Hype & Trust

in Quantum Technology

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The Australian National University

100 Years of Quantum physics 21st Rencontres du Vietnam Quy Nhon October 2025

The future = teleportation

Since Star Trek 1966 : "beam me up Scotty"

Living organism is complex -

but can possibly be represented by complex wavefunctions

Send information: Disassemble here ==>> reassemble there

Hype ? Science fiction ? Impossible?

2 Problems:

(1) The uncertainty principle and information loss

(2) non cloning theorem = no backup

Loophole since 1990:

Send full quantum information using entangled information channels!

Would you trust this technology ?

until 1990

and then:

Seth Lloyd 2015

Quantum Technology in our daily life

Display

Sensors

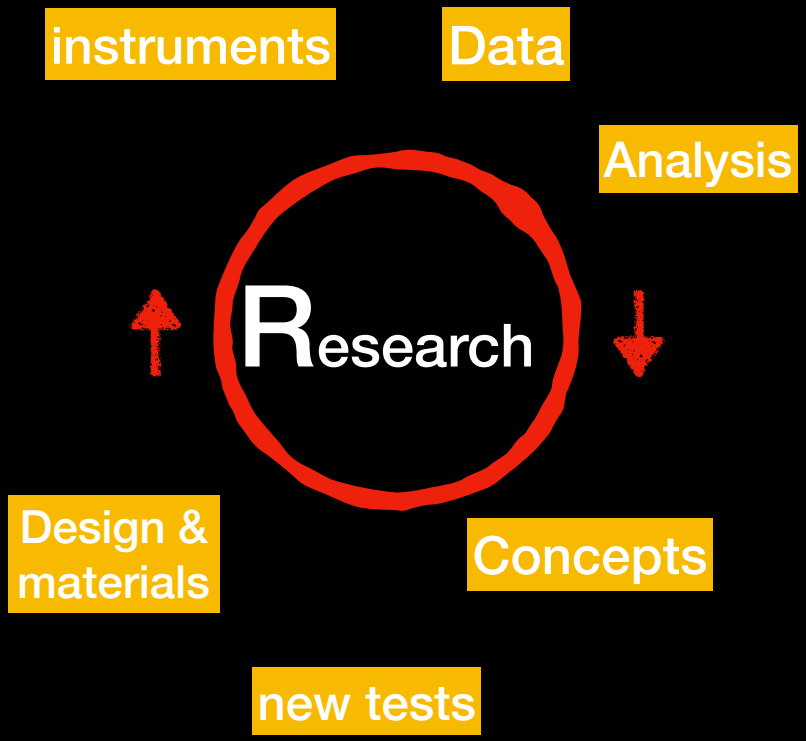
Camera

Data

Processing

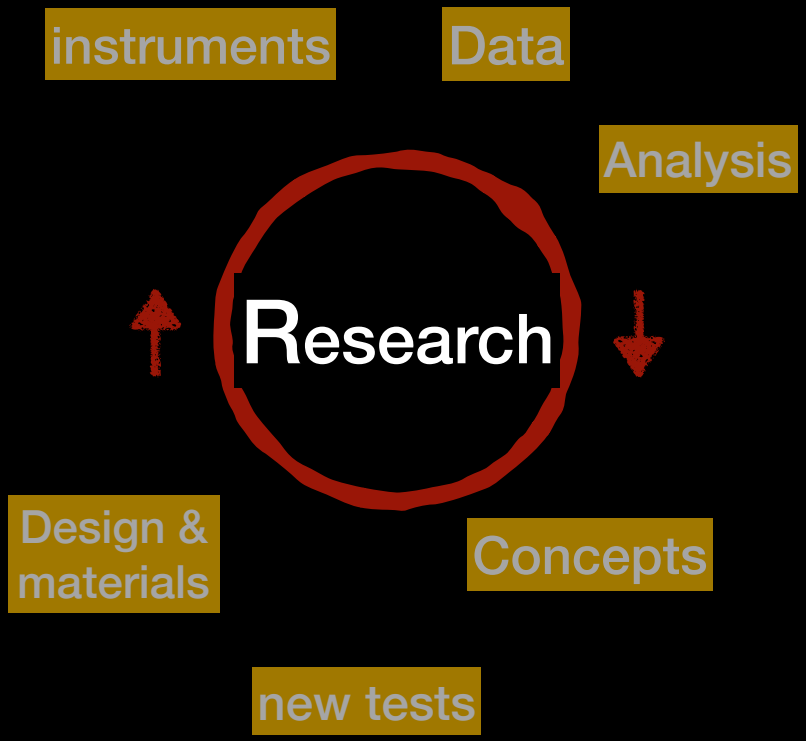
Internet

Trust



Science is self correcting

The scientific method



Science is self correcting

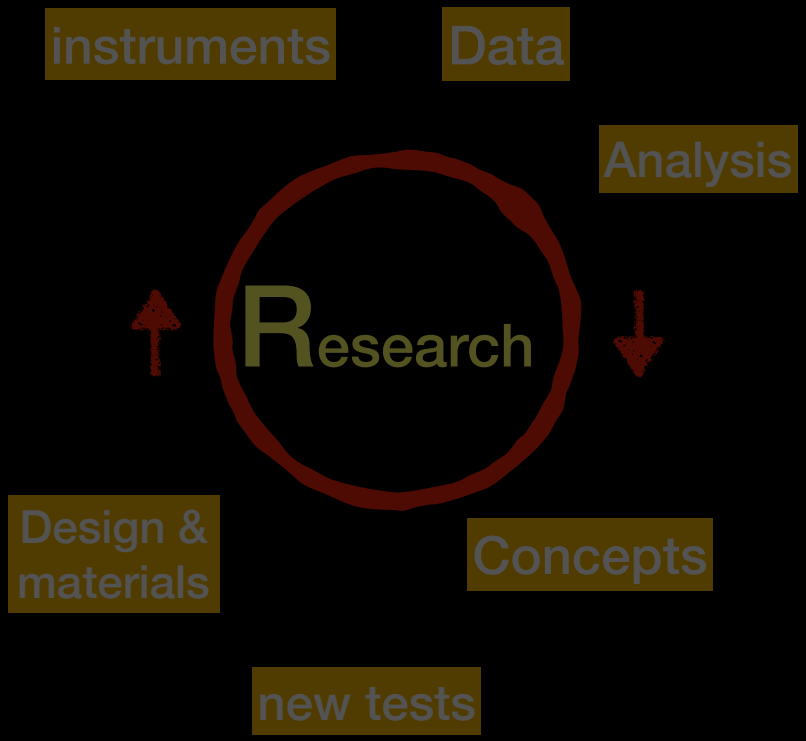
Self deceptions in Physics

N rays 1903

Weber detection of GW waves 1970s

Cold fusion 1989

Superluminary Neutrinos 2011



Science is self correcting

Fraud in Physics is rare : Organic transistor Jan Hendik Schön

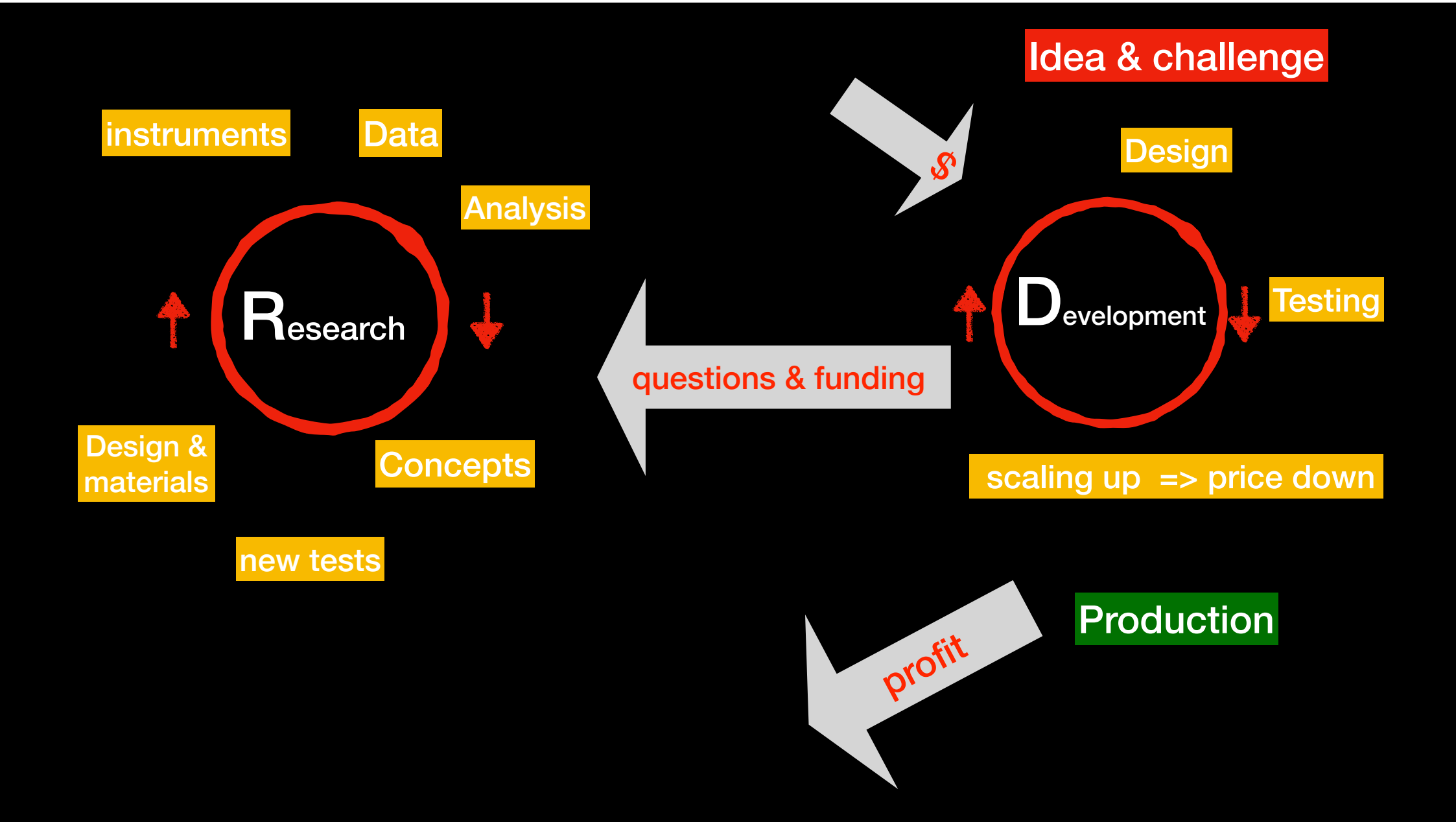
born in Verden GER, PhD in Konstanz 1997
=> Bell Labs/ Luncent Technology USA

Claims of organic transisitor.
Hype of future organic electronics

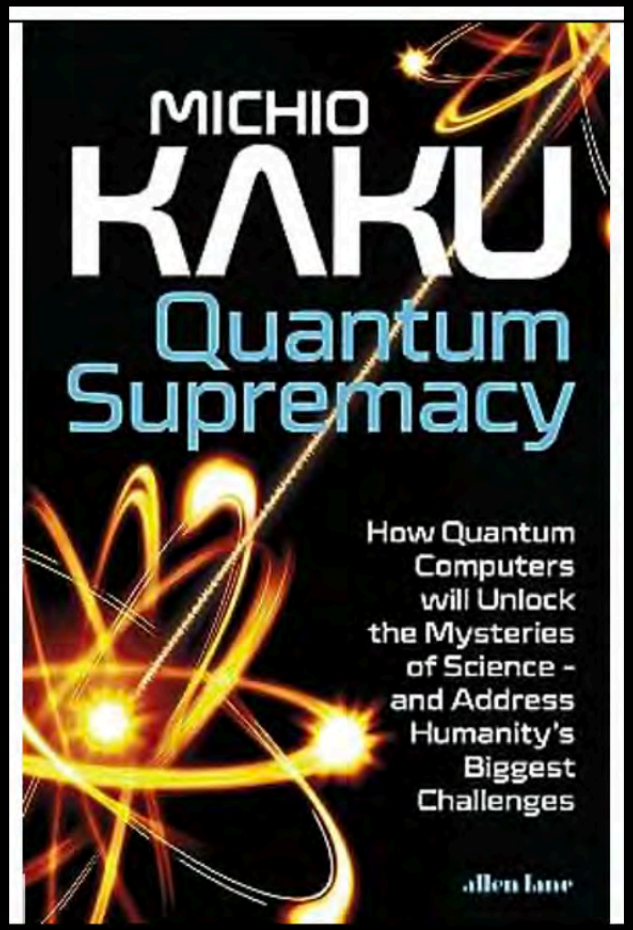
publications in *Nature* and *Science*
by 2001 about 1 paper / 8 days with co-authors

since 2000 results could not be reproduced,
2002 proof diagrams were duplicated, noise data duplicated, numerical data published as exp. data.
no notebooks, data deleted, ...

PhD revoked (2004). appeals upheld by Bundesverfassungsgericht (2014)
No further funding in GER


Idea & challenge
instruments
Data
Design
Analysis
Research
Development
Testing
questions & funding
Design & materials
Concepts
scaling up => price down
new tests
profit
Production

Hype



Long list of applications of Q-computing:

Can they be met? Ever? On what time scale?

Balance:

Hype &exageration / Trust in science

Supremacy is a loaded word

Hype = stimulation of discussion with the public

seeks a discussion and debate with public & decisions makers

is tempting, seeks to create debate

But: requires educated public

Hype = entertainment

a tool in science communication

provokes reaction, engagement

much like a clown in the circus

is harmless and creates interest

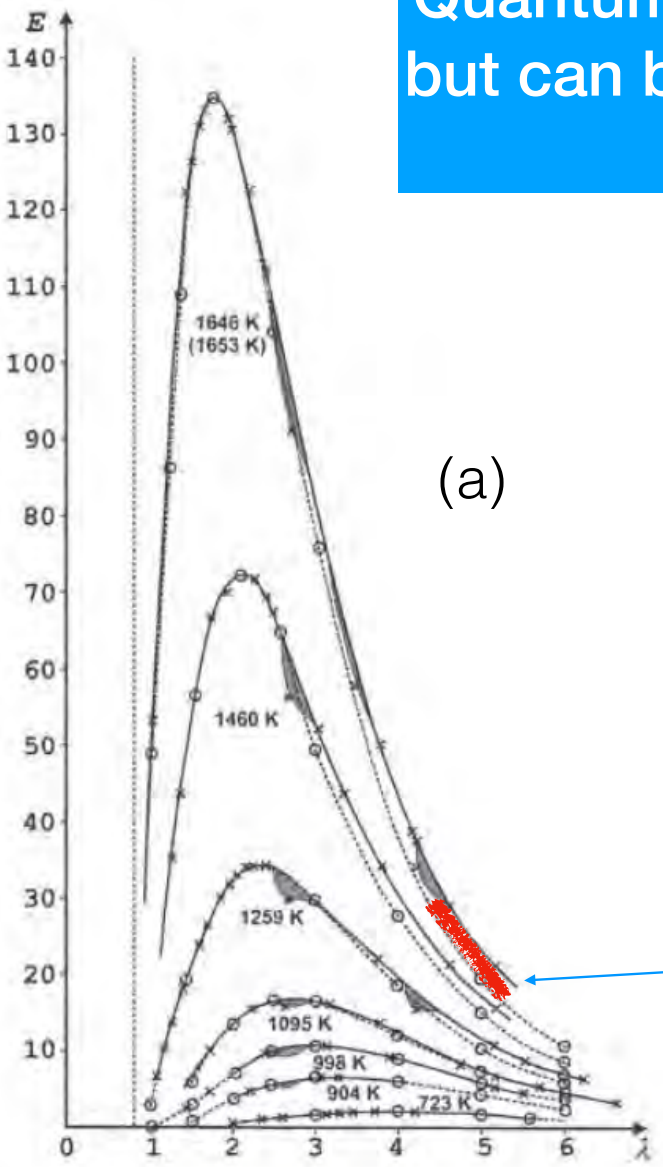
Hype = exageration

overstating benefits & understating risks and costs

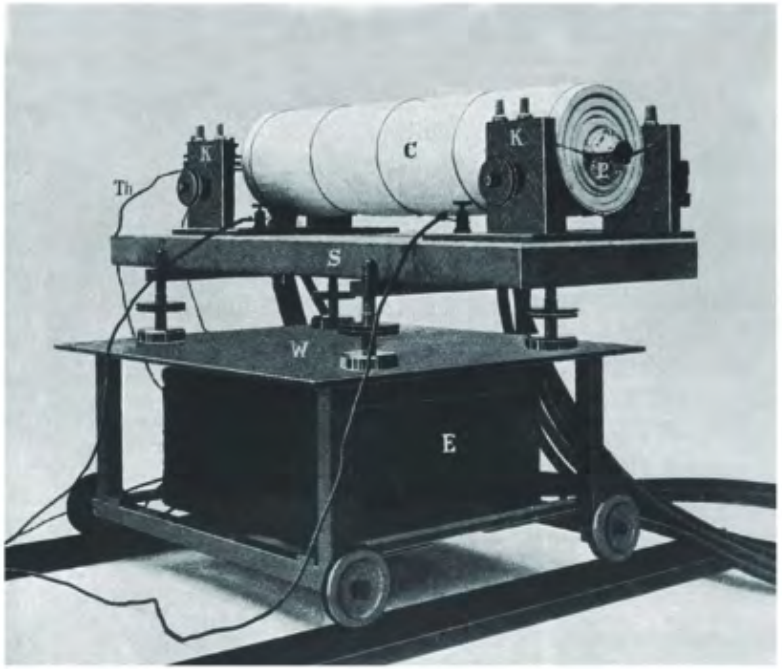
is supporting short term thinking, has negative outcomes long term

Example ***stem cell research*** from 2000

Quantum is not mysterious but can be counter-intuitive Photons



(a)



(b)

Quantitative data came first

Kaiser Wilhelm Institut Berlin

O. Lummer

E. Pringsheim

Max Planck

didn't like his new ideas

Albert Einstein

nobody interested

Charles Maiman

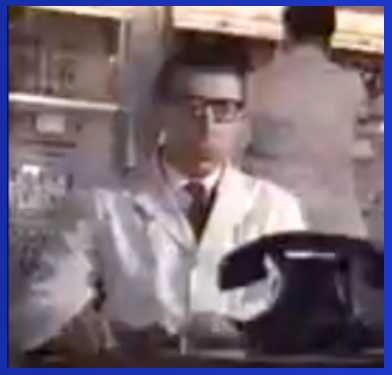
1. published in newspaper

and many others

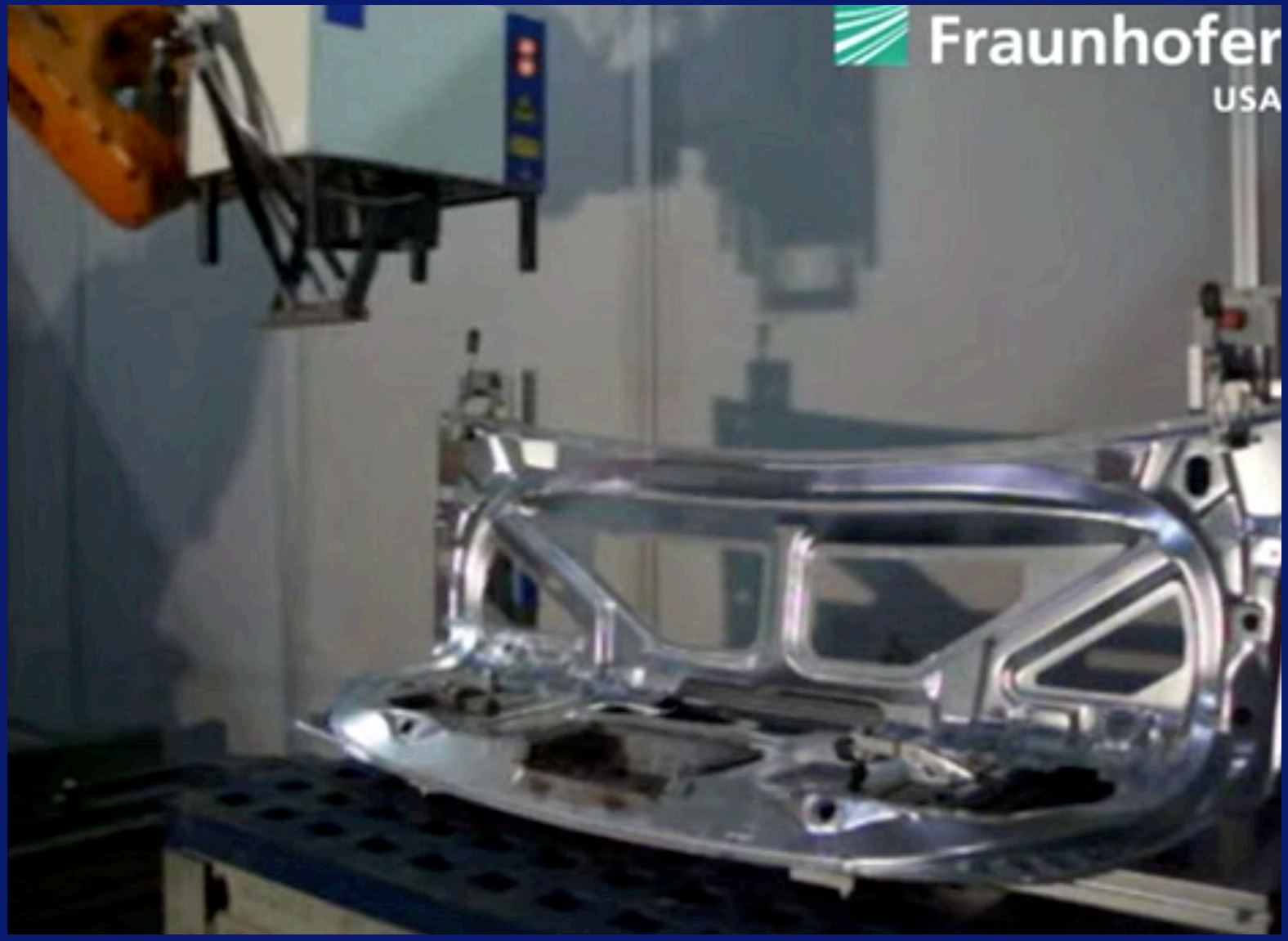
1. Idea : laser as a weapon

movie: Goldfinger 1964

1. Idea : laser as a weapon



What is wrong in this scence ?

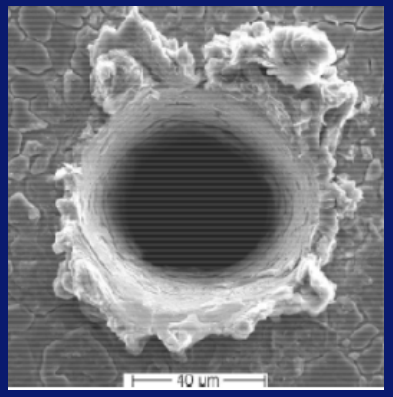


Laser welding

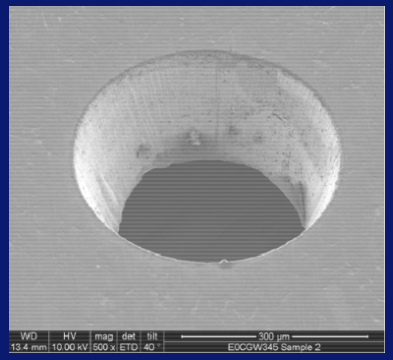
Ursula Keller

Donna Strickland

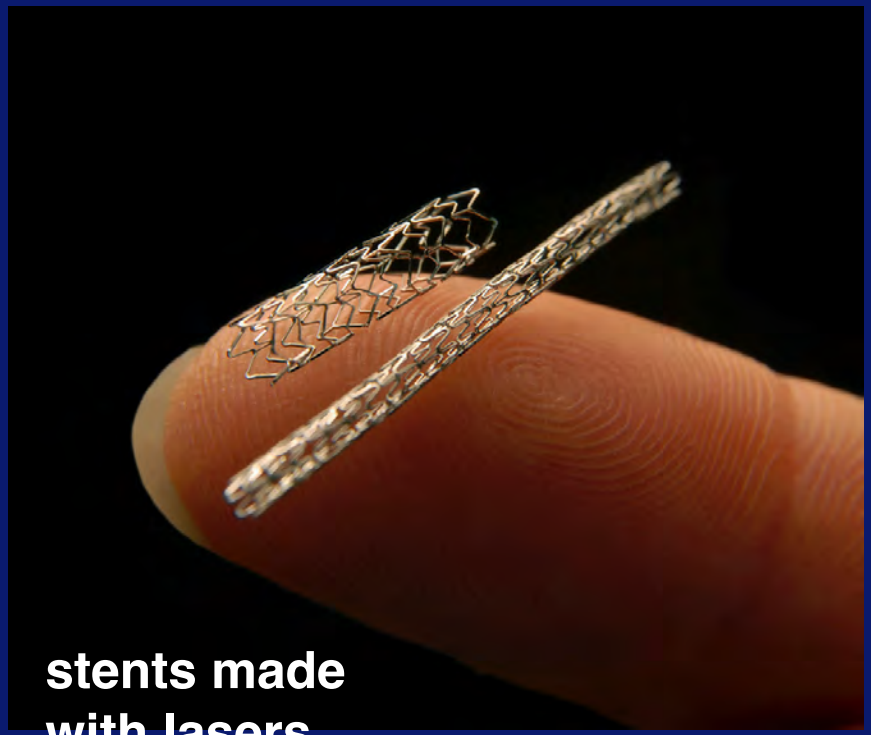
1 hair



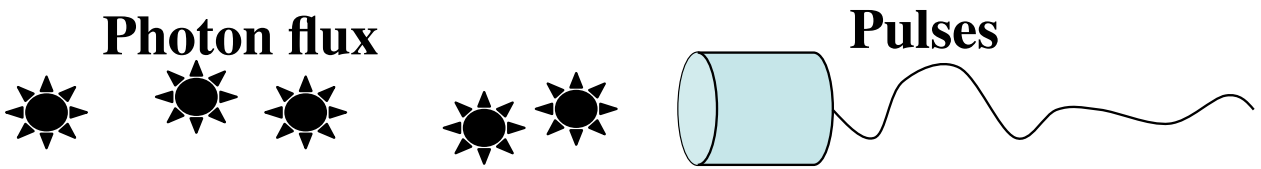
slow pulse



fast pulse

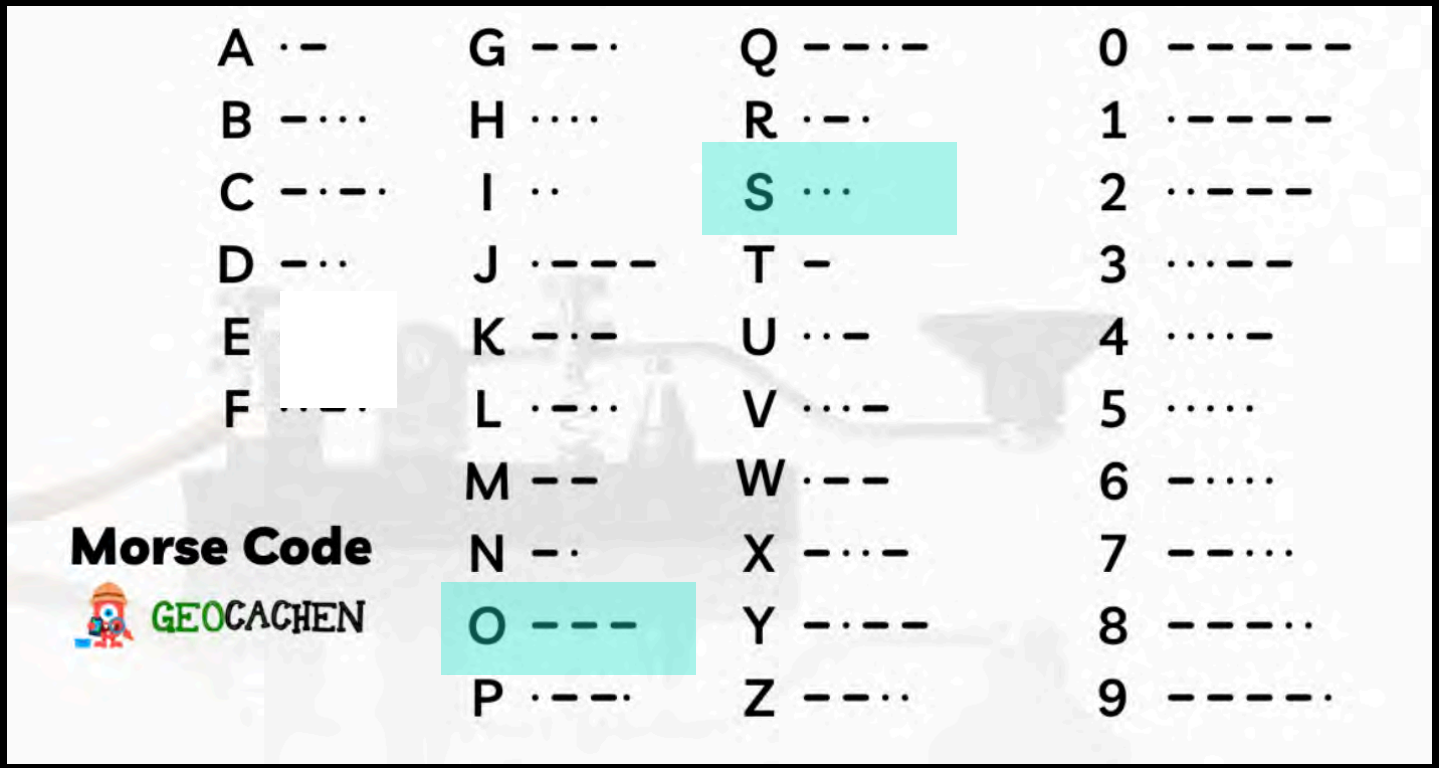


stents made with lasers

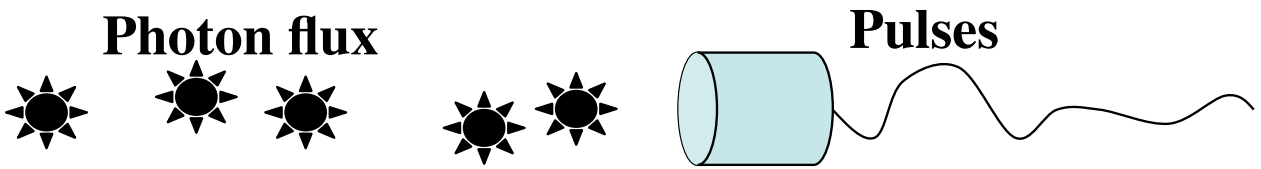


medium intensity

SOS morse code

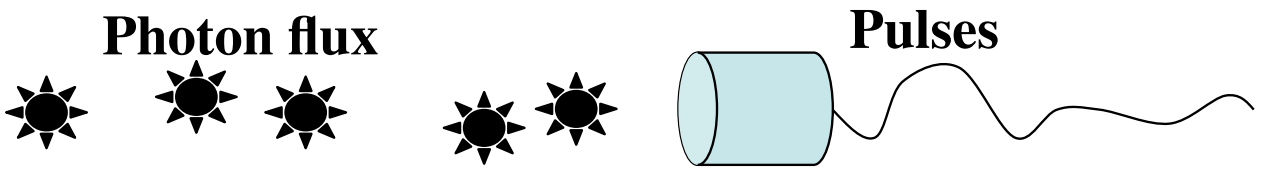


SOS



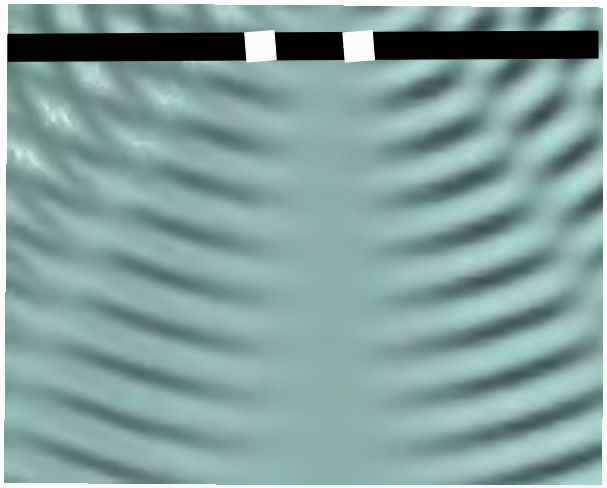
We can send signals

SOS



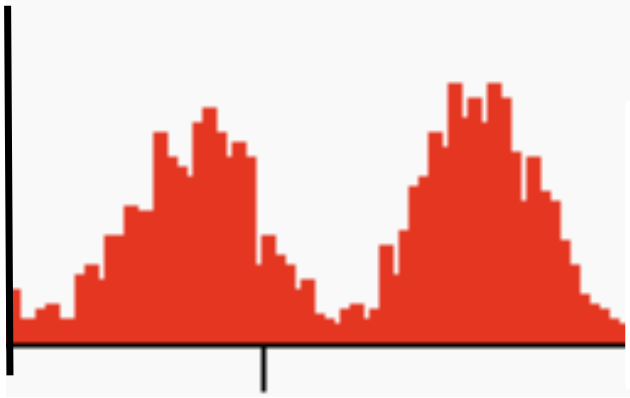
Quantum noise

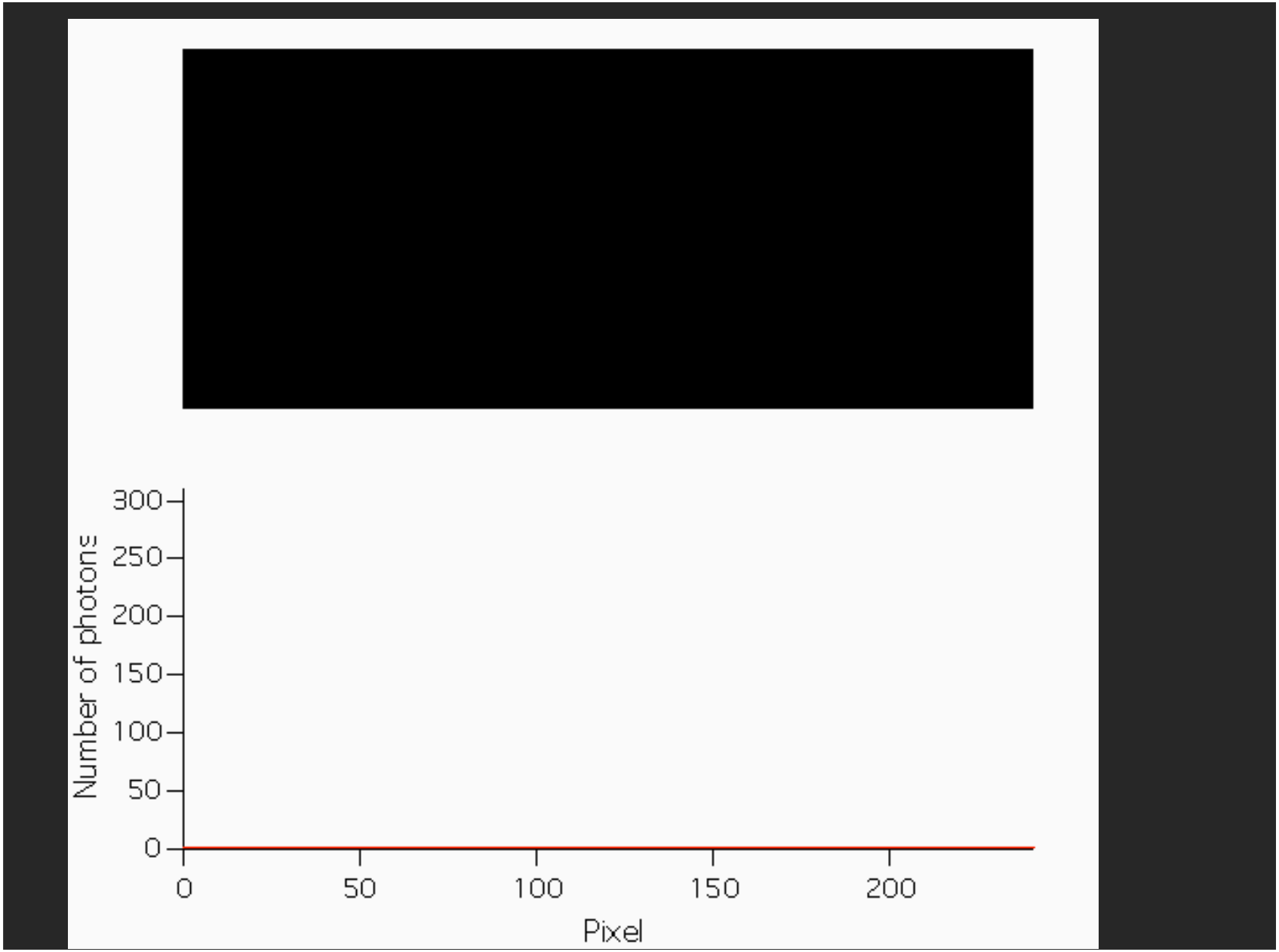
Double slit



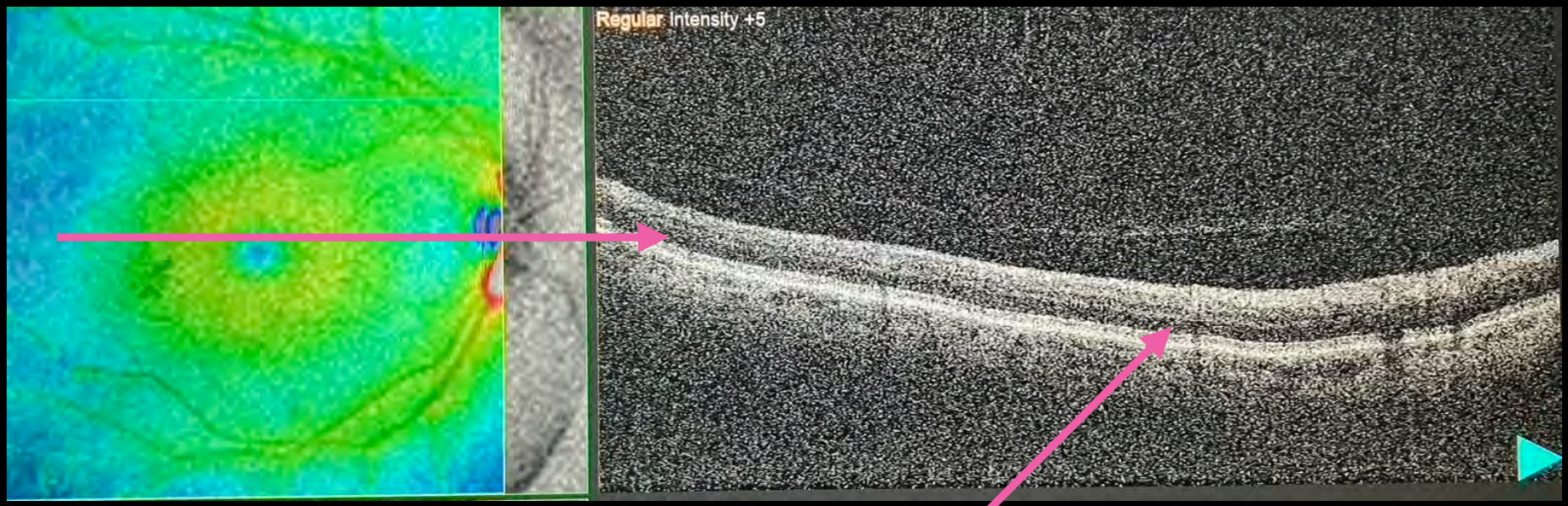
a practical way to
demonstrate interference

Intensity




300
250
200
150
100
50
0
Number of photons
0
50
100
150
200
Pixel

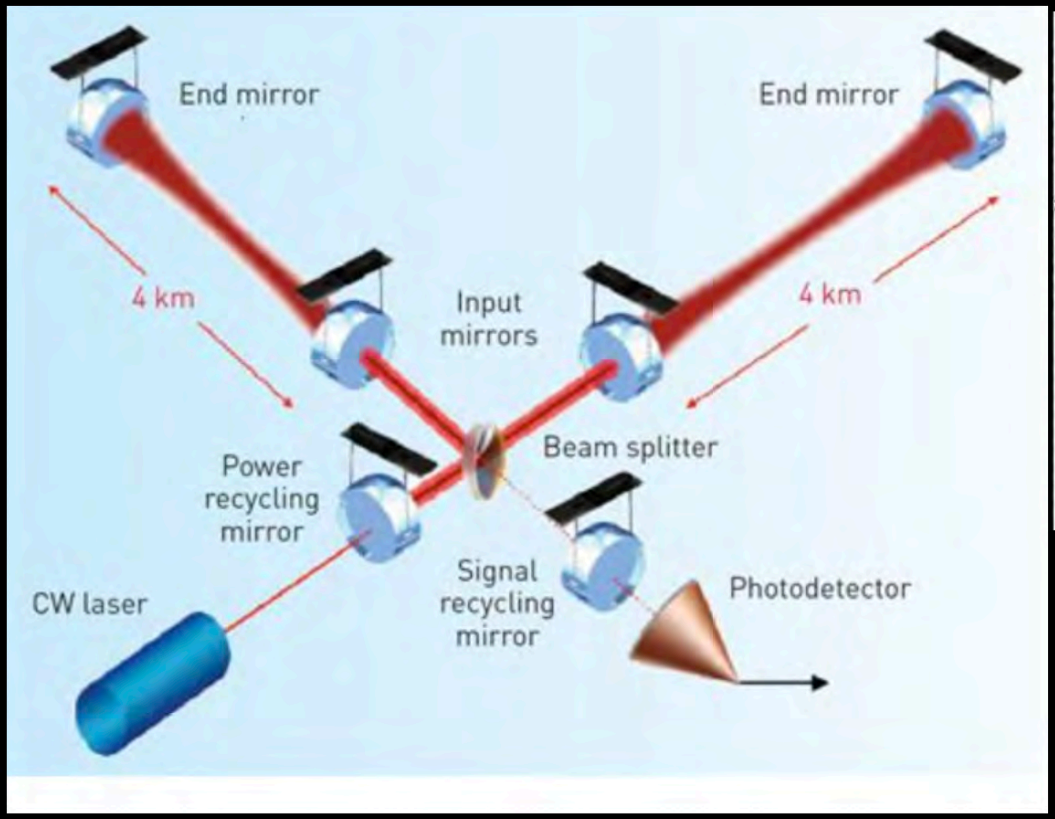
OCT scan of my own eye - health diagnosis



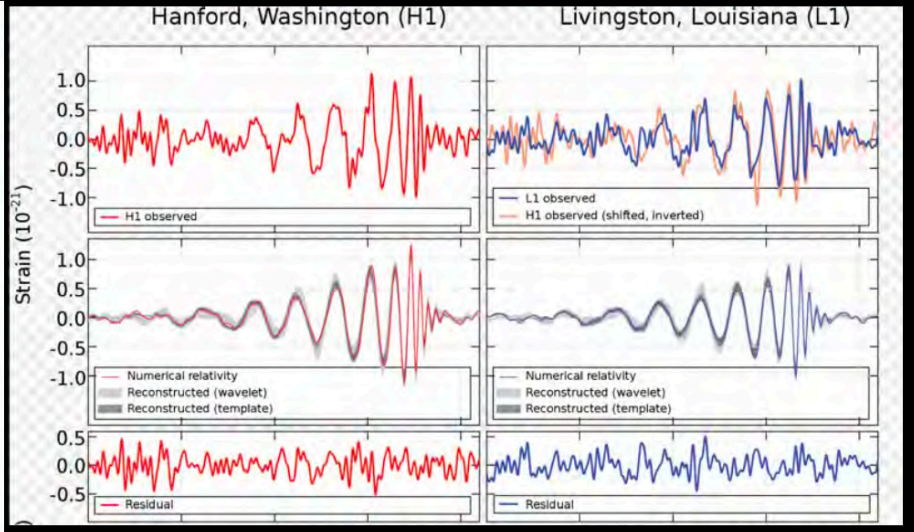
Retina : smooth thin layers is good

Optical coherence tomography available since 2000

LIGO for GW detection

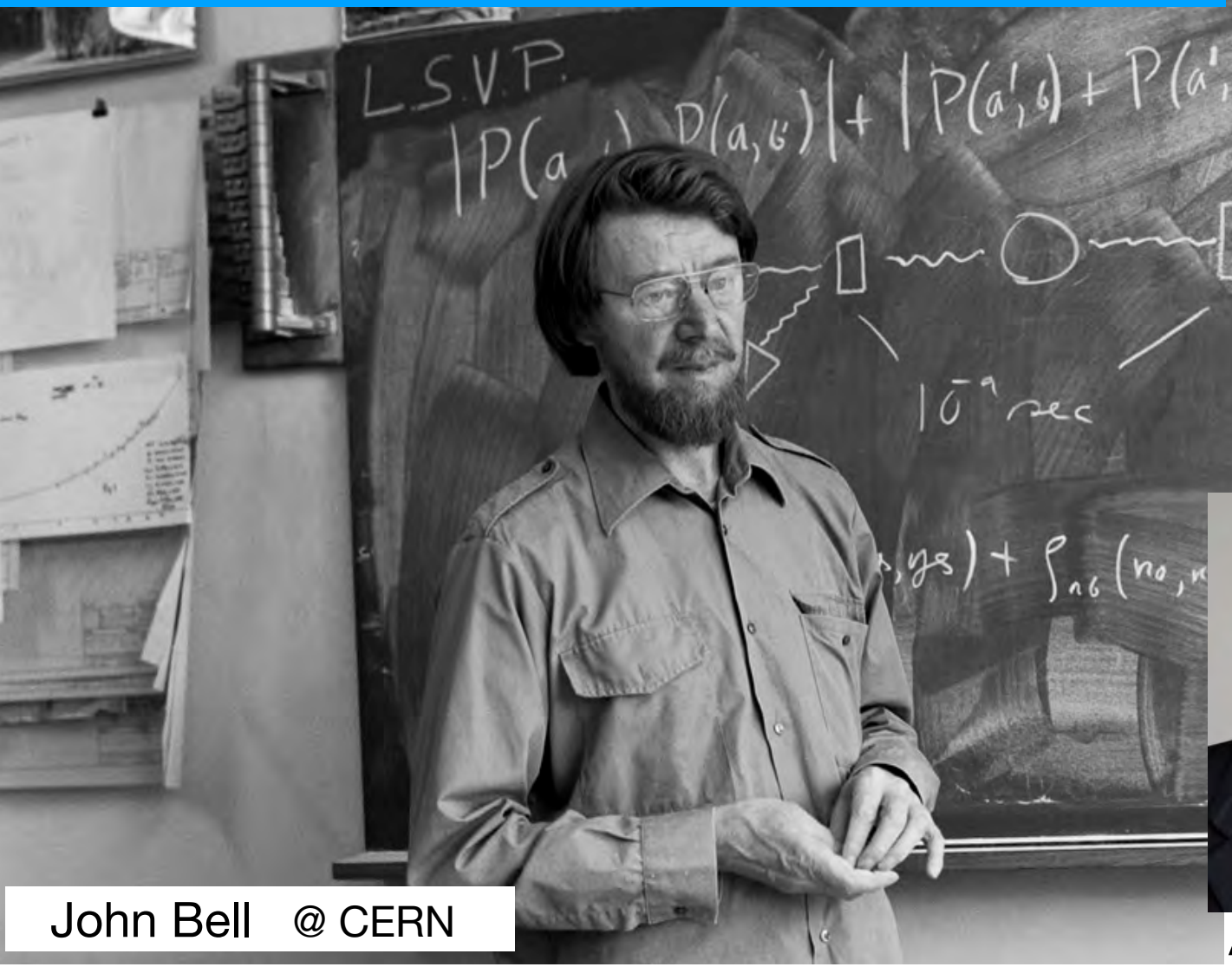


14/9/2015
ringdown of a single black hole



Noise is due to vaccum fluctuations:
Improvemt squeezed light

Predicted entanglement stronger than classical correlations



John Bell @ CERN

A.Aspect J.F. Clauser A.Zeilinger

Entanglement measured deeper than classical correlation

A.Aspect J.F. Clauser A.Zeilinger

time

Light

Interference Young / Fresnel

1960

Photon correlations HBT 1955

Laser 1960

Single photon 1964

$X^{(2)}$ photon pairs 1970s

Bell's inequality rad. cascade
1972, 1982

beyond SQL squeezing 1985

1990

HOM with $X^{(2)}$ pairs 1987

Bell's inequality X(3) pairs

photon on demand generation and counting

2020

Bell inequality with x(2) pairs 2015

The future

Atoms

Interference 1990

BEC 1995

Single atoms 2002

Atom correlations HBT 2005

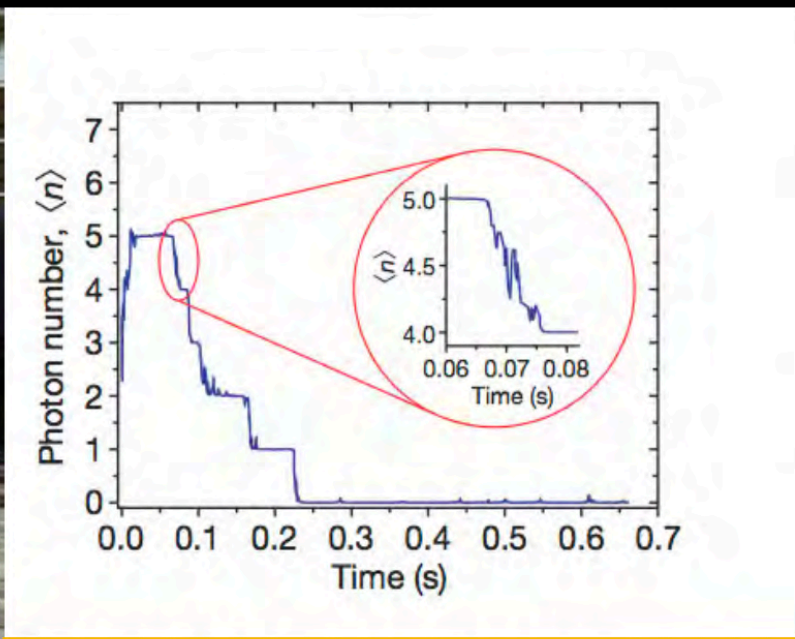
$X^{(3)}$ photon pairs 2007

beyond SQL 2010

HOM with $X^{(3)}$ pairs 2014

Bell's inequality mol. disassociation

Bell's inequality X (3) pairs



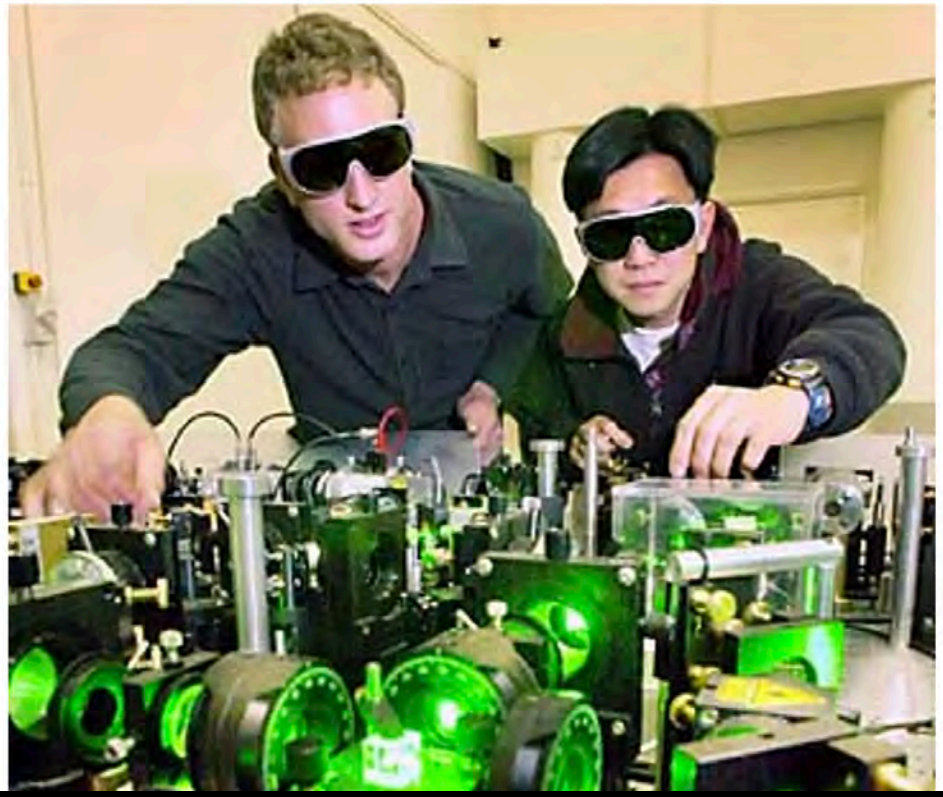
Direct observation of dynamics of photons in a cavity

S Haroche & team

Be cautious : a personal story

Australian scientists claim to have 'teleported' data

By **Peter O'Connor**, *Associated Press*



17. June 2002

Australian scientists claim to have 'teleported' data

By **Peter O'Connor**, *Associated Press*

Higher education

Physicists beaming with teleport success

EducationGuardian.co.uk

Staff and agencies

Mon 17 Jun 2002 14.06 CEST

A team of physicists in Australia have successfully teleported a laser beam of light from one spot to another in a split second, it emerged today.

The physicists, from the Australian National University, said they had managed to disembody a laser beam in one location and rebuild it in a different spot about one metre away in the blink of an eye.

Australian scientists claim to have 'teleported' data

By **Peter O'Connor**, *Associated Press*
June 22, 2002

Higher education

Physicists beaming with teleport success

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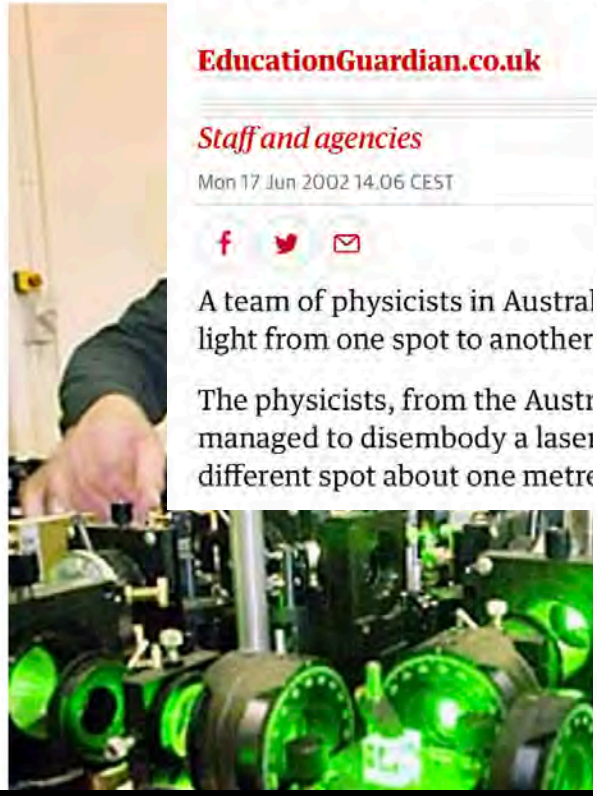


A team of physicists in Austral
light from one spot to another

The physicists, from the Austr
managed to disembody a laser
different spot about one metre

Australia makes teleporting a reality

CANBERRA
PUBLISHED JUNE 17, 2002

This article was published more than 21 years ago. Some information may no longer be current.

COMMENTS SHARE

In a world breakthrough out of the realms of *Star Trek*, scientists in Australia have successfully teleported a laser beam of light from one spot to another in a split second but warn: Don't sell the car yet.

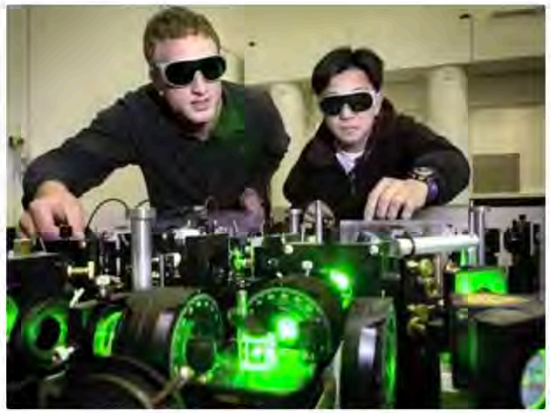
A team of physicists at the Australian National University (ANU) announced on Monday they had successfully disembodied a laser beam in one location and rebuilt it in a different spot about one metre away in the blink of an eye.

Australische Physiker teleportieren einen Laserstrahl

"Beam me up, Scotty": Das Teleportieren, lange pure Science-Fiction, wird in den Labors bereits teilweise zur Realität. Australische Forscher wollen einen Laserstrahl von einem Ort zum anderen versetzt haben.

17.06.2002, 16.36 Uhr

In der US-Fernsehserie "Raumschiff Enterprise" ist das Beamen schon seit Jahrzehnten Realität: Ein Handgriff des Chefingenieurs Scotty genügt, und Captain Kirk löst sich mitsamt seiner Begleitung flirrend auf, um auf kargen, mit Styropor-Steinen dekorierten Planeten wieder aufzutauchen.



Physiker Lam (r.) beim Beamen: Hoffen auf superschnelle Quantenrechner Foto: AFP

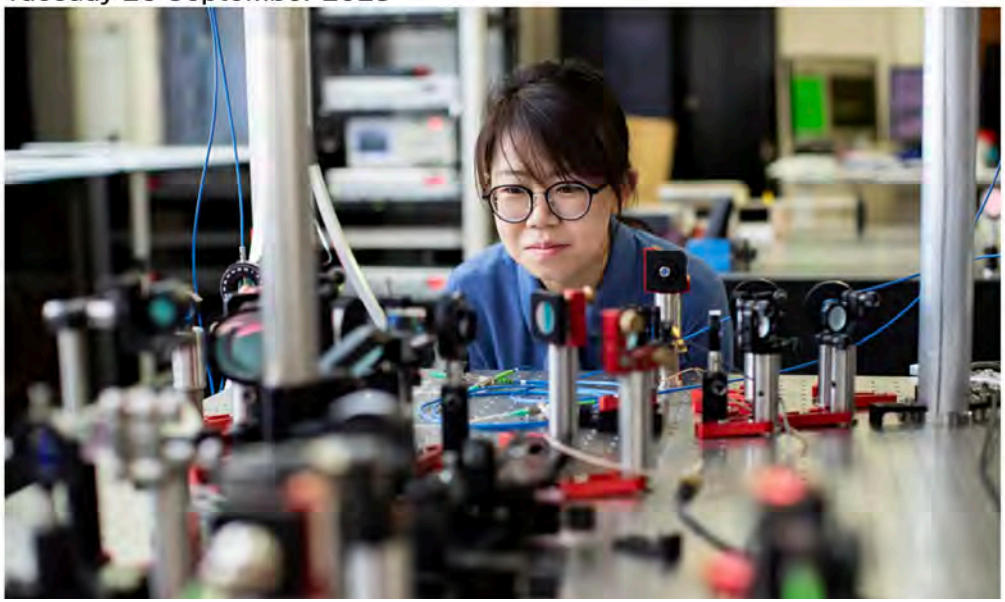
Enhancing quantum teleportation efficacy with noiseless linear amplification

Jie Zhao, Hao Jeng, Lorcán O. Conlon, Spyros Tserkis, Biveen Shajilal, Kui Liu, Timothy C. Ralph, Syed M. Assad & Ping Koy Lam

Nature Communications **14**, Article number: 4745 (2023)

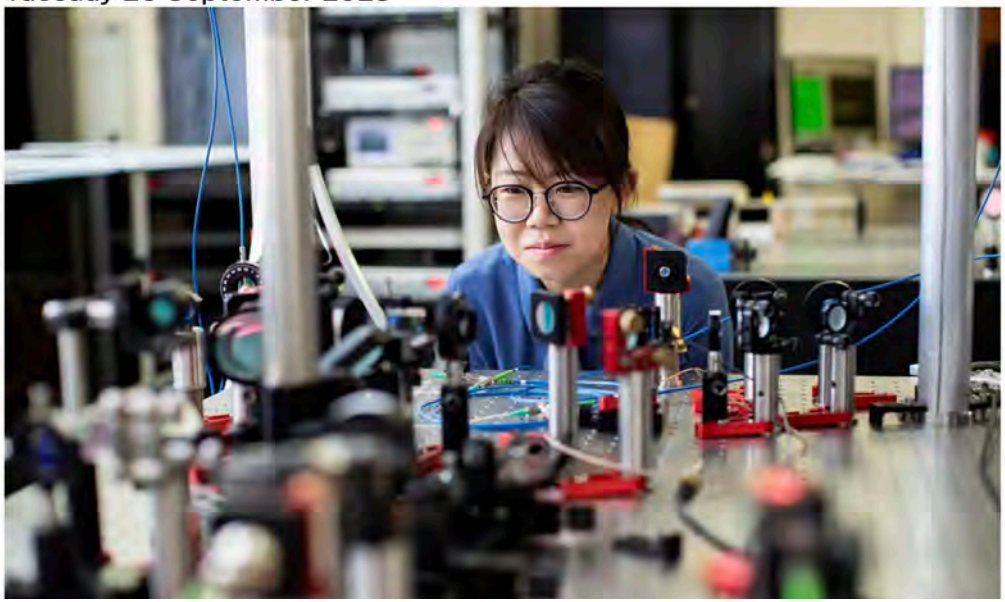
Teleportation fidelity the big winner in the quantum lottery

Tuesday 26 September 2023

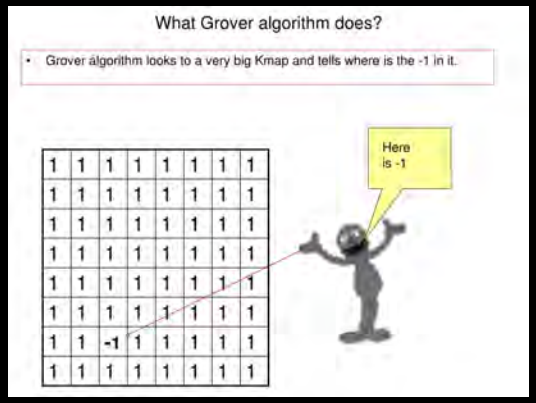


Teleportation of humans will not work

Tuesday 26 September 2023



Quantum algorithms



Grover P. Shore D. Deutsch

Mathematically hard calculations like Factorisation scale with exponential number of steps

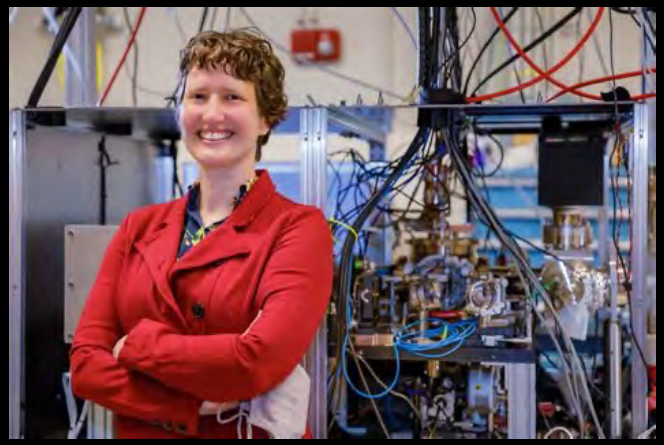
basis of encryption

Use evolution of ensemble of Q-bits for factorisation

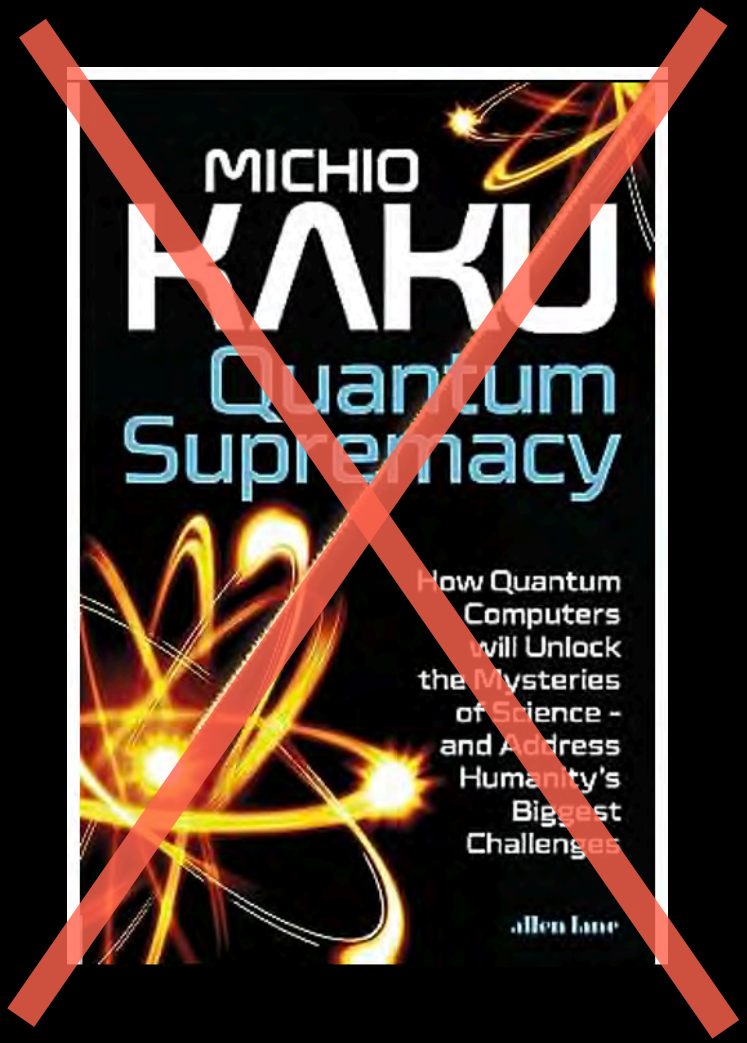
potentially no longer a hard math problem

code can be broken

Q-engineer = engineer with Q - intuition & skills



Hype = stimulation of discussion with the public



entertainment

exageration

WE all will gain from Q-tech

Camera ??
GPS ??

Cyber security

Sensors
on satellites
in vivo etc

cloud
storage
processing

better
data
quality
integrity

Physics is behind the creation of any new technology
in the 20. & 21. century for bad and good

Physicists gave us the nuclear bomb,
the technology behind hedge funds
and the spread of fake news

Phillip Adams ABC, well informed radio presenter in Australia 2016

A personal choice & dilema

INTERNATIONAL YEAR OF
Quantum Science and Technology

1. QUANTUM PHYSICS IS THE MOST ACCURATE THEORY EVER CREATED

2. QUANTUM PHYSICS IS THE BASIS OF ALL MODERN TECHNOLOGY

3. FUTURE TECHNOLOGY WILL MAKE ESSENTIAL USE OF QUANTUM PHYS

4. QUANTUM PHYSICS IS SEEN AS MYSTERIOUS; BUT IT'S NOT

5. QUANTUM PHYSICS EDUCATION IS RARE AND FRAGMENTED