UNIVERSITÀ
DI PAVIA

Curriculum Fisica delle Tecnologie Quantistiche

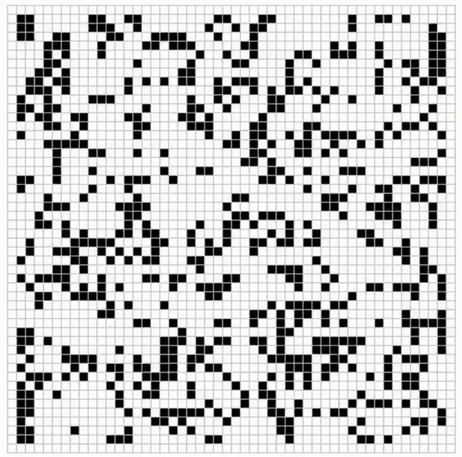
Pavia, 8 maggio 2026

Quantum Information: Origin

Quantum computer

N qubits: $d=2^N$

quantum parallelism



Journal of Statistical Physics, Vol. 22, No. 5, 1980

The Computer as a Physical System: A Microscopic Quantum Mechanical Hamiltonian Model of Computers as Represented by Turing Machines

Paul Benioff[1,2]

Received June 11, 1979; revised August 9, 1979

International Journal of Theoretical Physics, Vol. 21, Nos. 6/7, 1982

Simulating Physics with Computers

Richard P. Feynman

Department of Physics, California Institute of Technology, Pasadena, California 91107

Received May 7, 1981

"I want to talk about the possibility that there is to be an exact simulation, that the computer will do exactly the same as nature. If this is to be proved and the type of computer is as I've already explained, then it's going to be necessary that everything that happens in a finite volume of space and time would have to be exactly analyzable with a finite number of logical operations. The present theory of physics is not that way, apparently. It allows space to go down into infinitesimal distances, wavelengths to get infinitely great, terms to be summed in infinite order, and so forth; and therefore, if this proposition is right, physical law is wrong."

Quantum Information: Origin

Proc. R. Soc. Lond. A **400**, 97–117 (1985)
Printed in Great Britain

Quantum theory, the Church–Turing principle and the universal quantum computer

By D. Deutsch
Department of Astrophysics, South Parks Road, Oxford OX1 3RQ, U.K.

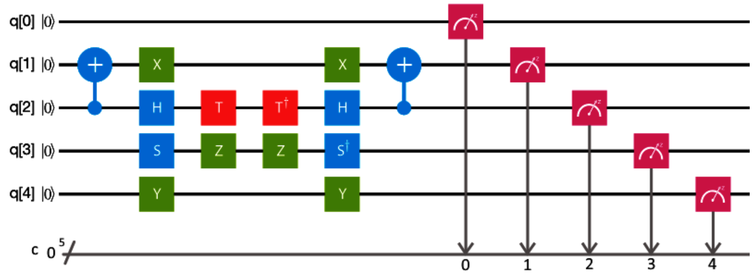
(*Communicated by R. Penrose, F.R.S. – Received* 13 *July* 1984)

Proc. R. Soc. Lond. A **425**, 73–90 (1989)
Printed in Great Britain

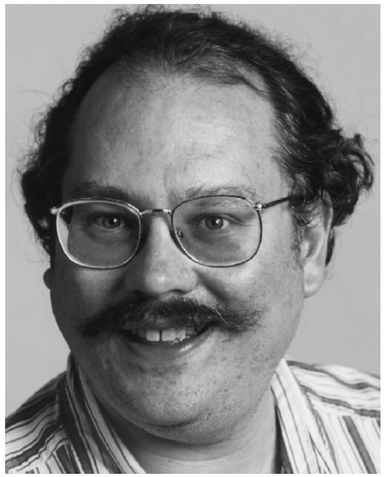
Quantum computational networks

By D. Deutsch
Oxford University Mathematical Institute, 24–29 St Giles, Oxford OX1 3LB, U.K.

(*Communicated by R. Penrose, F.R.S. – Received* 8 *July* 1988)

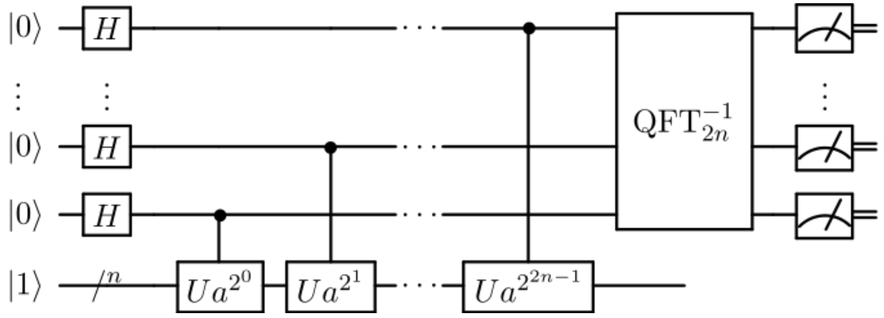


Quantum Computing



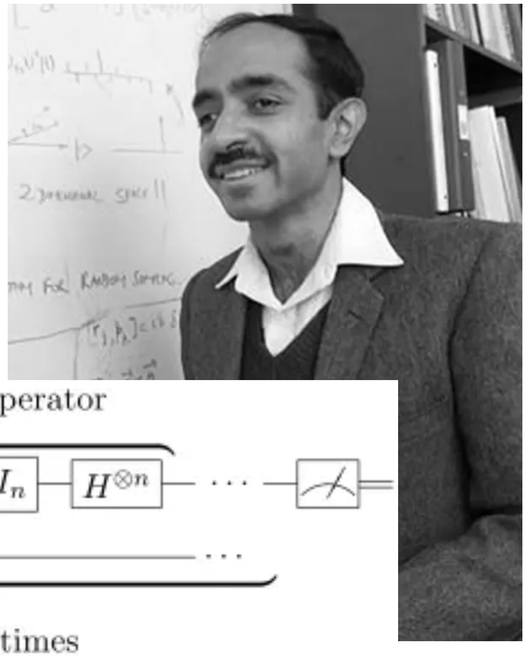
Algorithms for Quantum Computation: Discrete Logarithms and Factoring

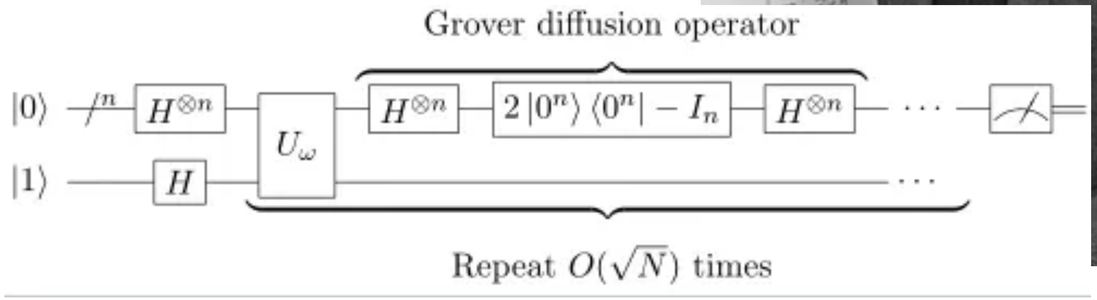
Peter W. Shor
AT&T Bell Labs
Room 2D-149
600 Mountain Ave.
Murray Hill, NJ 07974, USA



A fast quantum mechanical algorithm for database search

Lov K. Grover
3C-404A, AT&T Bell Labs
600 Mountain Avenue
Murray Hill NJ 07974
lkg@mhcnet.att.com





"Quantum computers do not solve hard search problems instantaneously by simply trying all the possible solutions at once" (Aaronson)

Quantum Foundation: Reborn

Quantum Foundations in the Light of Quantum Information

Christopher A. Fuchs
Computing Science Research Center
Bell Labs, Lucent Technologies
Room 2C-420, 600–700 Mountain Ave.
Murray Hill, New Jersey 07974, USA

COMMENTARY

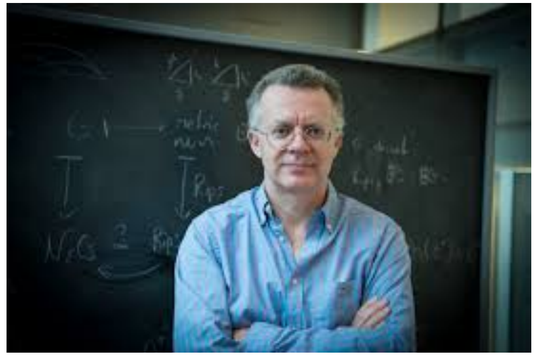
Is information the key?

GILLES BRASSARD

is in the Département d'informatique et de recherche opérationnelle, Université de Montréal, Québec H3C 3J7, Canada.

e-mail: brassard@iro.umontreal.ca

Quantum information science has brought us novel means of calculation and communication. But could its theorems hold the key to understanding the quantum world at its most profound level? Do the truly fundamental laws of nature concern — not waves and particles — but information?



Quantum Theory From Five Reasonable Axioms

Lucien Hardy*
Centre for Quantum Computation,
The Clarendon Laboratory,
Parks road, Oxford OX1 3PU, UK

Quantum Technologies: the NISQ era

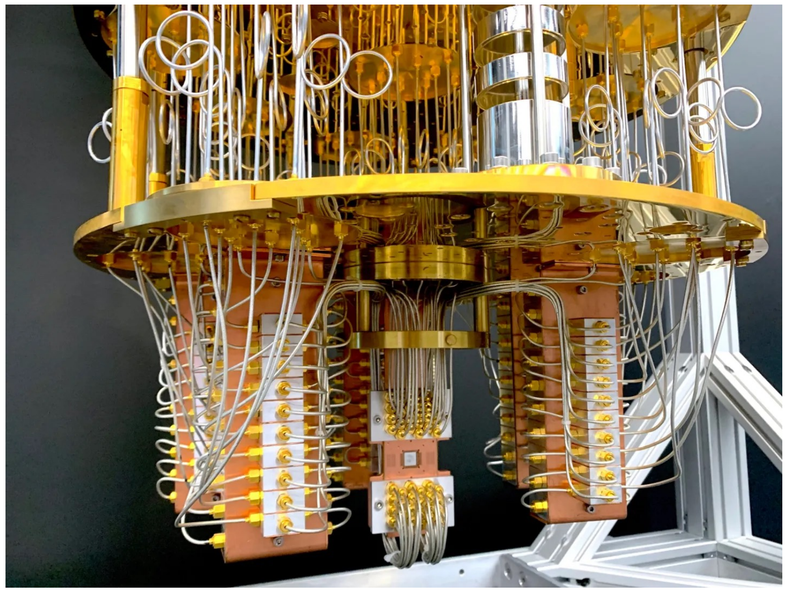
Quantum Computing in the NISQ era and beyond

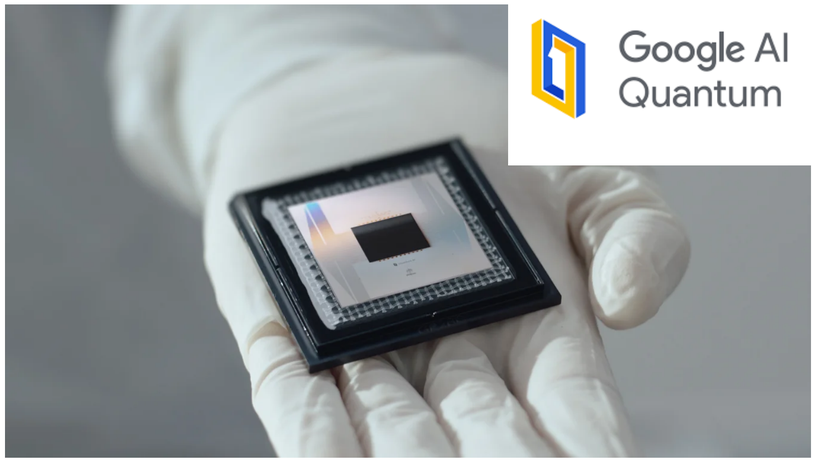
John Preskill

Institute for Quantum Information and Matter and Walter Burke Institute for Theoretical Physics,
California Institute of Technology, Pasadena CA 91125, USA

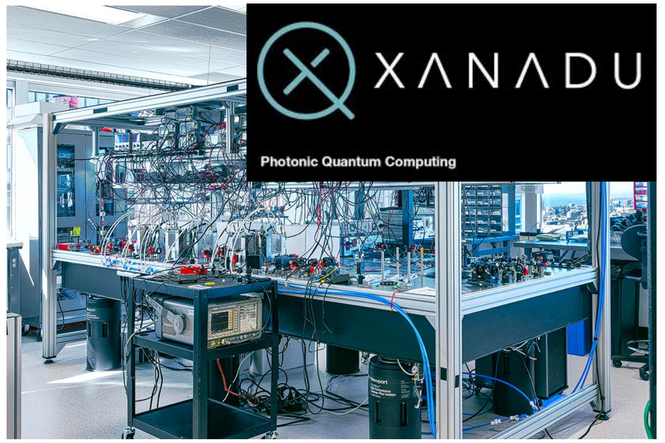
30 July 2018

IBM





Google AI Quantum



QUANTINUM

algorithmiq

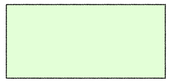
PsiQuantum

Fermioniq

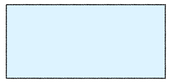
Piano degli studi

48 CFU (8 insegamenti) scelti fra la lista dei corsi caratterizzanti

Insegnamento	Semestre
Laboratorio di Fisica Quantistica	II
Fondamenti della Meccanica Quantistica	I
Fisica Quantistica della Computazione	II
Fotonica (solo secondo anno)	I
Teoria Fisica dell'Informazione	I
Nanostrutture Quantistiche	II
Ottica Quantistica	I
Termodinamica Quantistica	I
Meccanica Statistica (triennale)	II
Gruppi e Simmetrie Fisiche	II
Magnetismo e Superconduttività	I
Fisica dello Stato Solido I	I



Cond-matter/optics oriented

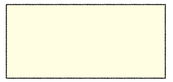


theoretical/math oriented

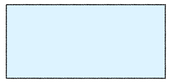
Piano degli studi

12 CFU (2 insegnamenti) scelti fra la lista dei corsi affini

Insegnamento	Semestre
Digital Communications	II
Statistical Learning Theory	I
Algorithms and systems for robotics	I
Artificial Intelligence	I
Deep Learning	II
Information Security	I
Machine Learning	II
Bioinformatica	I
Elementi di Statistica Matematica	I
Processi Stocastici	II
Teoria dei Sistemi Dinamici	II



Computer science oriented



theoretical/math oriented

Piano degli studi

12 CFU a scelta **libera**.
Tra questi possono essere scelti questi corsi attivati dal nostro dipartimento

Insegnamento	CFU	Semestre
Tecniche di presentazione	3	II
Agile project management	3	II
Entrepreneurship	3	I
Startup e Open Innovation	3	II
Quantum Simulation (from AI4ST)	6	II
Optical communication	9	I
Optoelectronic devices	9	I

soft-skills oriented

Cond-matter/optics oriented

theoretical/math oriented

Quantum Cryptography: security by physical laws

QUANTUM CRYPTOGRAPHY: PUBLIC KEY DISTRIBUTION AND COIN TOSSING

Charles H. Bennett (IBM Research, Yorktown Heights NY 10598 USA)
Gilles Brassard (dept. IRO, Univ. de Montreal, H3C 3J7 Canada)

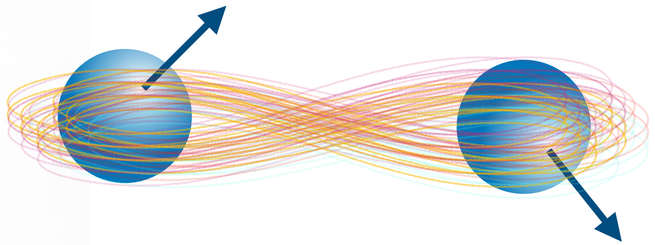
Complementarity

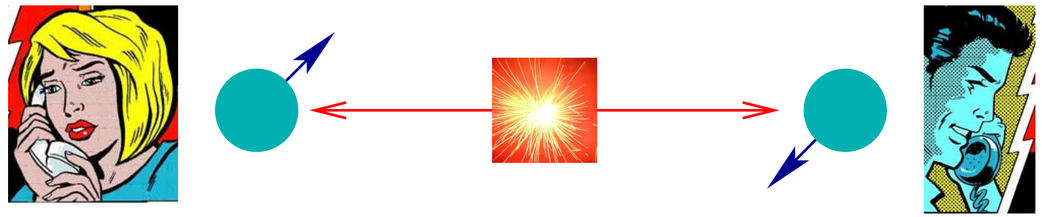
Alice's bit	0	1	1	0	1	0	0	1
Alice's basis	+	+	X	+	X	X	X	+
Alice's polarization	↑	→	↖	↑	↖	↗	↗	→
Bob's basis	+	X	X	X	+	X	+	+
Bob's measurement	↑	↗	↖	↗	→	↗	→	→
Public discussion								
Shared Secret key	0		1			0		1

Quantum Cryptography Based on Bell's Theorem

Artur K. Ekert
Merton College and Physics Department, Oxford University, Oxford OX1 3PU, United Kingdom
(Received 18 April 1991)

Non locality





FISICA DELLE TECNOLOGIE QUANTISTICHE

8 insegnamenti scelti fra i seguenti c**orsi caratterizzanti**

Nome insegnamento	**Settore**	**Semestre**
Artificial Intelligence	ING-INF/05	I
Processi Stocastici	MAT/06	II
Teoria dei Sistemi Dinamici	MAT/07	I
Elementi di Statistica Matematica	MAT/06	I
Robotics	ING-INF/05	I
Digital Communications	ING-INF/03	II
Information Security	ING-INF/05	I
Bioinformatica	ING-INF/06	I

FISICA DELLE TECNOLOGIE QUANTISTICHE

8 insegnamenti scelti fra i seguenti c**orsi affini**

Nome insegnamento	**Settore**	**Semestre**
Artificial Intelligence	ING-INF/05	I
Processi Stocastici	MAT/06	II
Teoria dei Sistemi Dinamici	MAT/07	I
Elementi di Statistica Matematica	MAT/06	I
Robotics	ING-INF/05	I
Digital Communications	ING-INF/03	II
Information Security	ING-INF/05	I
Bioinformatica	ING-INF/06	I