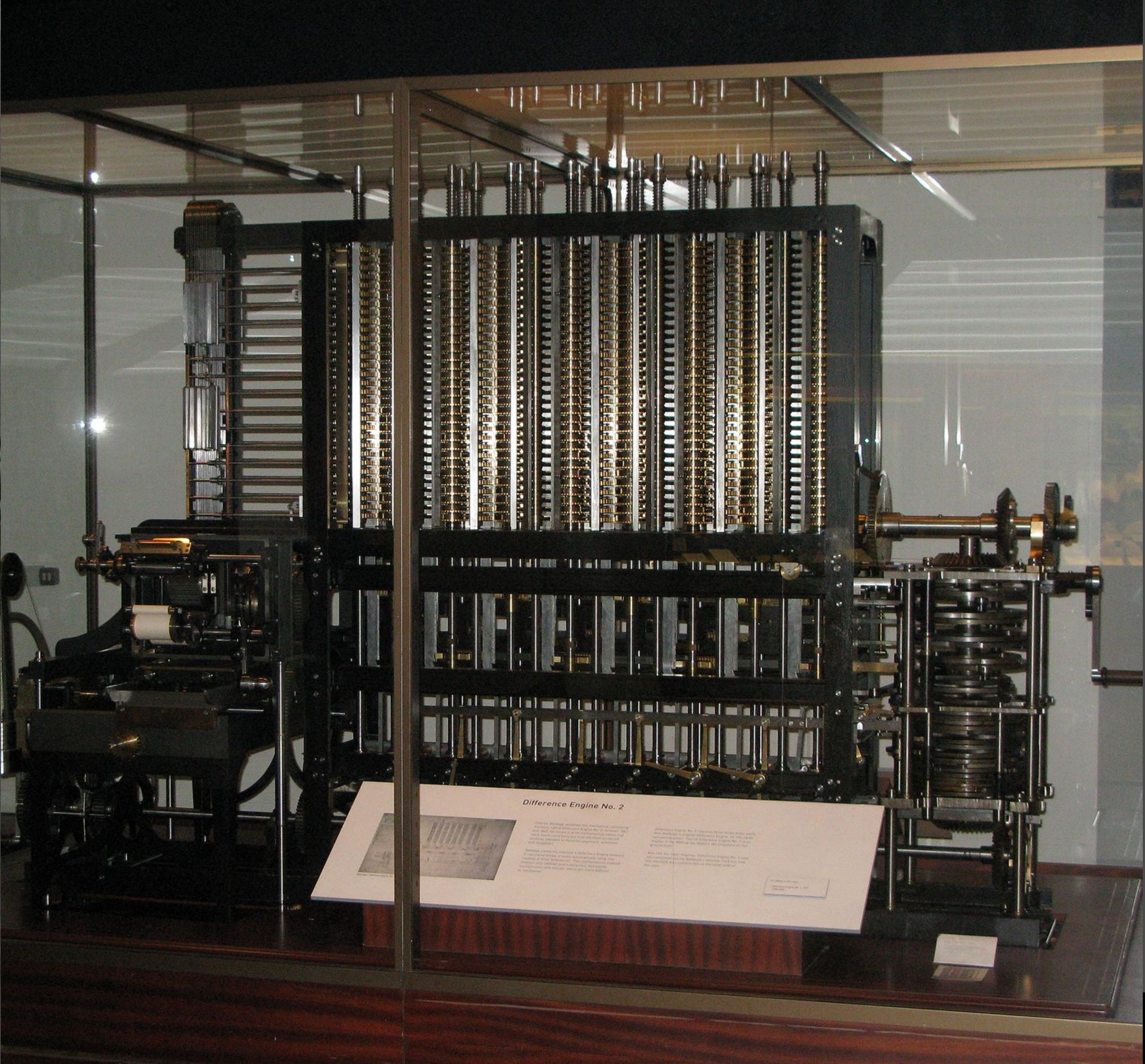
FEBRUARY 1790. [15]					
Days.	Semidia- meter of the Sun.	Time of D' passing the Meridian.	Hourly Motion of the Sun.	Logarithm of the Sun's Distance.	Place of the Moon's Node.
	M. S.	M. S.	M. S.		S. D. M.
1	16. 16.5	1. 8.1	2.32.1	9.993816	7. 14. 58
7	16. 15.5	1. 7.4	2.31.8	9.994290	7. 14. 39
13	16. 14.5	1. 6.7	2.31.5	9.994822	7. 14. 20
19	16. 13.1	1. 6.2	2.31.0	9.995385	7. 14. 1
25	16. 11.7	1. 5.5	2.30.5	9.995987	7. 13. 42
ECLIPSES OF THE SATELLITES OF JUPITER.					
I. Satellite. Immersions.		II. Satellite. Immersions.		III. Satellite.	
Days.	H. M. S.	Days.	H. M. S.	Days.	H. M. S.
*1	11.40. 3	2	20.43. 0	*7	11.47. 19 I
3	6. 8. 19	*6	10. 0. 33	*7	15. 15. 50 E
4	0. 36. 39	9	23. 18. 19	*14	15. 45. 57 I
6	19. 5. 3	*13	12. 36. 21	14	19. 14. 4 E
*8	13. 33. 30	Emeritions.		21	19. 45. 14 I
*10	8. 1. 58	17	4. 44. 30	21	23. 13. 0 E
12	2. 30. 29	20	18. 2. 53	28	23. 45. 21 I
13	20. 59. 2	*24	7. 21. 32		
Emeritions.		27	20. 40. 30		
*15	17. 42. 19			IV. Satellite.	
*17	12. 11. 38			3	19. 30. 40 I
*19	6. 40. 19			4	13. 25. 24 E
21	1. 9. 2			*20	13. 29. 44 I
22	19. 37. 46			20	18. 11. 16 E
*24	14. 6. 34				
*26	8. 35. 24				
*28	3. 4. 17				



Charles Babbage's Difference Engine, 1822

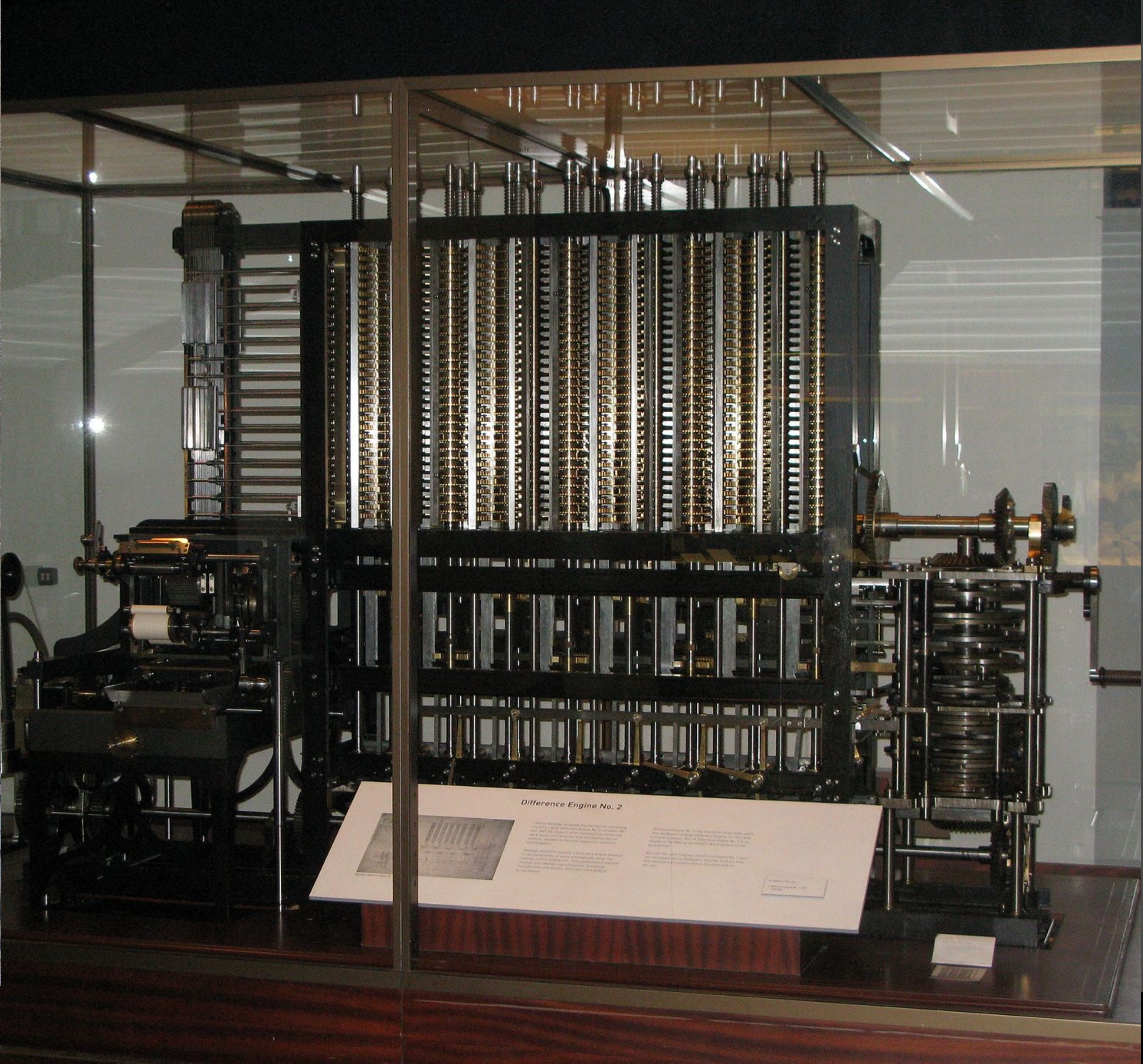


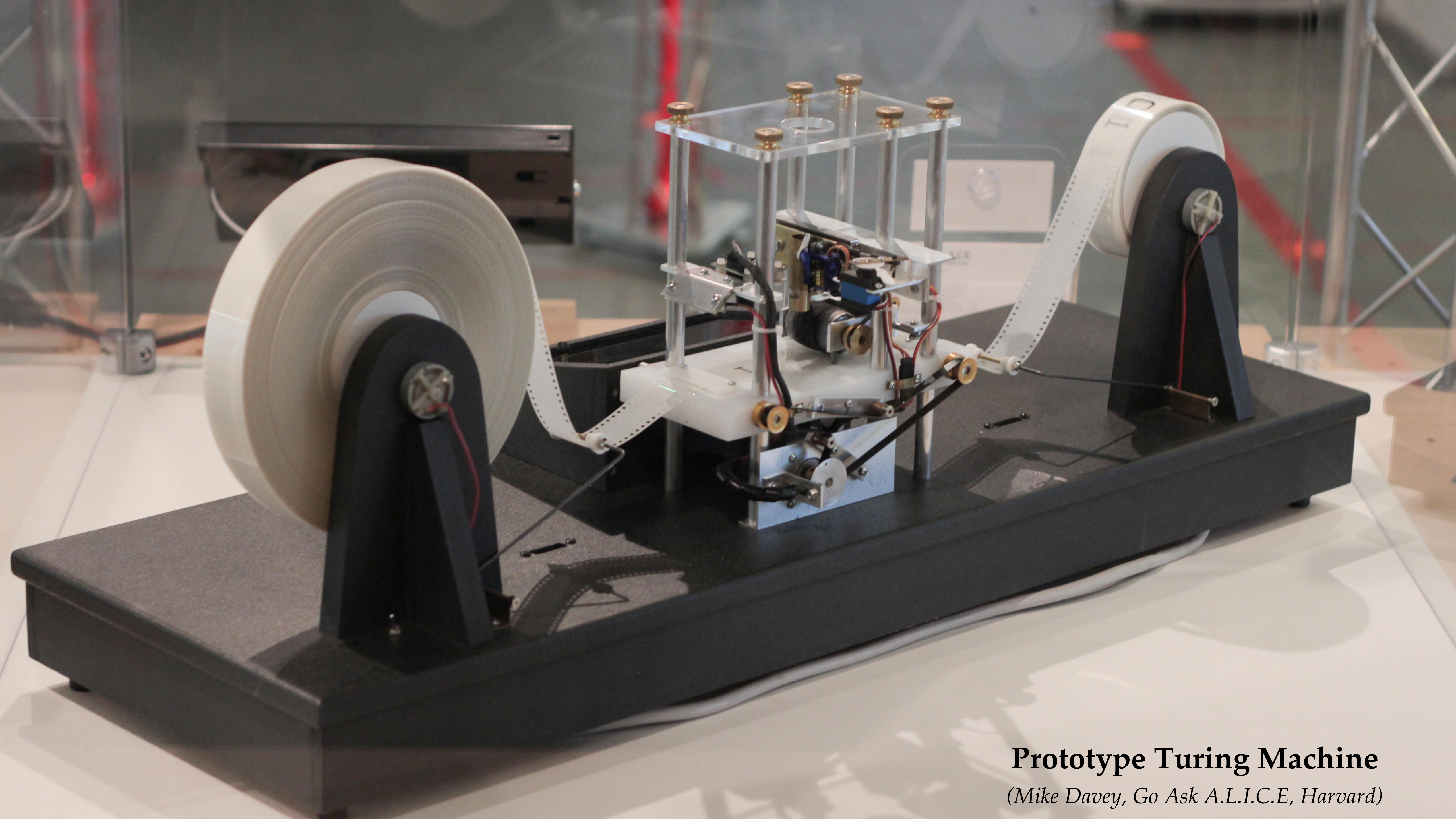
Charles Babbage's Difference Engine, 1822





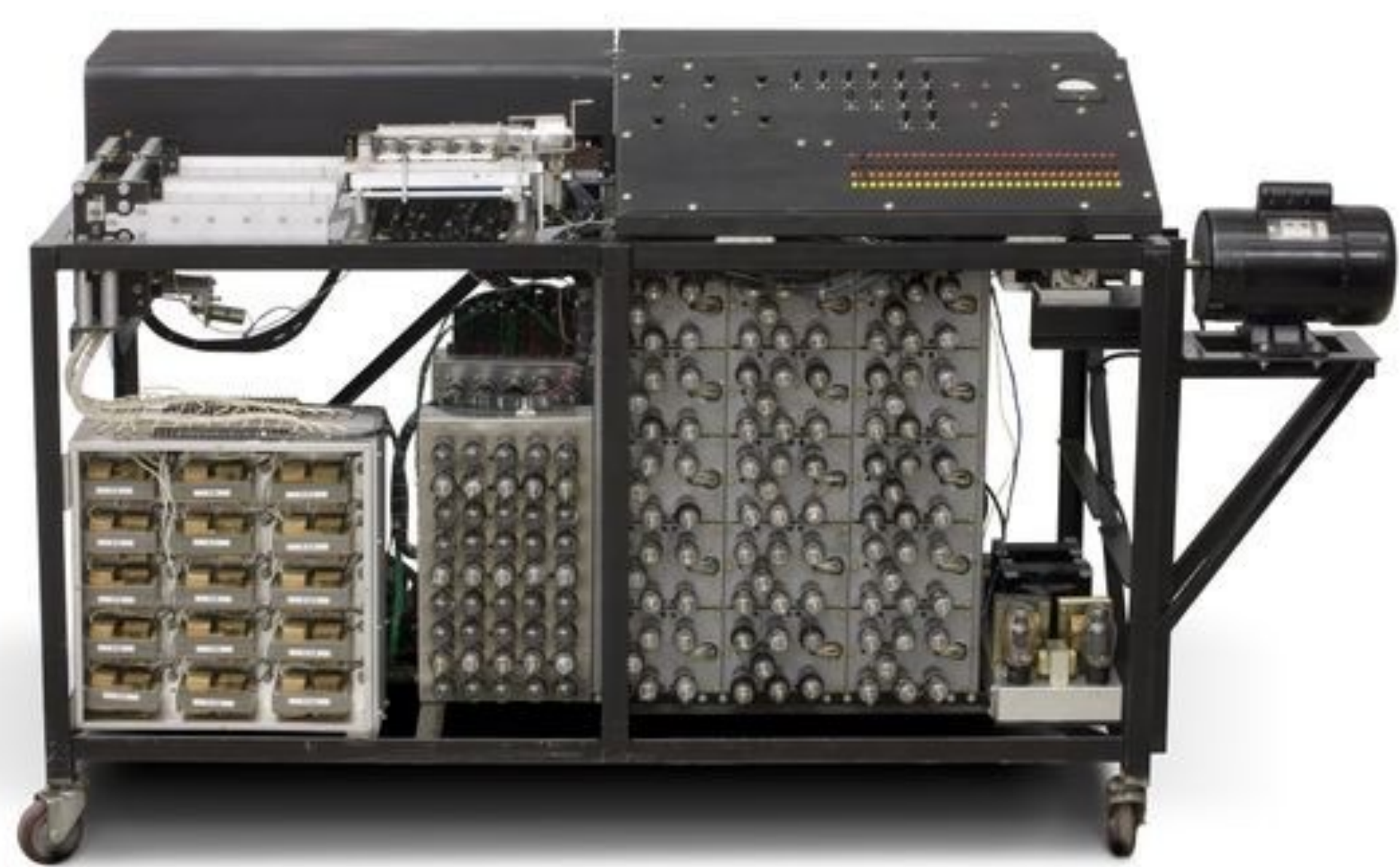
Ada (Byron) Lovelace



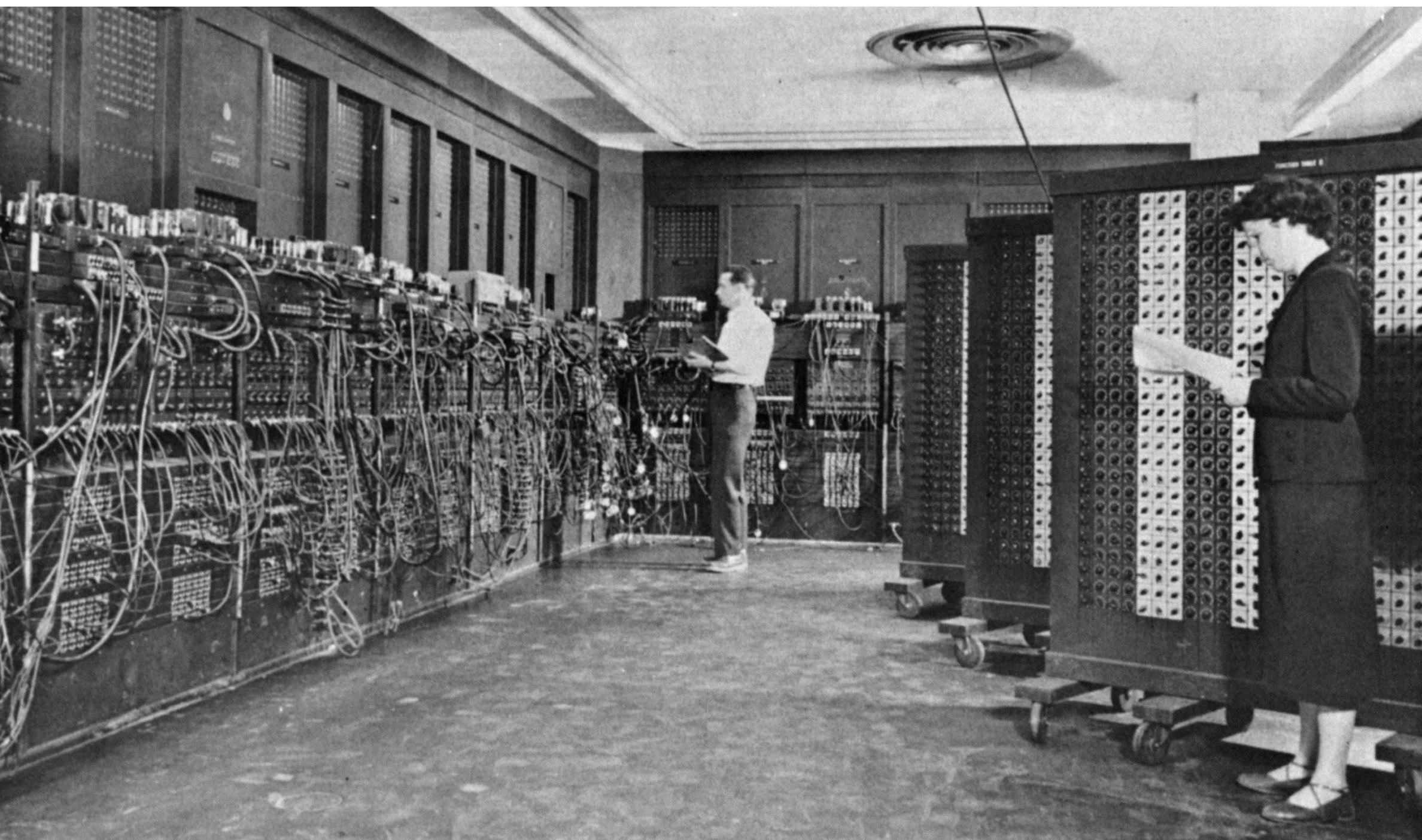


Prototype Turing Machine

(Mike Davey, Go Ask A.L.I.C.E, Harvard)



Atanasoff-Berry-Computer, 1939



First programmable, electronic,
general-purpose digital computer

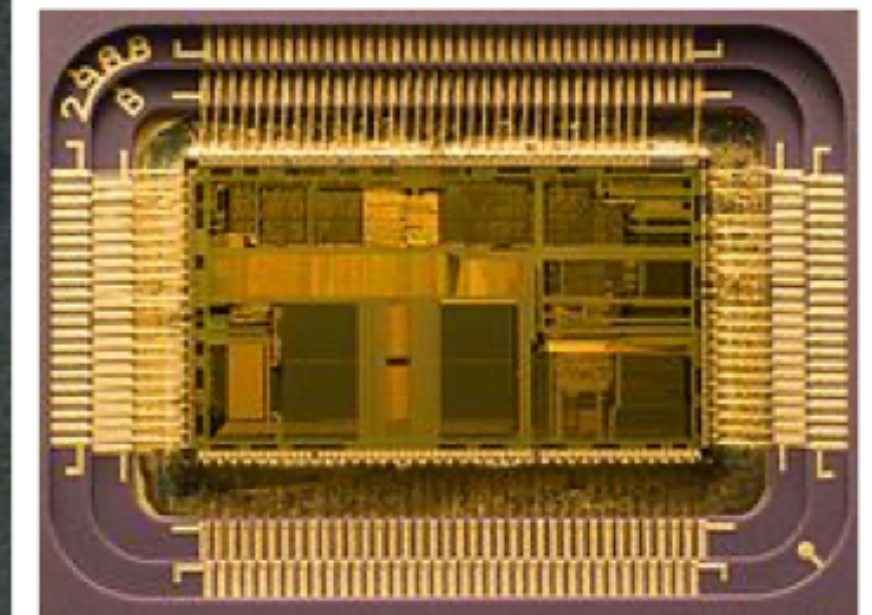
ENIAC, 1945



Add-subtract module



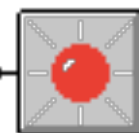
“Moore’s Law”



20 billion
transistors!

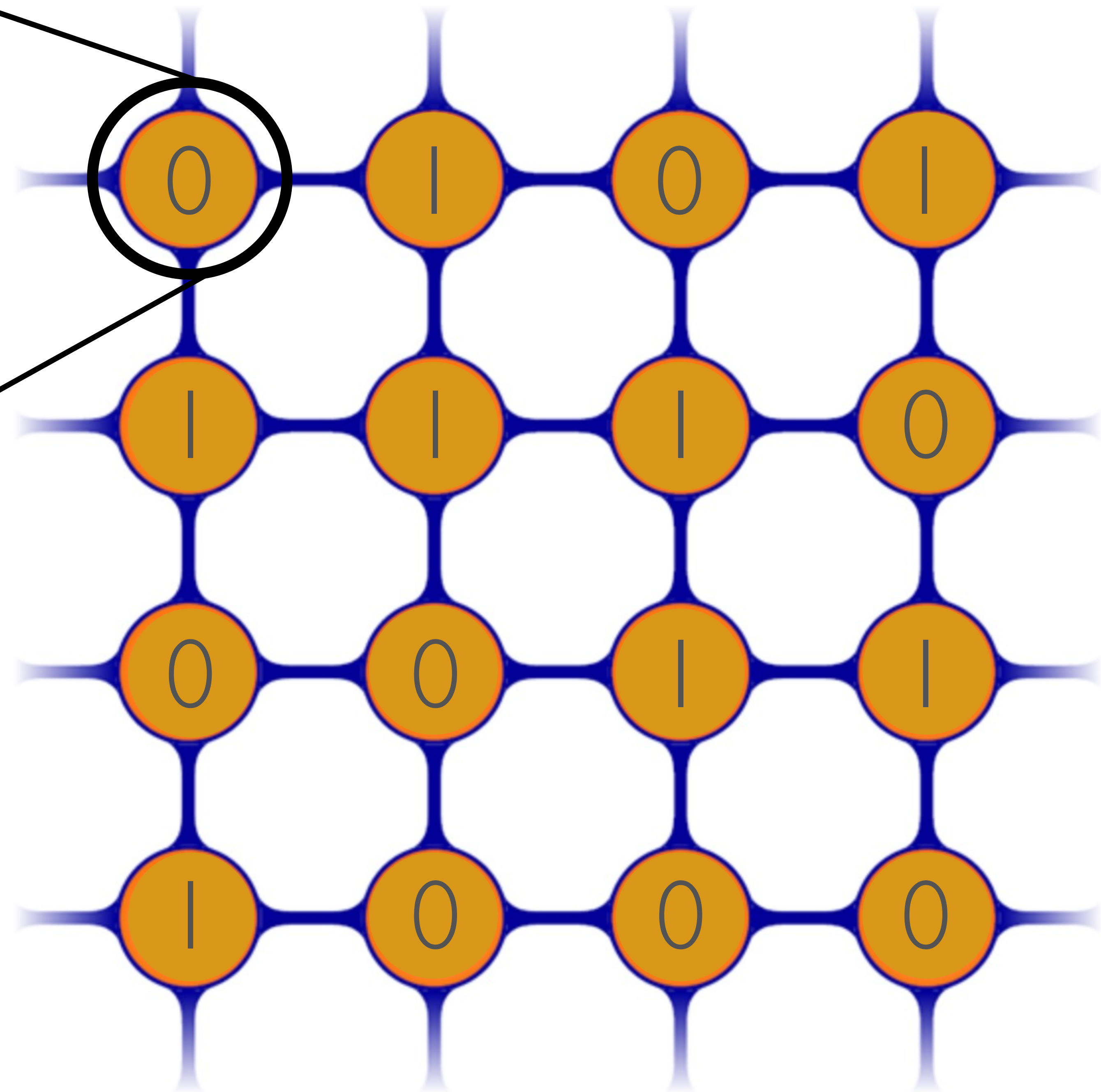


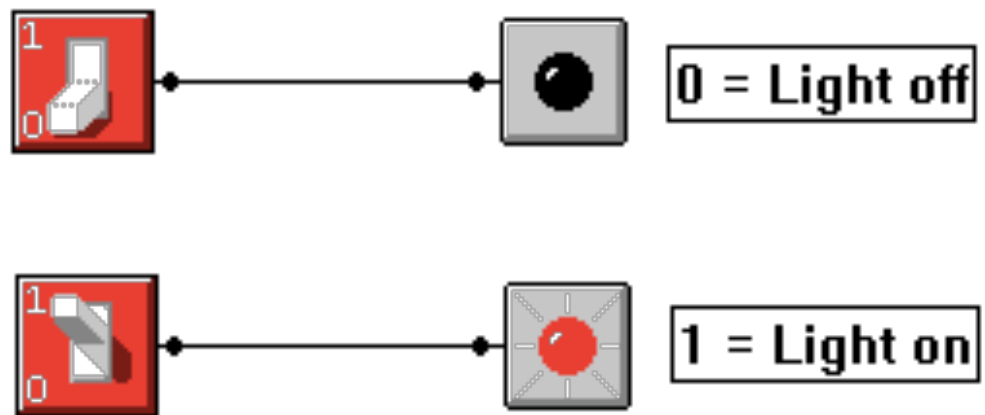
0 = Light off



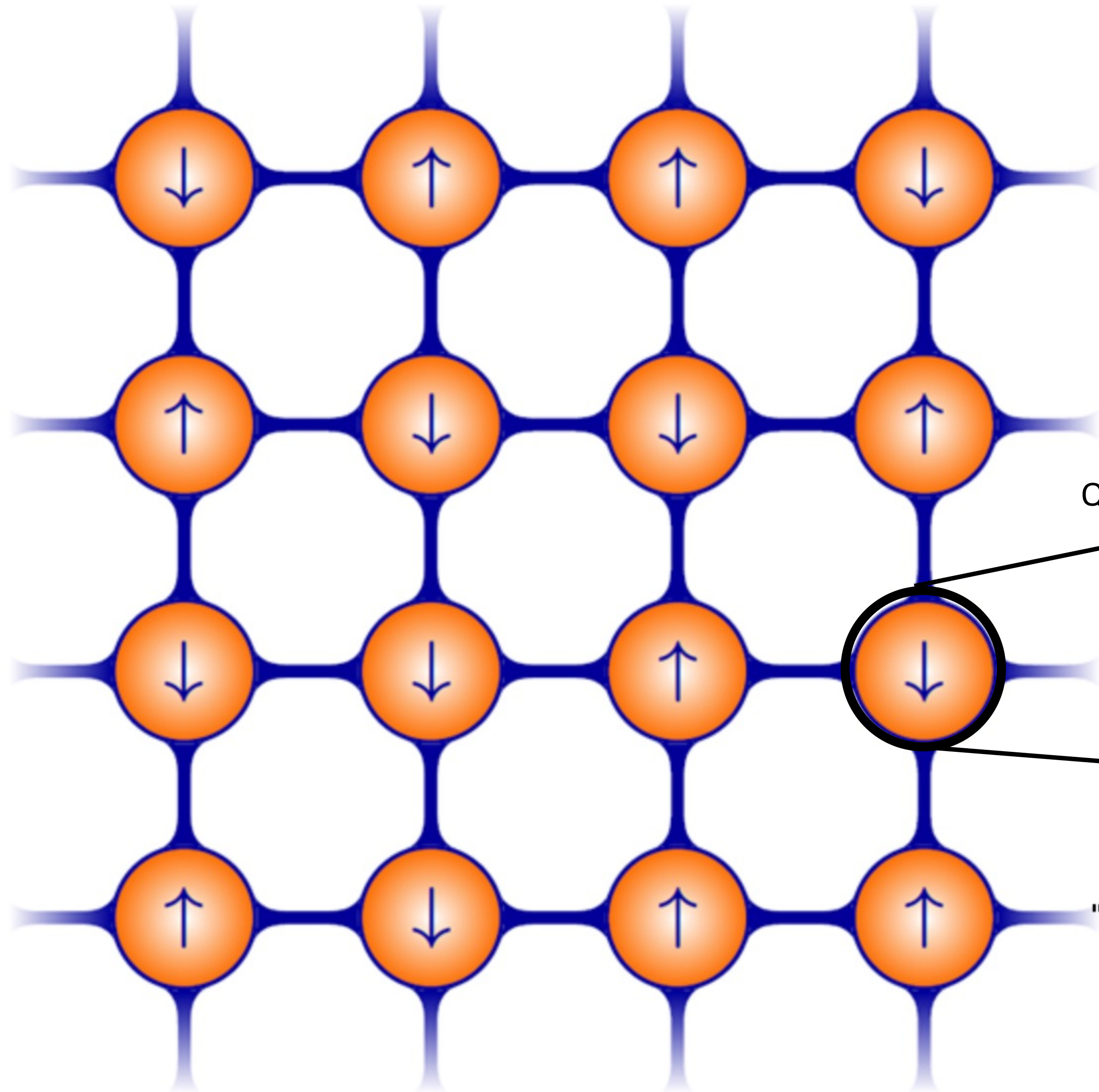
1 = Light on

Digital Bit

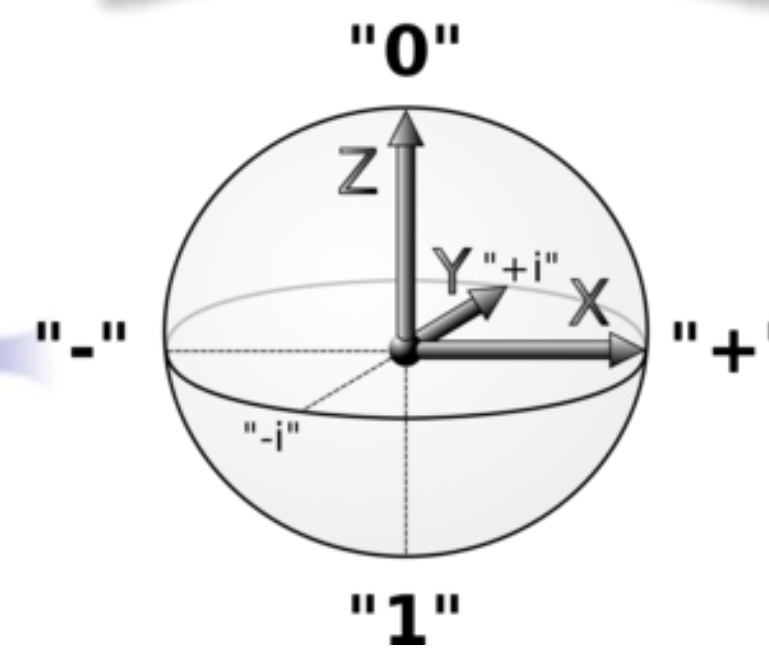
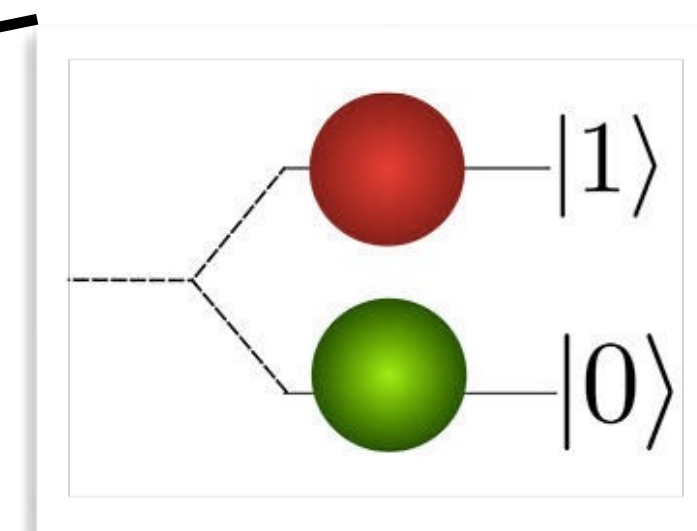




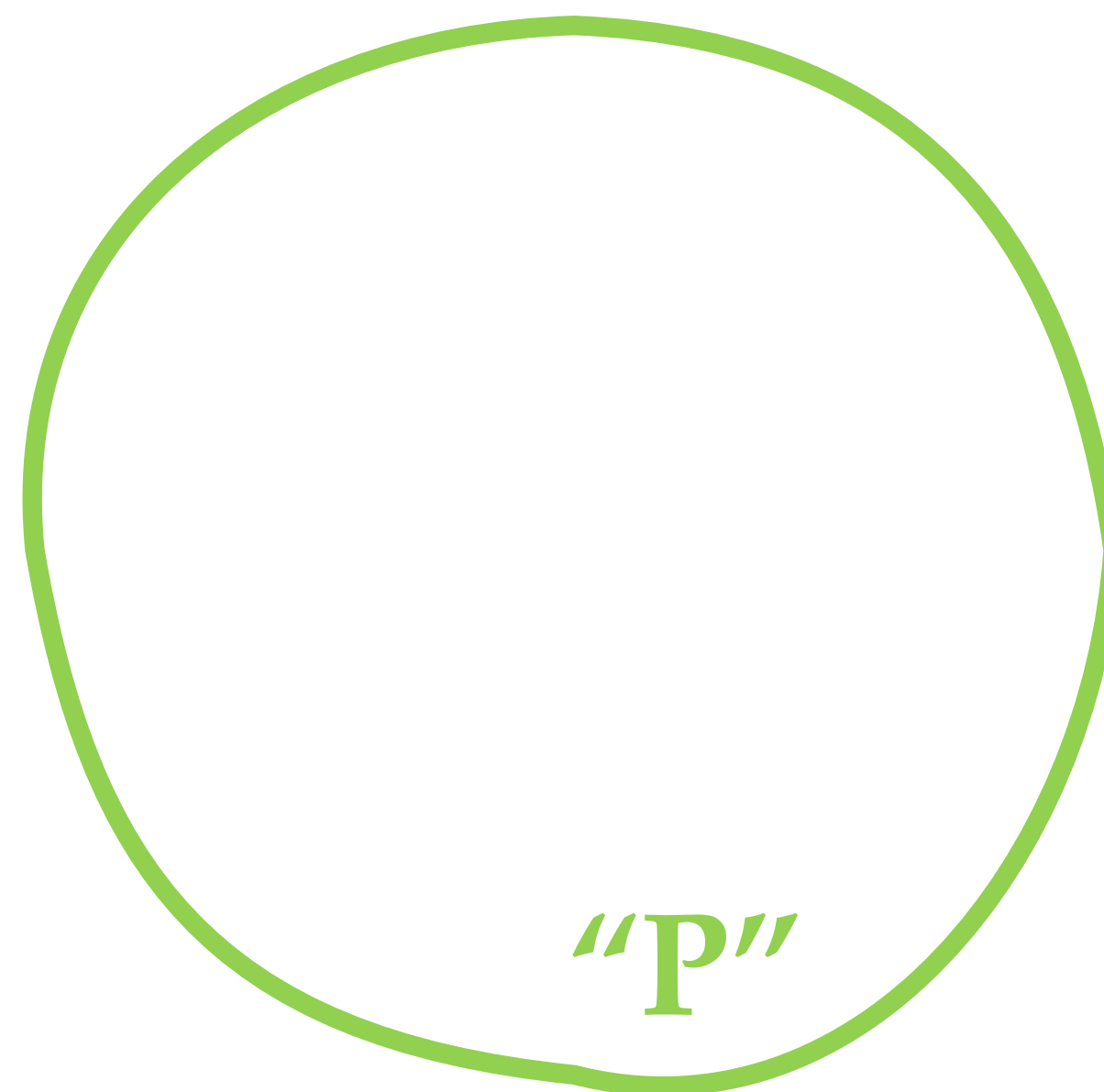
Digital Bit

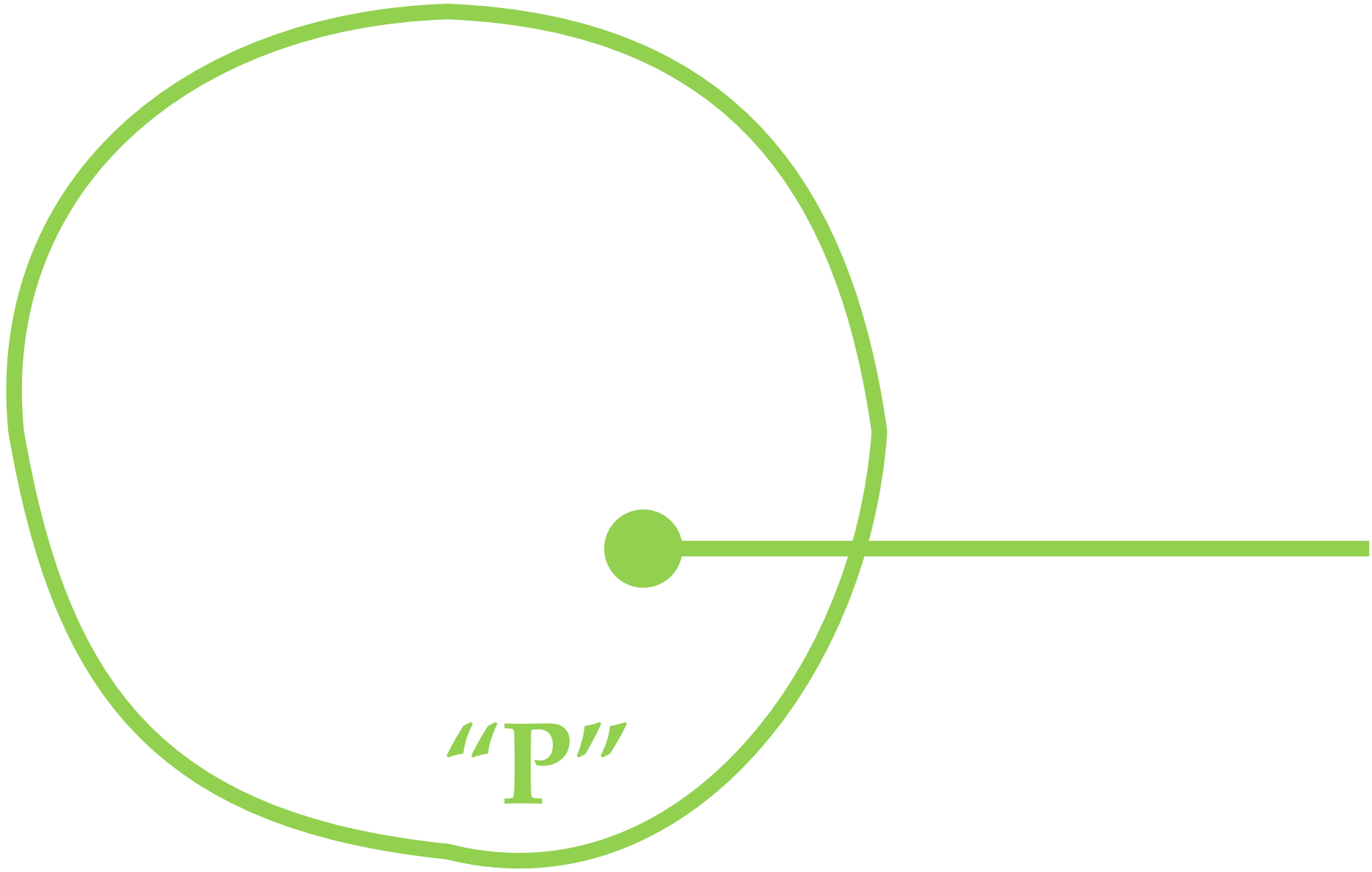
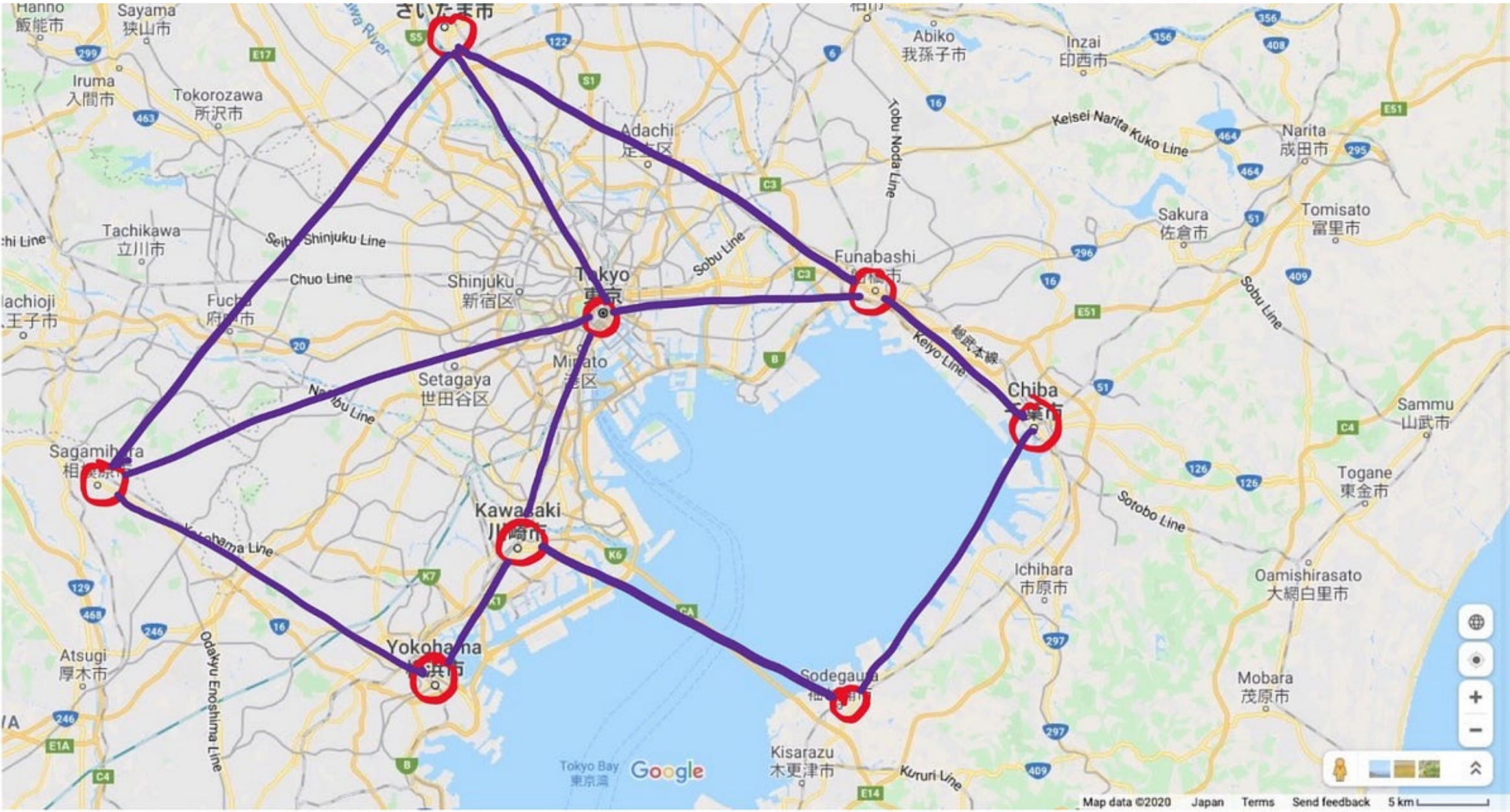


Quantum Bit: "Qubit"

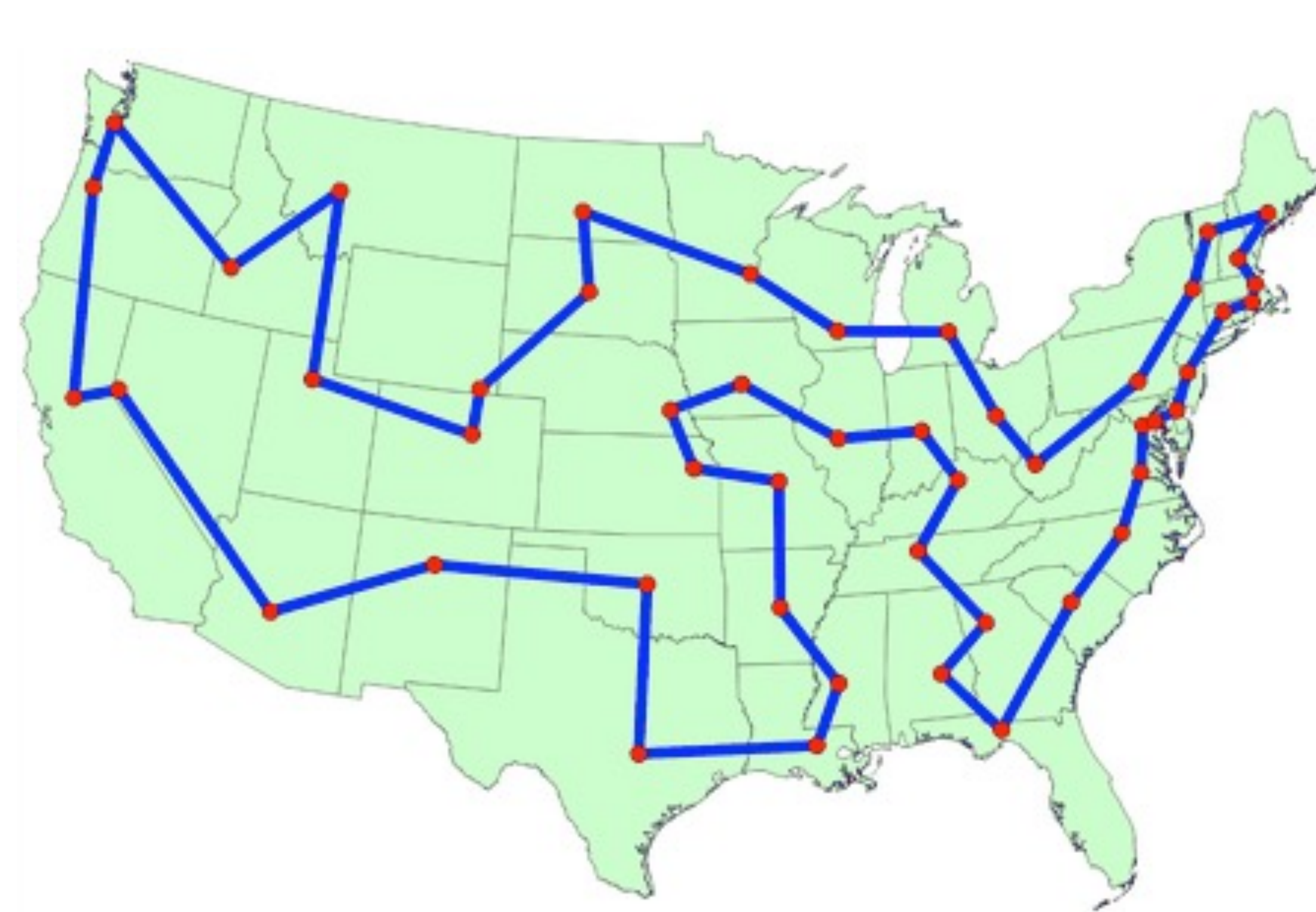


Big question: Why?

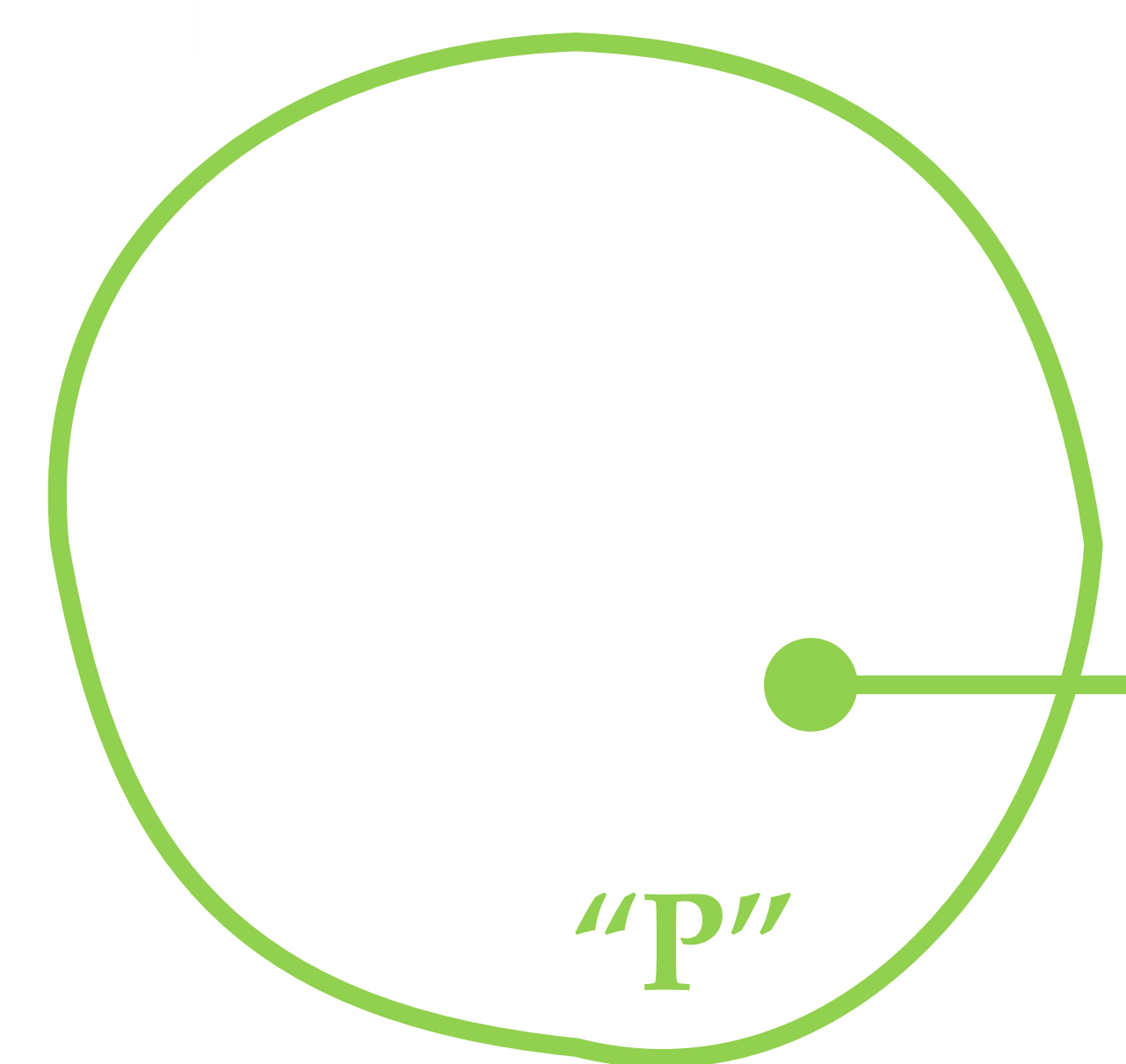




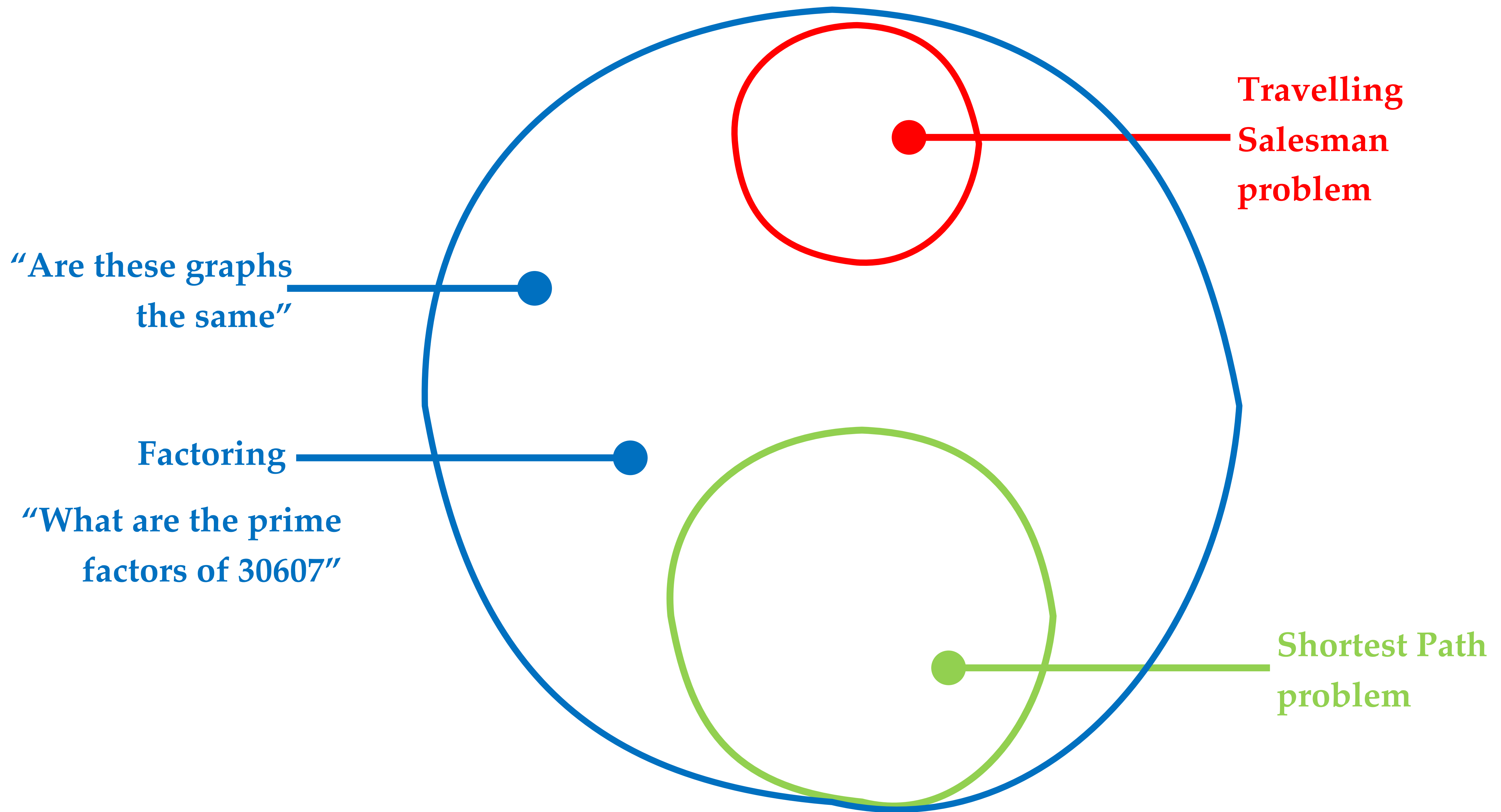
Shortest Path
problem

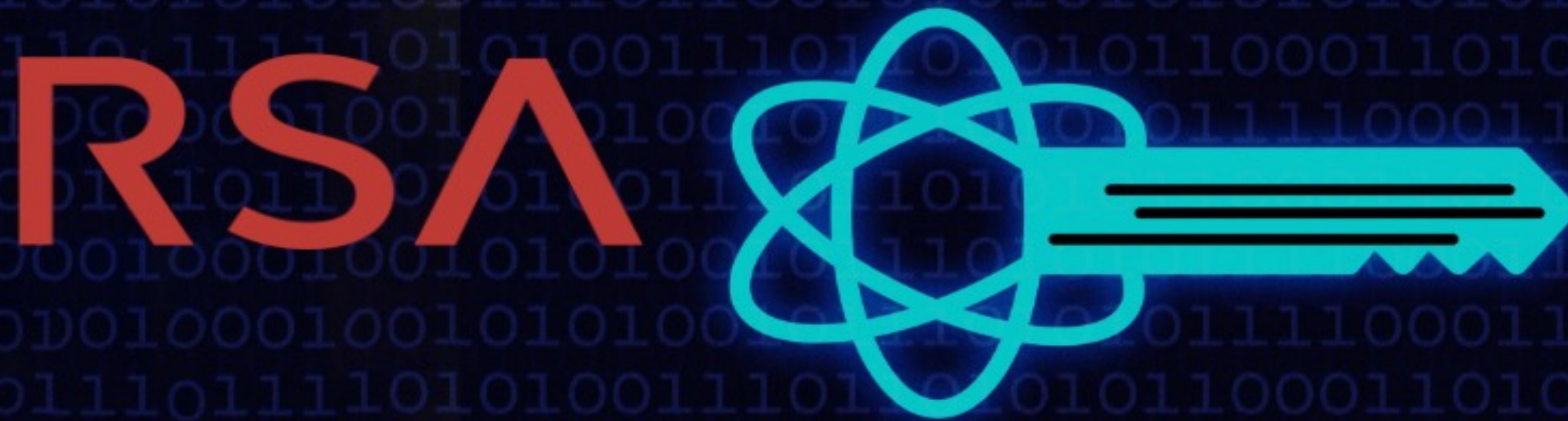


Travelling
Salesman
problem



Shortest Path
problem

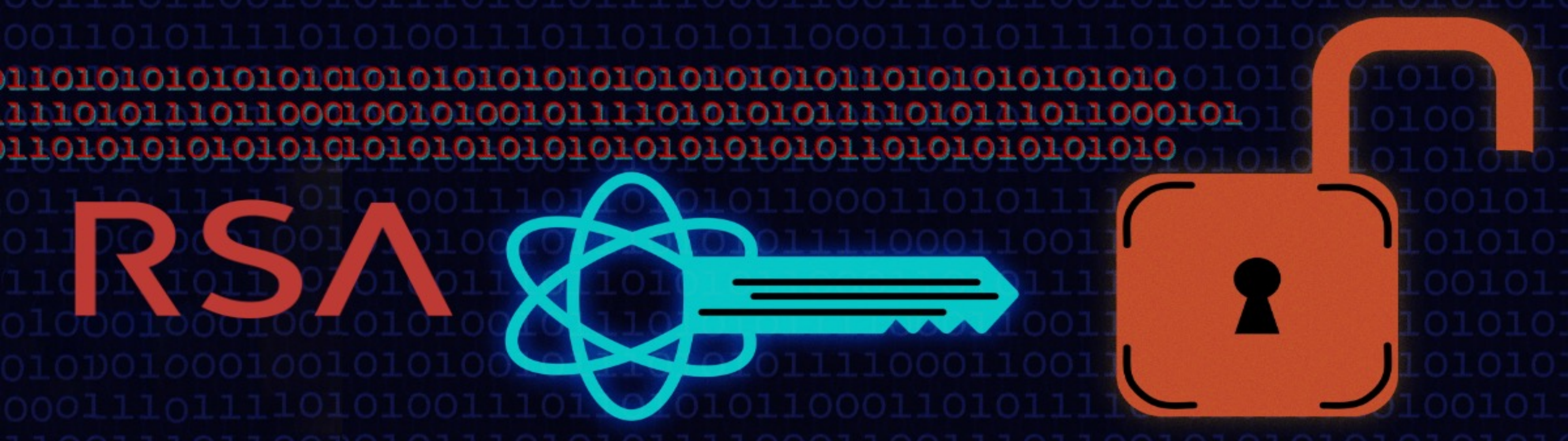




Factoring

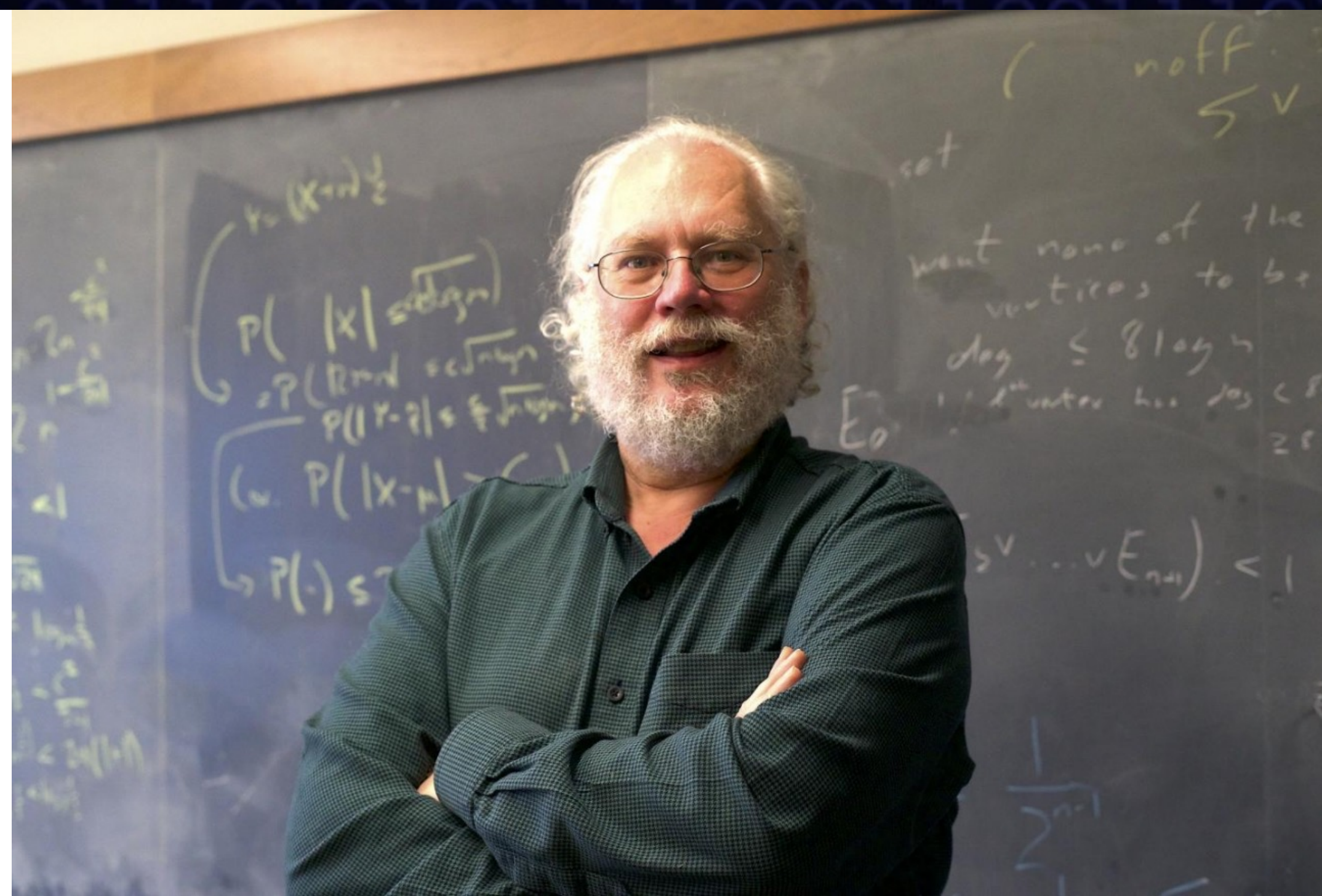
“What are the prime
factors of 30607”

Basis of modern cryptography



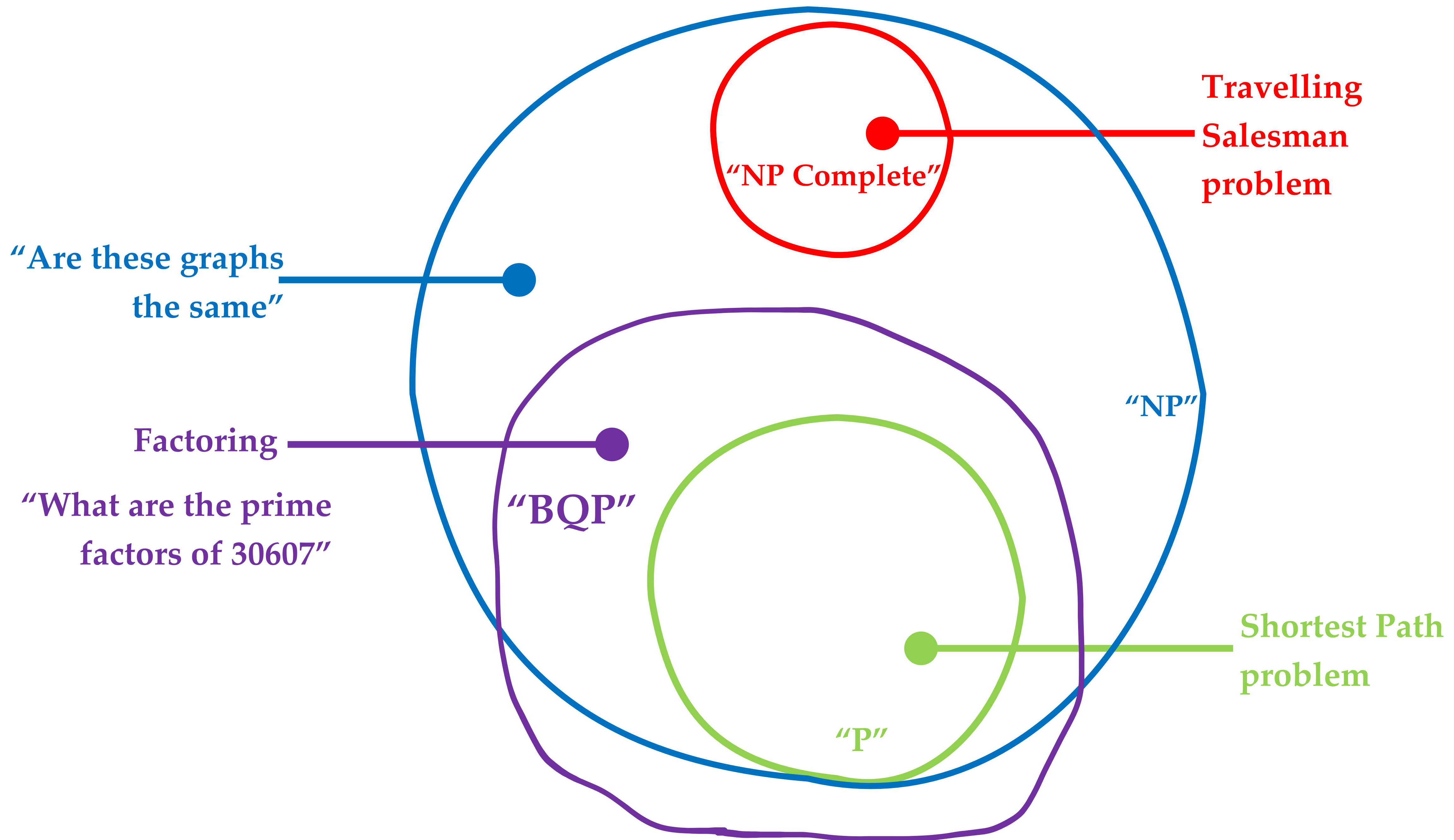
Factoring

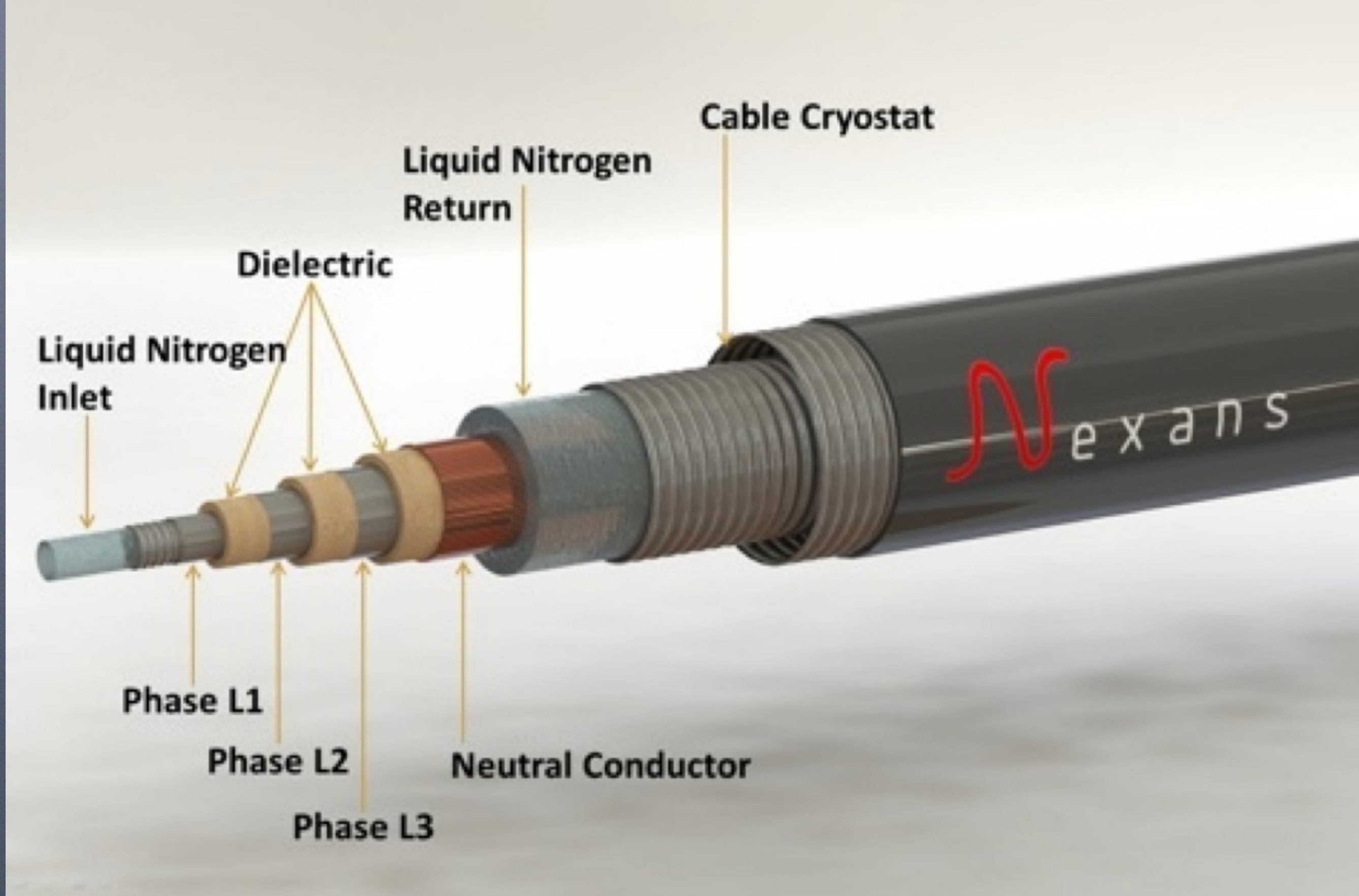
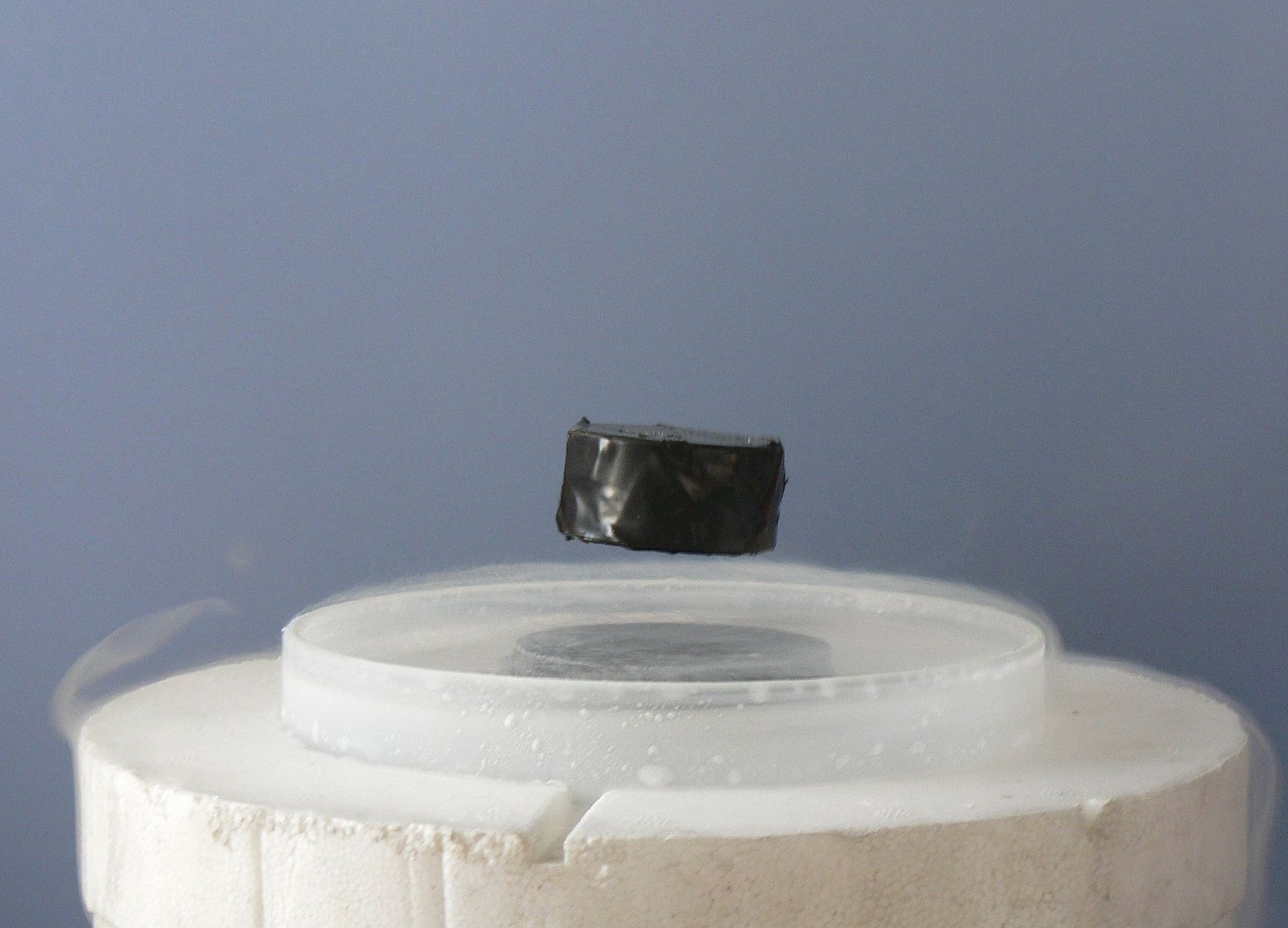
“What are the prime
factors of 30607”



**Shor's
Algorithm, 1994**

Quantum Computing!





**Materials Design.
Superconductors for:**

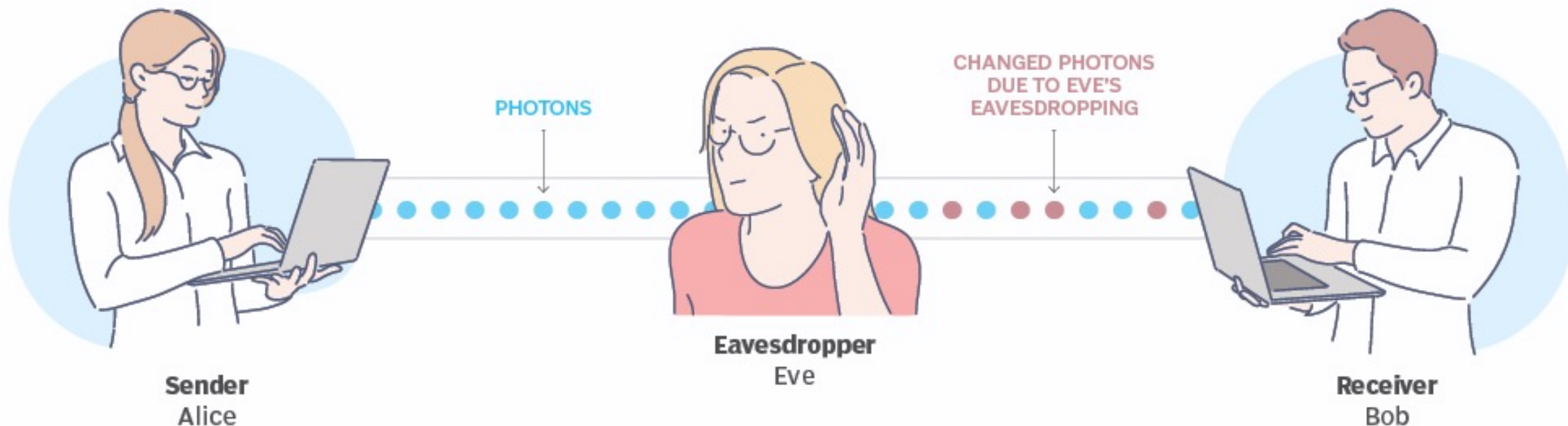
**Levitating trains?
Loss-less undersea cables?**



This Chemical Reaction Revolutionized Farming. It's Also Destroying the Planet.

Scientists are looking for a cleaner way to grow food.

Quantum cryptography model: The case of Alice, Bob and Eve





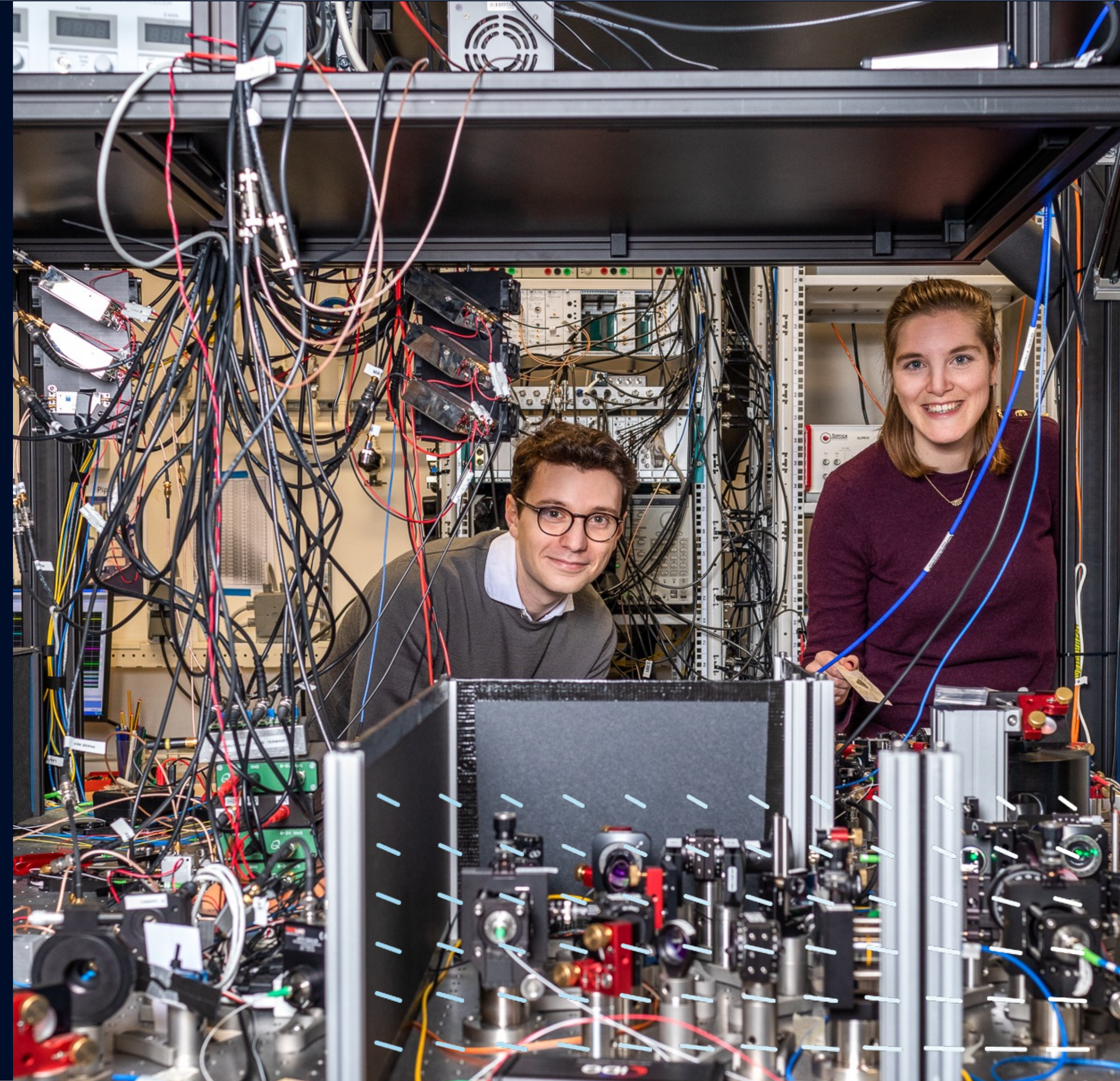
**A rudimentary quantum network link
between Dutch cities**

QuTech

*Creating the quantum future:
From world-class research to
world-changing innovation*

We perform world-class research leading to scalable prototypes of a quantum computer and a quantum internet, enabling and in close connection with a thriving quantum technology ecosystem

60 fte in 2014, 300 fte today



The IBM logo, consisting of the letters "IBM" in a blue, horizontally-striped font.The Google logo, with the word "Google" in its multi-colored sans-serif font.The Amazon logo, with the word "amazon" in a black, lowercase sans-serif font and a curved orange arrow underneath.

*Governments,
companies,
startups*

The BlueFors logo, featuring a small blue circle with a white dot inside, followed by the words "BLUE" and "FORS" in a bold, black, sans-serif font.The Atlantic Quantum logo, featuring a stylized blue "Q" icon above the words "ATLANTIC" and "QUANTUM" in a black, sans-serif font.The D-Wave logo, featuring the word "D-WAVE" in a bold, black, sans-serif font, with "The Quantum Computing Company™" in a smaller font below it.The OQC logo, featuring the letters "OQC" in a white, sans-serif font on a black background.The Qblox logo, featuring a stylized blue cube icon followed by the word "QBLOX" in a blue, sans-serif font.The Quantum Motion logo, featuring a red circle with a white dot inside, followed by the words "QUANTUM" and "MOTION" in a black, sans-serif font.The Rigetti logo, featuring the word "rigetti" in a teal, lowercase, sans-serif font.The Dirac logo, featuring a stylized brown icon followed by the word "dirac" in a black, lowercase, sans-serif font.The Delft Circuits logo, featuring a stylized blue icon followed by the words "Delft Circuits" and "Hardware for quantum engineers" in a blue, sans-serif font.



THIS MACHINE
CAN SOLVE
PROBLEMS
IN SECONDS
THAT USED TO
TAKE YEARS

THE
FUTURE OF
COMPUTING
IS HERE
by
**CHARLIE
CAMPBELL**

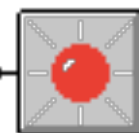
+
INTEL
CEO PAT
GELSINGER
ON THE
RISKS OF AI

Tech for Impact:

*How can we accelerate
the quantum
revolution?*

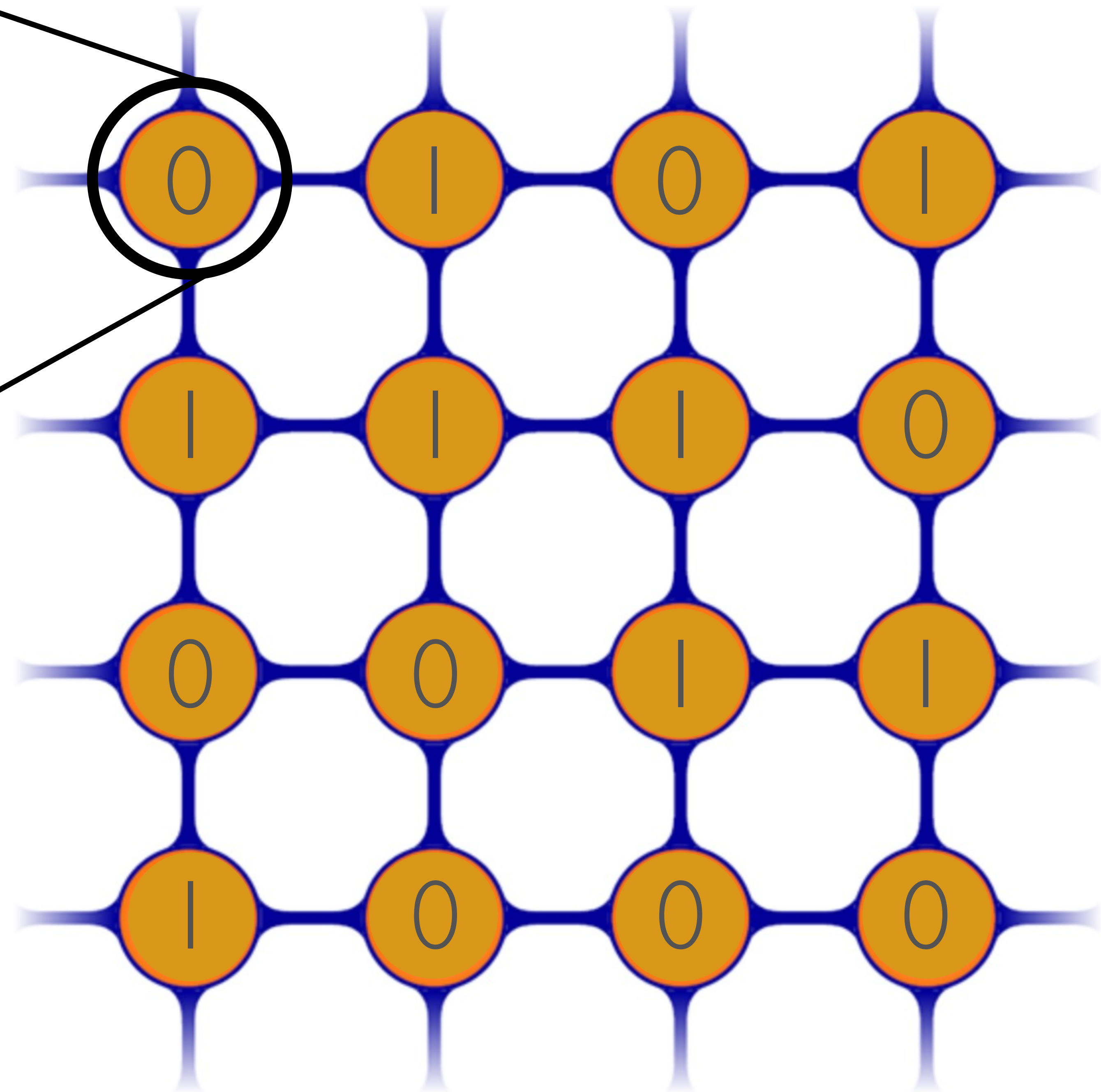


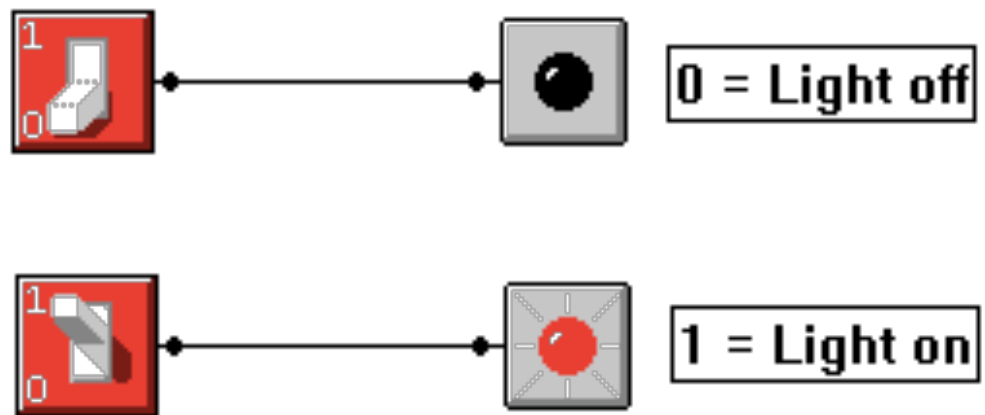
0 = Light off



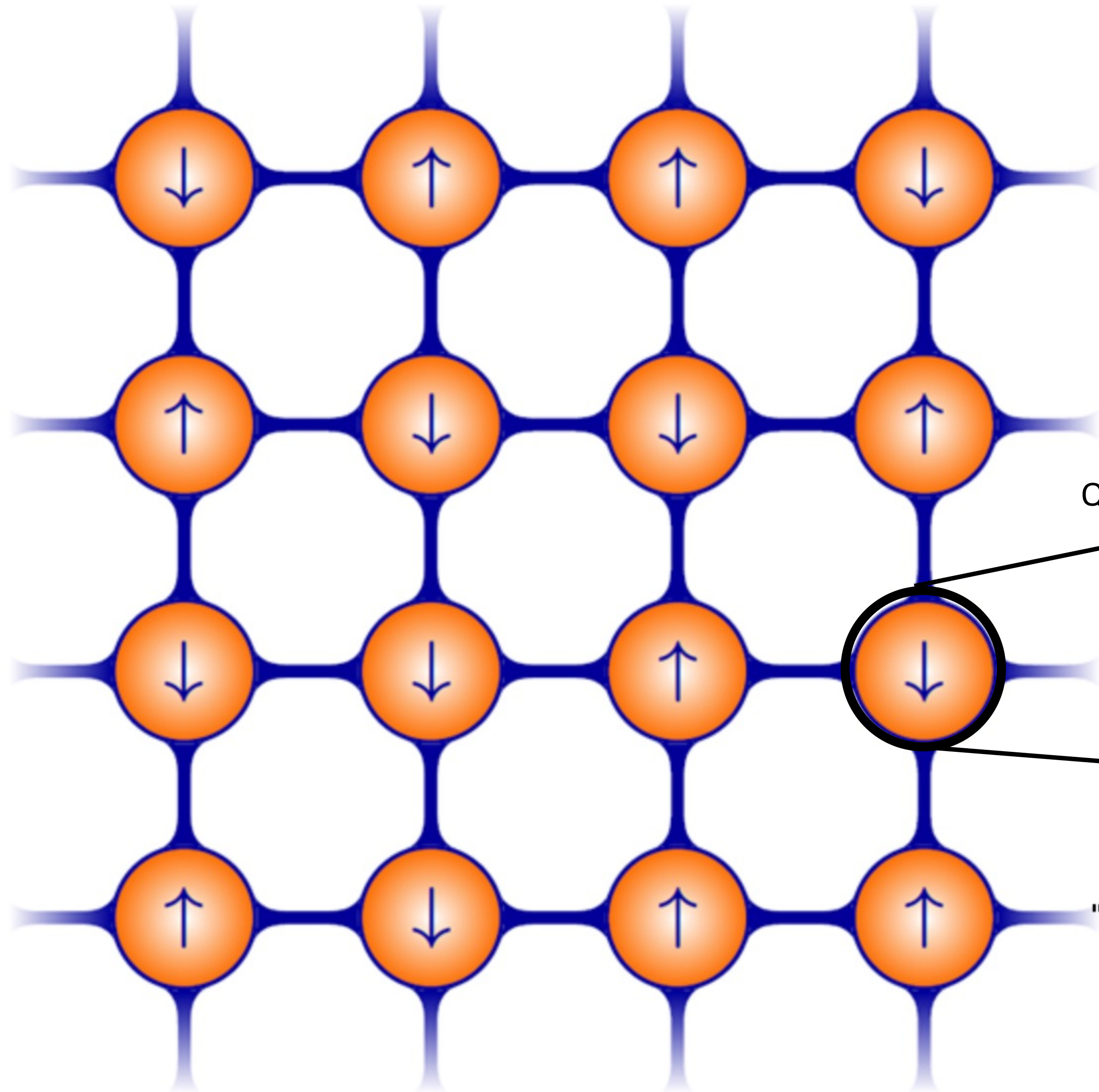
1 = Light on

Digital Bit

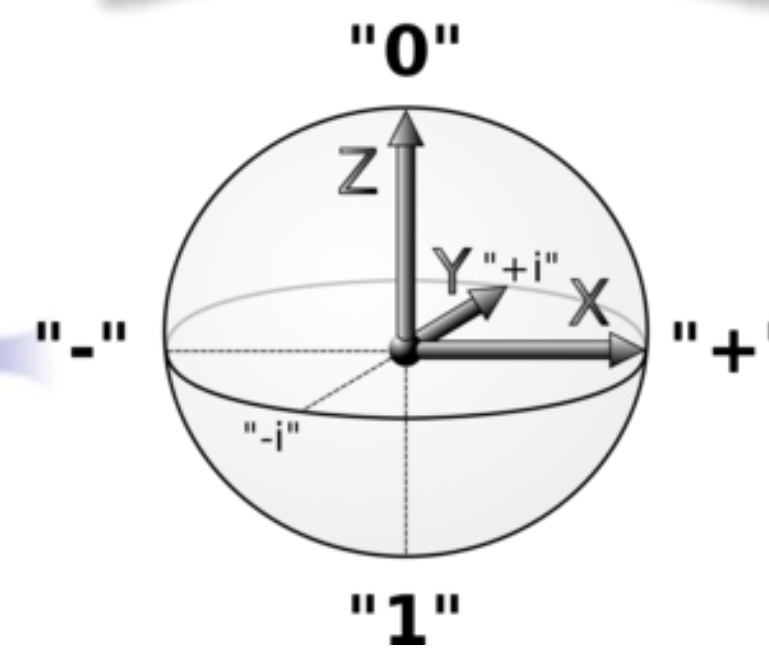
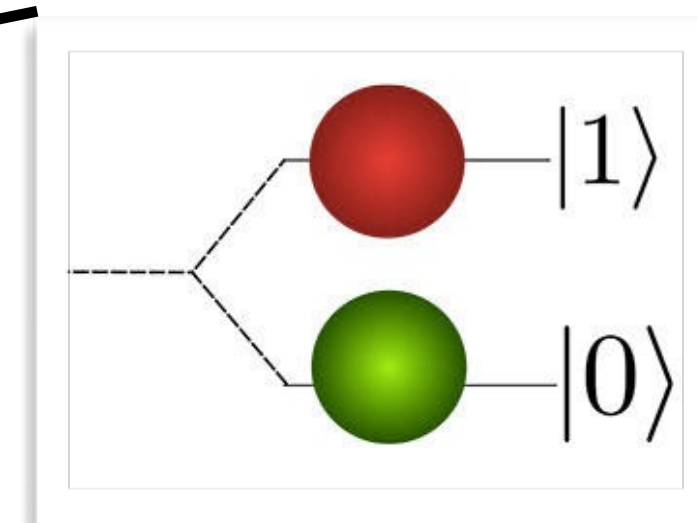


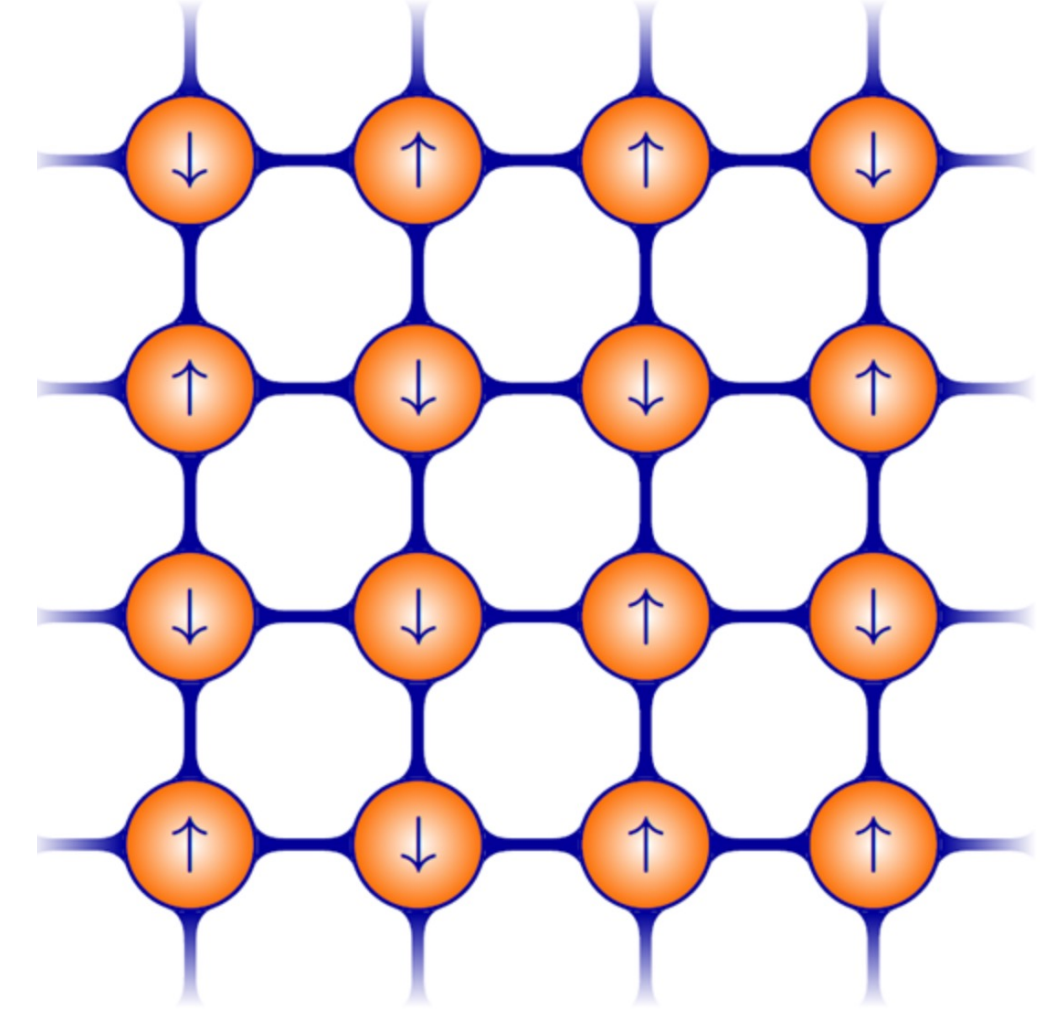
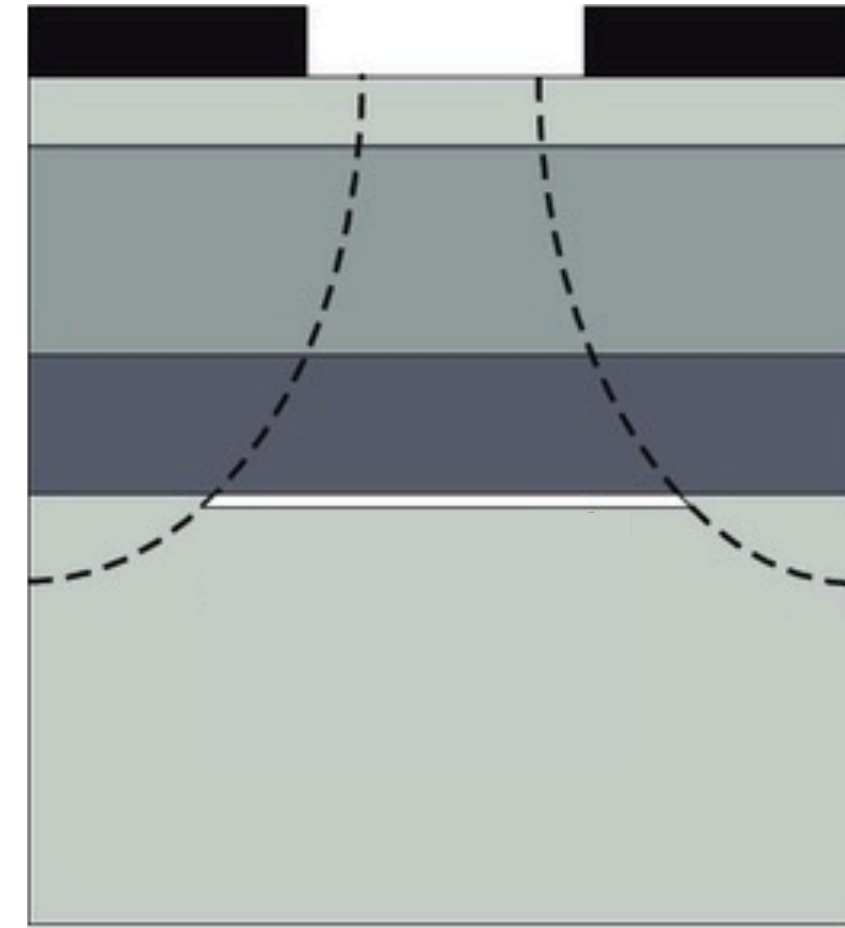
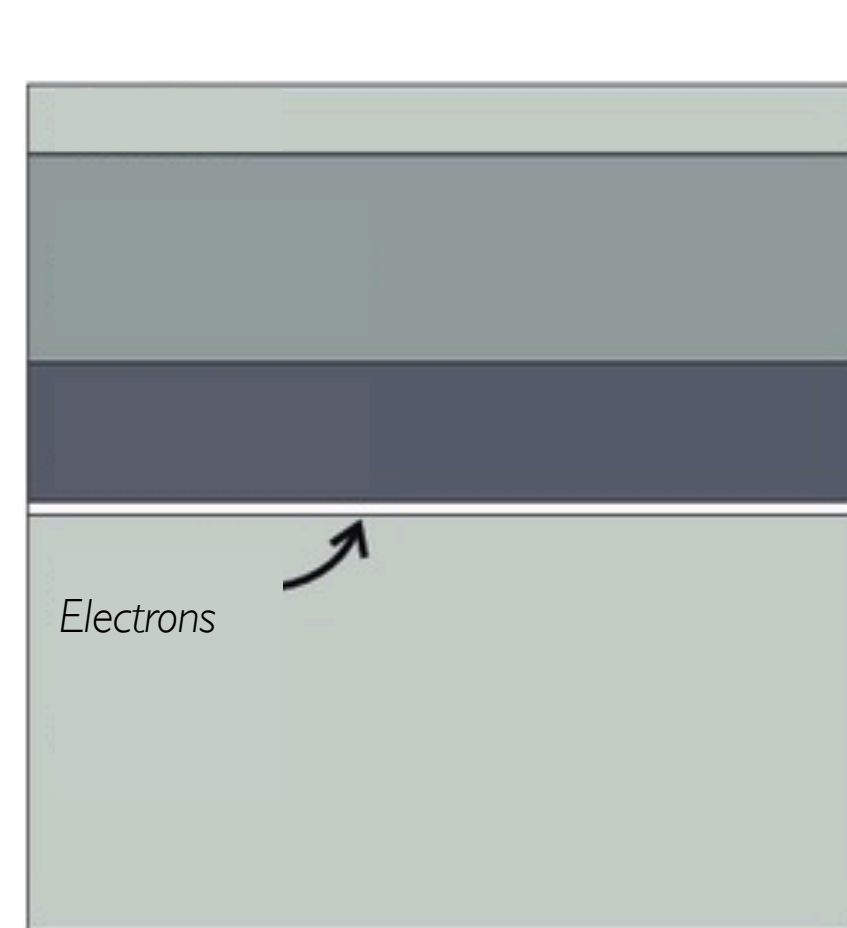
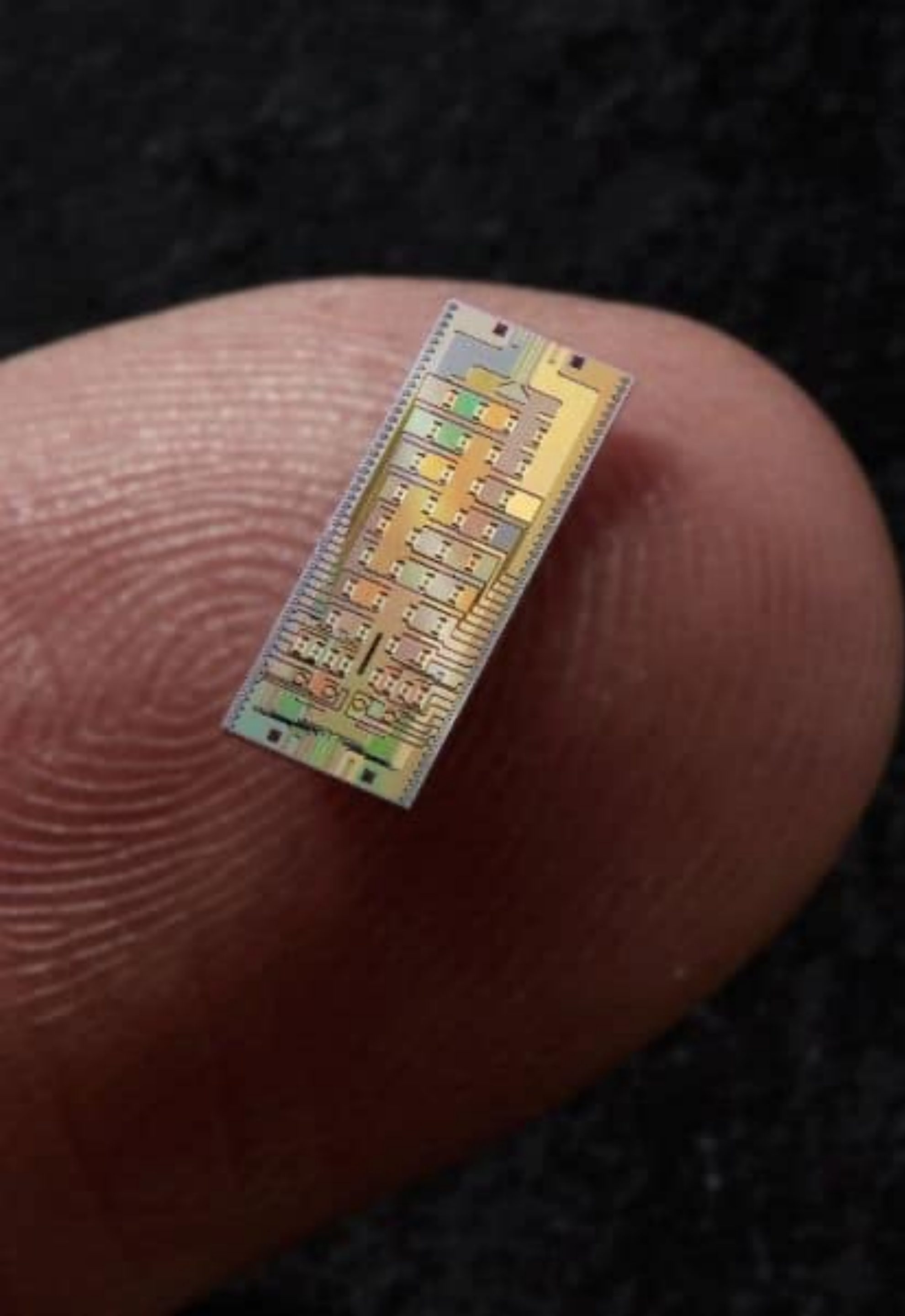


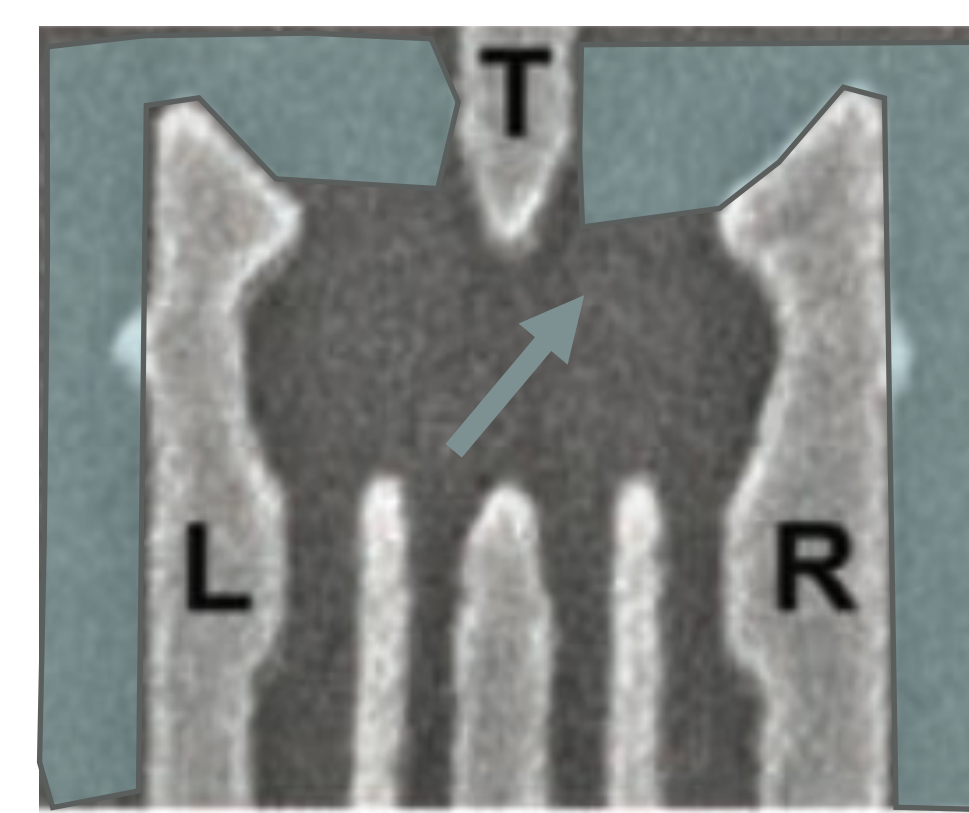
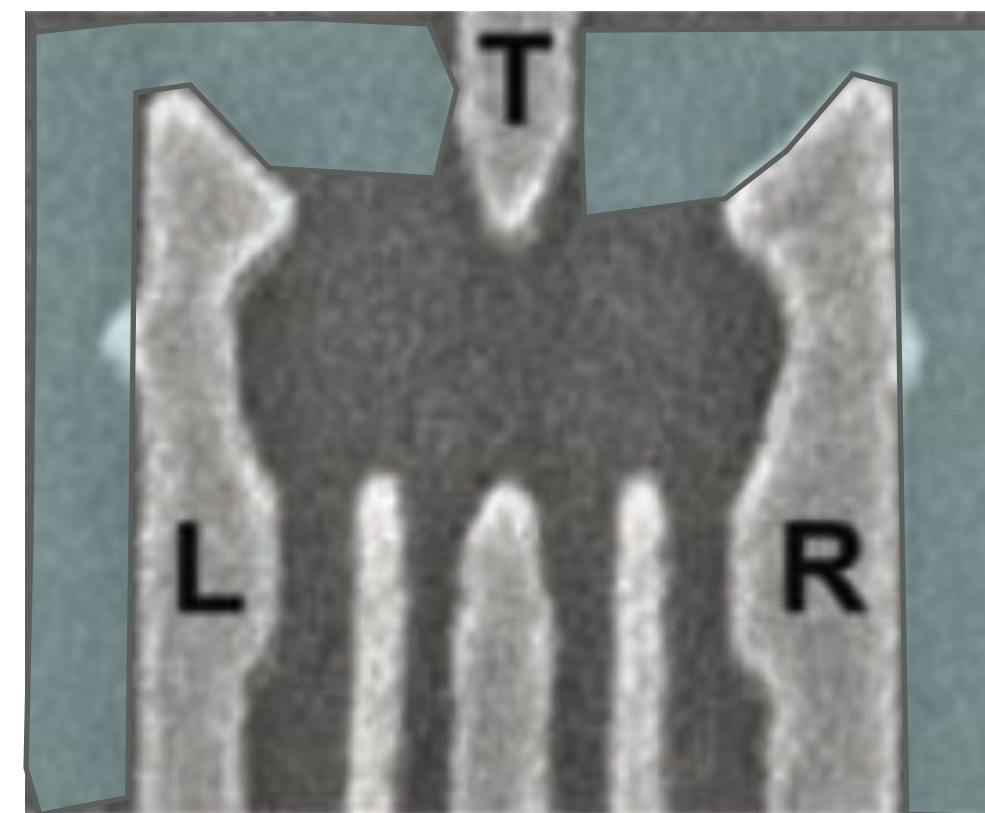
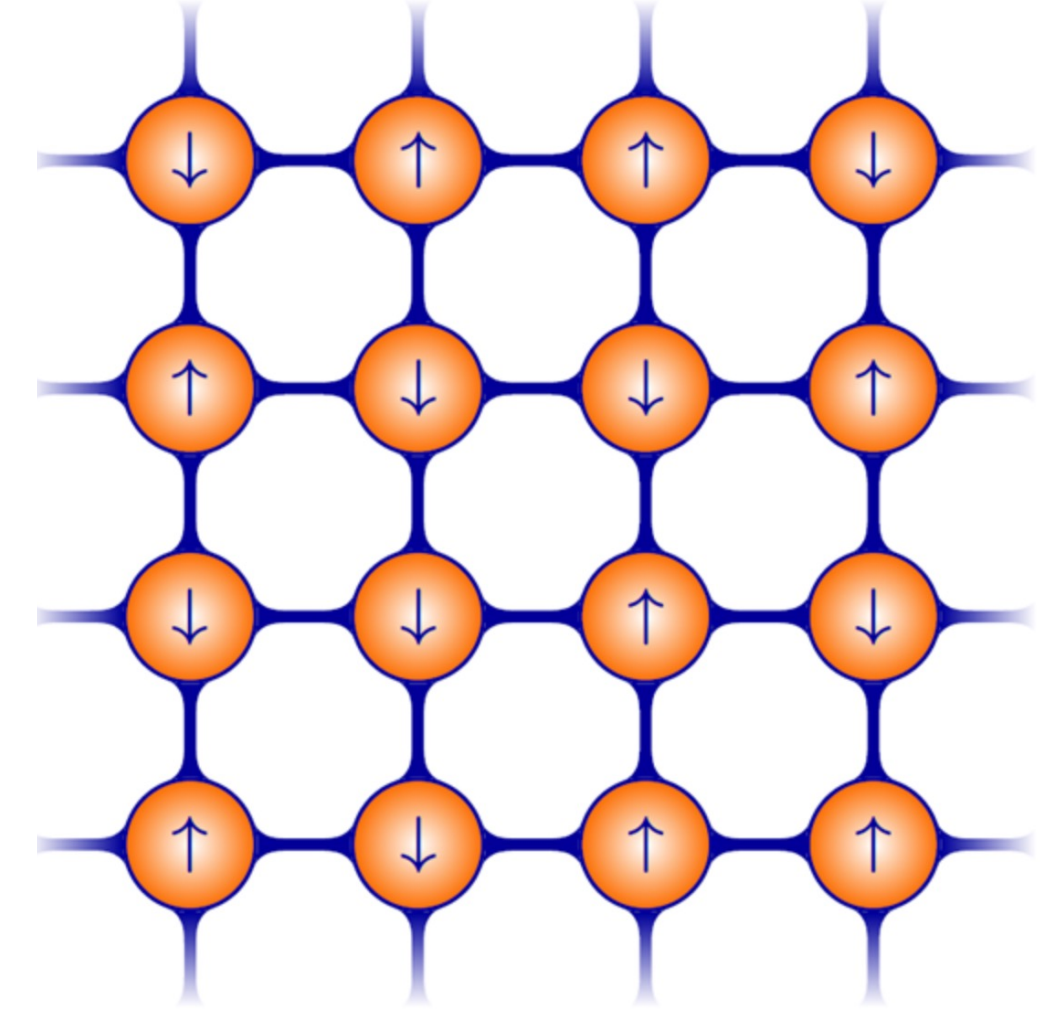
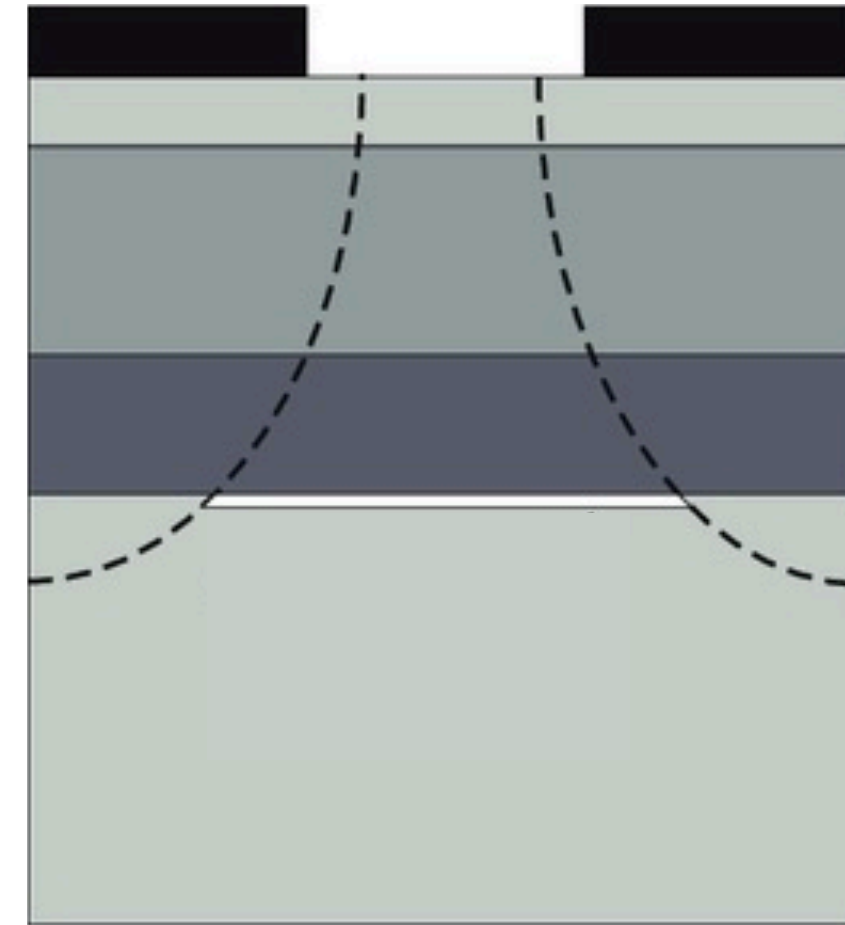
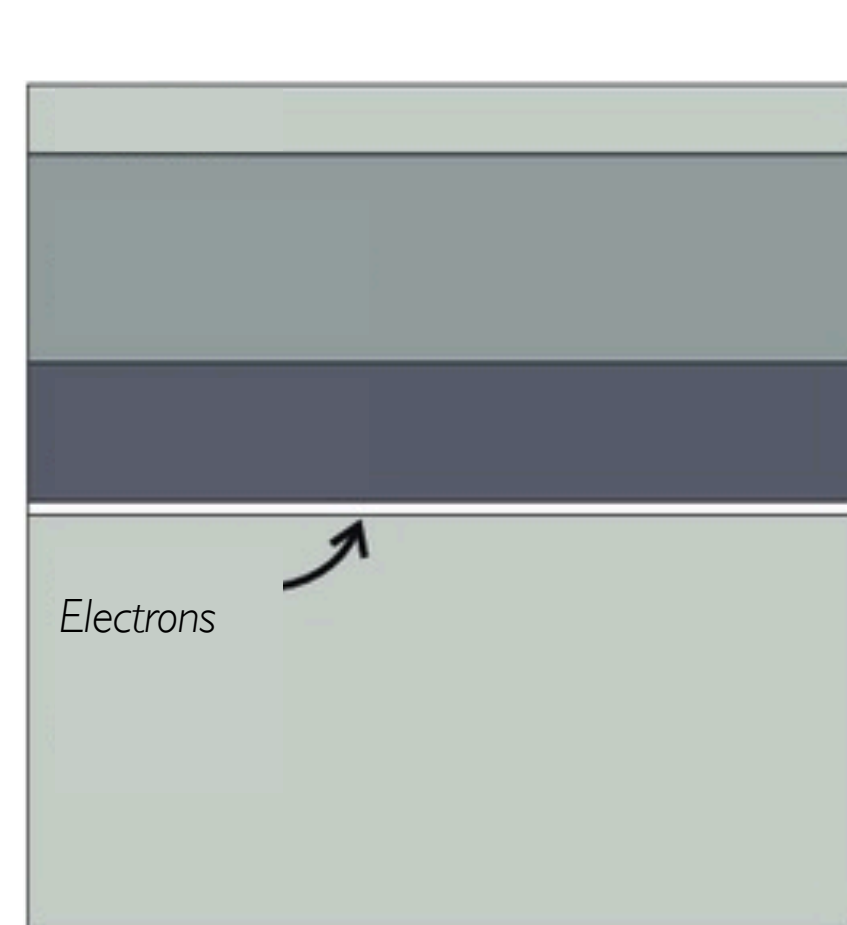
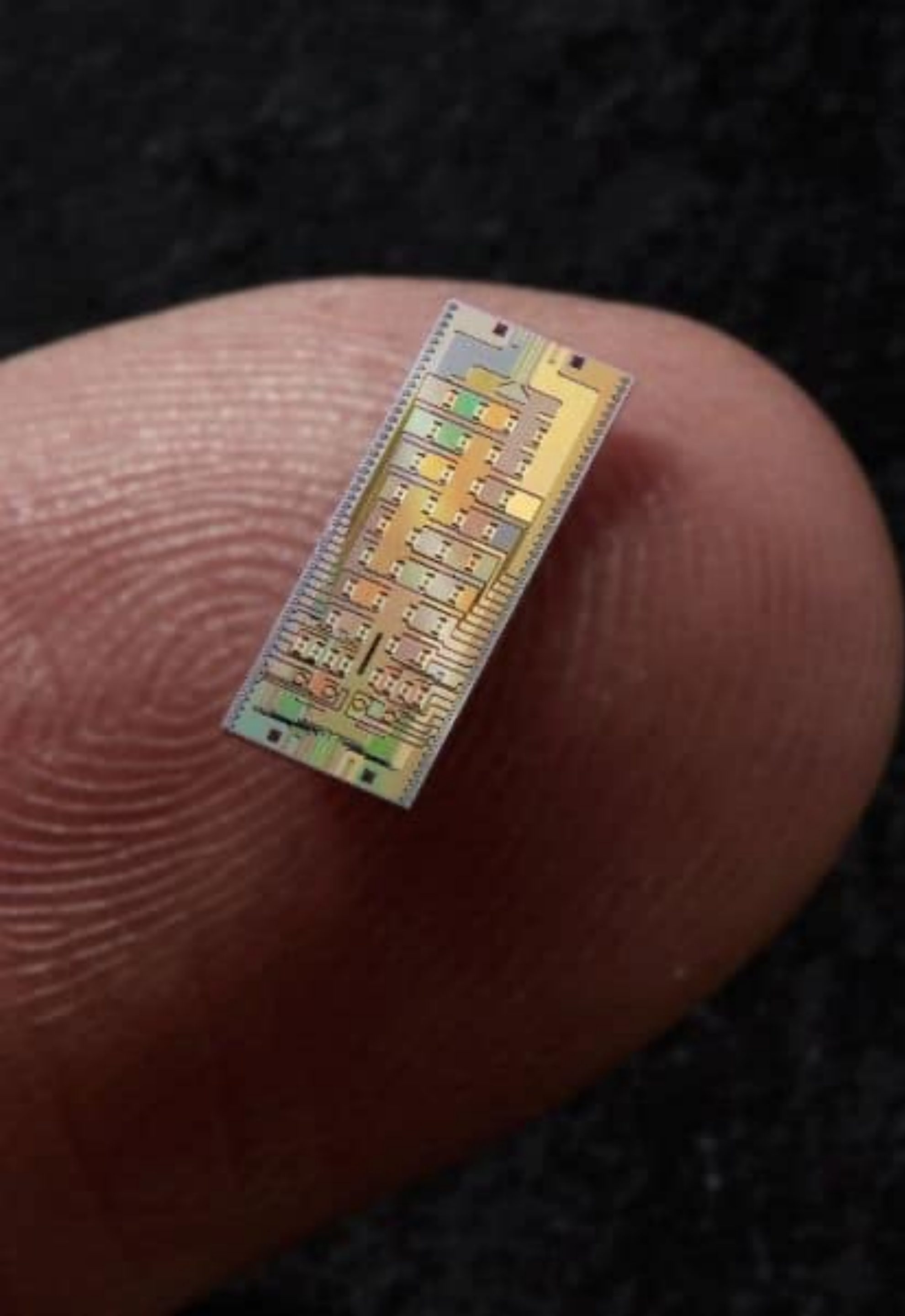
Digital Bit

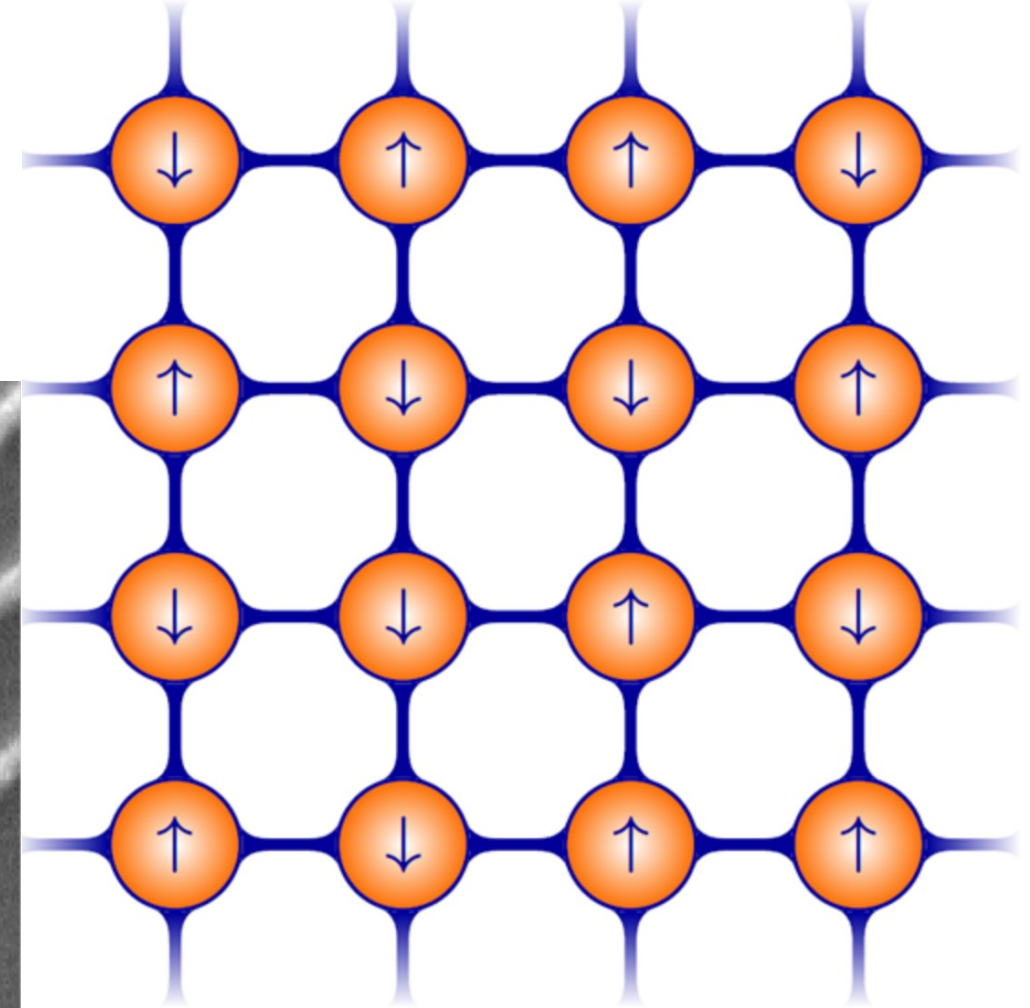
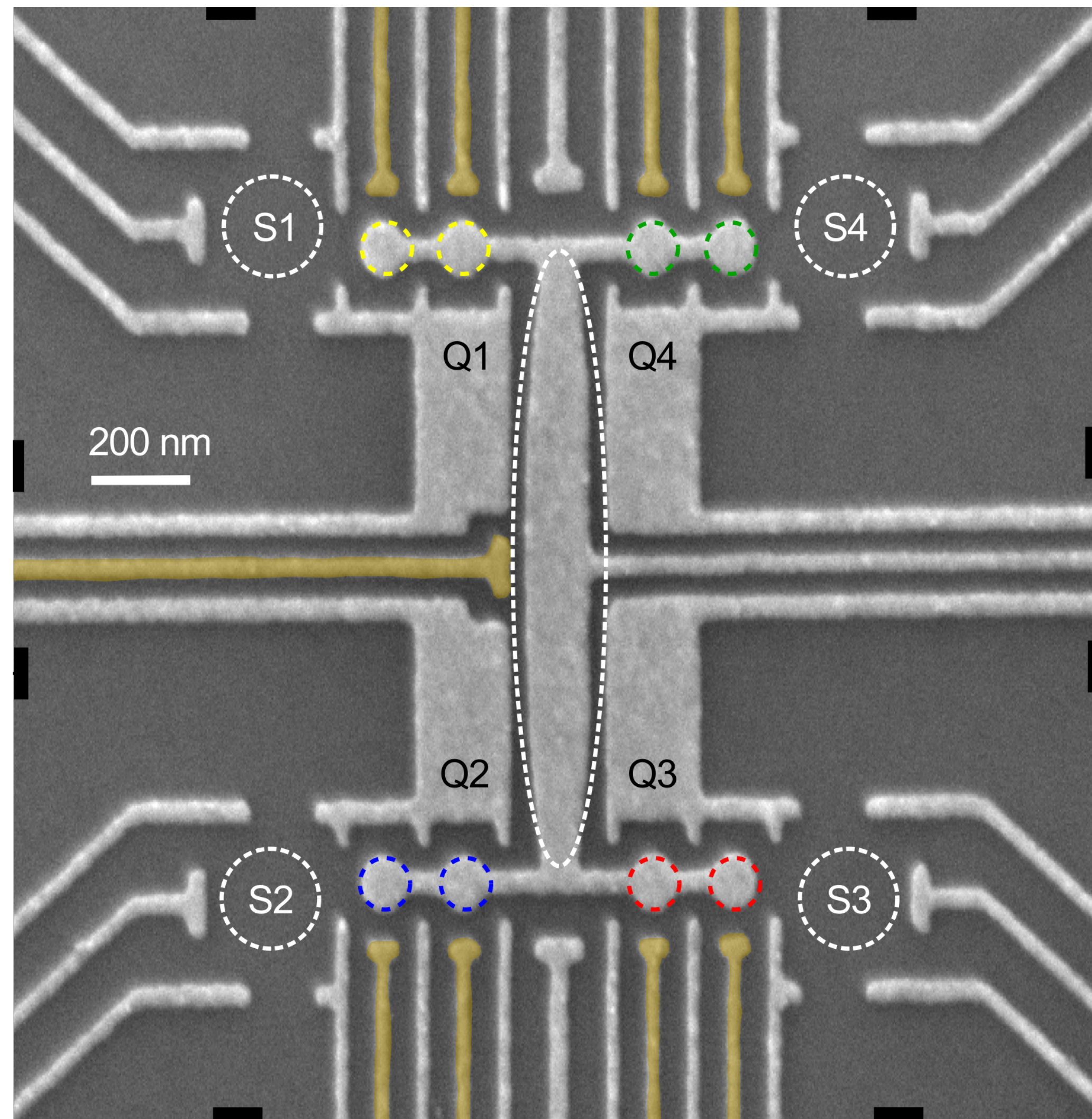
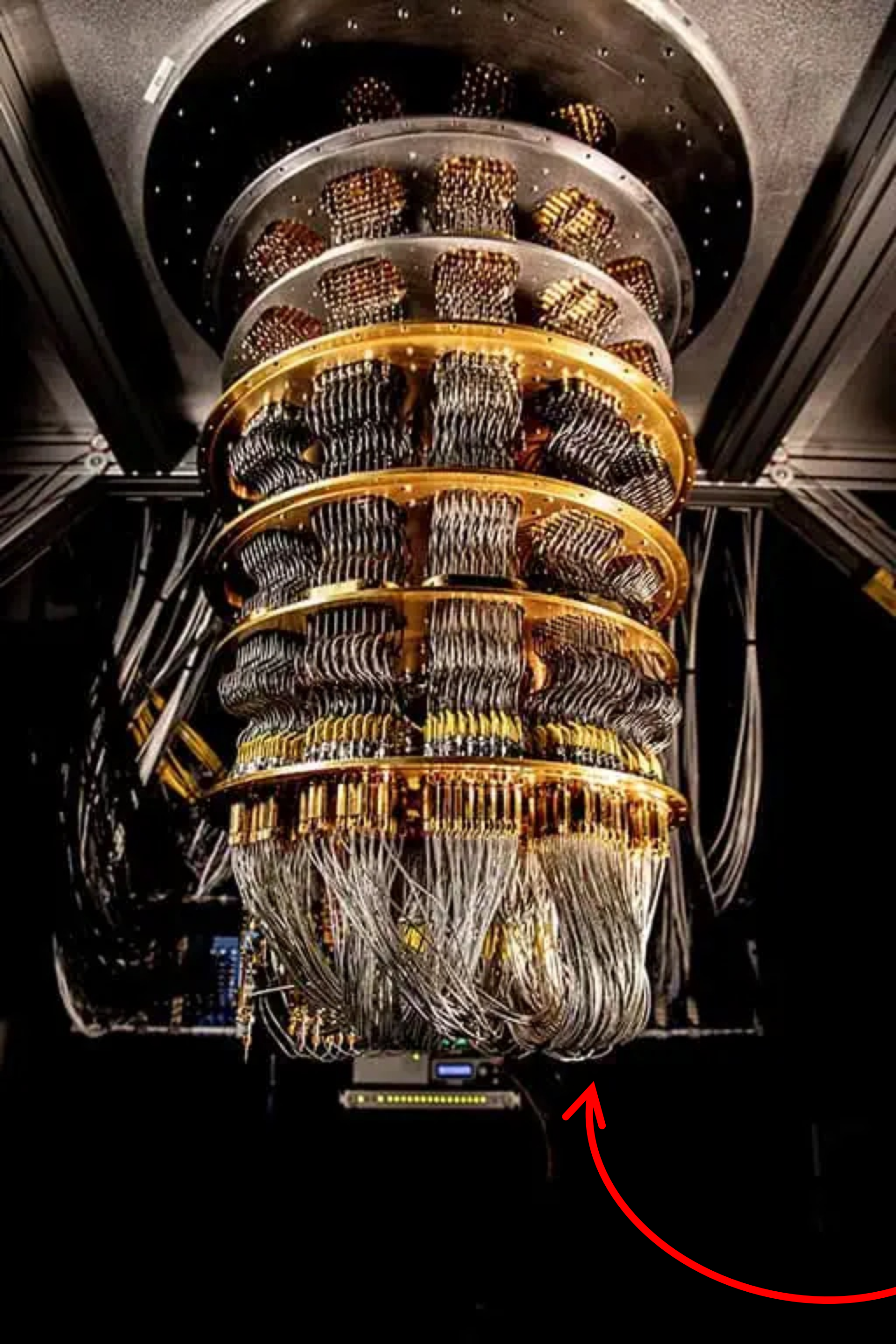


Quantum Bit: "Qubit"



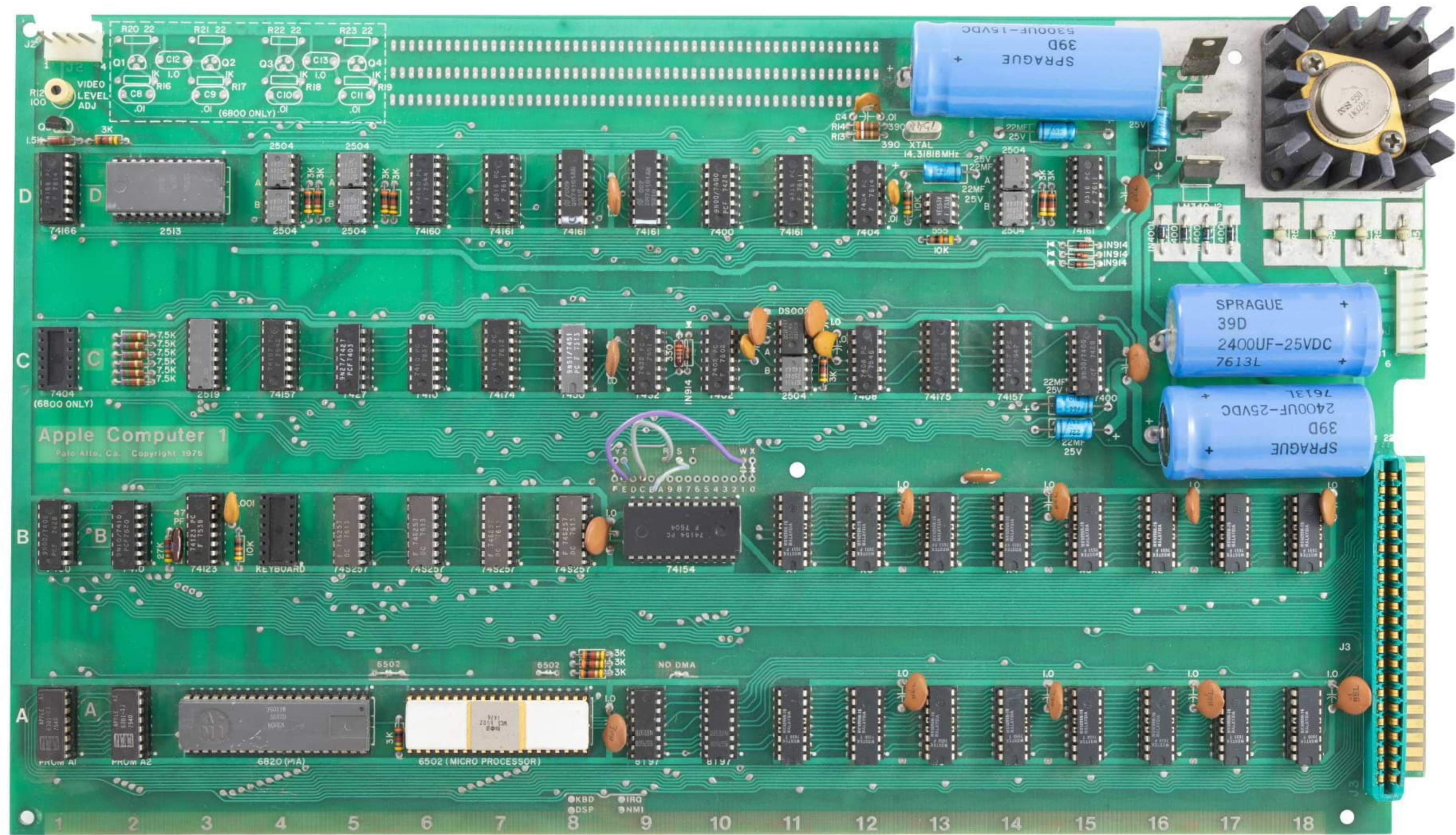






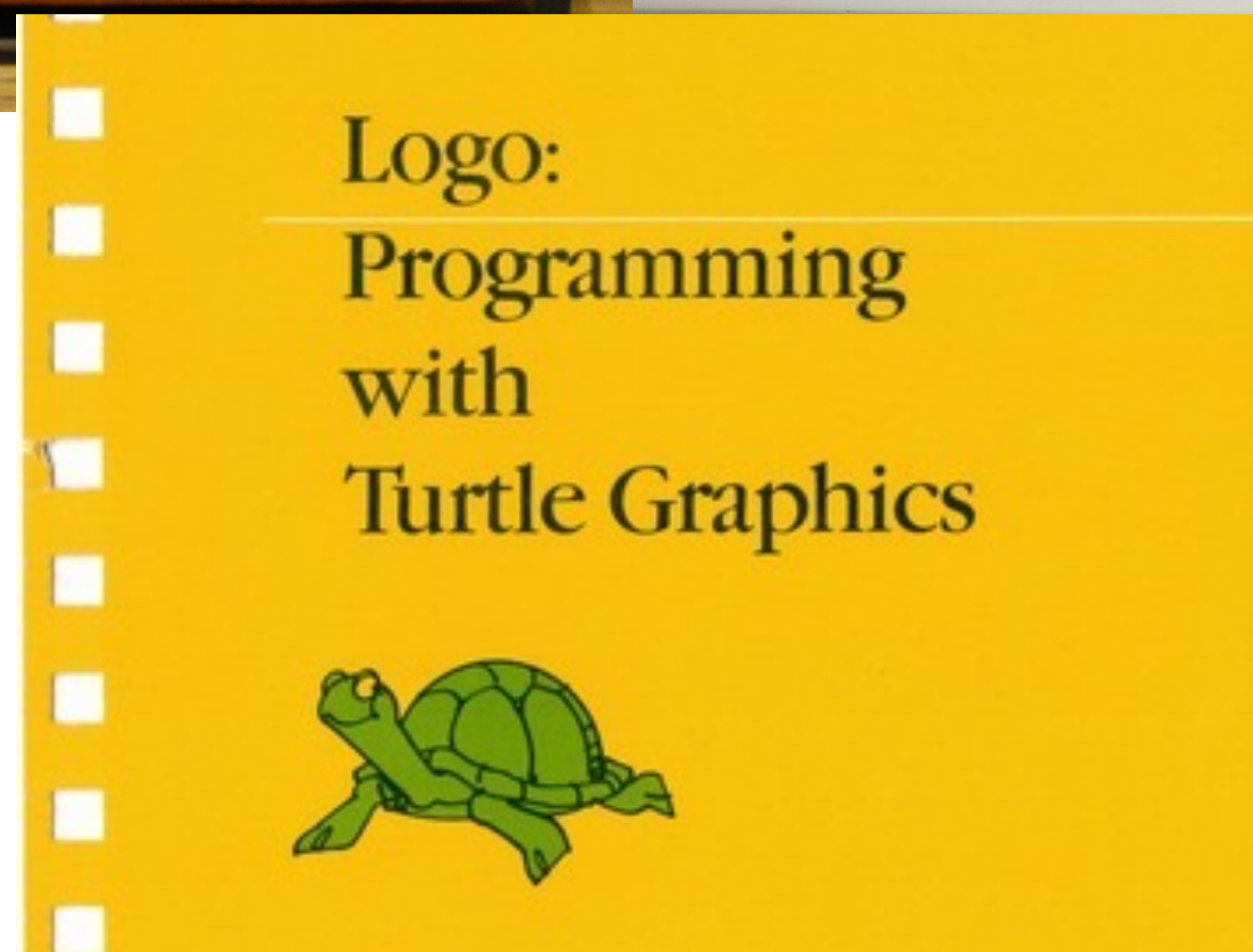
100 times colder than outer space!

APPLE-1



“First unit produced was used in a high school math class”

Apple I computer, 1976



```

READY
>10 PRINT TAB(32);"HAMURABI"
>20 PRINT TAB(15);"CREATIVE COMPUTING M
ORRISTOWN, NEW JERSEY"
>30 PRINT:PRINT:PRINT
>80 PRINT "TRY YOUR HAND AT GOVERNING AN
CIENT SUMERIA"
>90 PRINT "FOR A TEN-YEAR TERM OF OFFICE
":PRINT
>95 D1=0: P1=0
>100 Z=0: P=95:S=2800: H=3000: E=H-S
>110 Y=3: A=H/Y: I=5: Q=1
>210 D=0
>215 PRINT:PRINT:PRINT "HAMURABI: I BEG
TO REPORT TO YOU,";Z=Z+1
>217 PRINT "IN YEAR";Z;" ";D;"PEOPLE STA
RUED,";I;"CAME TO THE CITY,"
>218 P=P+I
>227 IF Q>0 THEN 230
>228 P=INT(P/2)
>229 PRINT "A HORRIBLE PLAGUE STRUCK! H
ALF THE PEOPLE DIED."
>
  
```

"First unit produced was used in a high school math class"

Apple I computer, 1976



Drexel University, 1983



Get it into the students' hands!





QuTech Academy

Show filters

QuTech Academy

Lorentzweg 1
2628 CJ Delft
Netherlands

info-qutechacademy@tudelft.nl
www.qutech.nl/academy

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Design & development by Bureau Visueel

Quantum 101

Welcome to the world of quantum!

Measurements, entanglement, superposition, these are some concepts which are fundamental to quantum computers. Quantum is, in many ways, different from the world as you know it, and it can be a puzzling subject to start learning about. Here we introduce some of these essential concepts so that you are ready to dive right into the World of Quantum and take the first steps in becoming a quantum expert!

The Building Blocks of a Quantum Computer | DelftX on edX





Watch on  YouTube

Introducing: the Qubit

Controllability of Qubits

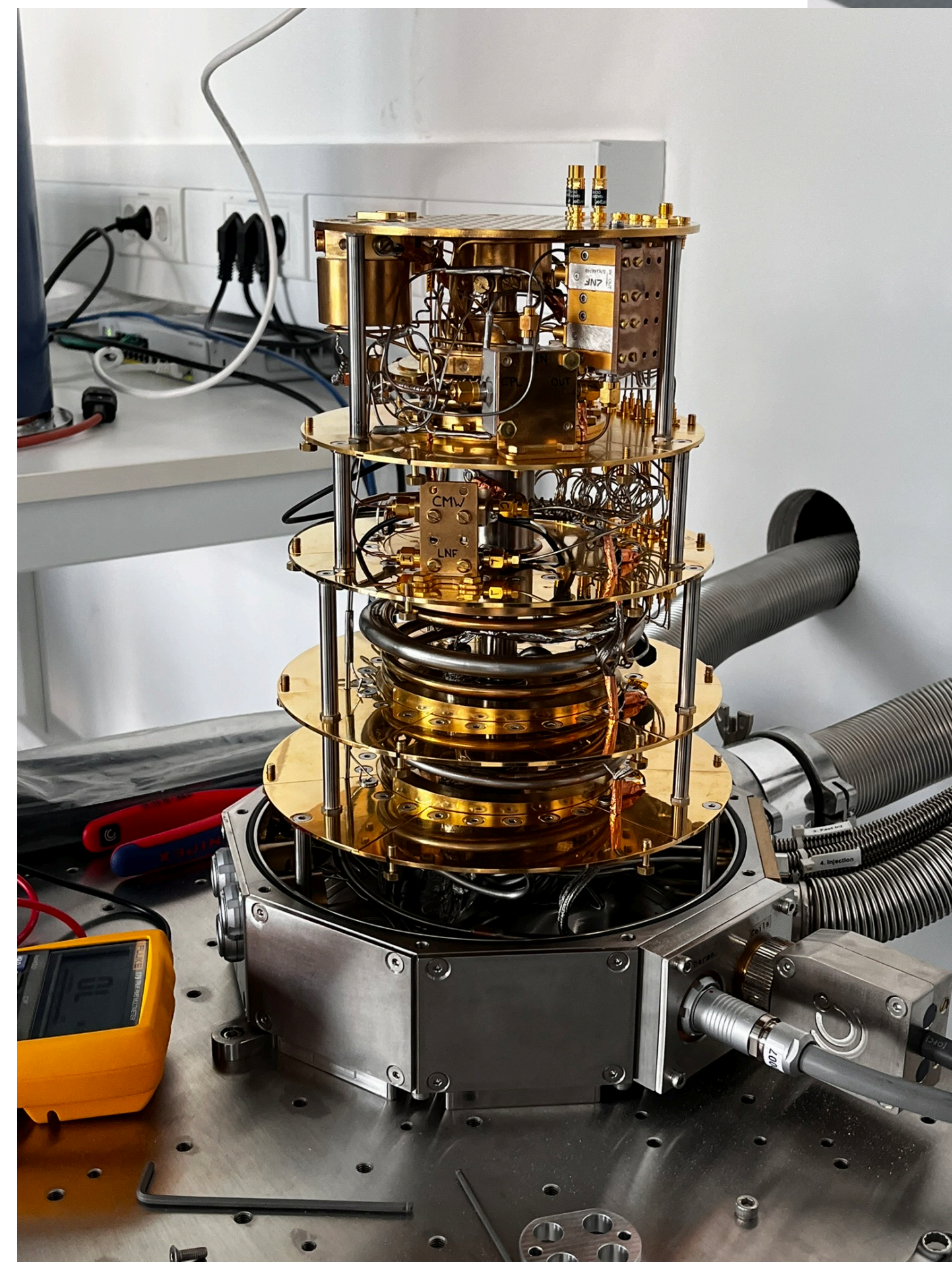
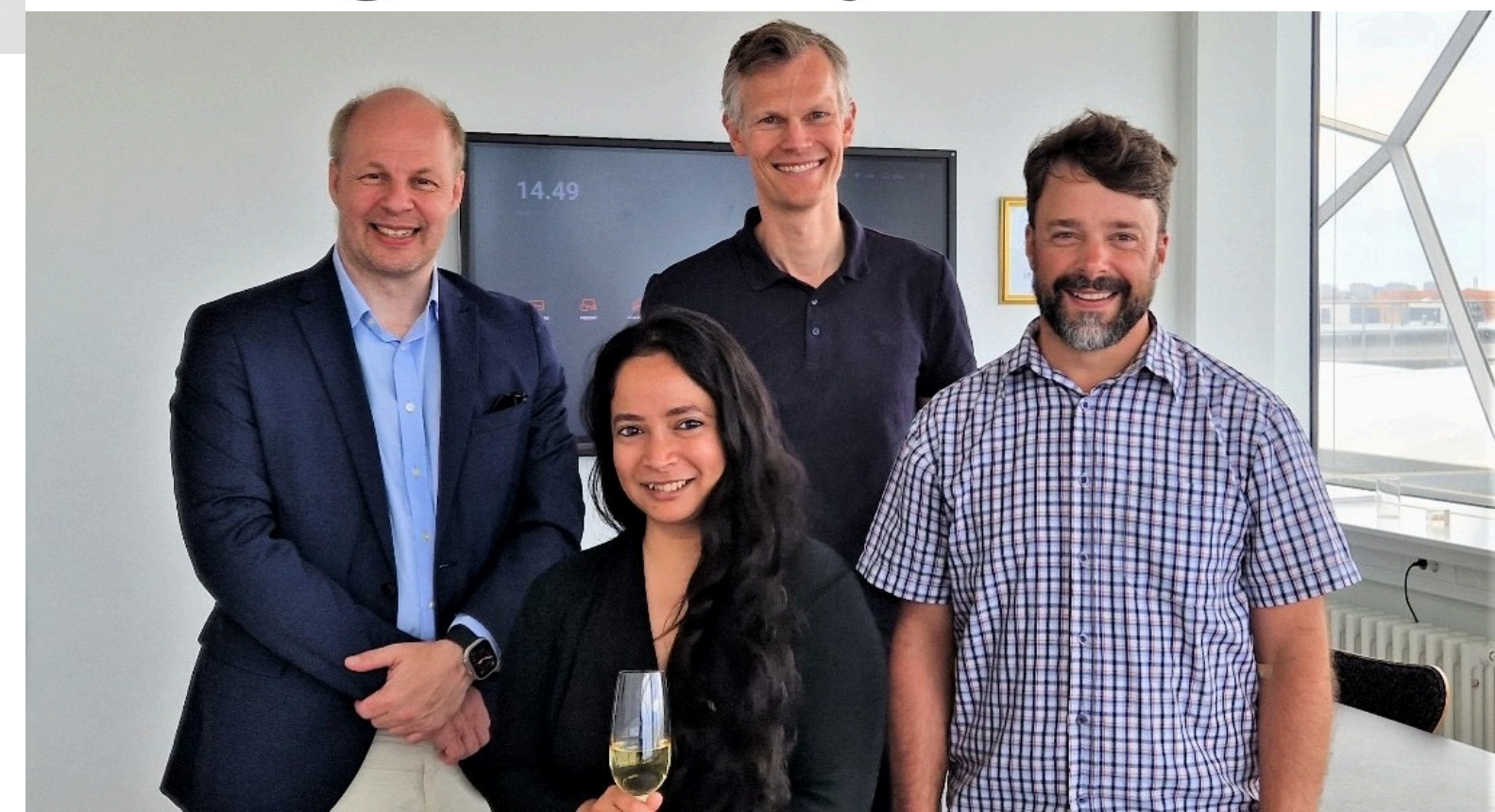
Mission of
QuTech Academy

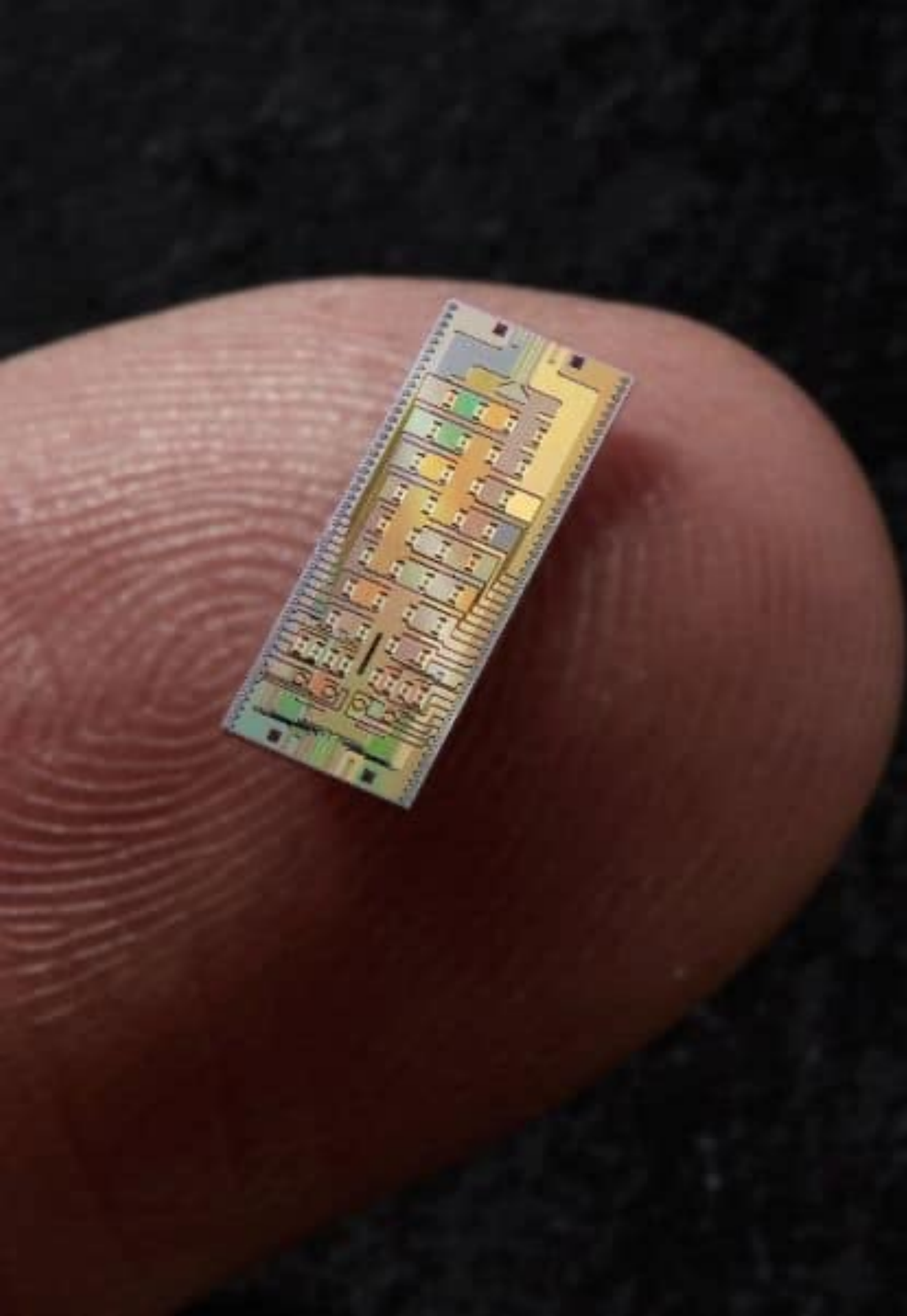
...and others



The University of Copenhagen is
Awarded a Quantum Technology
Training Laboratory

*A.P.Møller Mærsk Quantum
Training Laboratory*





Tech for Impact:

*How can we accelerate
the quantum revolution?*

*By getting quantum
chips into the hands of
students!*