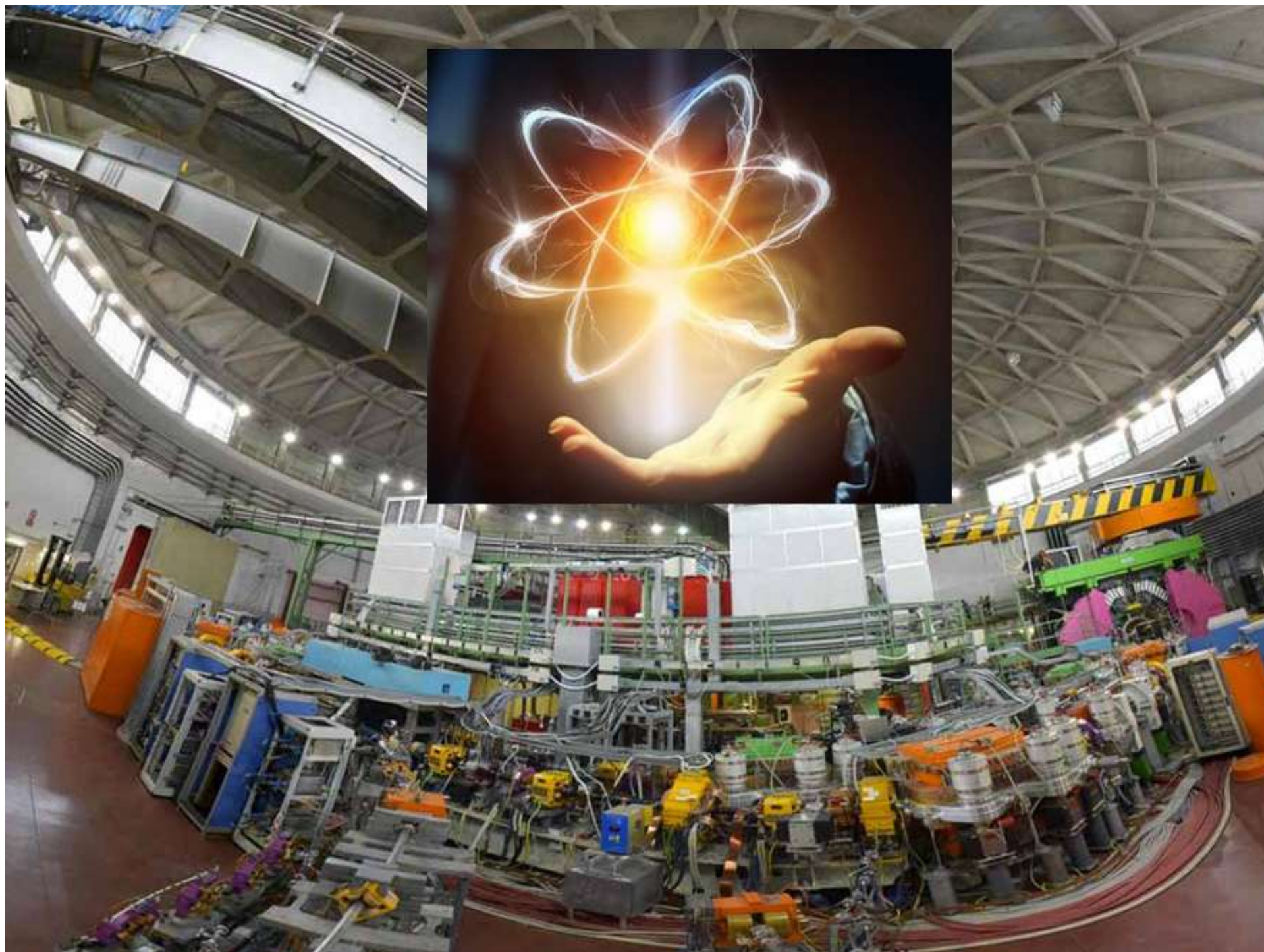


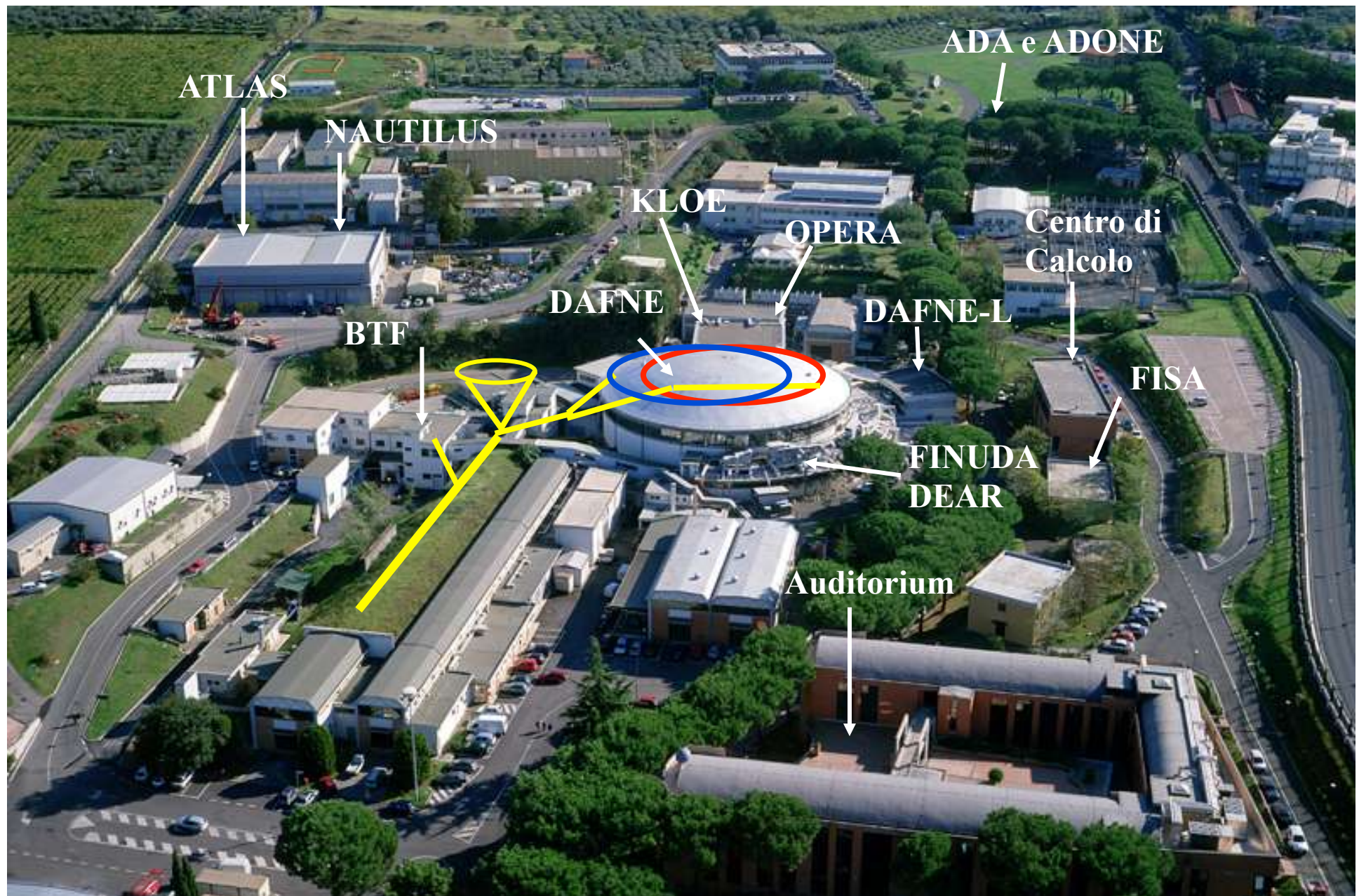
Researchers @Home
Dai laboratori alla società



Catalina Curceanu, LNF-INFN, 28 maggio 2020



Laboratori Nazionali di Frascati

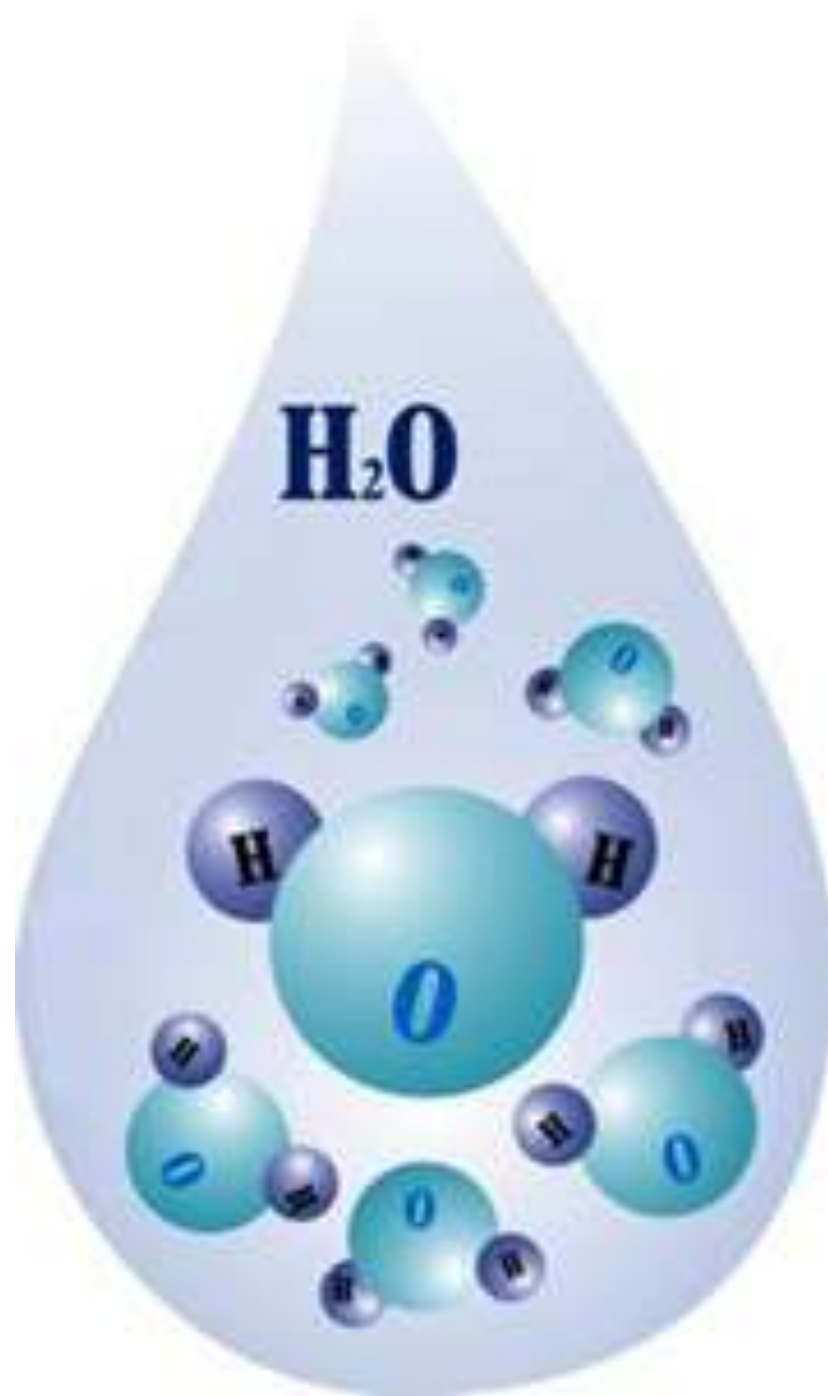


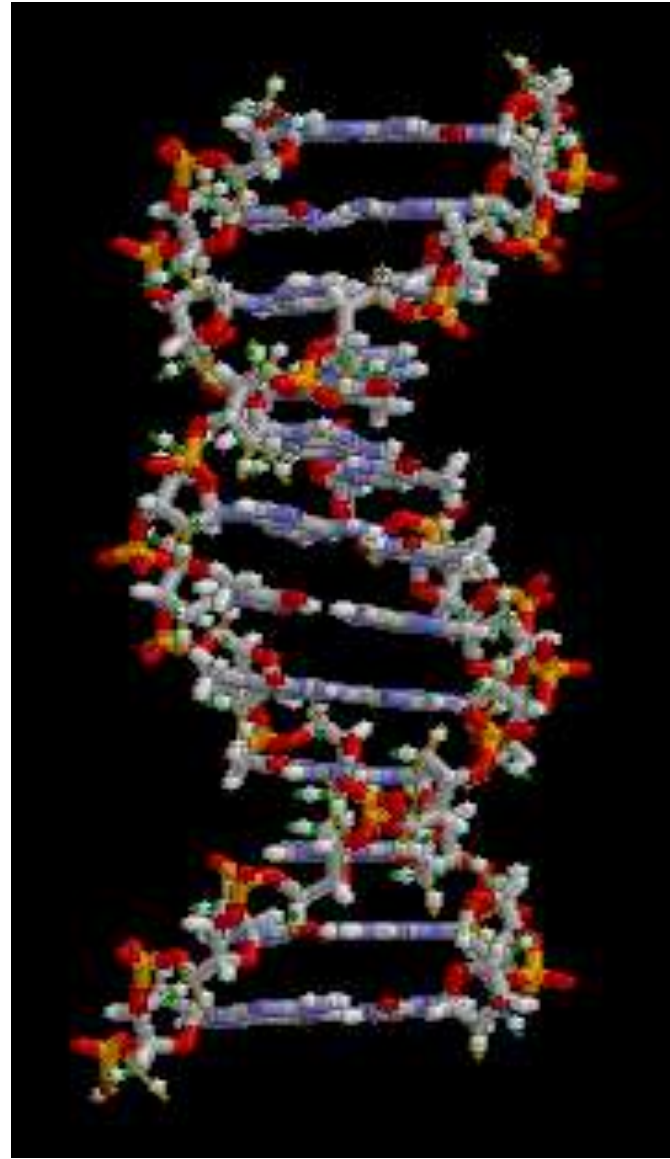
ΔΑΦΝΕ











PERIODIC TABLE of the ELEMENTS



Provided and printed by the
**SHUTTLEWORTH
FOUNDATION**
[www.shuttleworthfoundation.org.uk]
Tel: 01273 826 000 Fax: 01273 826 001 Email: info@shuttleworthfoundation.org.uk

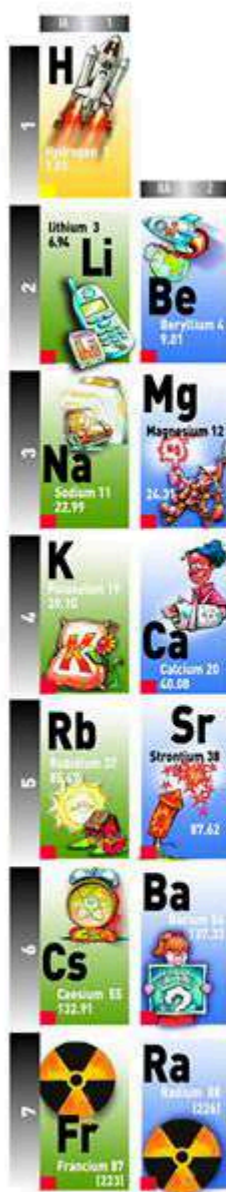
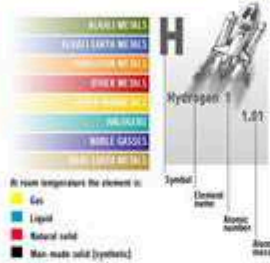
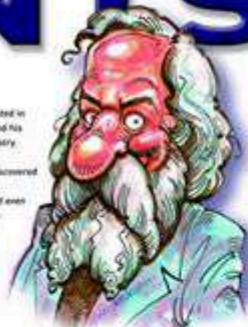


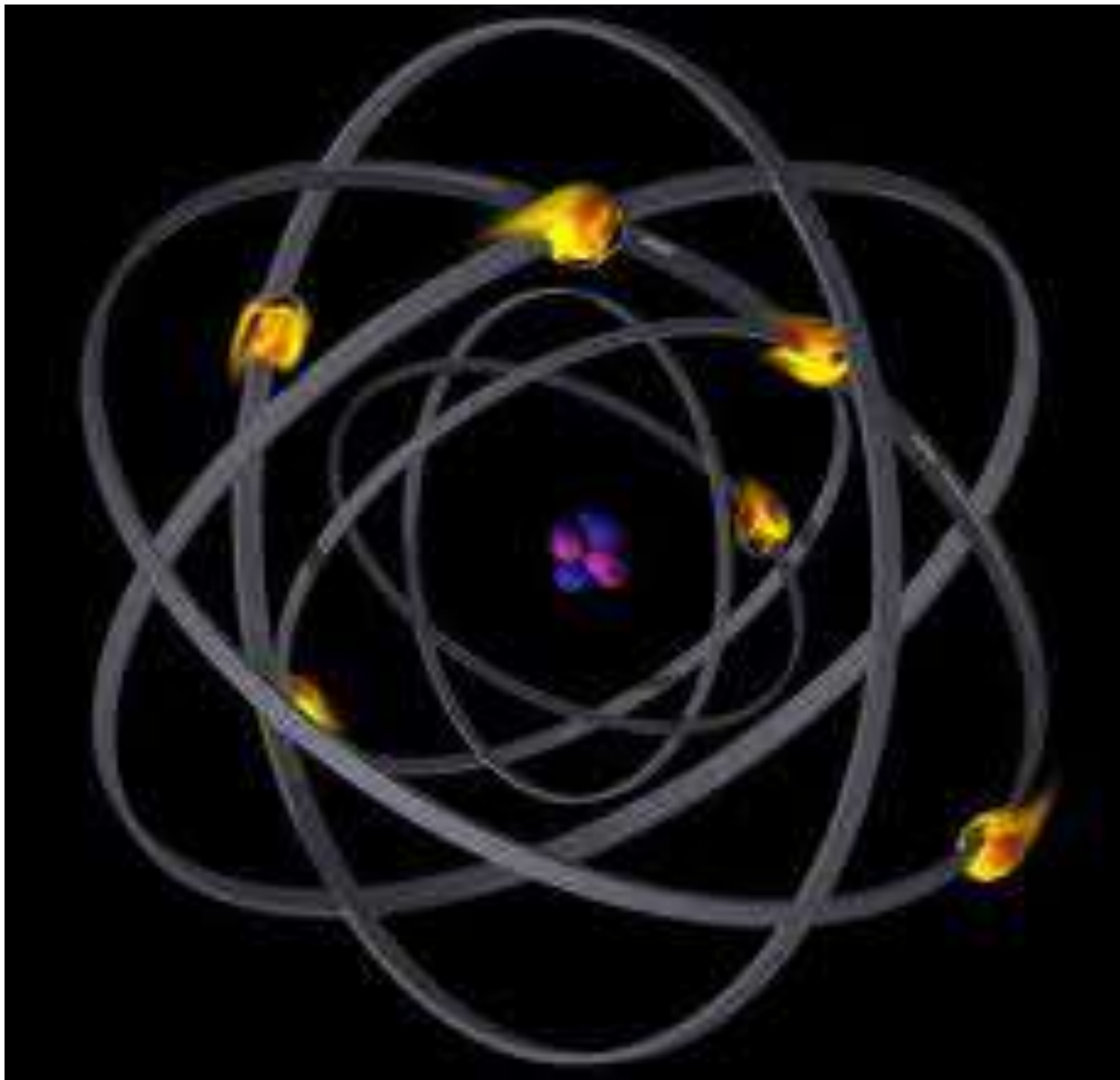
DMITRI MENDELEYEV (1834 - 1907)

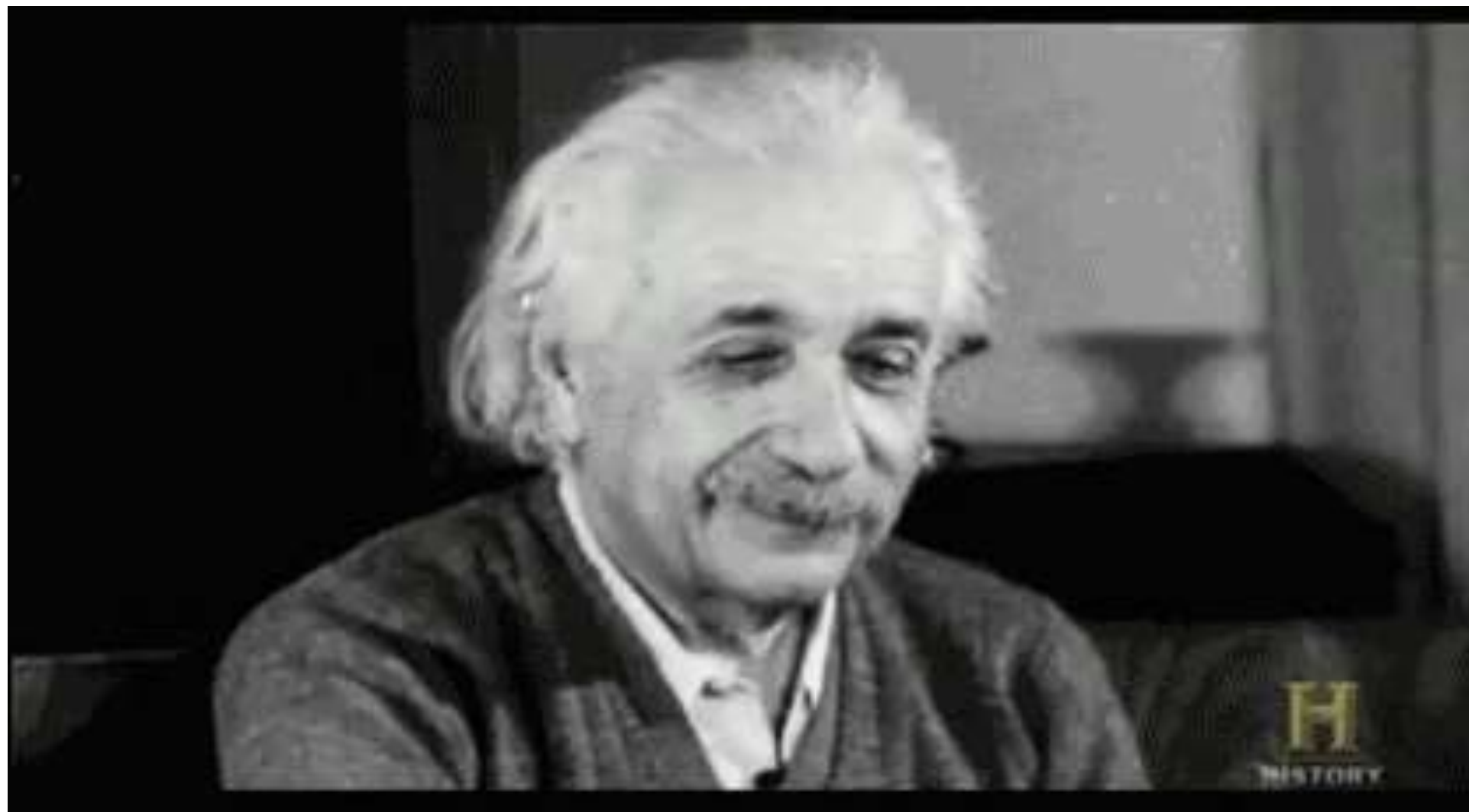
The Russian chemist, Dmitri Mendeleev, was the first to observe that if elements were listed in order of atomic mass, they showed regular (periodical) repeating properties. He formulated his discovery in a periodic table of elements, now regarded as the backbone of modern chemistry.

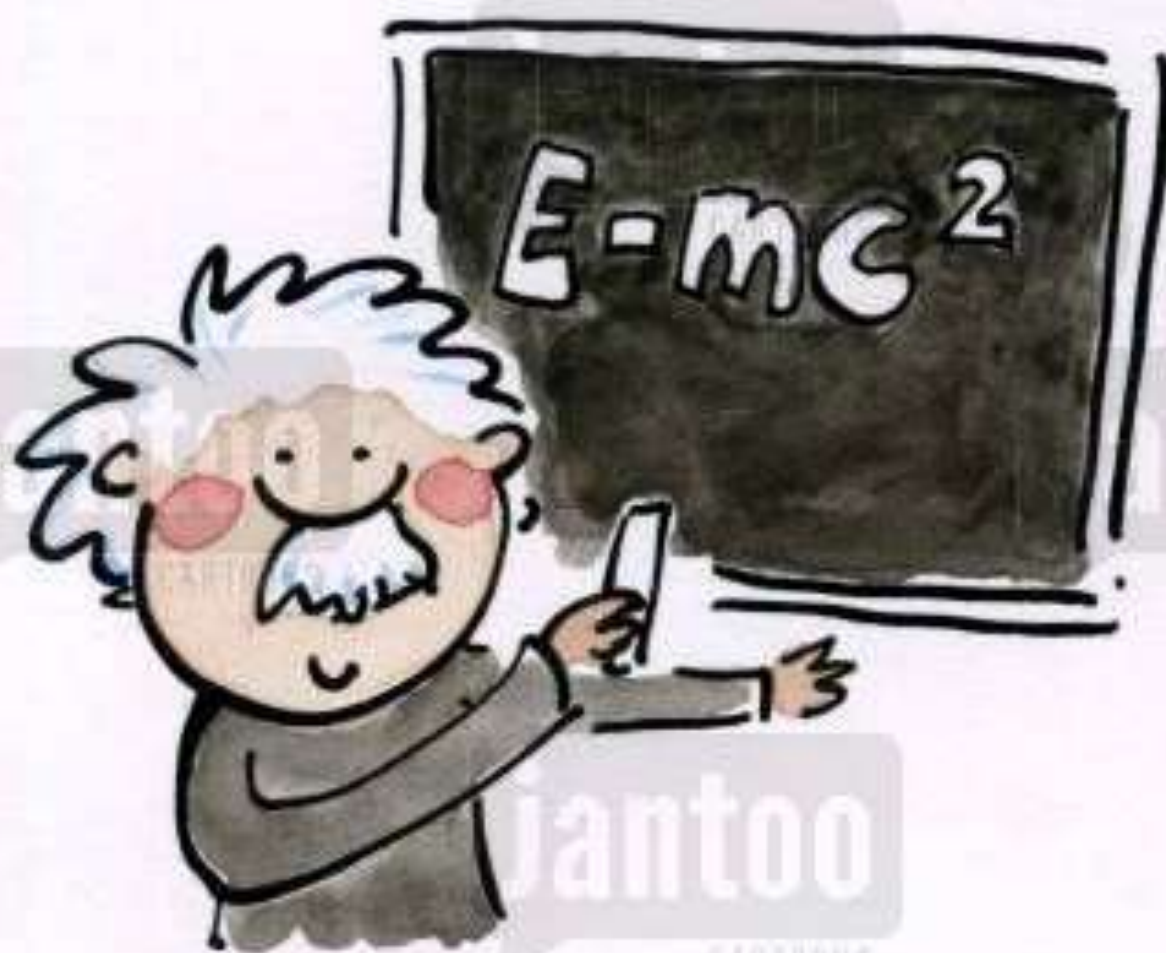
The crowning achievement of Mendeleev's periodic table lay in his prophesy of then undiscovered elements. In 1869, the year he published his periodic classification, the elements gallium, germanium and scandium were unknown. Mendeleev left spaces for them in his table and even predicted their atomic masses and other chemical properties. Six years later, gallium was discovered and his predictions were found to be accurate. Other discoveries followed and their chemical behaviour matched that predicted by Mendeleev.

This remarkable man, the youngest in a family of 17 children, has left the scientific community with a classification system so powerful that it became the cornerstone in chemistry teaching and the prediction of new elements ever since. In 1955, element 101 was named after him: Md, Mendelevium.



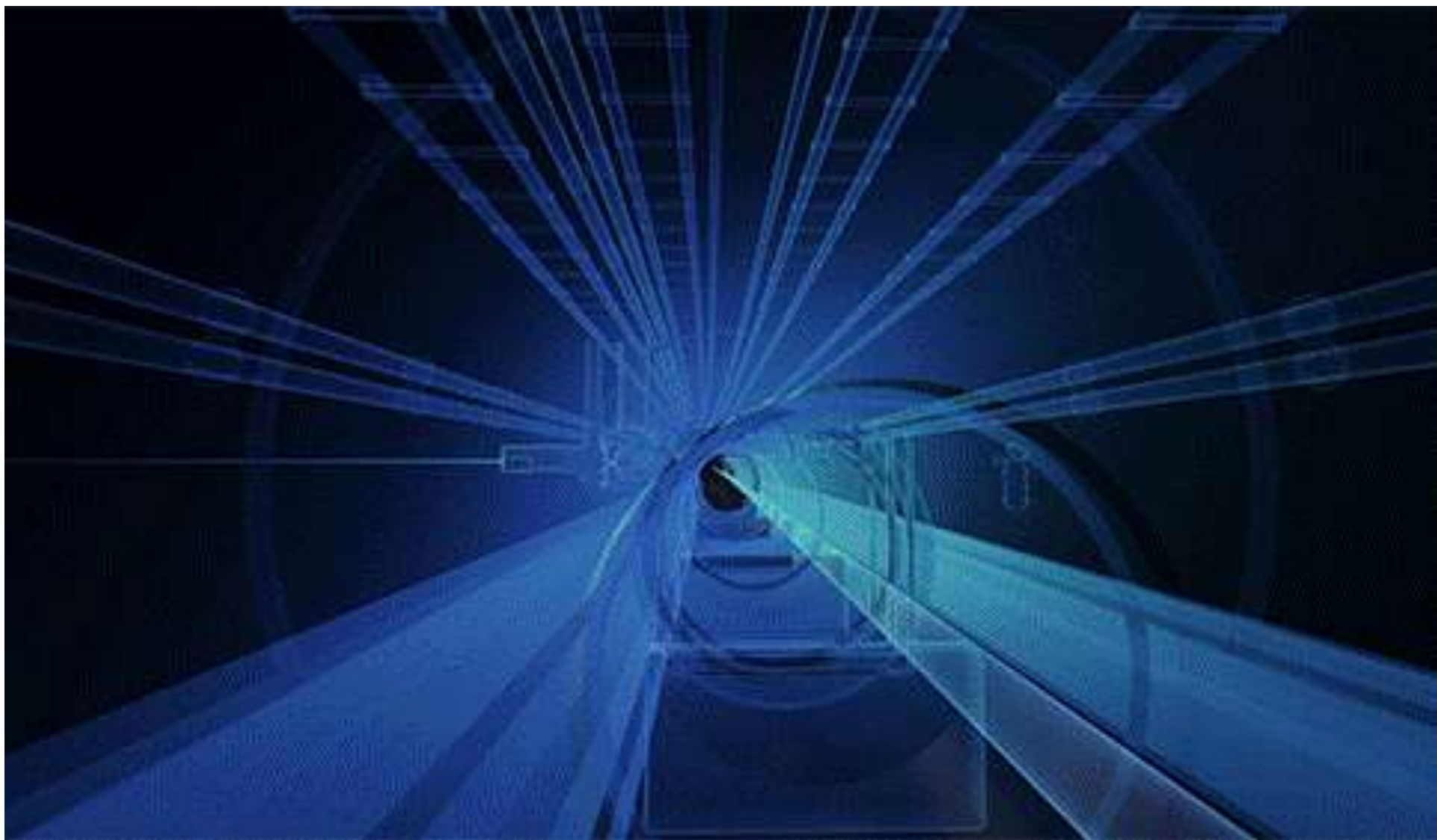


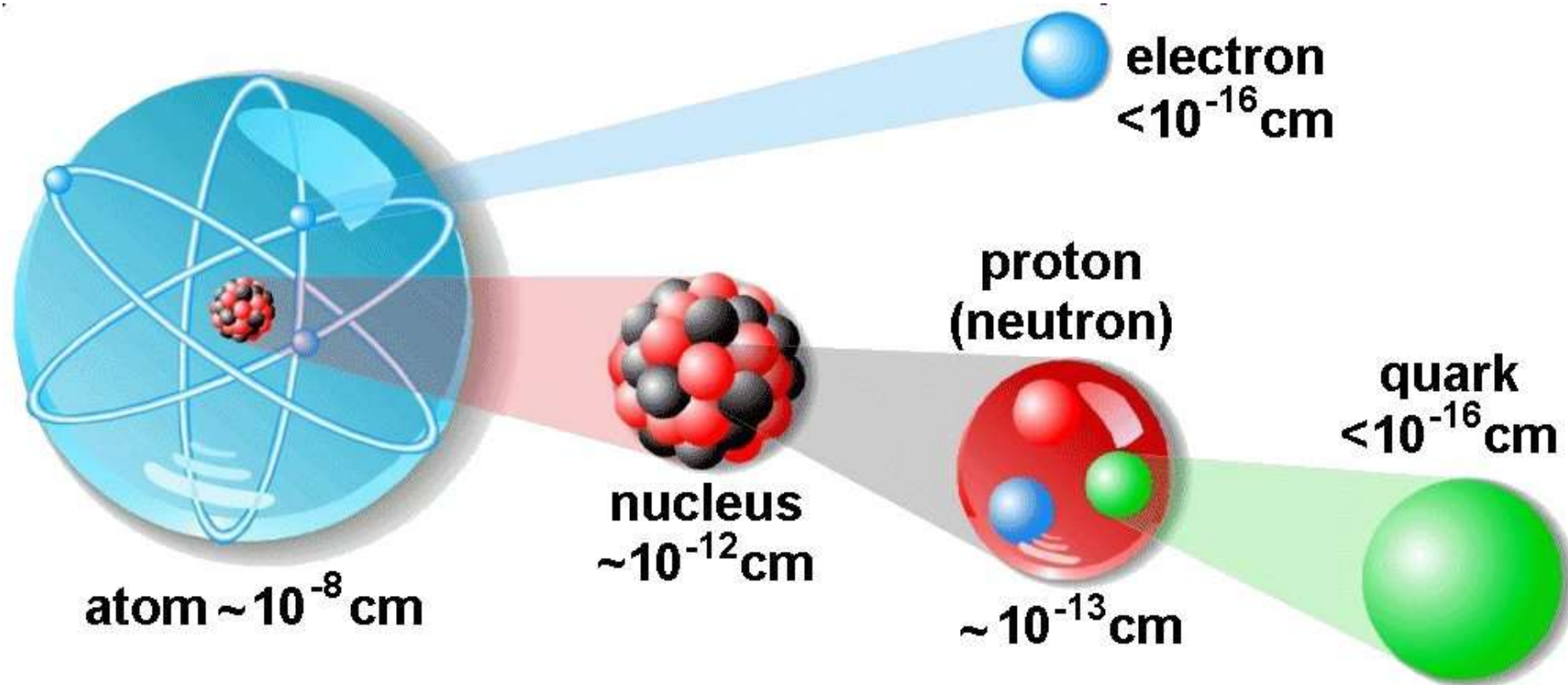


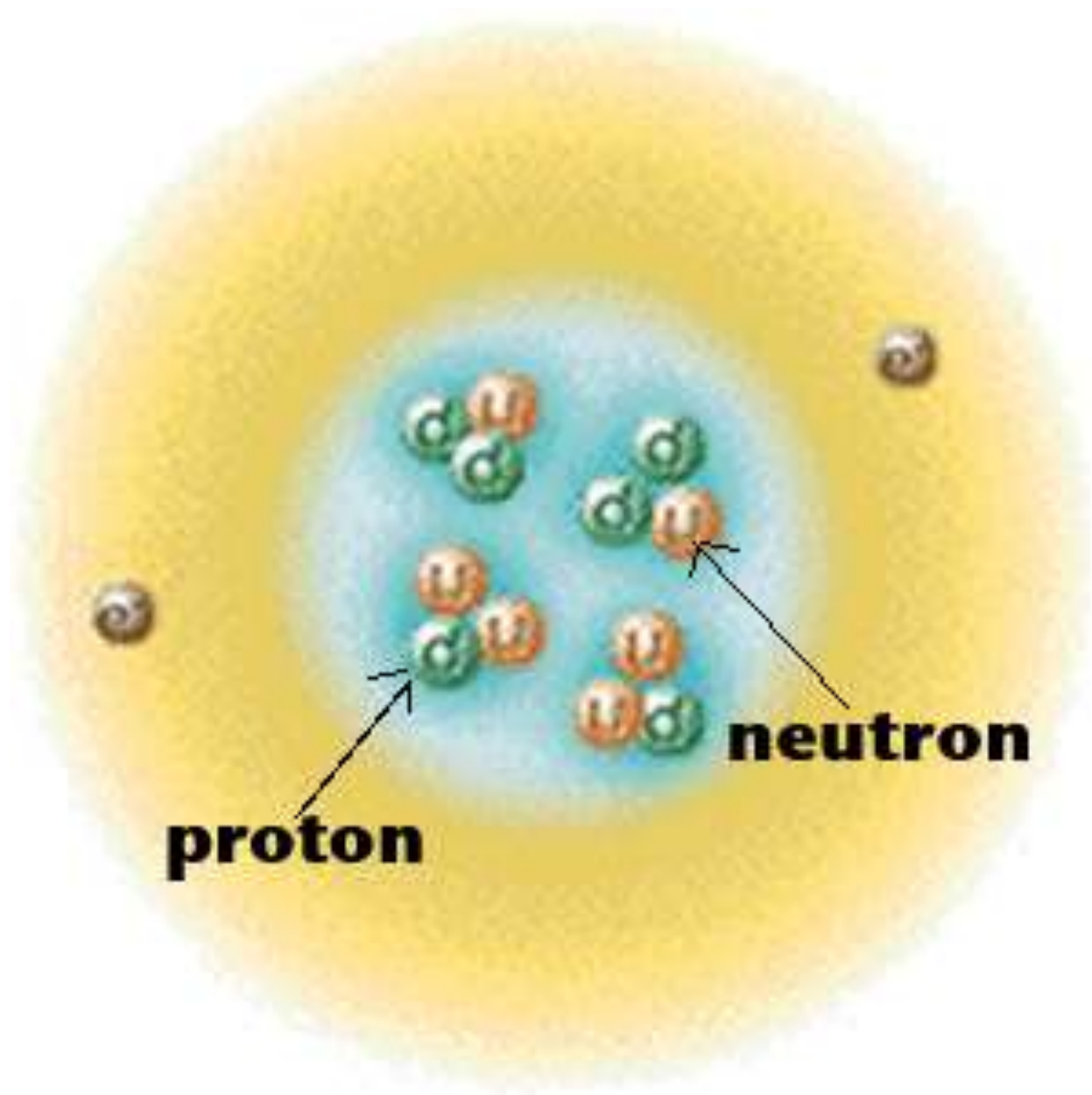


Search: 30430174

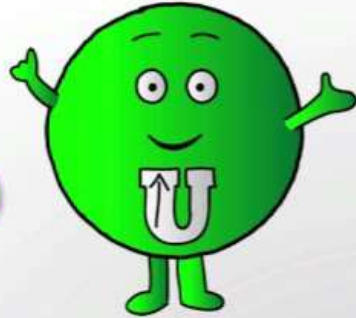




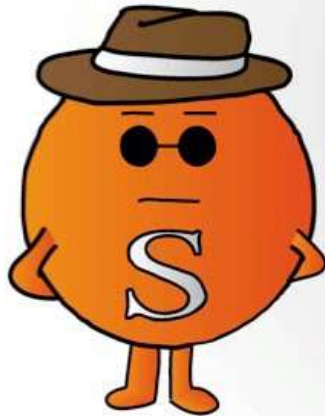




Up



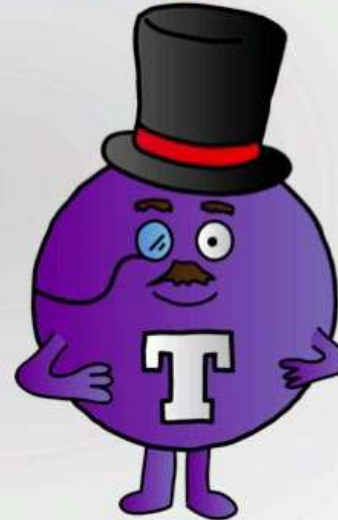
Down



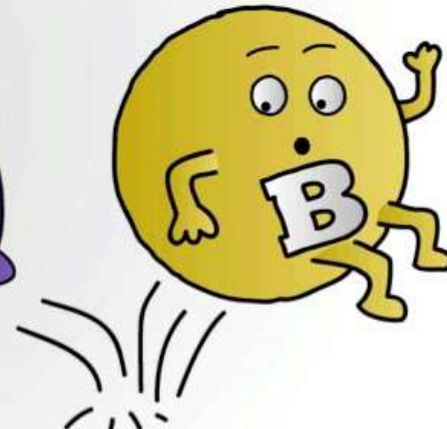
Strange



Charm



Top



Bottom



STANDARD MODEL OF ELEMENTARY PARTICLES

QUARKS

UP
 mass $2,3 \text{ MeV}/c^2$
 charge $\frac{2}{3}$
 spin $\frac{1}{2}$


CHARM
 mass $1,275 \text{ GeV}/c^2$
 charge $\frac{2}{3}$
 spin $\frac{1}{2}$


TOP
 mass $173,07 \text{ GeV}/c^2$
 charge $\frac{2}{3}$
 spin $\frac{1}{2}$


DOWN
 mass $4,8 \text{ MeV}/c^2$
 charge $-\frac{1}{3}$
 spin $\frac{1}{2}$


STRANGE
 mass $95 \text{ MeV}/c^2$
 charge $-\frac{1}{3}$
 spin $\frac{1}{2}$


BOTTOM
 mass $4,18 \text{ GeV}/c^2$
 charge $-\frac{1}{3}$
 spin $\frac{1}{2}$


GLUON
 mass 0
 charge 0
 spin 1


HIGGS BOSON
 mass $126 \text{ GeV}/c^2$
 charge 0
 spin 0


PHOTON
 mass 0
 charge 0
 spin 1


GAUGE BOSONS

LEPTONS

ELECTRON
 mass $0,511 \text{ MeV}/c^2$
 charge -1
 spin $\frac{1}{2}$


MUON
 mass $105,7 \text{ MeV}/c^2$
 charge -1
 spin $\frac{1}{2}$


TAU
 mass $1,777 \text{ GeV}/c^2$
 charge -1
 spin $\frac{1}{2}$


Z BOSON
 mass $91,2 \text{ GeV}/c^2$
 charge 0
 spin 1


ELECTRON NEUTRINO
 mass $<2,2 \text{ eV}/c^2$
 charge 0
 spin $\frac{1}{2}$


MUON NEUTRINO
 mass $<0,17 \text{ MeV}/c^2$
 charge 0
 spin $\frac{1}{2}$


TAU NEUTRINO
 mass $<15,5 \text{ MeV}/c^2$
 charge 0
 spin $\frac{1}{2}$


W BOSON
 mass $80,4 \text{ GeV}/c^2$
 charge ± 1
 spin 1


SIDDHARTA

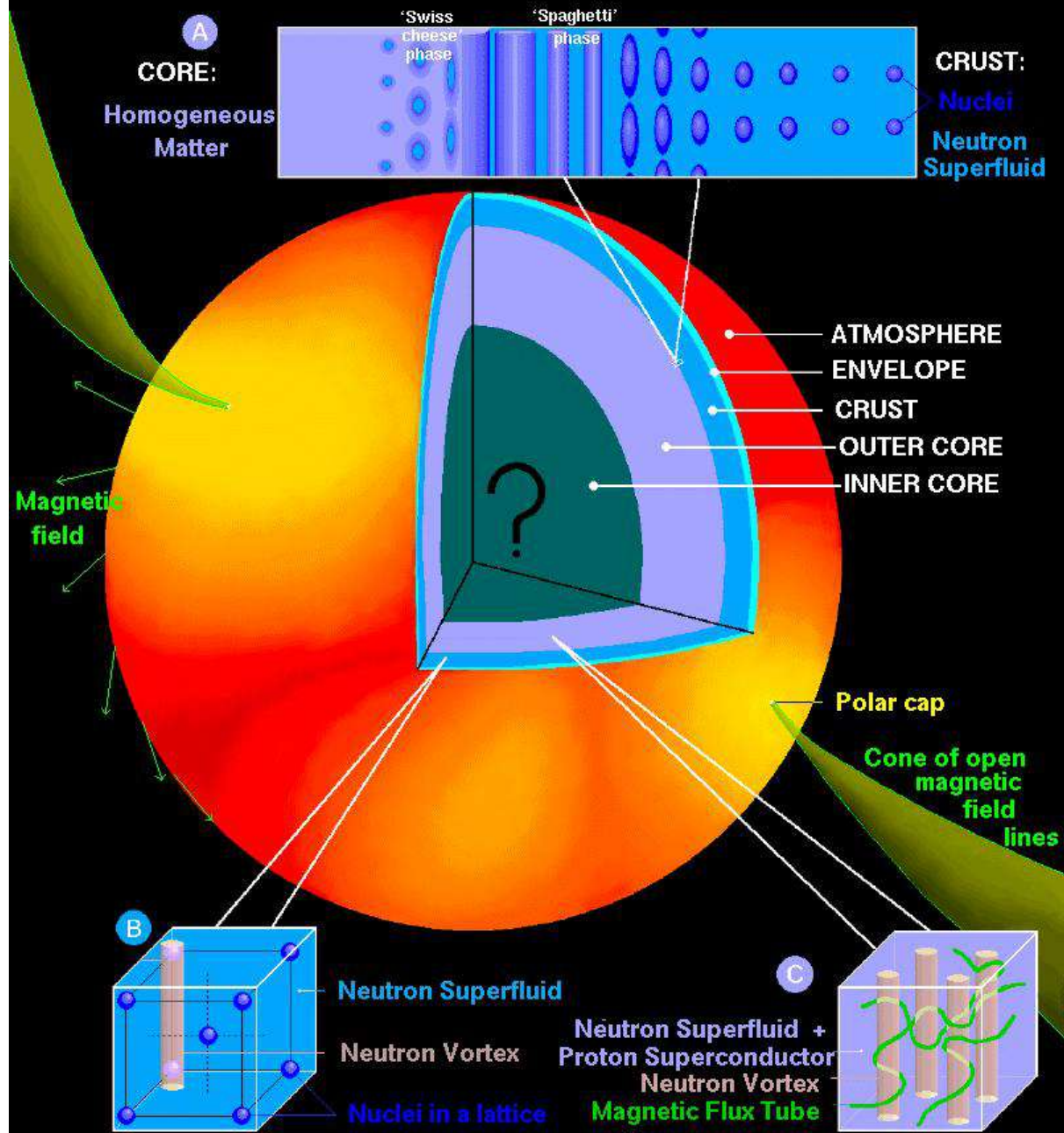
Si Silicon Drift Detector for Hadronic Atom Research by Timing Applications







A NEUTRON STAR: SURFACE and INTERIOR



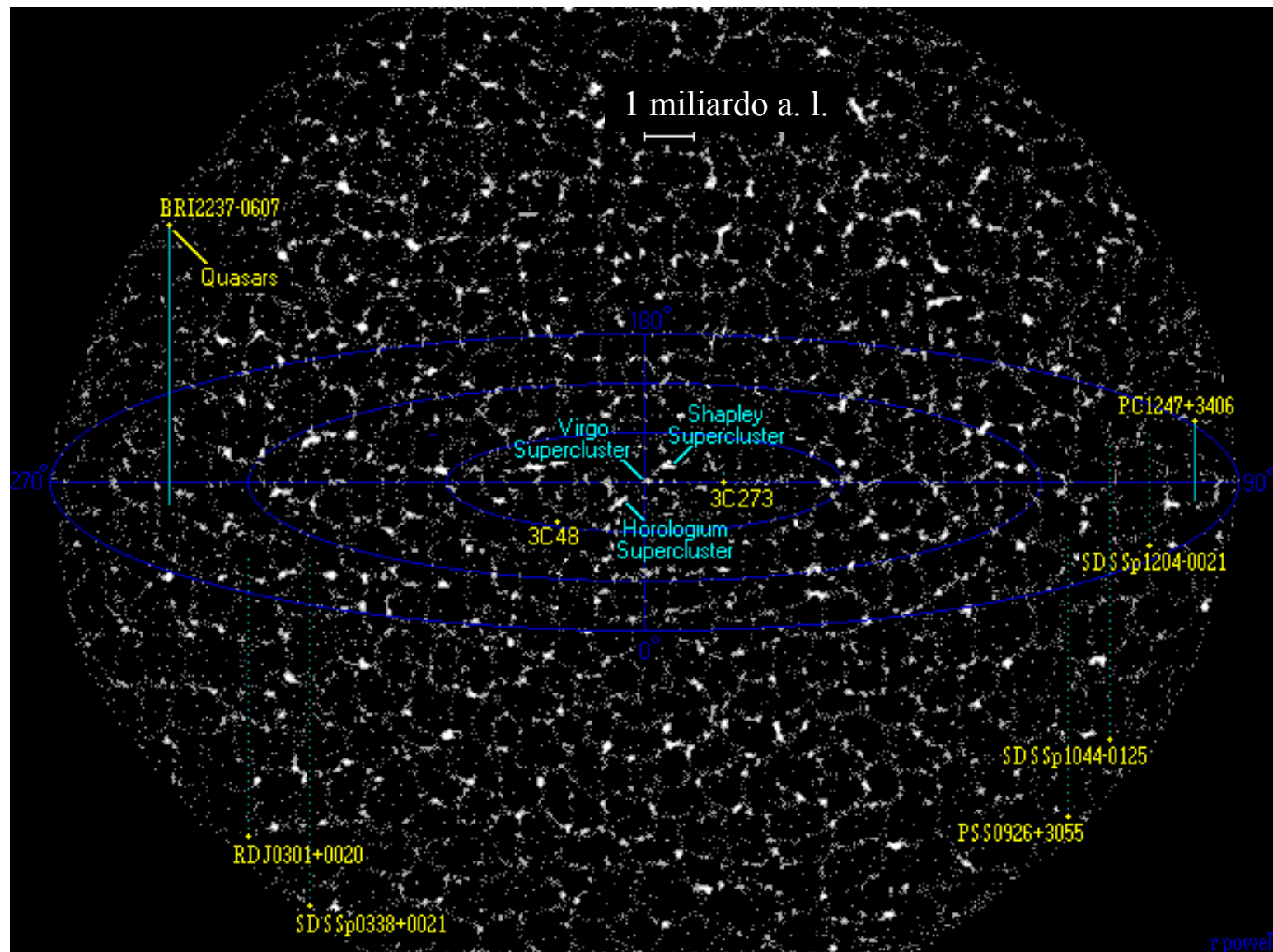
Modello standard della fisica delle particelle



NON include la gravita'!

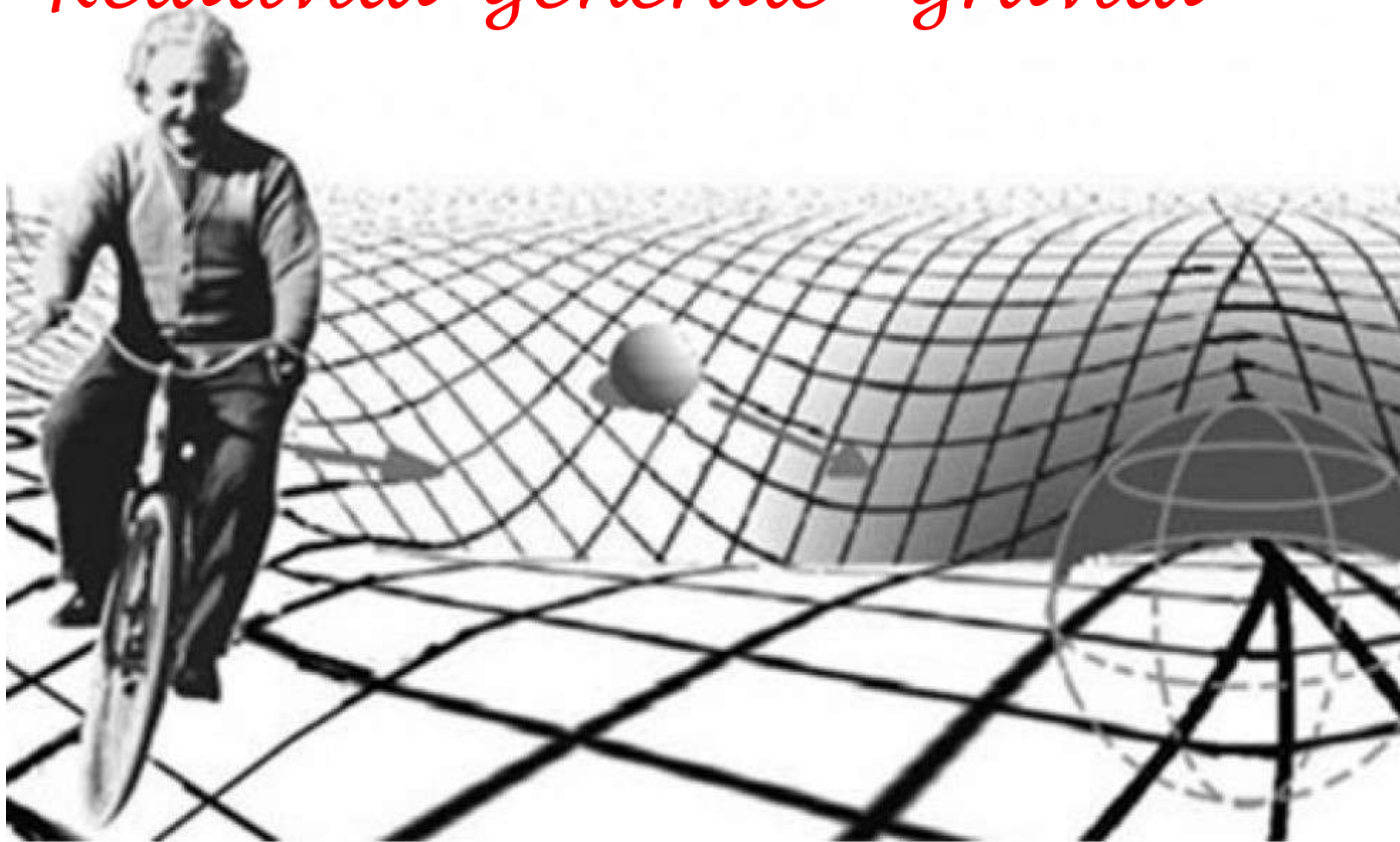


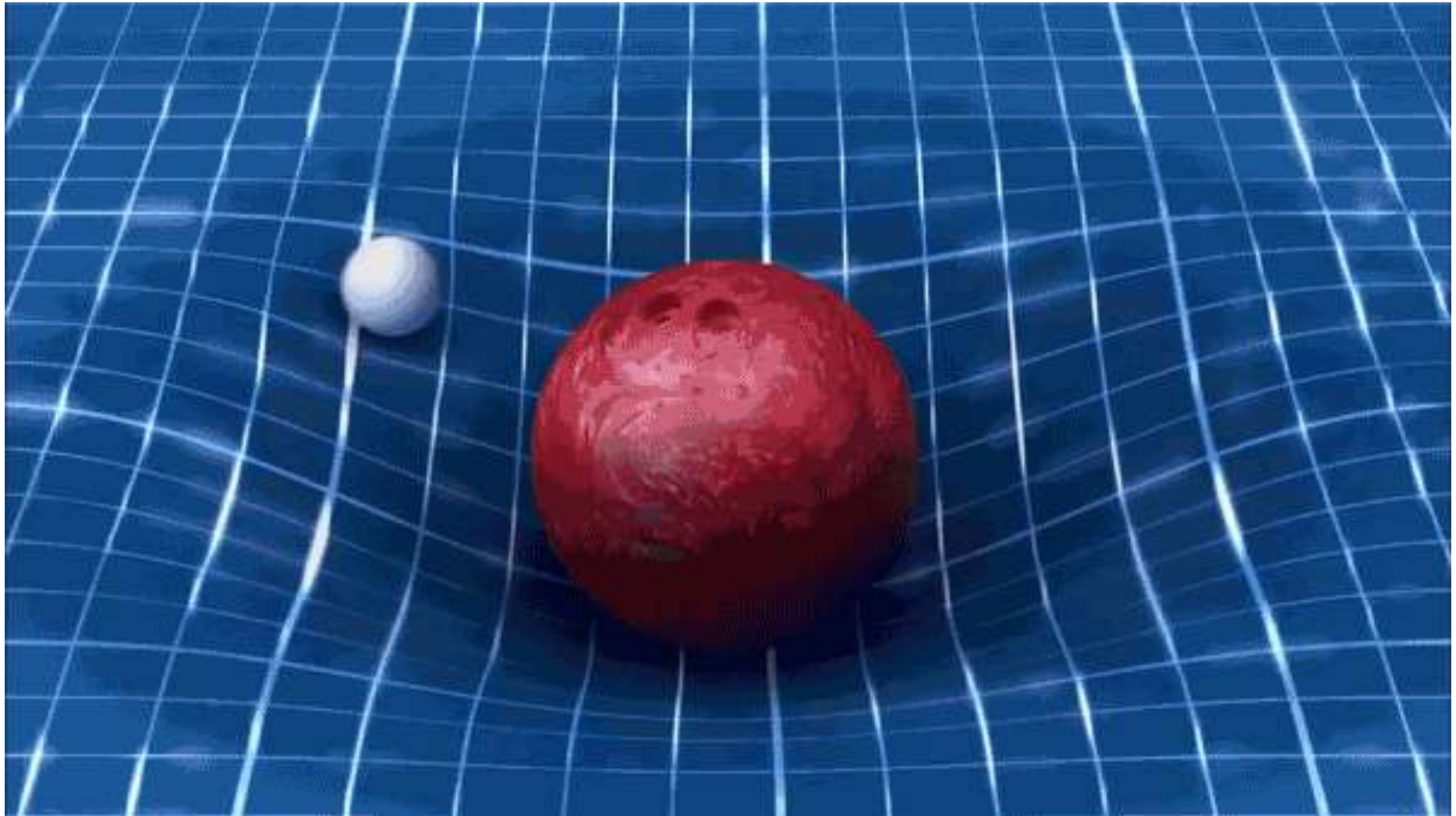




Zoom In x15

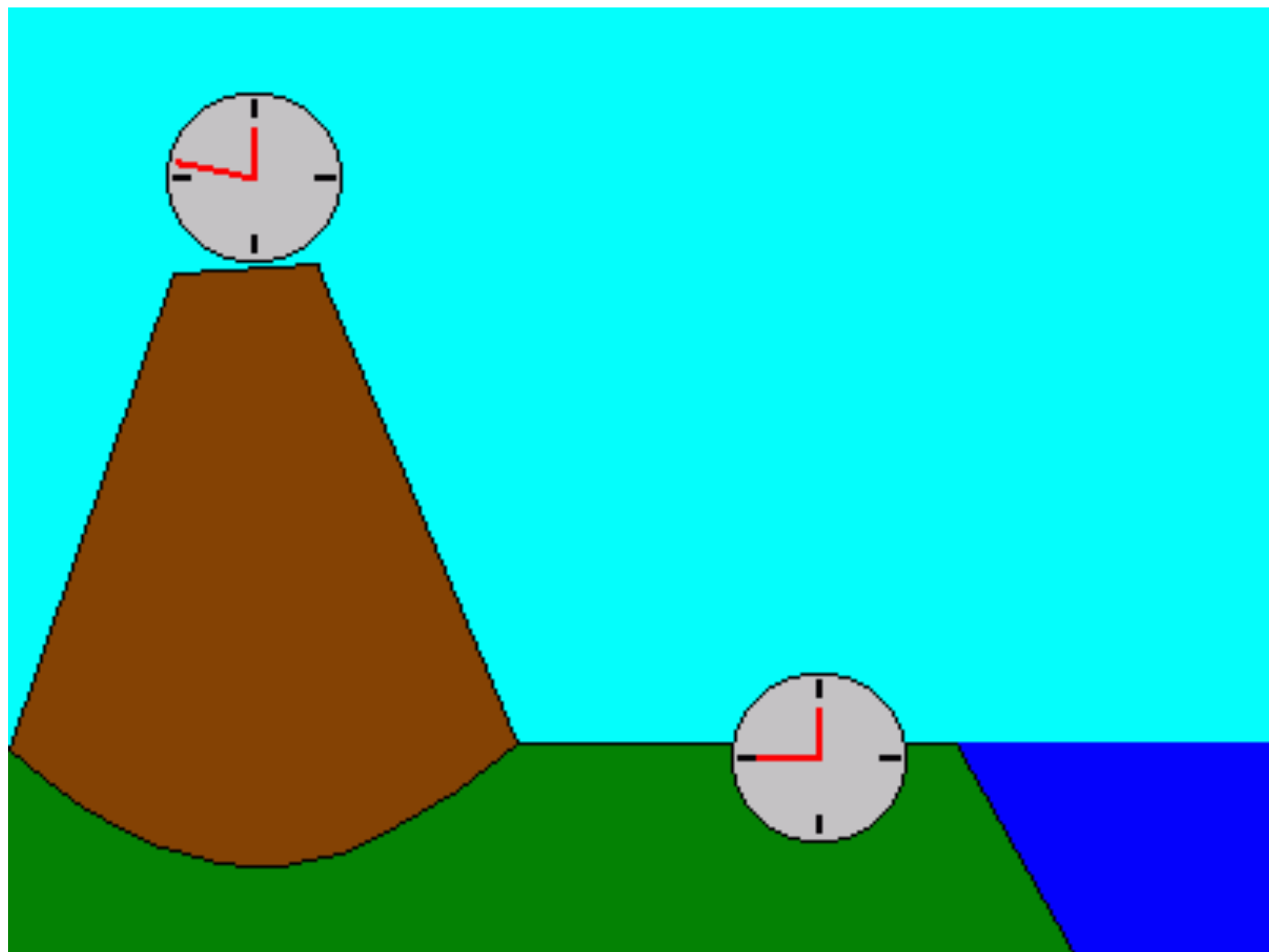
Relatività generale - gravità

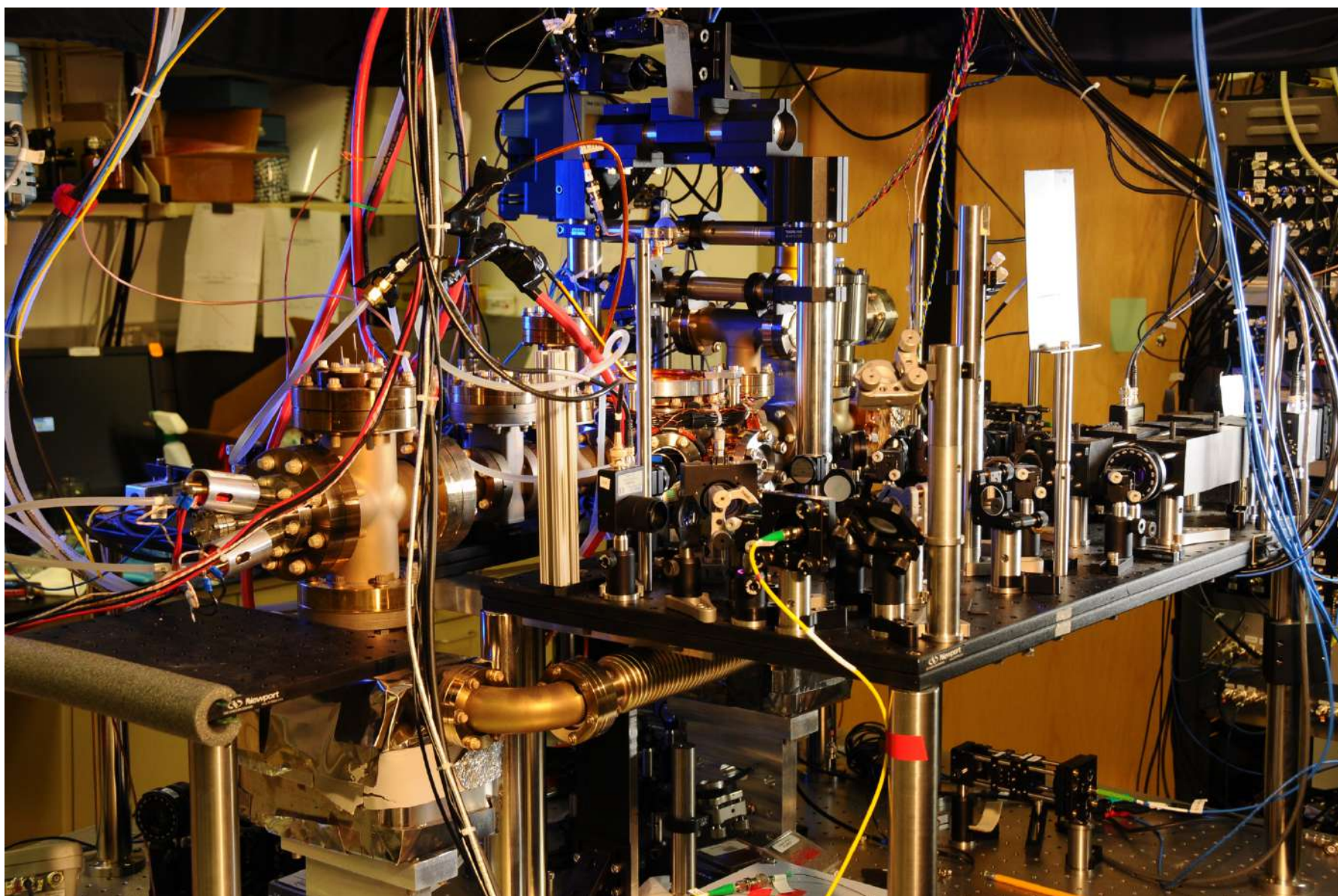




$$R_{ab} - \frac{1}{2}Rg_{ab} = \frac{8\pi G}{c^4}T_{ab}.$$

ALBERT EINSTEIN'S GENERAL THEORY OF RELATIVITY, 1916







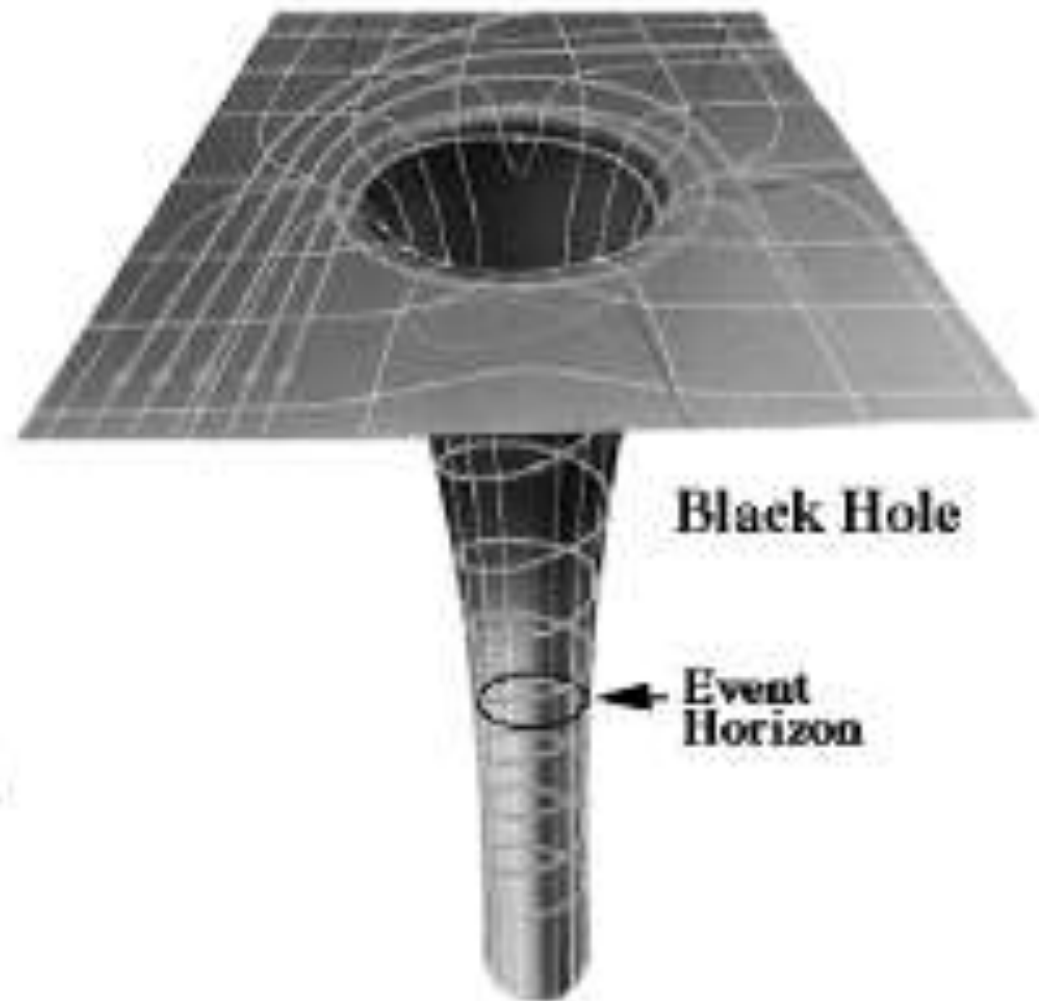
Sun



White Dwarf



Neutron Star



Black Hole

Event Horizon

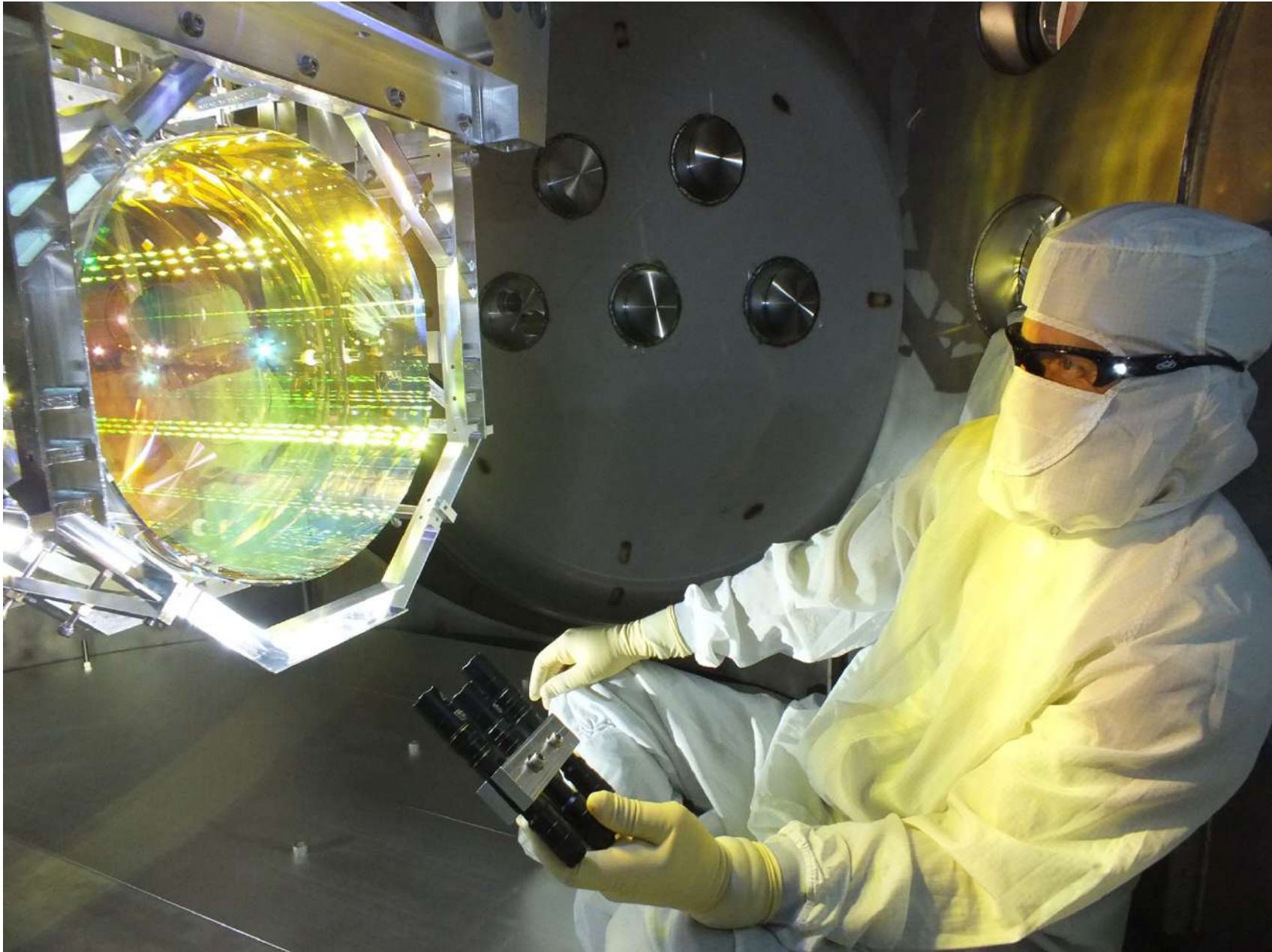
Credit: Adam Apollo

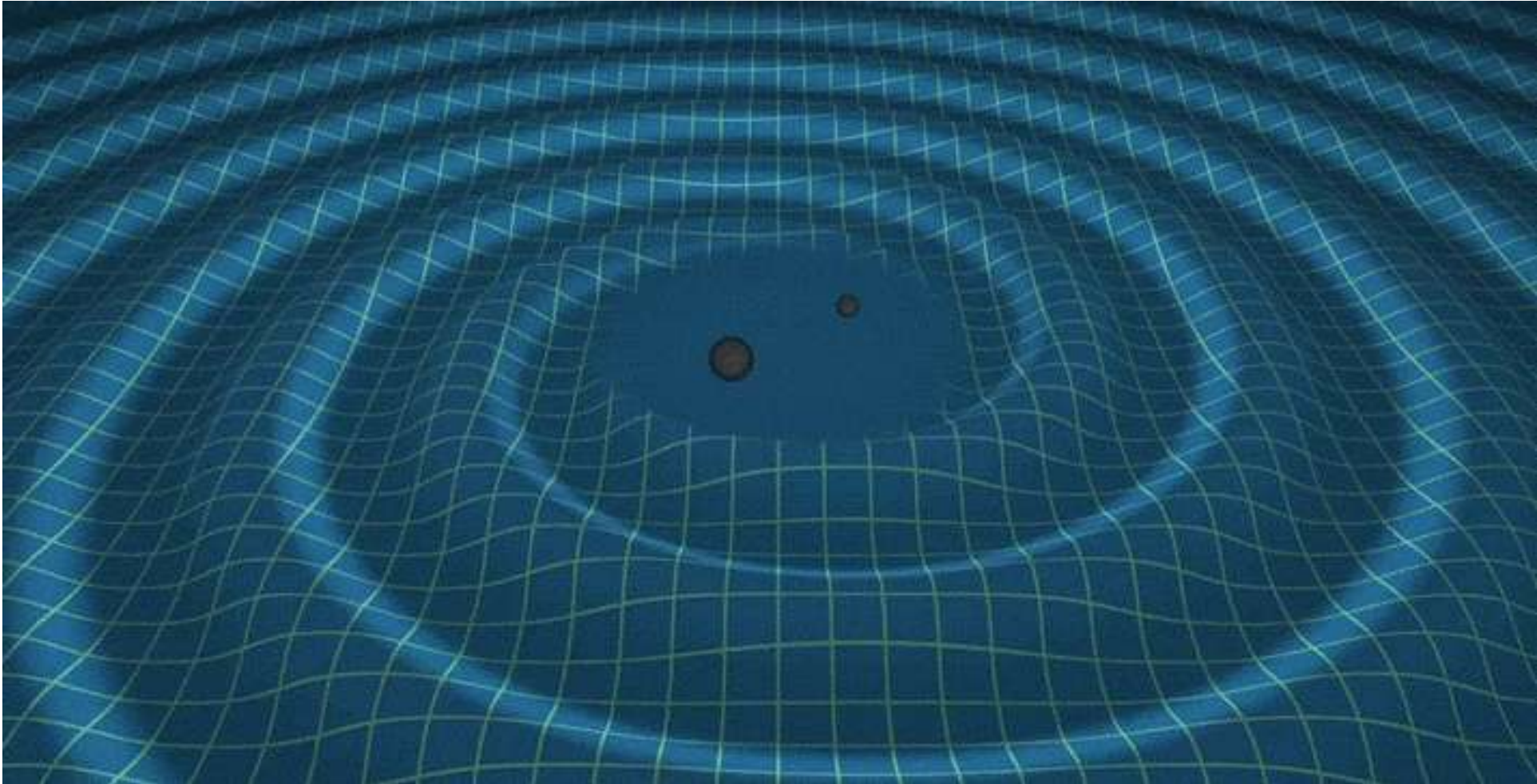




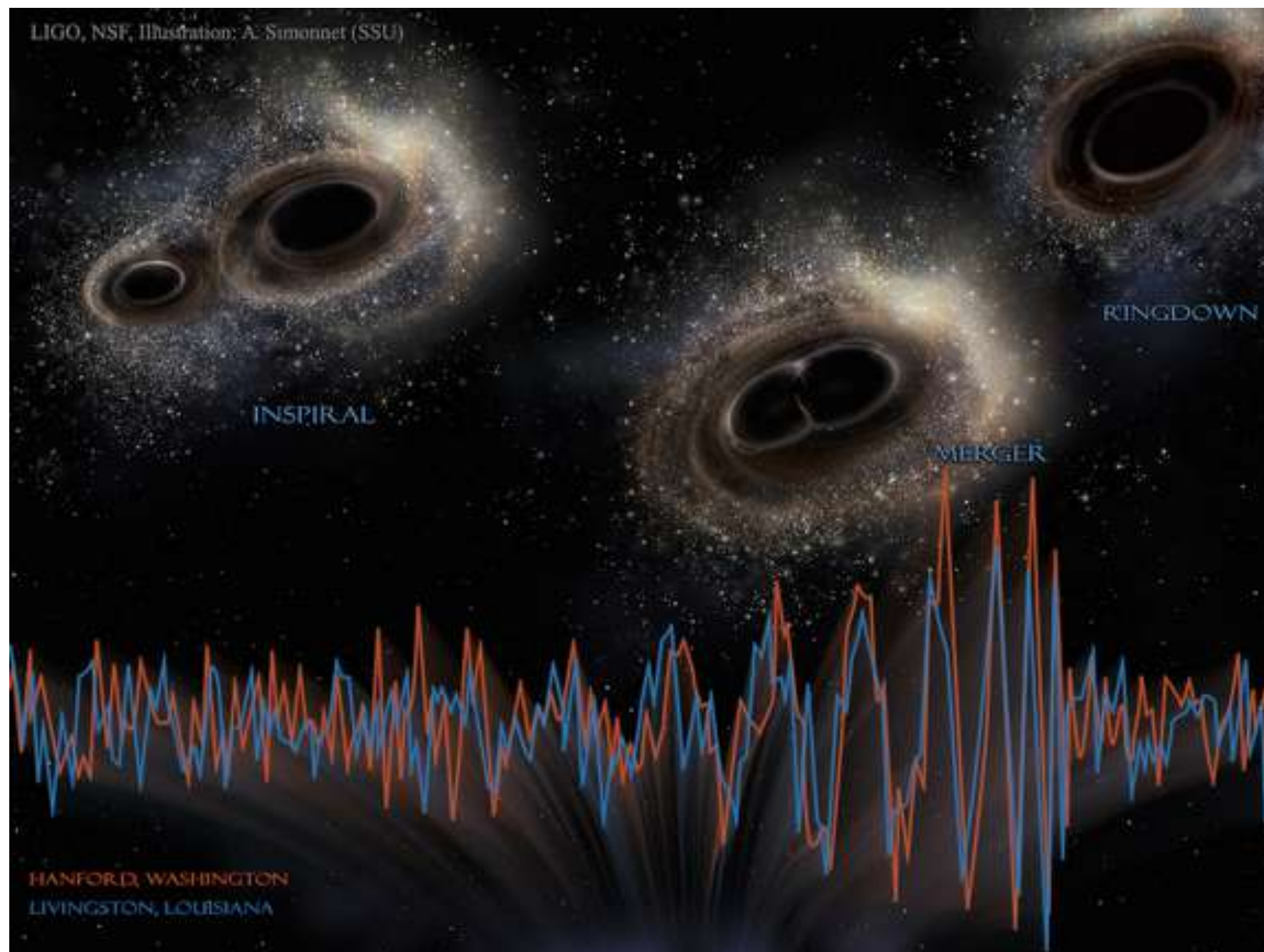
VIRGO

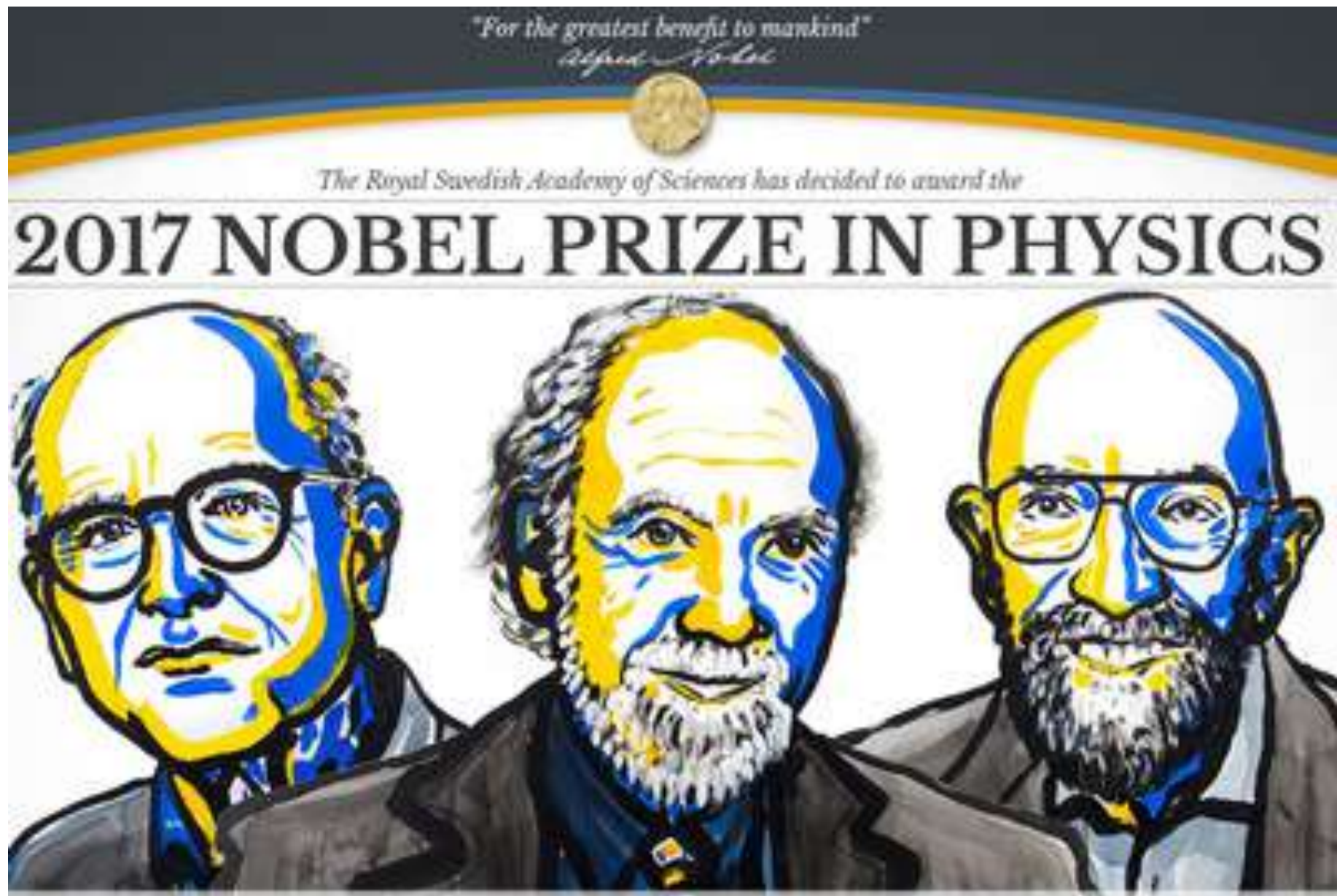






LIGO, NSF, Illustration: A. Simonnet (SSU)





Half: Rainer Weiss and the other half jointly to Barry C. Barish and Kip S. Thorne - LIGO/VIRGO Collb.

[LIGO'S **GRAVITATIONAL-WAVE** DETECTIONS]

[GW150914]

DISCOVERED:

14.09.2015

1.3 BILLION
LIGHT-YEARS
AWAY

62 SOLAR
MASSES

366 KILOMETRES IN
DIAMETER

[GW151226]

DISCOVERED:

26.12.2015

1.4 BILLION
LIGHT-YEARS
AWAY

21 SOLAR
MASSES

124 KILOMETRES IN
DIAMETER

[GW170104]

DISCOVERED:

04.01.2017

3 BILLION
LIGHT-YEARS
AWAY

49 SOLAR
MASSES

289 KILOMETRES IN
DIAMETER

**YOU ARE
HERE**

1 BILLION
LIGHT YEARS

2 BILLION
LIGHT YEARS

3 BILLION
LIGHT YEARS

4 BILLION
LIGHT YEARS

DID YOU KNOW ?

THE SOLAR MASS IS
A STANDARD UNIT OF MASS

IN ASTRONOMY

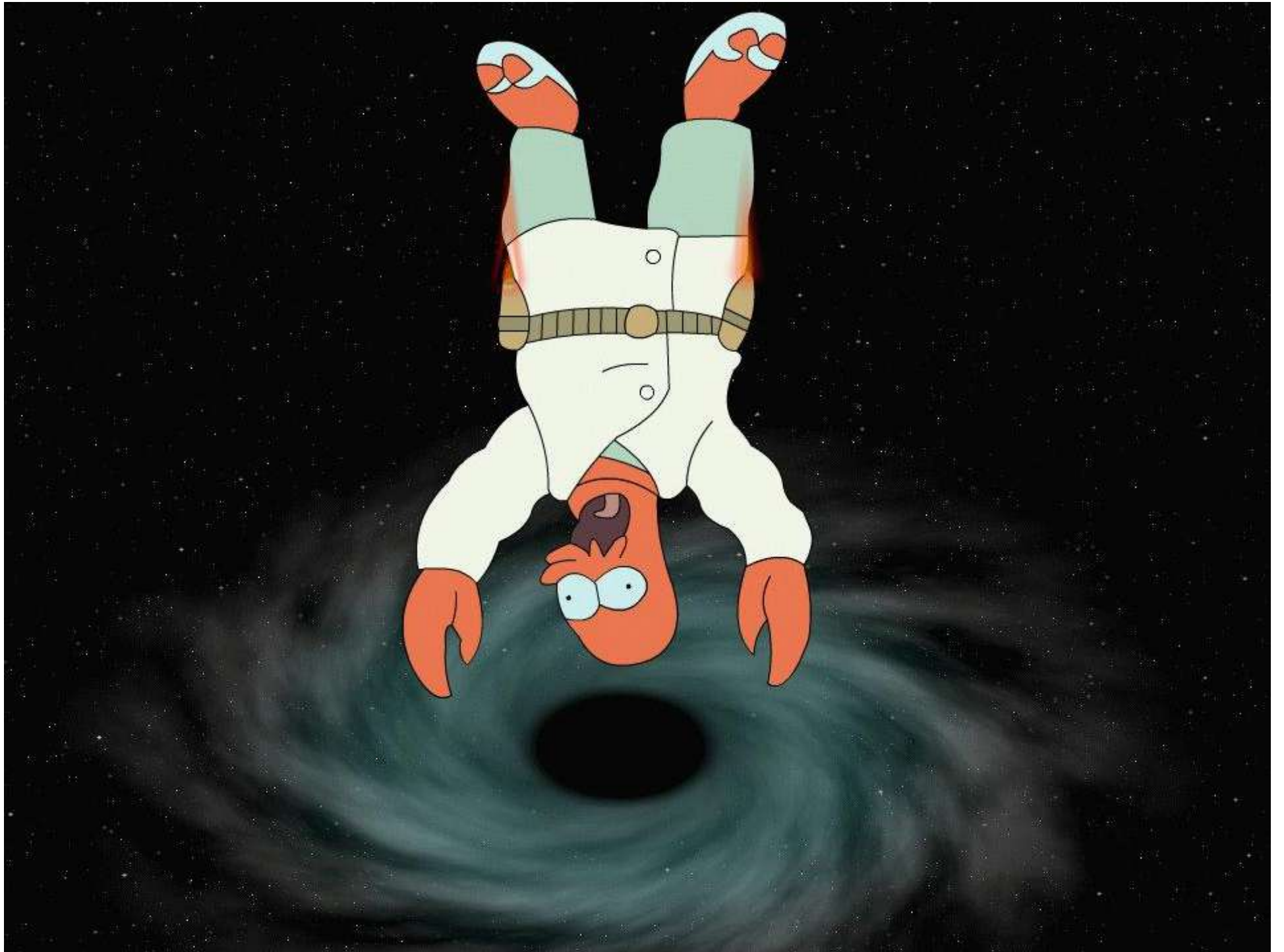
IT IS EQUAL TO
THE MASS OF THE SUN

EQUAL TO APPROXIMATELY
 1.99×10^{30} KG

LIGO

Laser Interferometer
Gravitational-Wave Observatory
Supported by the National Science Foundation
Operated by Caltech and MIT

OzGrav
ARC Centre of Excellence for Gravitational Wave Discovery



Interstellar??

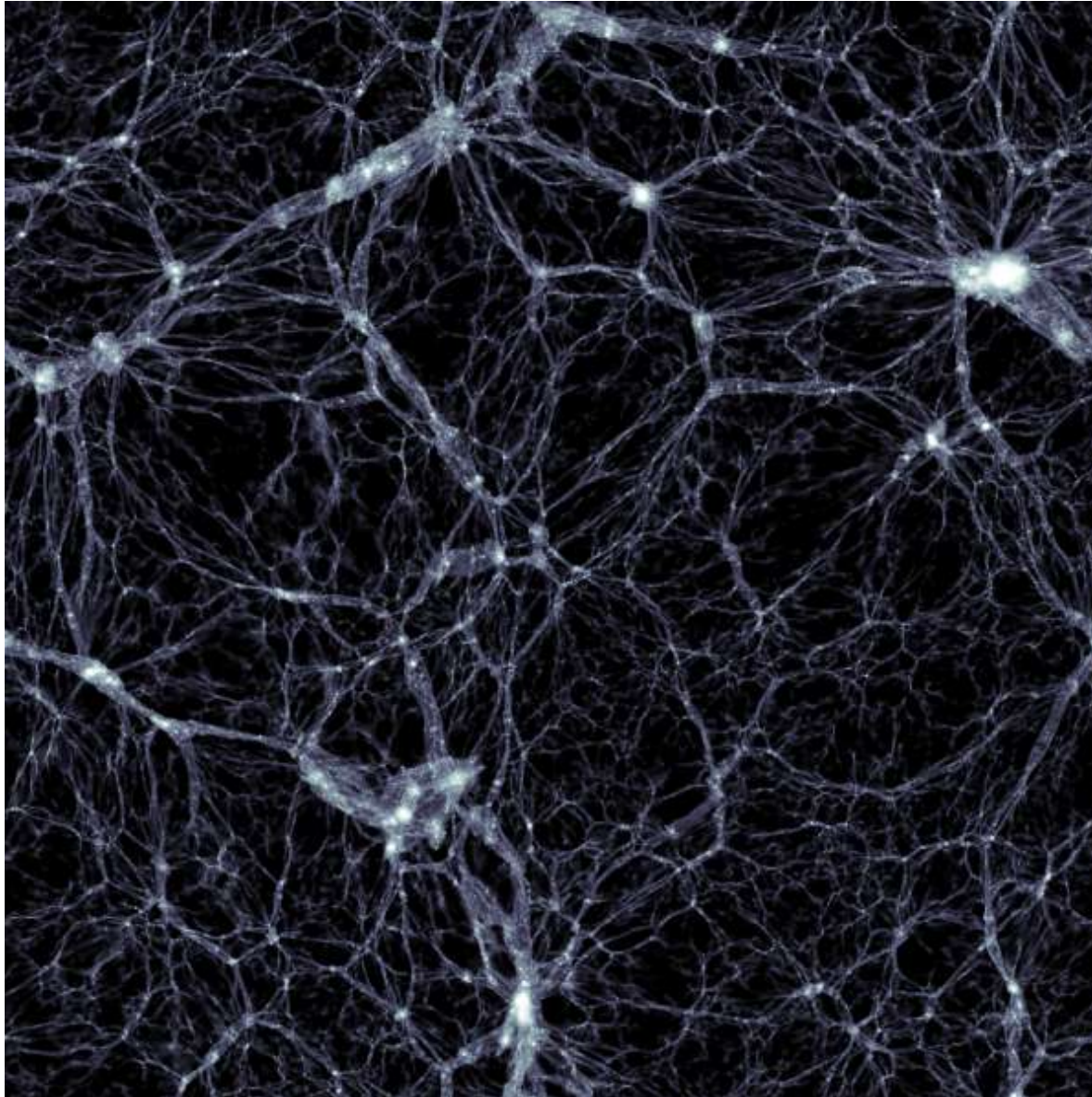




Black Holes Are Passage To Another Universe

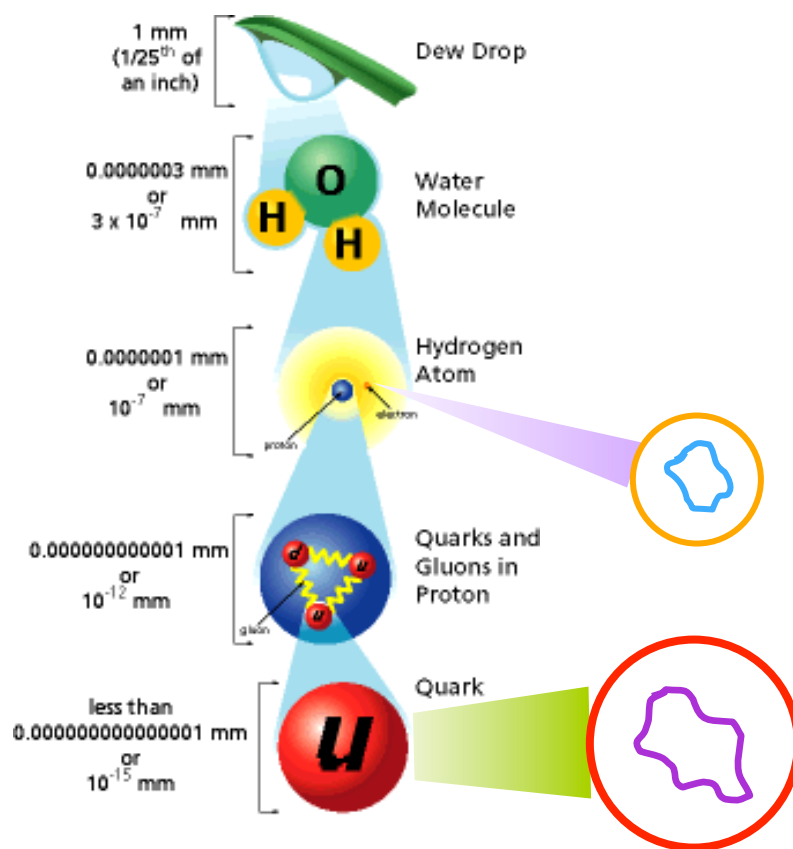


Gravita' quantistica?



Teoria delle stringhe

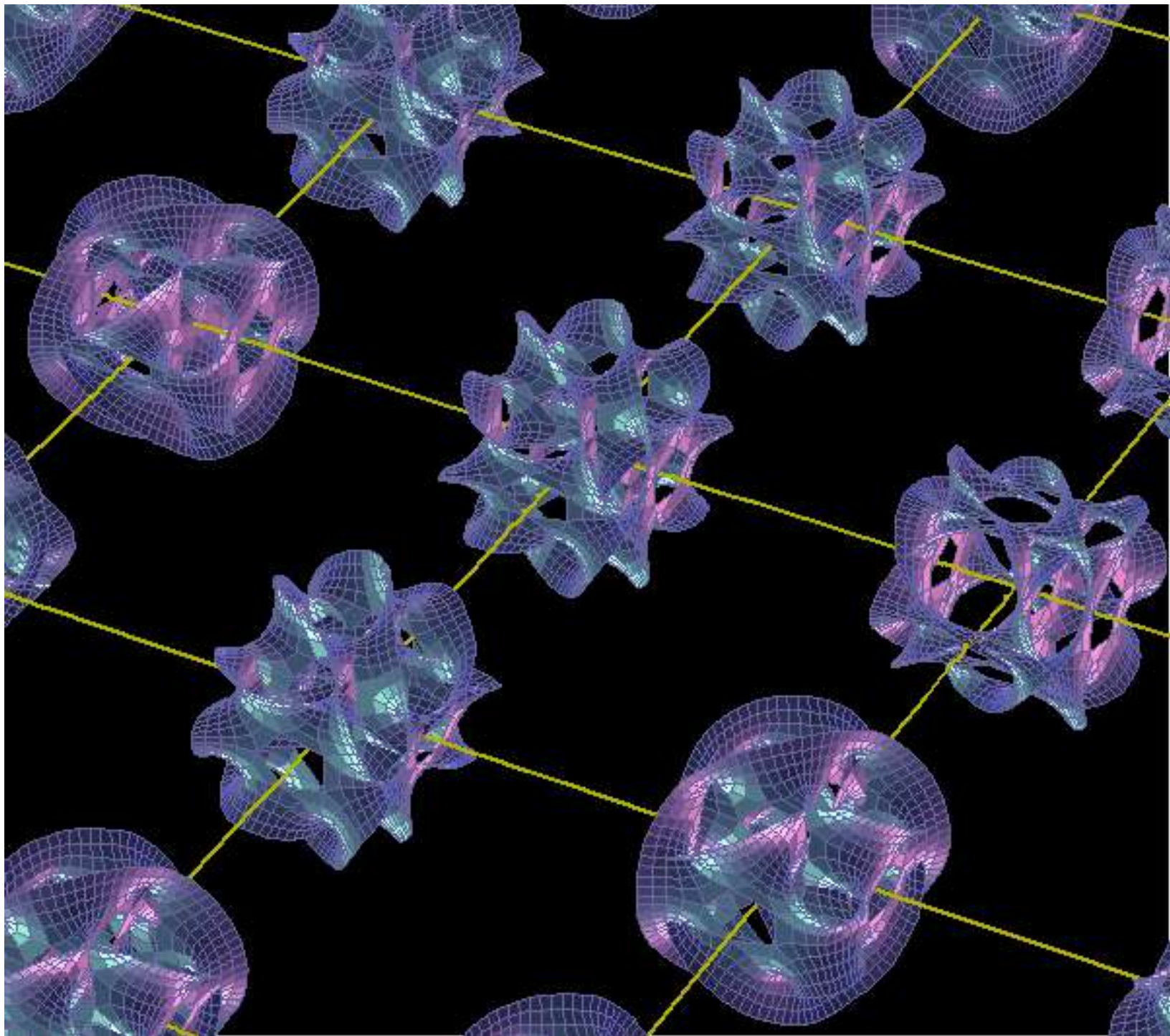
- Le particelle sono veramente puntiformi ?



Teoria delle Stringhe

ulteriore livello
microscopico: particelle
non sono puntiformi, ma
piccoli (10^{-33} cm) anelli
oscillanti

diversi stati di oscillazione
della stringa → particelle
diverse



10^{500} Universi paralleli!!!

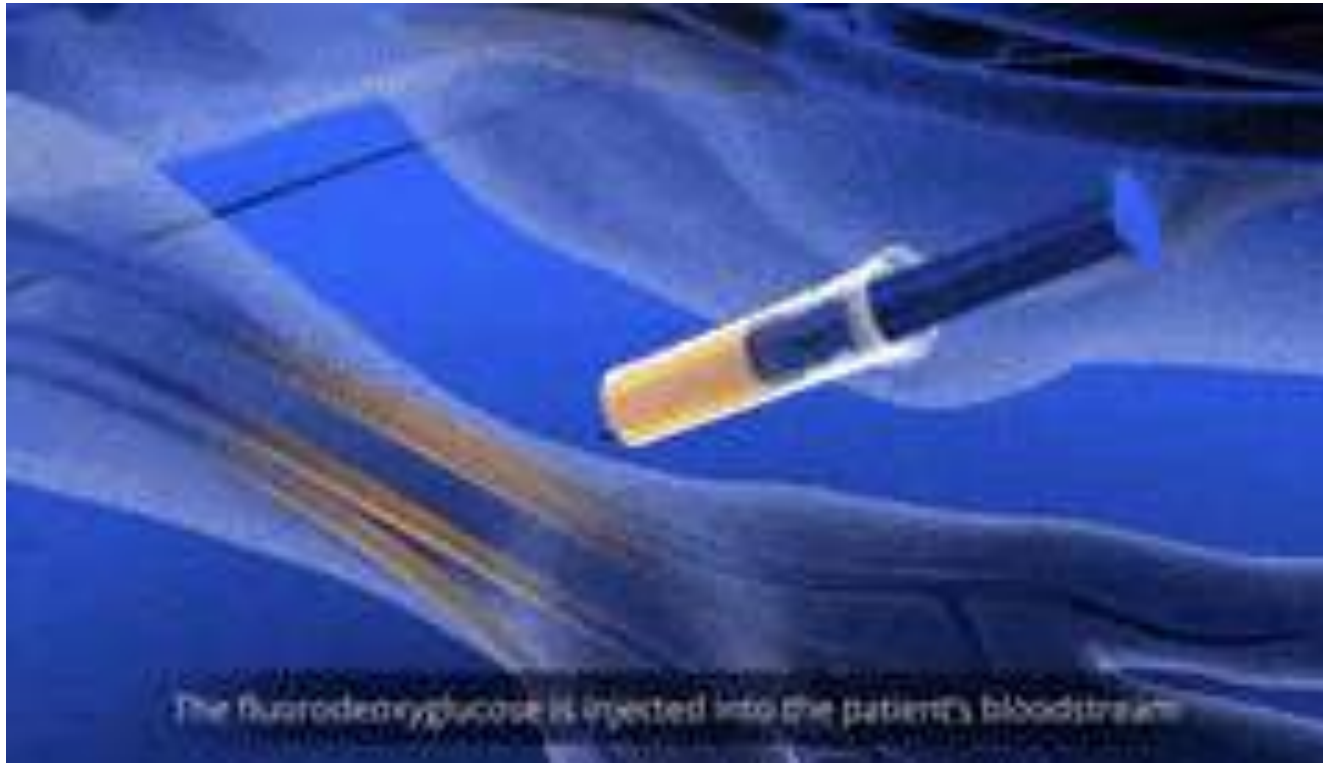


Dai laboratori alla Societa':

- Medicina**
- Arte**
- Energia**
- Nuove tecnologie**
- Meccanismi della vita**
-**

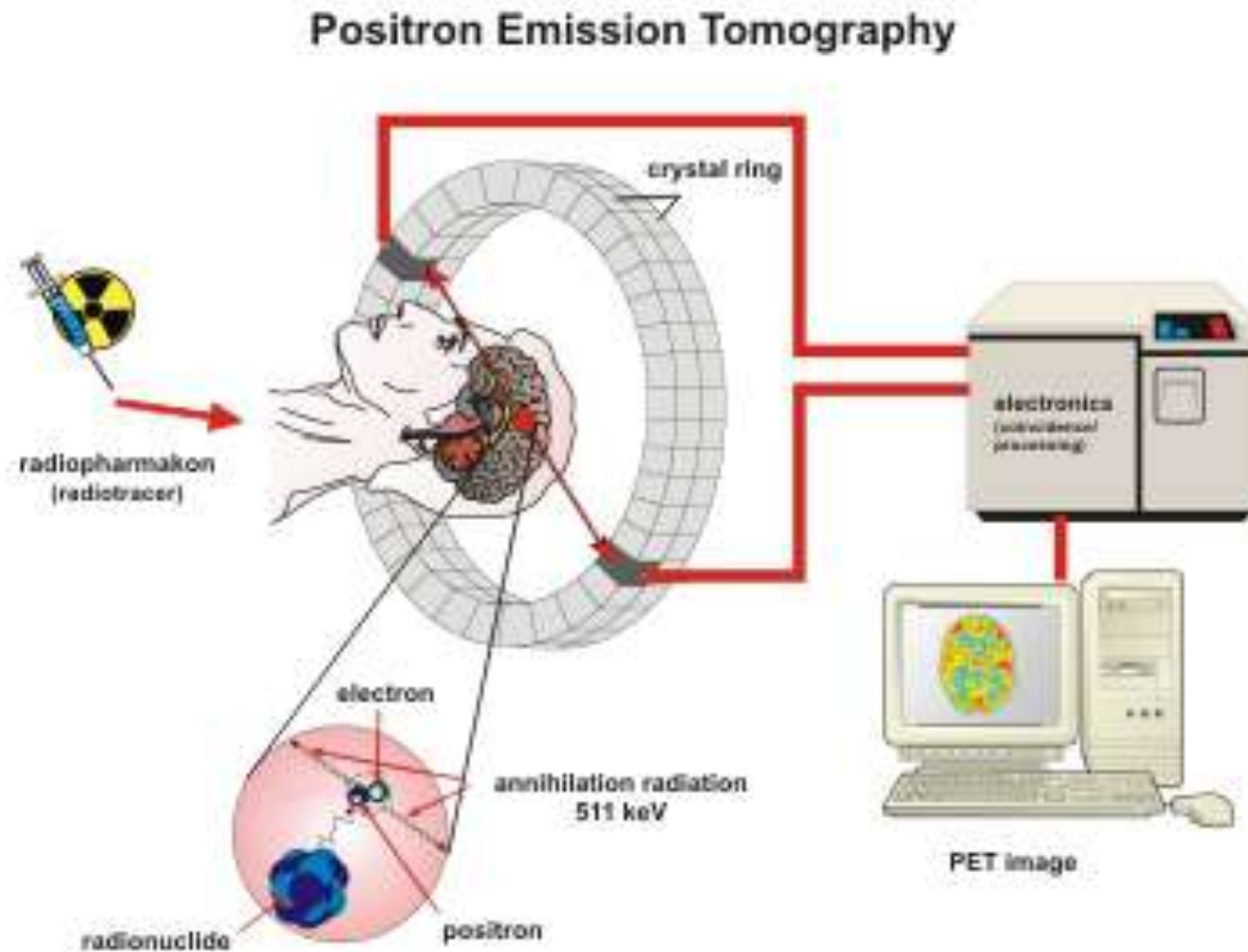




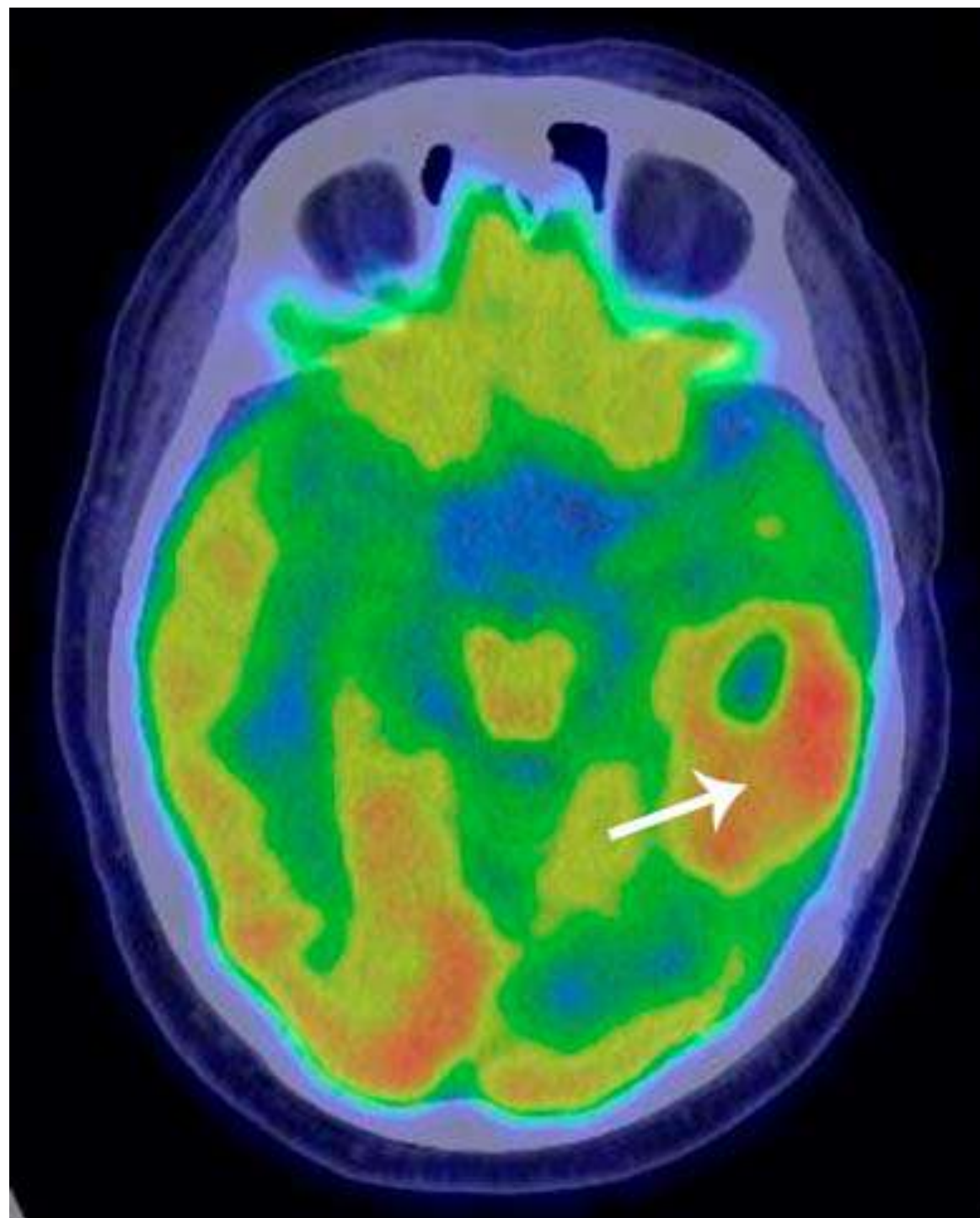


The fluorodeoxyglucose is injected into the patient's bloodstream

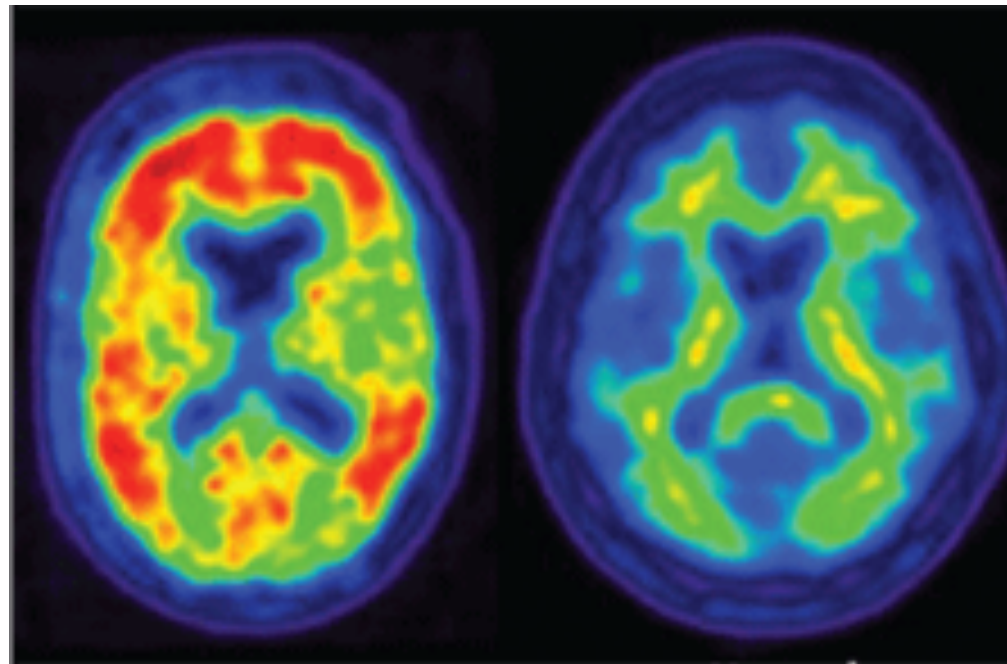
Tomografia con Emissione di Positroni (PET)



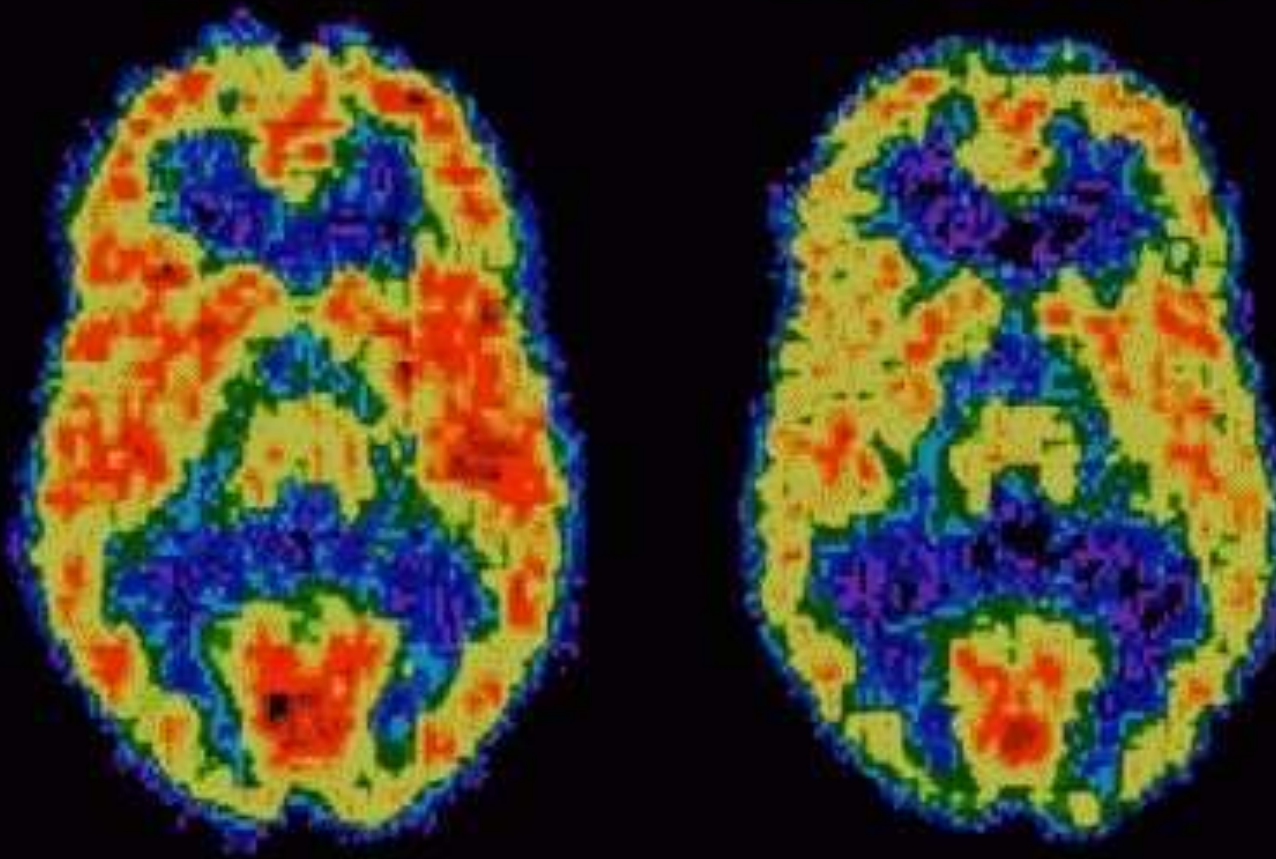




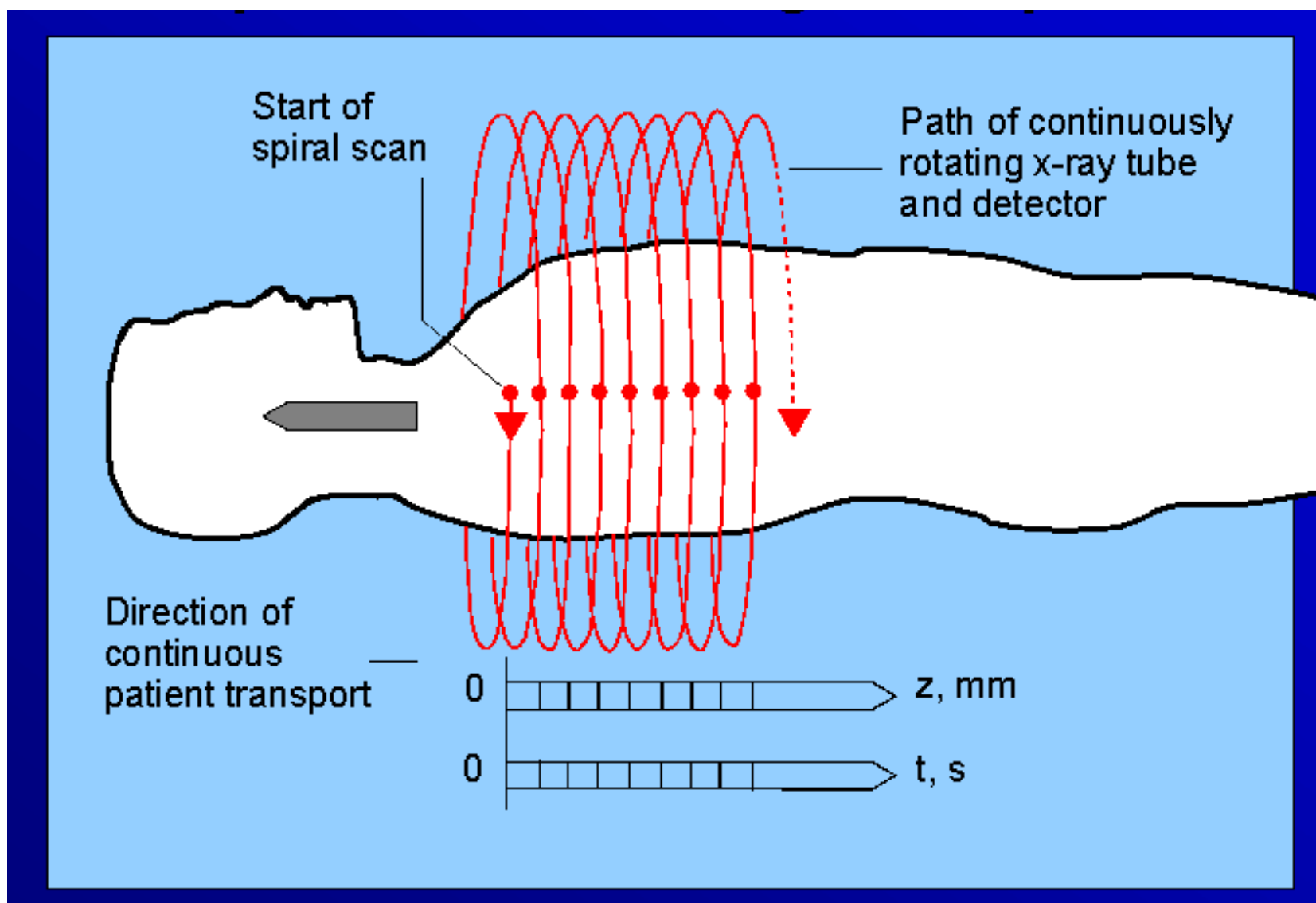
Alzheimer

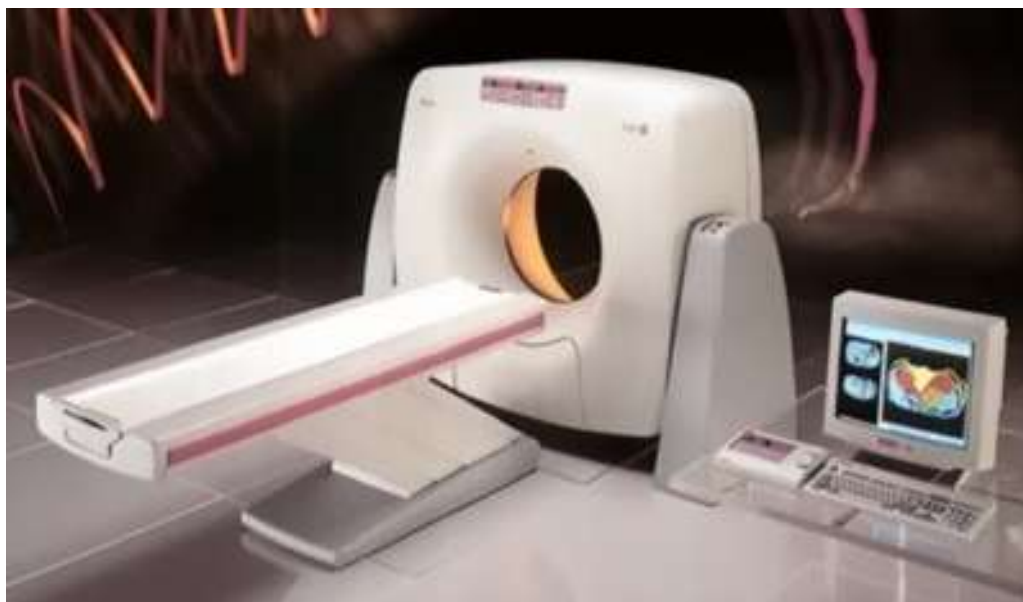


on cocaine



Tomografia Computerizzata

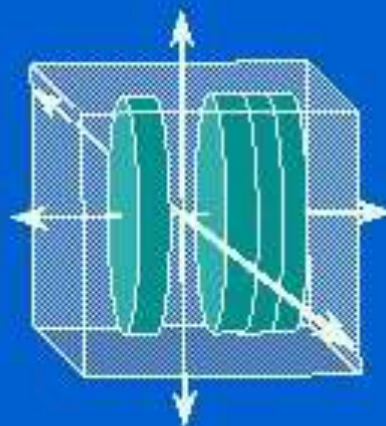
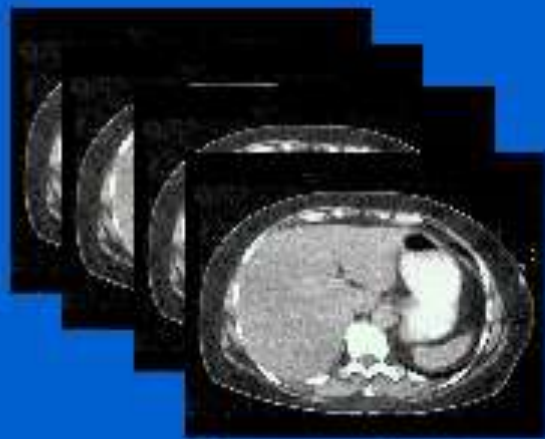






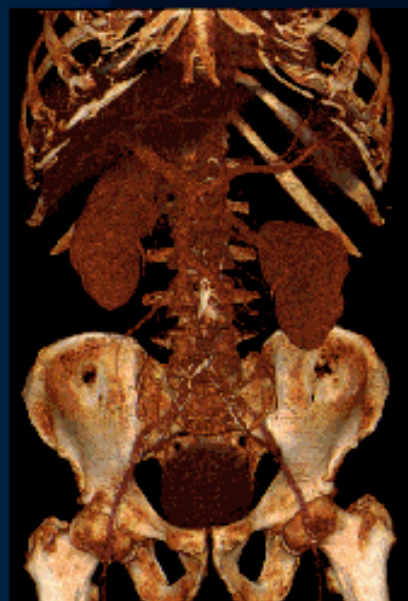
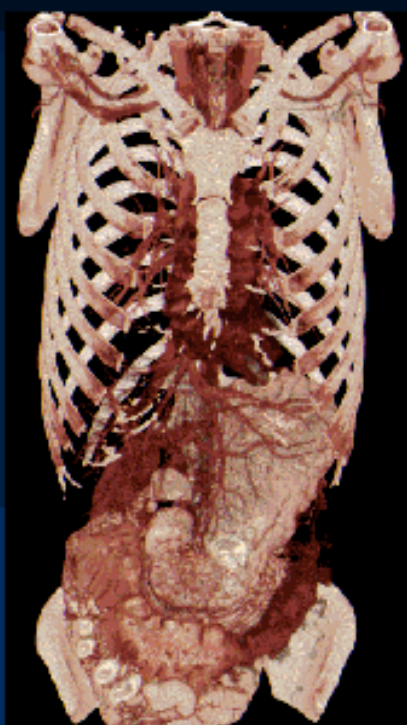
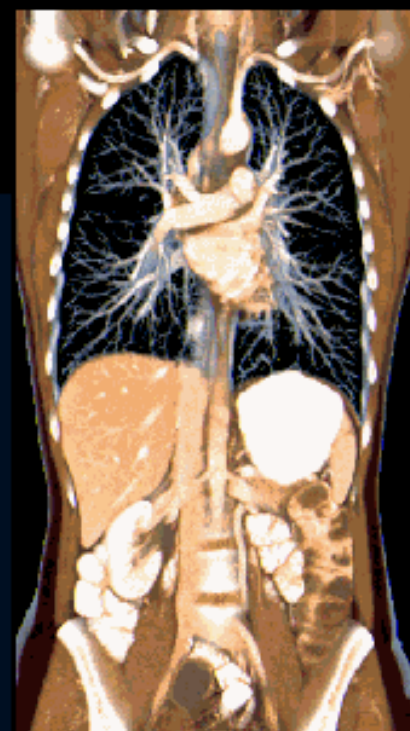
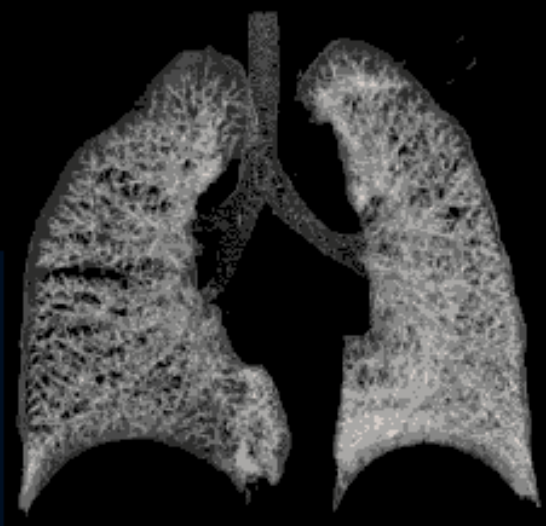
3-D Visualisation

- Greater application with multi-slice



70 sec, 2.5 mm



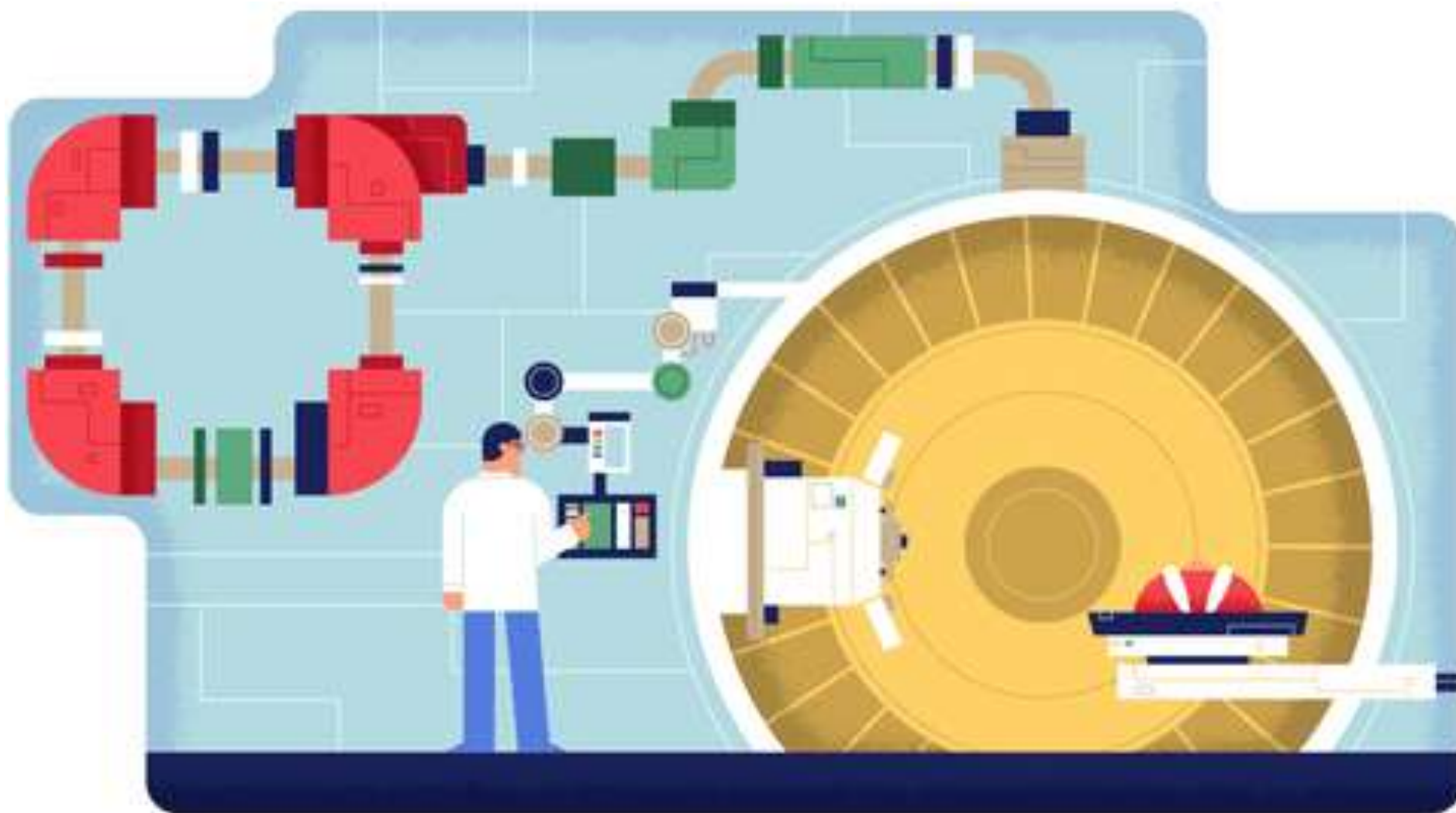


**The 3,300-year-old mummy
of King Tutankhamun is scanned to assess the need
for restoration and also to attempt to discover the
cause of his early death (January 2005)**

(Computed Tomography Imaging (CT Scan)



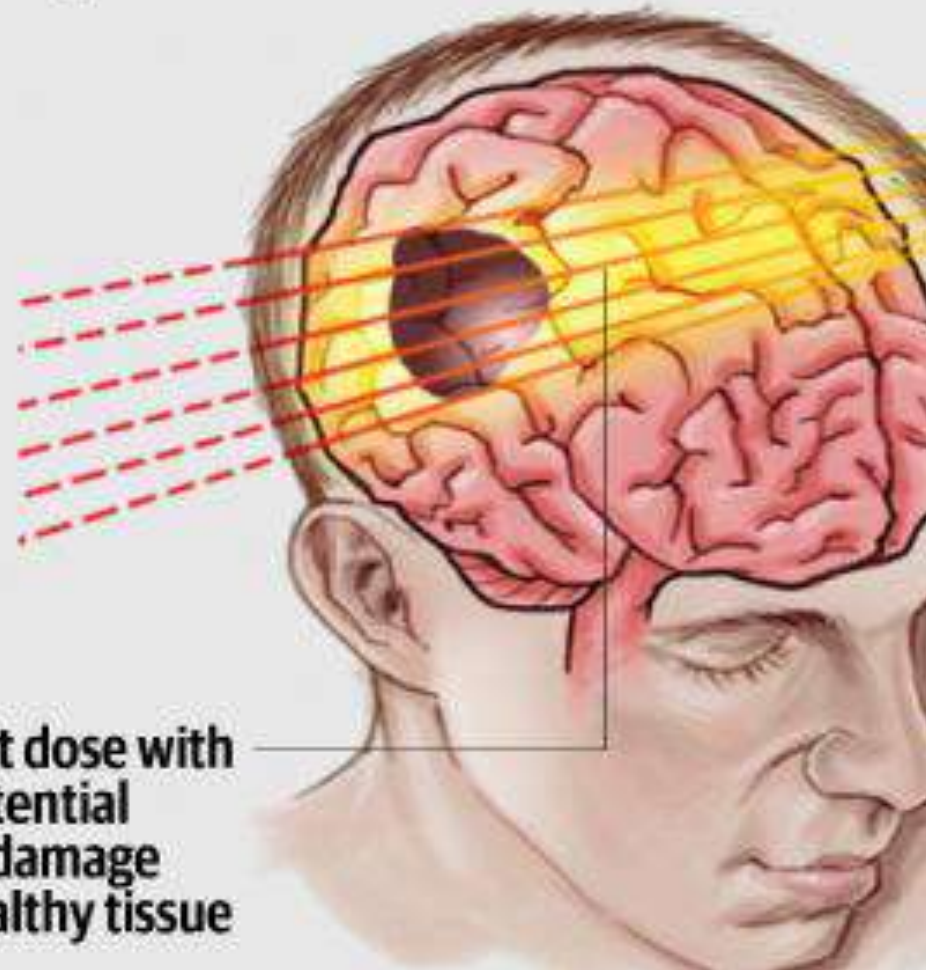
Adroterapia



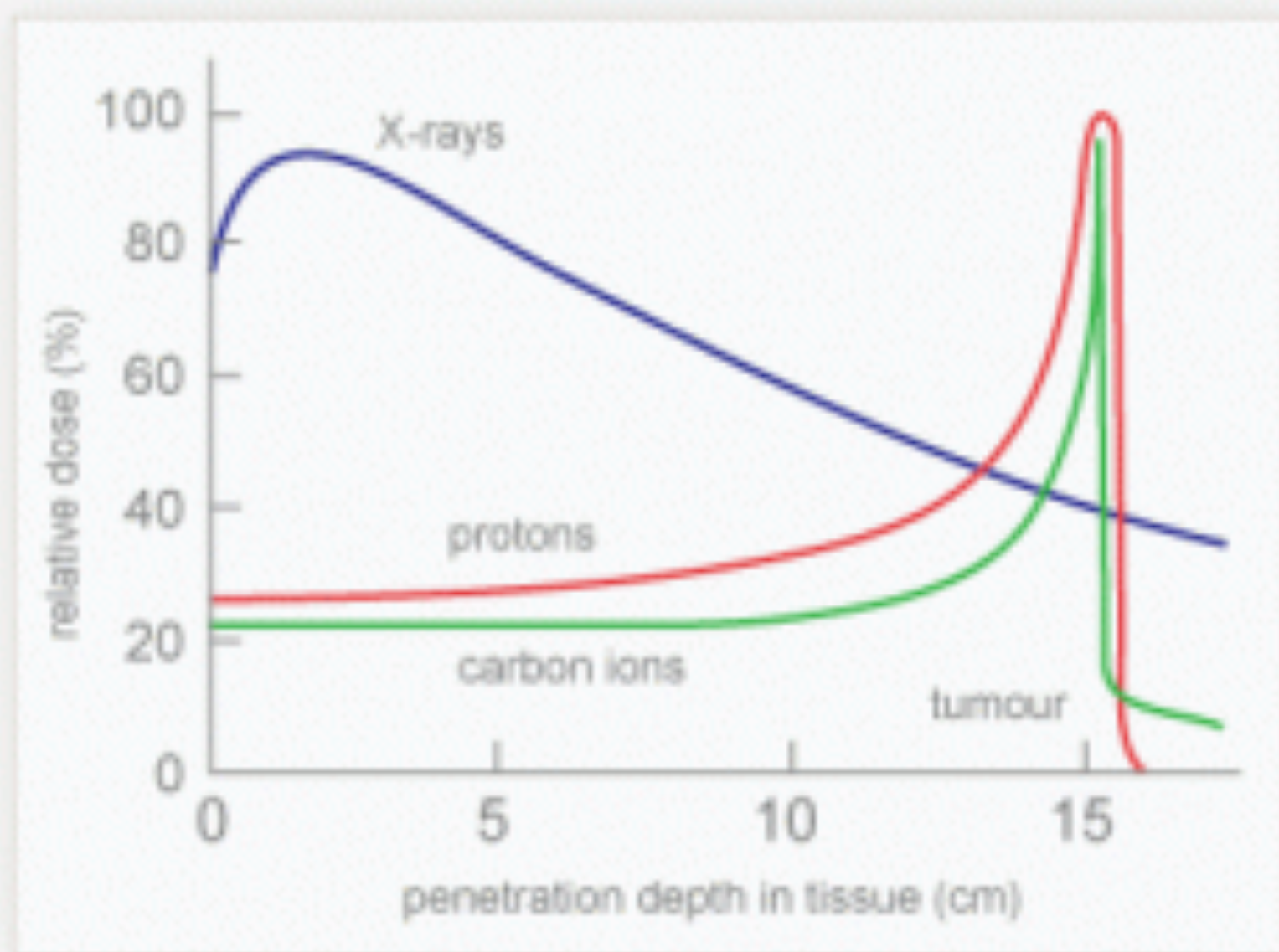


TRADITIONAL X-RAY THERAPY

Smaller doses of radiation are used to reduce damage to healthy tissue due to the inability to restrict radiation pattern to cancerous tissue

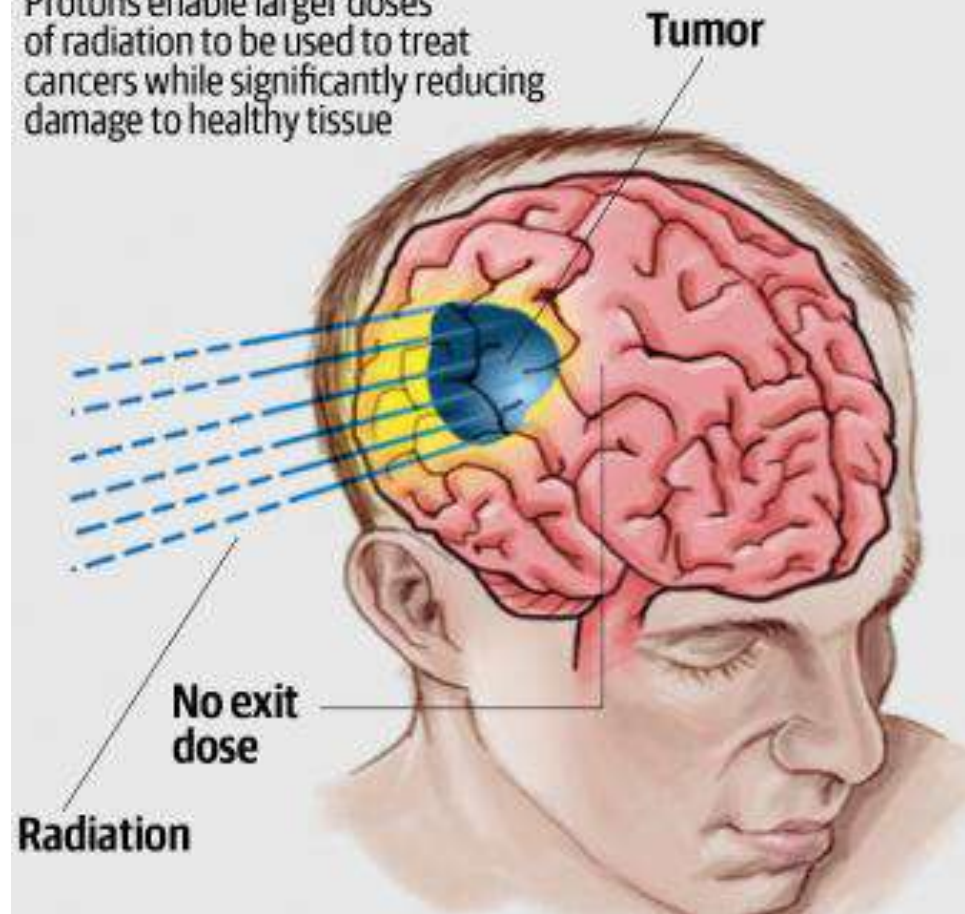


Exit dose with
potential
to damage
healthy tissue



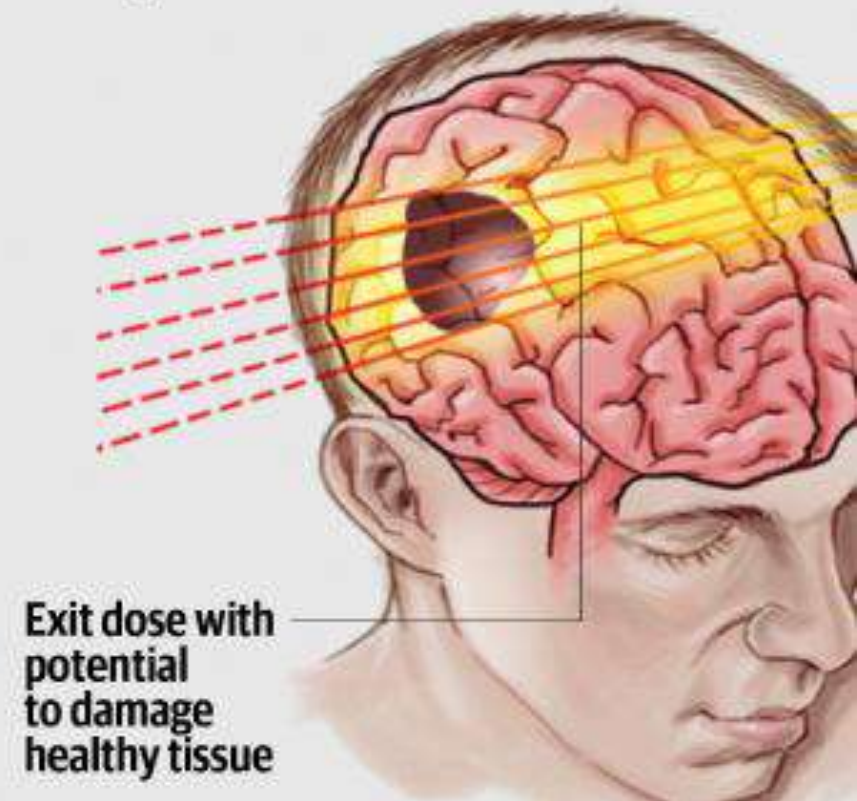
PROTON THERAPY

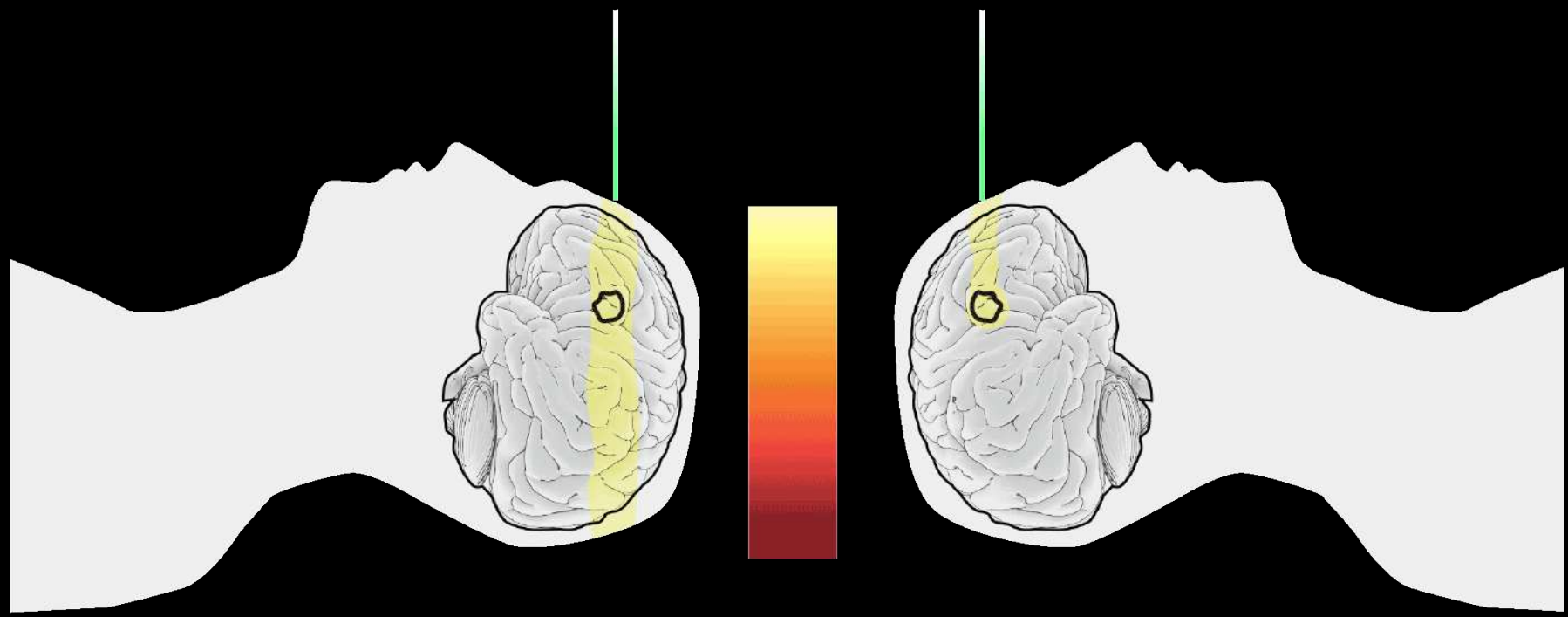
Protons enable larger doses of radiation to be used to treat cancers while significantly reducing damage to healthy tissue



TRADITIONAL X-RAY THERAPY

Smaller doses of radiation are used to reduce damage to healthy tissue due to the inability to restrict radiation pattern to cancerous tissue





**Scopriamo l'alta tecnologia del CNAO facendo un tour
e seguendo il fascio dall'origine fino al paziente ...**



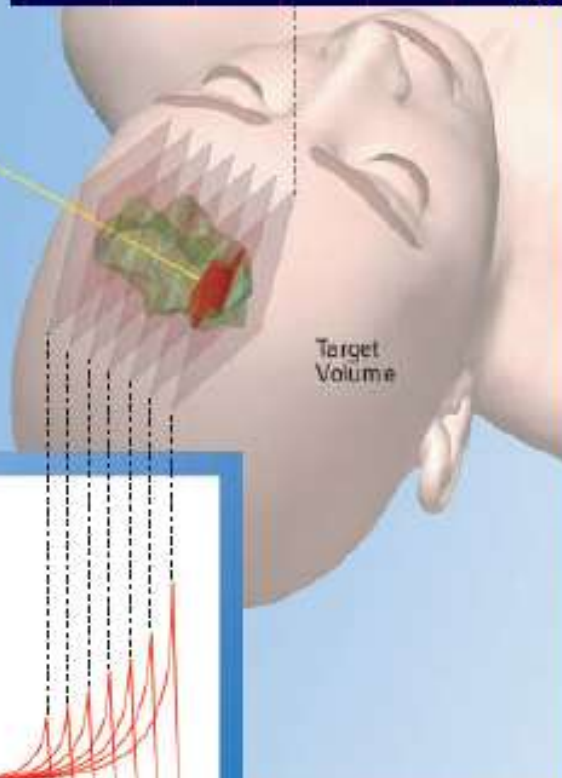
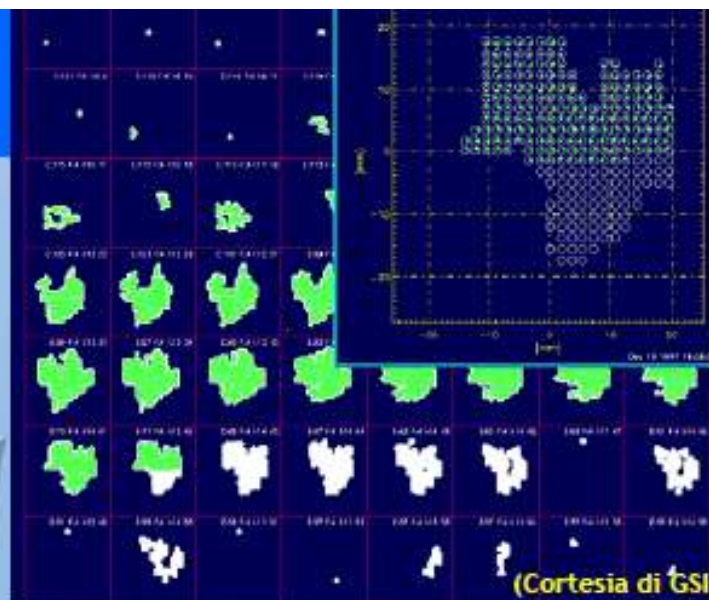
Scanning System

Scanning magnets

Members

Localization members

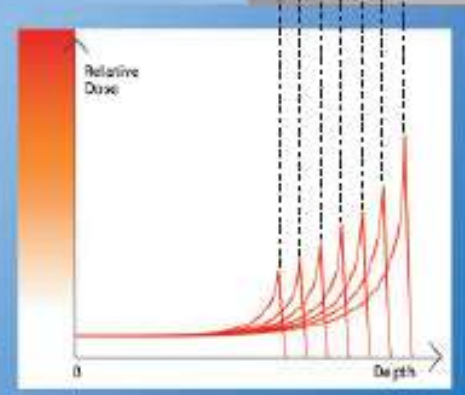
Monitor system



Example:

Depth 5 cm:
Proton 80 MeV
Carbon 150 MeV/u

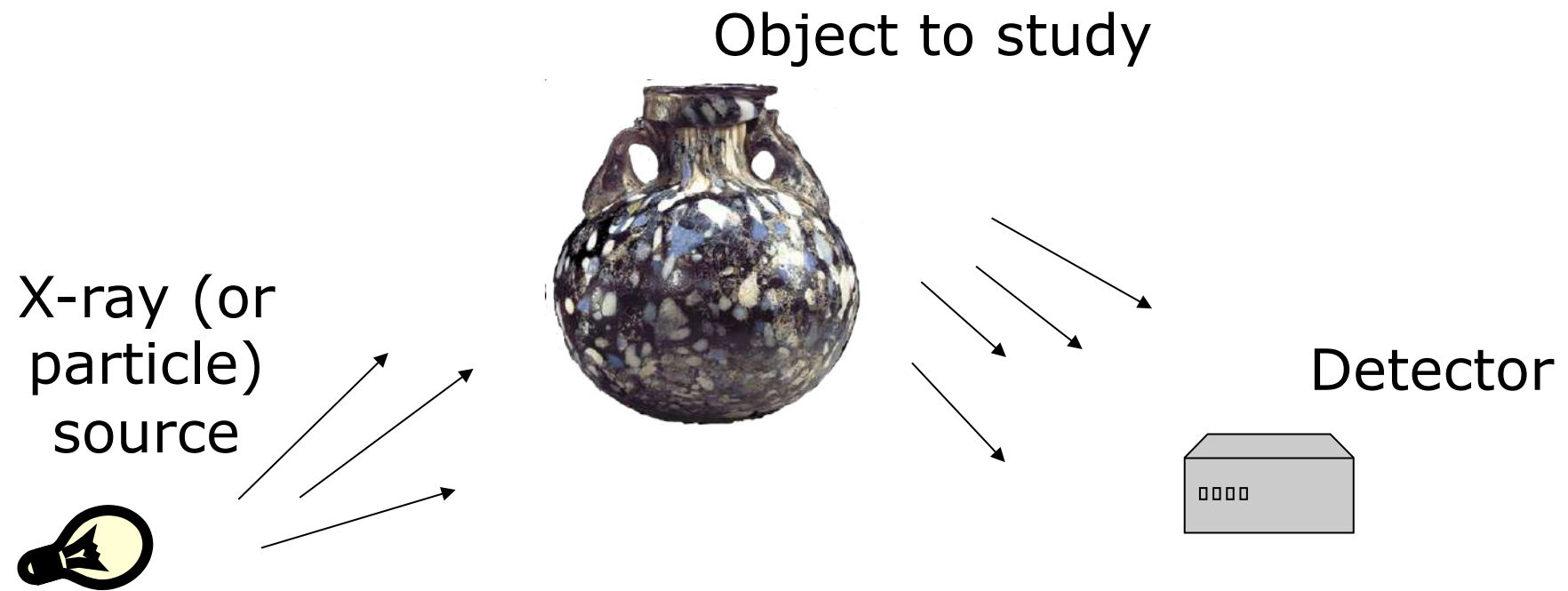
Depth 25 cm:
Proton 195 MeV
Carbon 380 MeV/u



**Tecnica di
irraggiamento
sistema attivo**

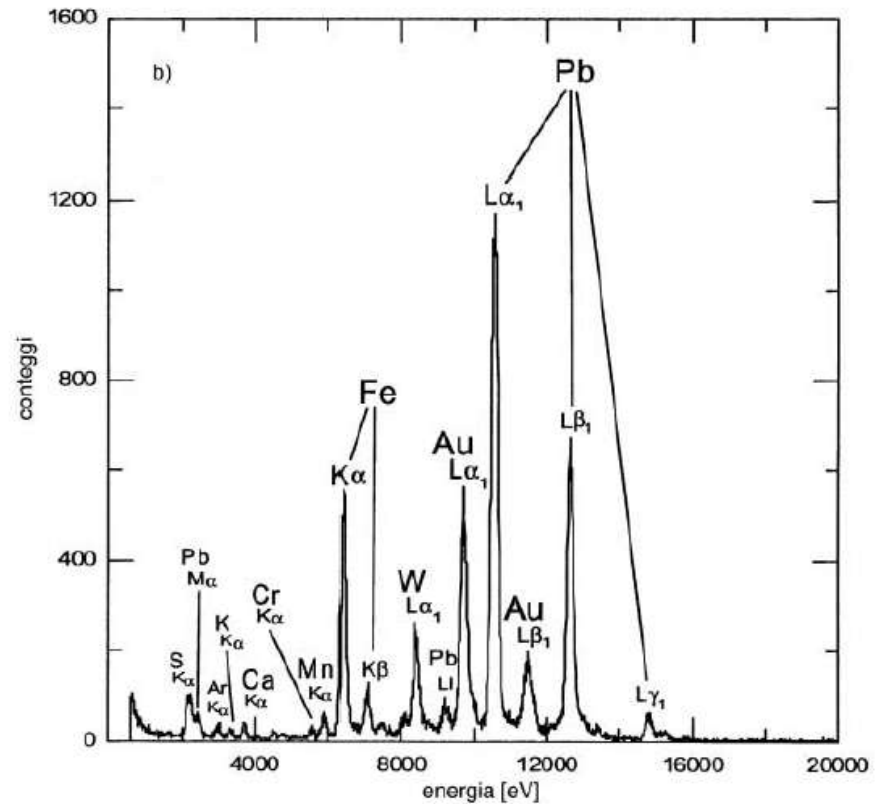
(Cortesia di Siemens Medical)

fondazione **CNAO**



Fisica e l'arte – **l'impronta dell'artista**

- Ogni elemento atomico un impronta (raggi X)
- Nello spettro di fluorescenza dell'affresco di *Lorenzo Lotto* si nota la presenza di ferro (Fe) e di oro (Au).



Pentimenti

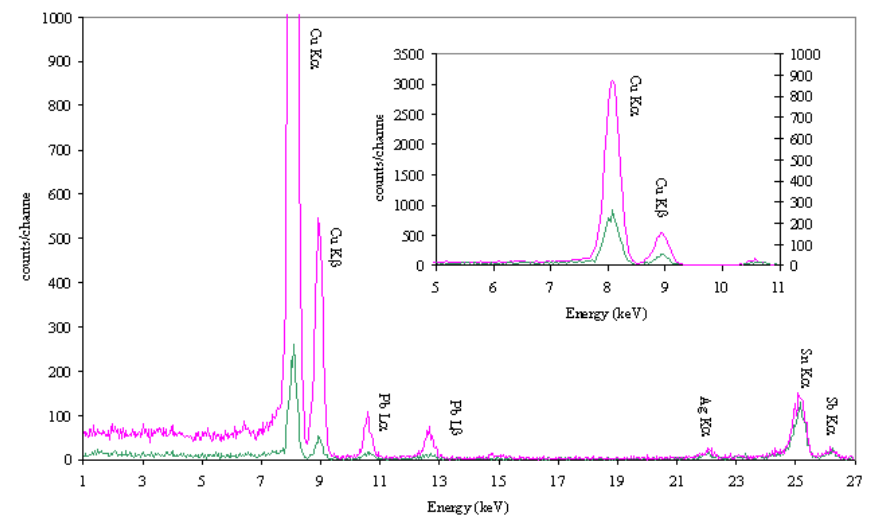
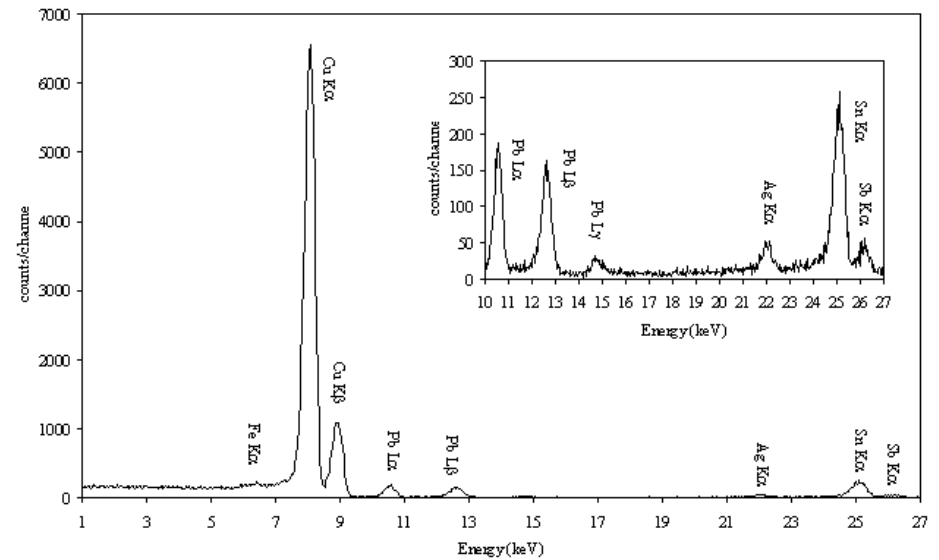
Le Sueur – musa Urania (particolare)



Rembrandt – Ritrato giovane uomo Titus

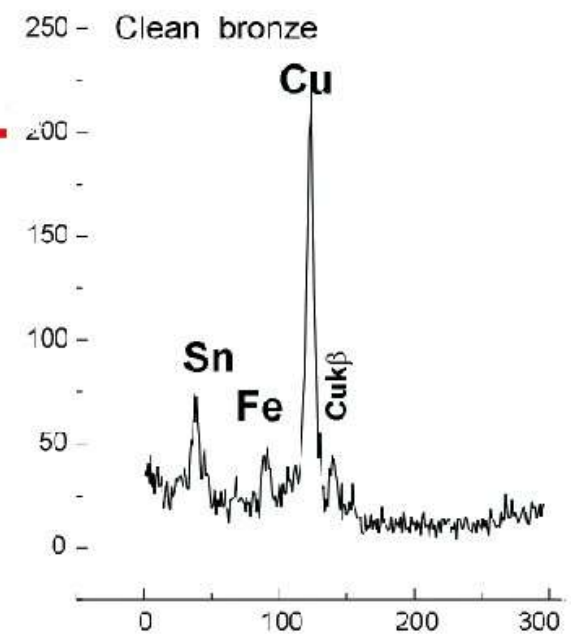
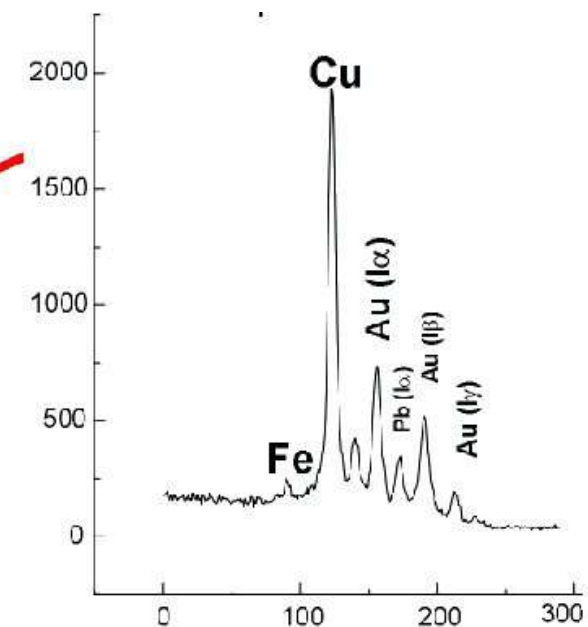


Cellini - Perseo



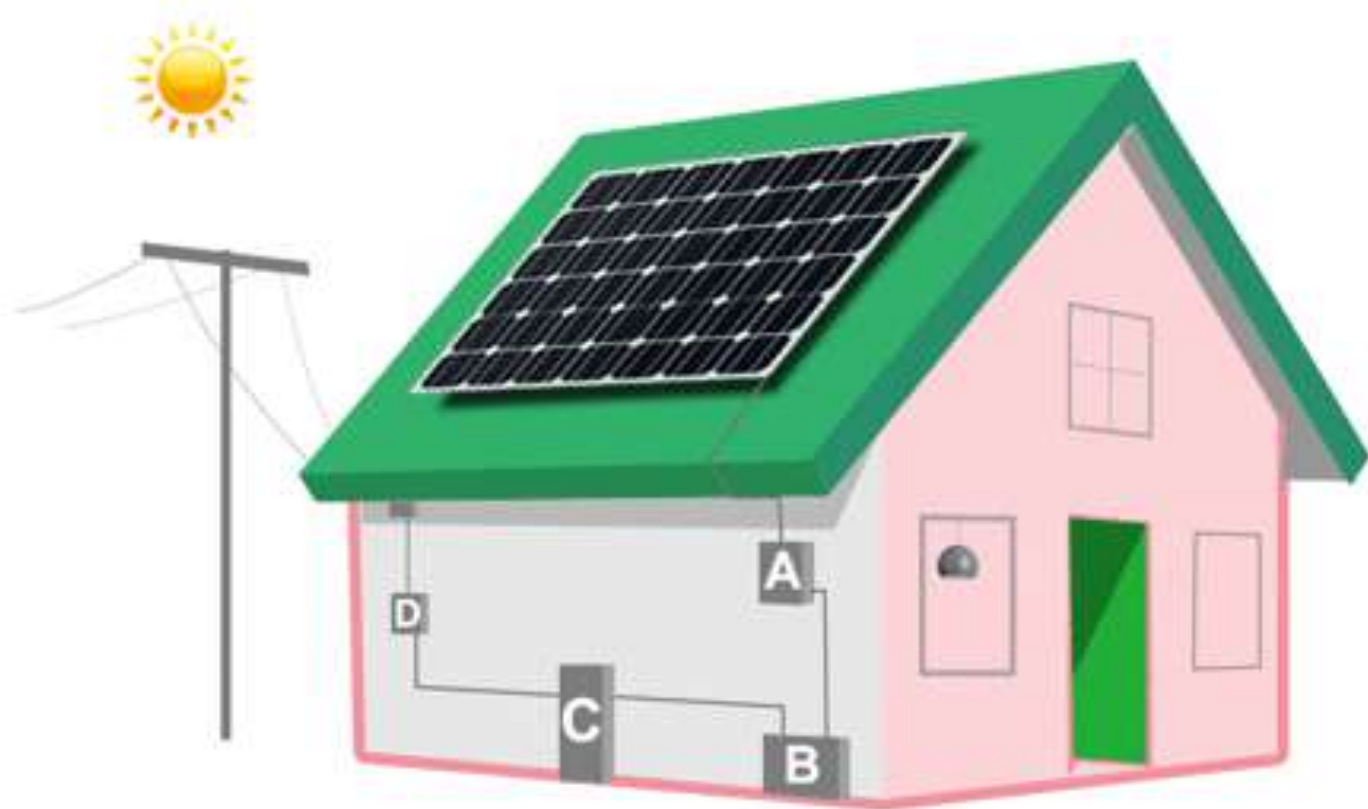
Esempio di
influenza
della
patina
sullo
spettro.

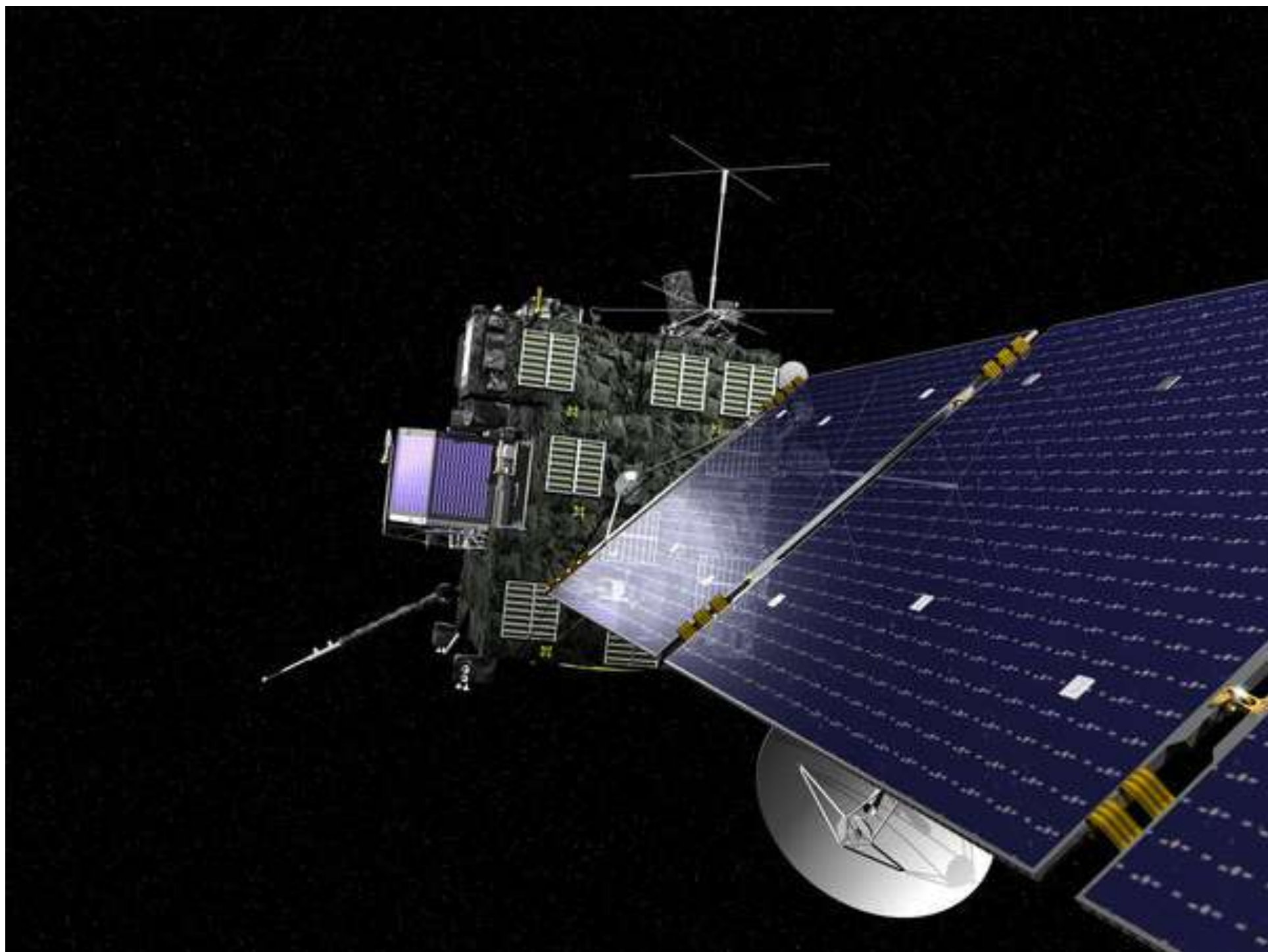
XRF bronzo





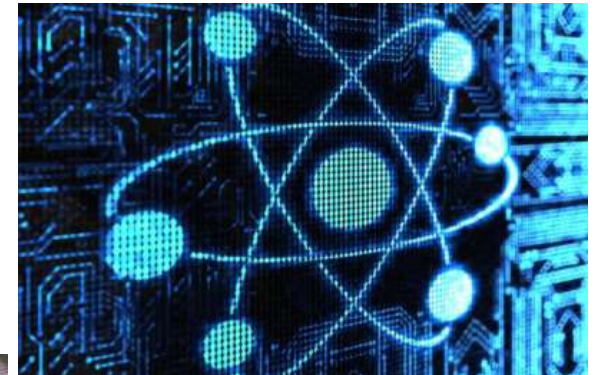








La rivoluzione quantistica nei computer di domani: dal *bit* al *qubit*



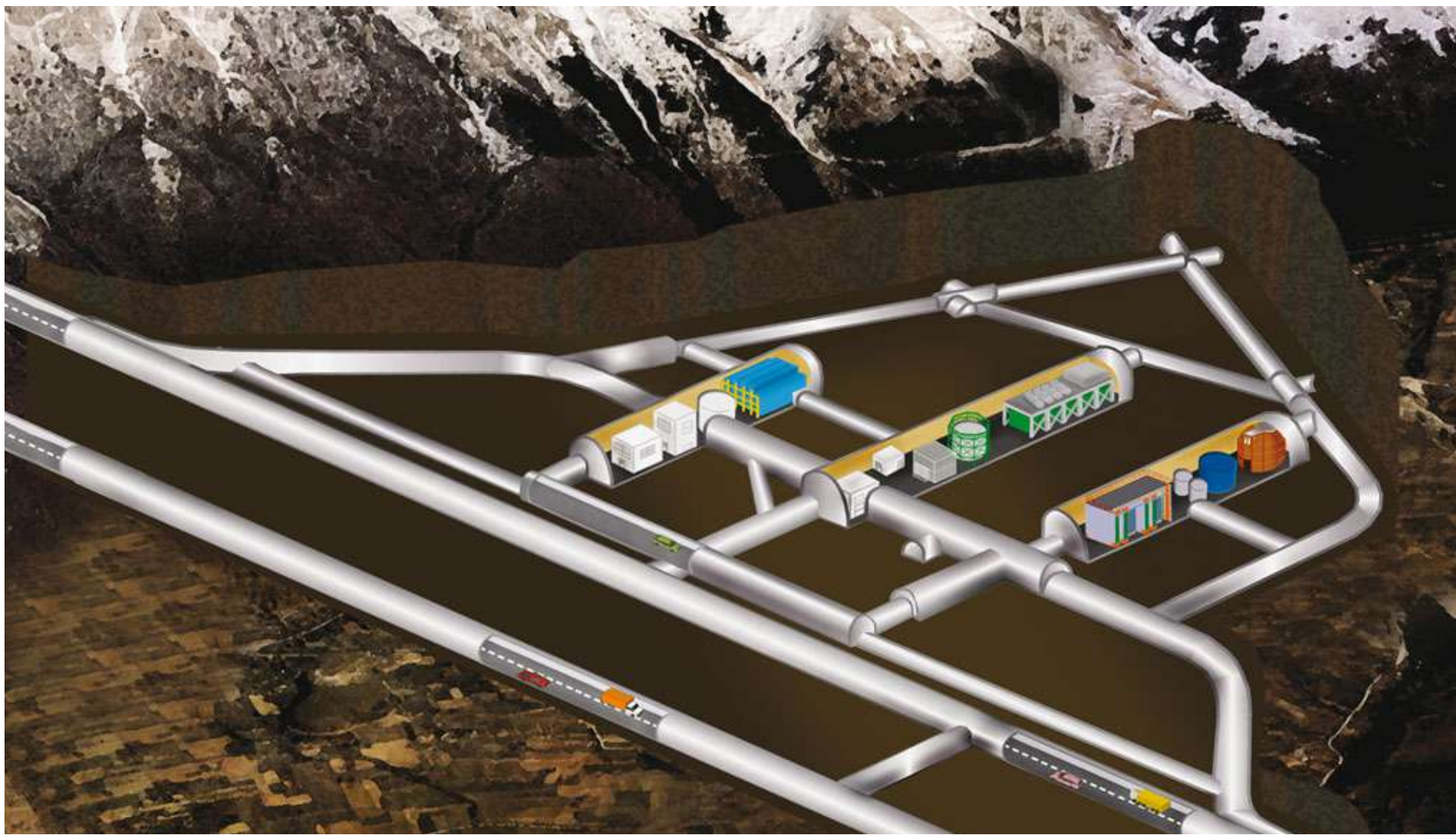
Le meraviglie quantistiche: dal gatto di Schroedinger al computer quantistico

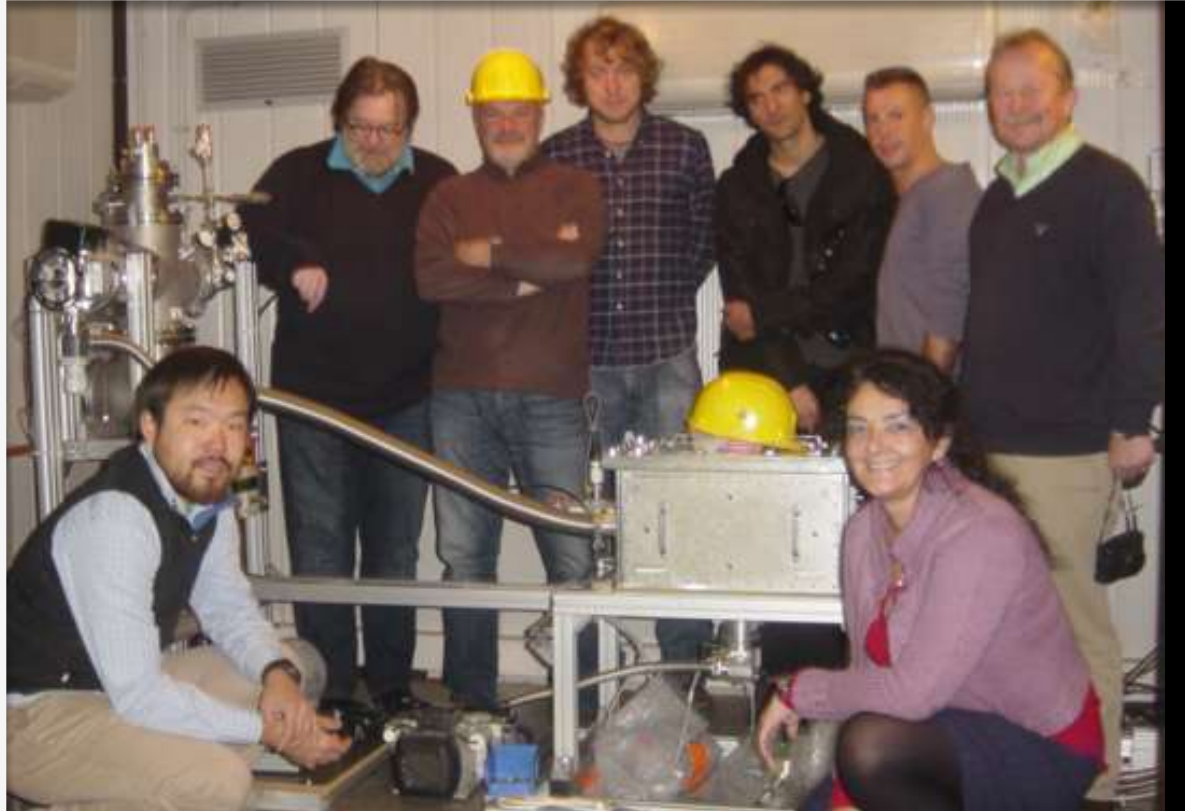






Photo Credit: Danilo Pivato





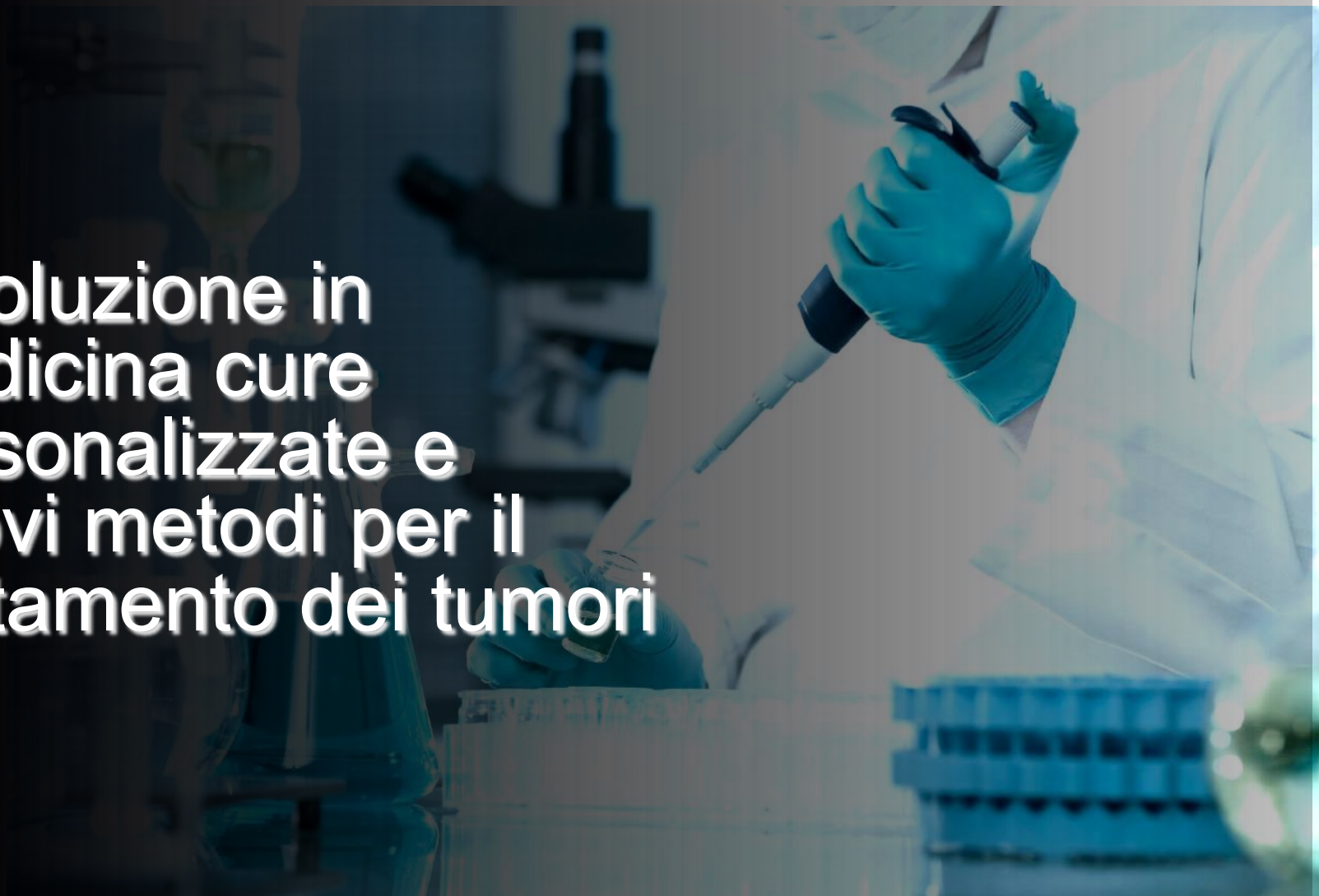
A cosa
servono i
Computer
Quantistici?

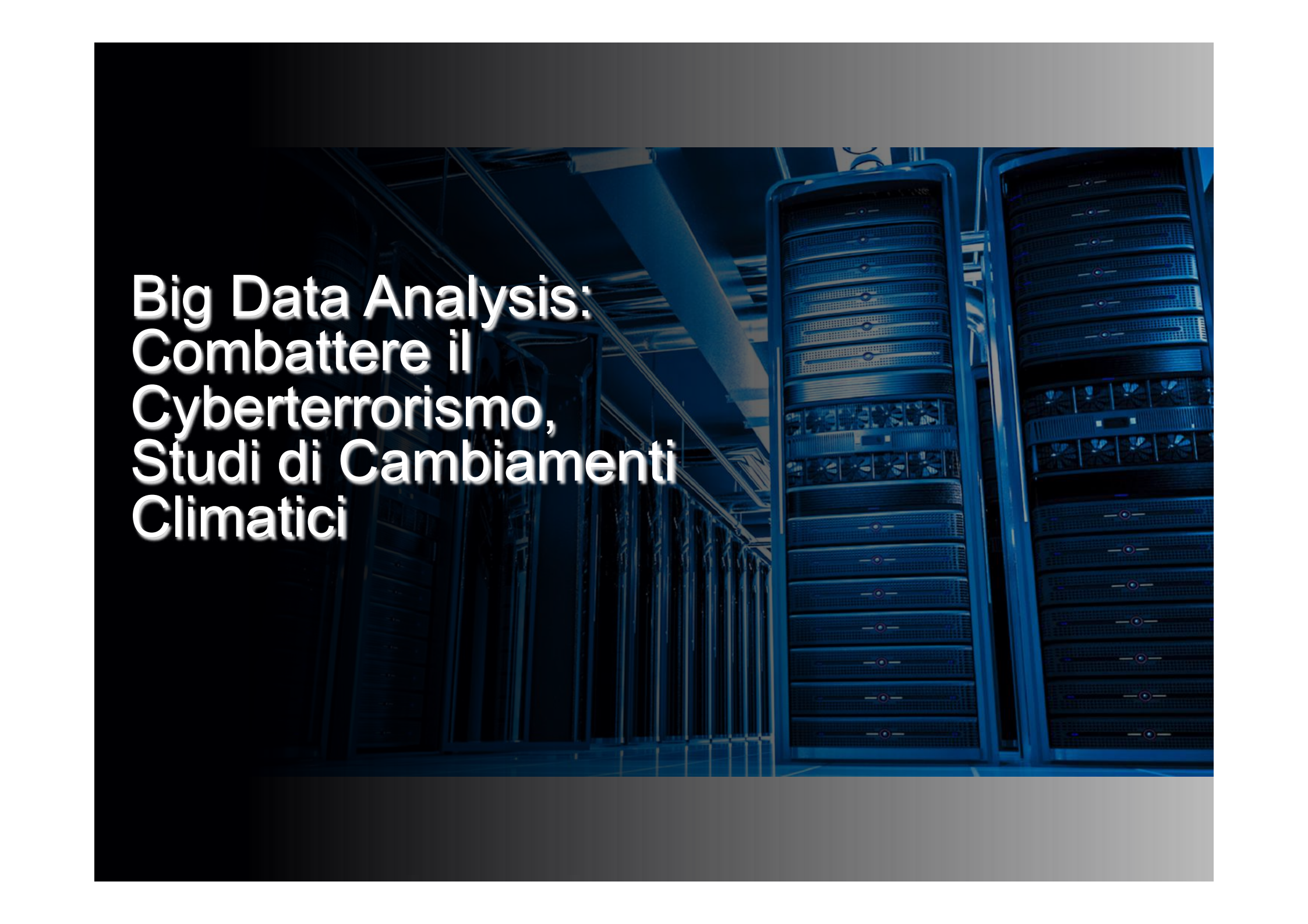


Potenziamento delle
tecnologie attuali:
Realta' virtuale
Intelligenza Artificiale



**Rivoluzione in
medicina cure
personalizzate e
nuovi metodi per il
trattamento dei tumori**



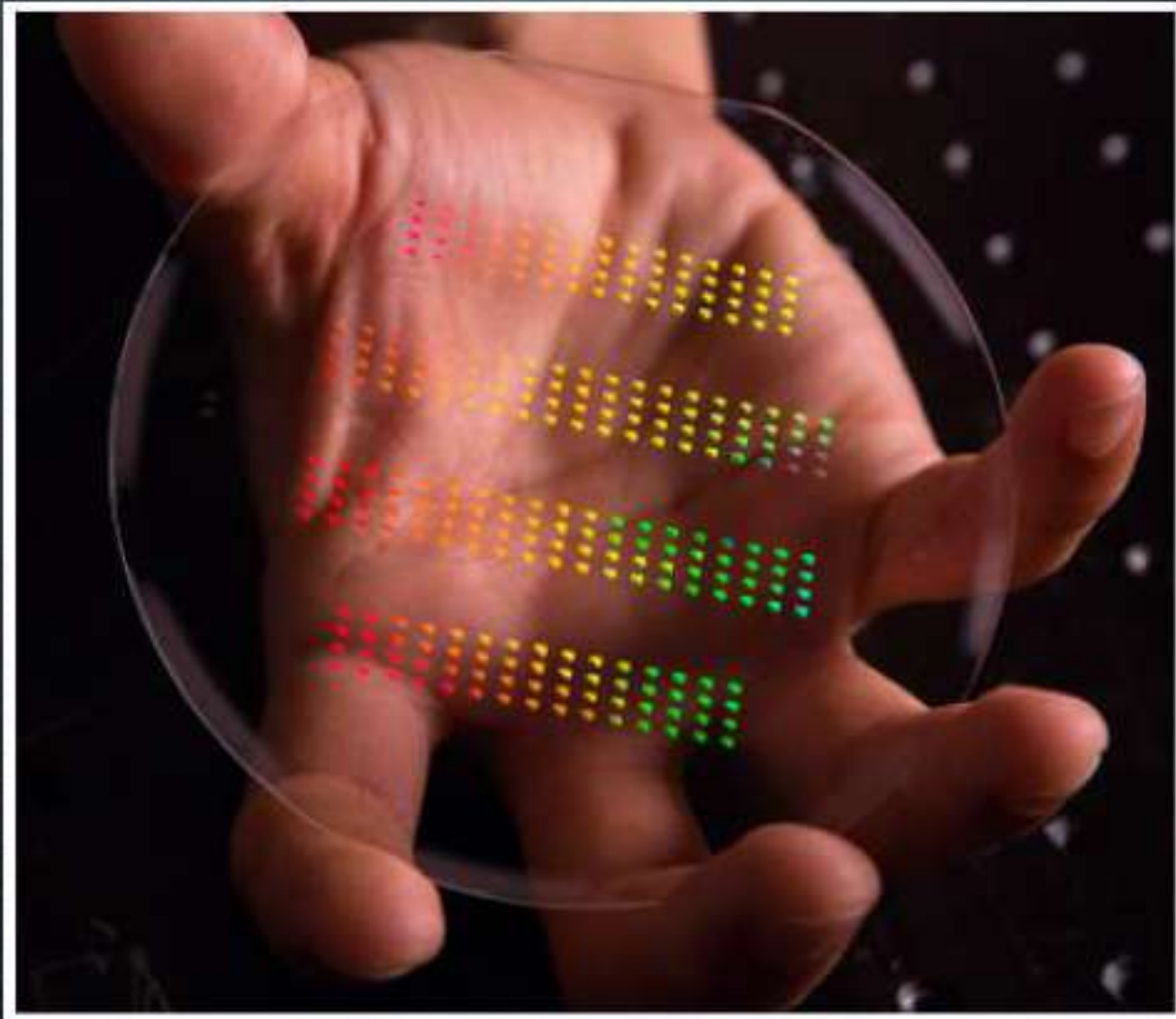
The background of the slide is a photograph of a server room. The room is dimly lit with a strong blue light source, likely from the server racks themselves. In the foreground, two tall server racks are visible, filled with numerous server units. Each unit has a front panel with a small circular indicator light. The racks extend into the background, creating a sense of depth. The floor is dark and reflective, showing some light from the racks. The overall atmosphere is technological and futuristic.

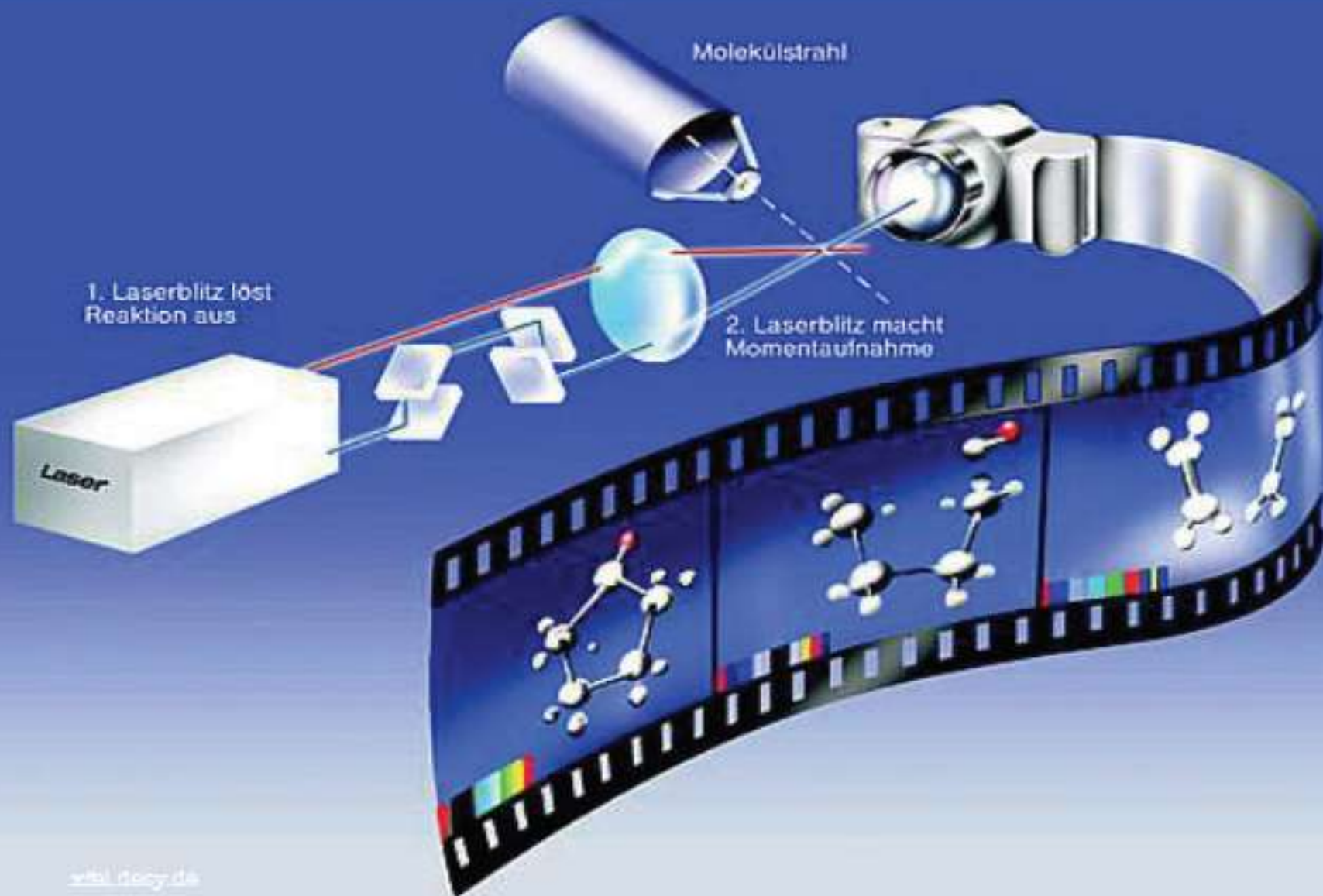
Big Data Analysis: Combattere il Cyberterrorismo, Studi di Cambiamenti Climatici

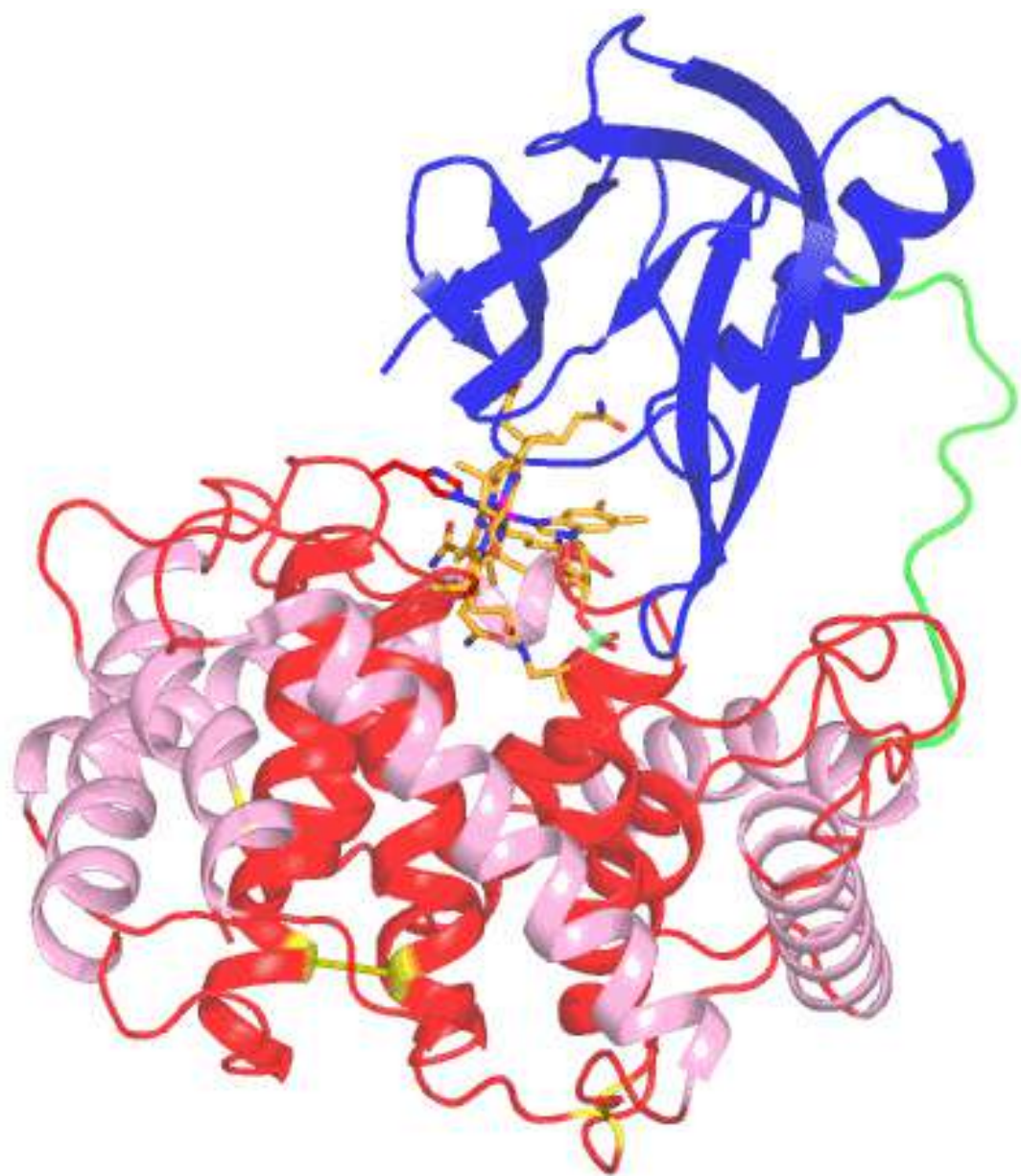
Capire come funziona il Cervello: Cura delle malattie mentali (demenza, schizofrenia...)

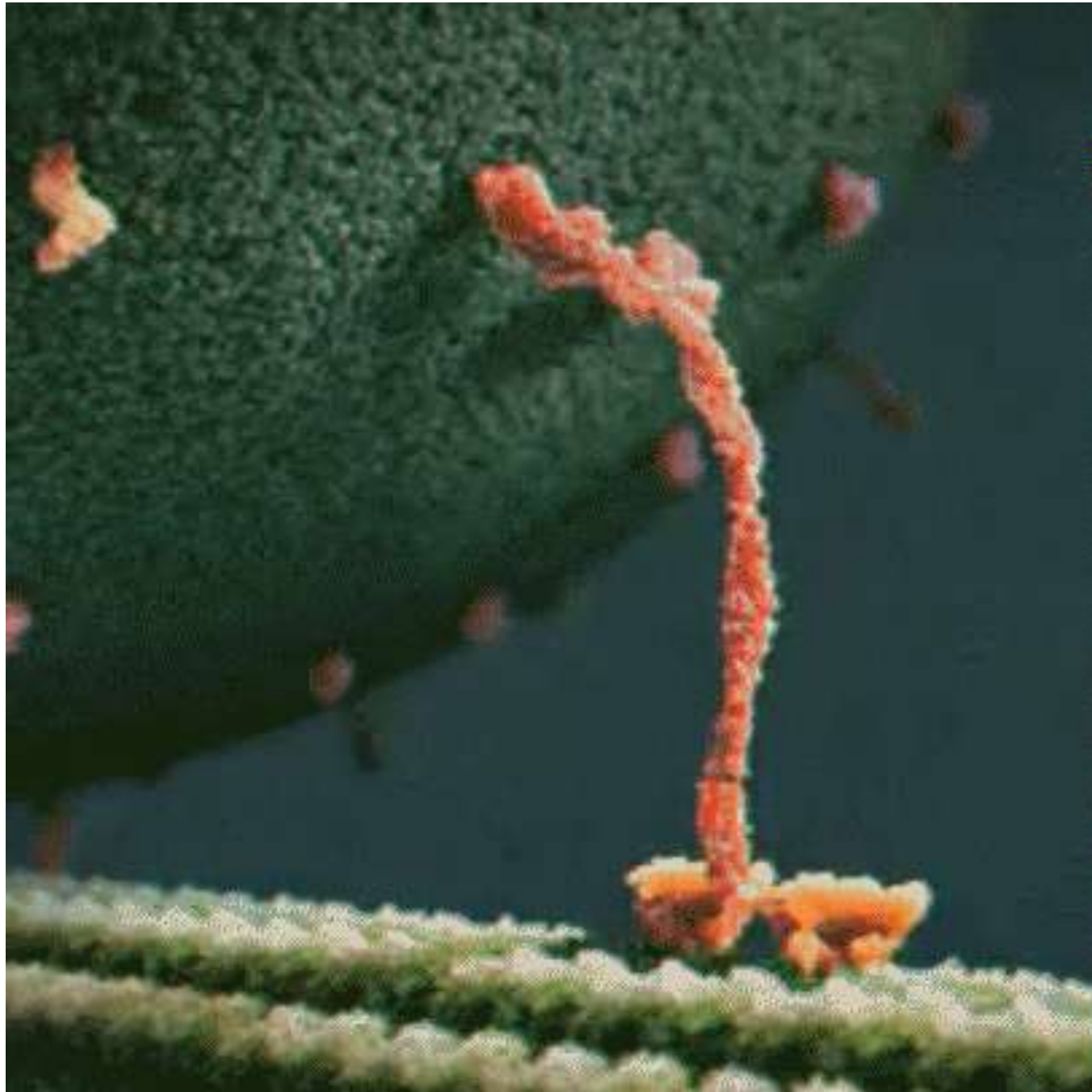


Accelerator on a Chip?

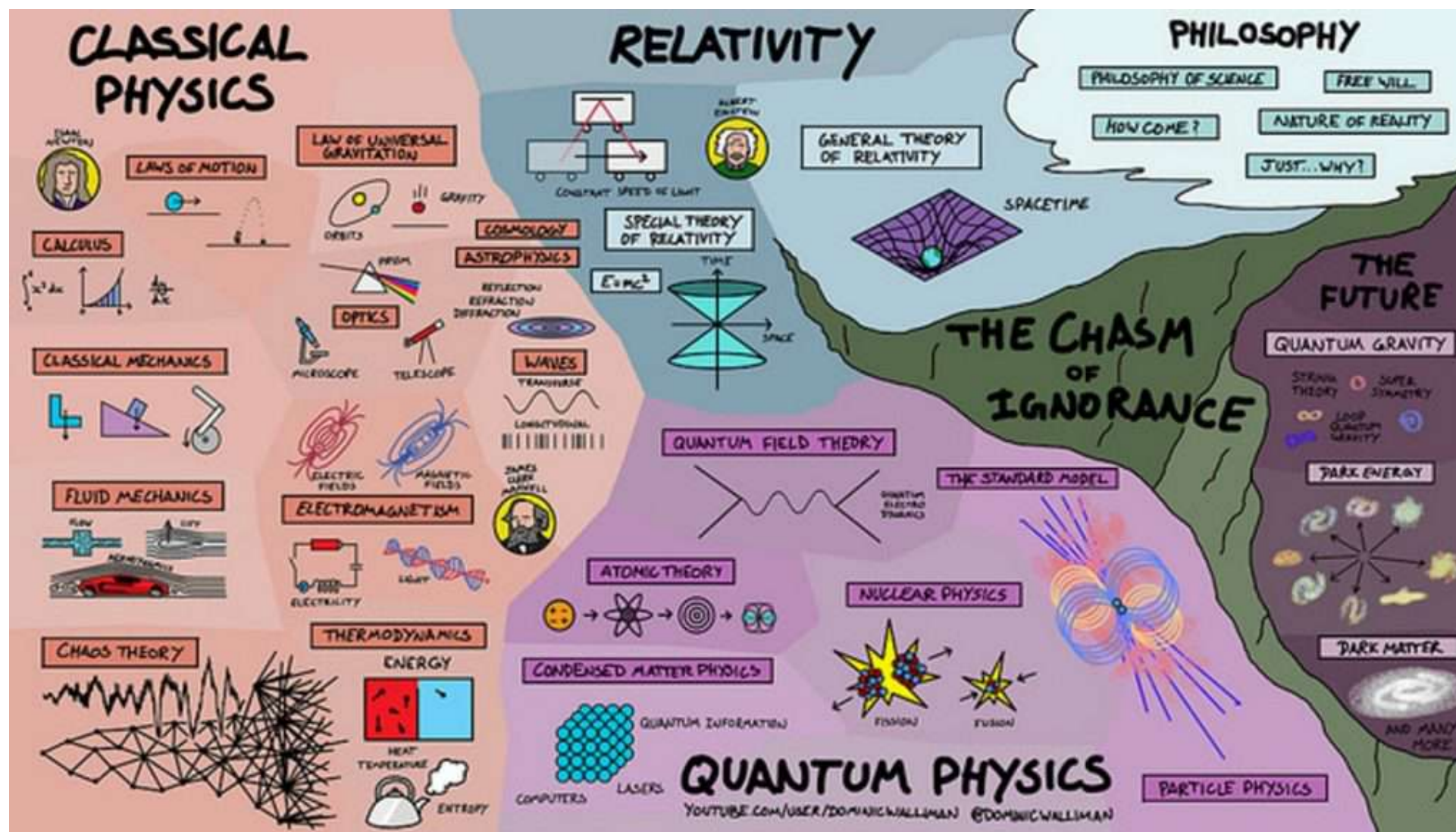








La Terra Incognita della Fisica moderna



Che cos'è la **scienza**? Con questa parola di solito s'intendono **tre cose diverse**, o un misto delle tre. «Scienza» a volte significa **un metodo speciale** di scoprire le cose; a volte significa **l'insieme delle conoscenze** che si originano dalle cose scoperte, ma può anche significare **tutte le cose nuove che si possono fare usando la conoscenza acquisita**, o il fare effettivamente queste cose.



Richard P. Feynman

STRONG Acknowledgements

2020



Farnesina
Ministero degli Affari Esteri
e della Cooperazione Internazionale



John
Templeton
Foundation

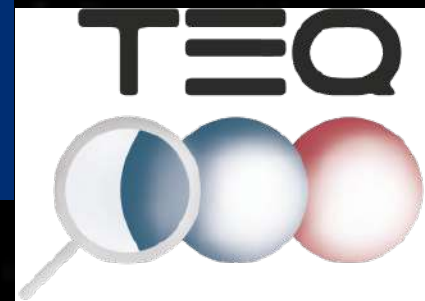
CENTRO
FERMI

Enrico Fermi

MUSEO
STORICO DELLA FISICA
E
CENTRO
STUDI E RICERCHE
ENRICO FERMI

FQXi

FOUNDATIONAL QUESTIONS INSTITUTE



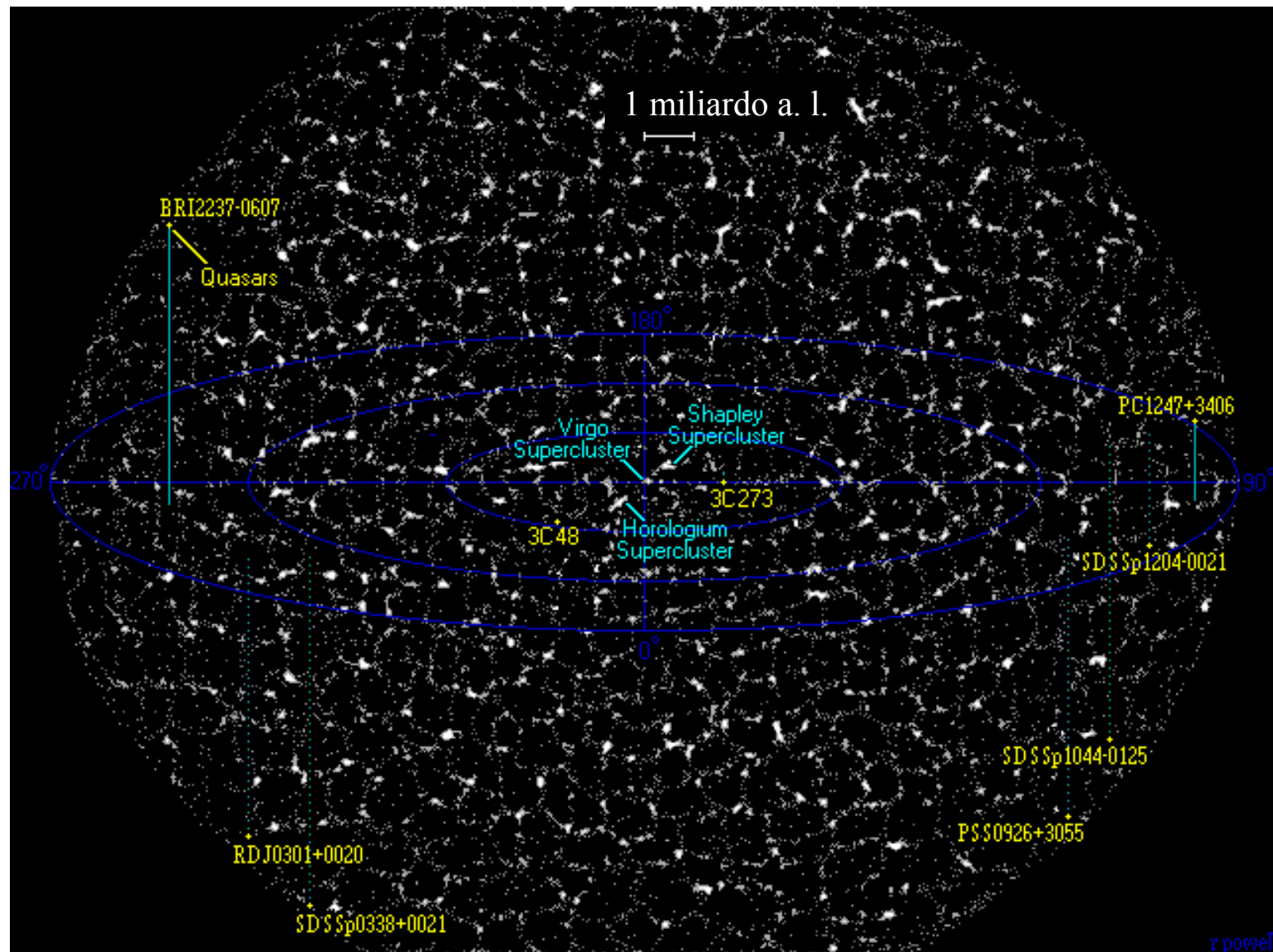
**«La vita non è facile per nessuno di
noi. E allora? Noi dobbiamo
perseverare e soprattutto avere
confidenza in noi stessi. Dobbiamo
credere che siamo dotati per
qualcosa e che questa cosa deve
essere raggiunta.» Marie Curie**

Catalina Curceanu (Facebook)

Catalina.Curceanu@LNF.INFN.IT

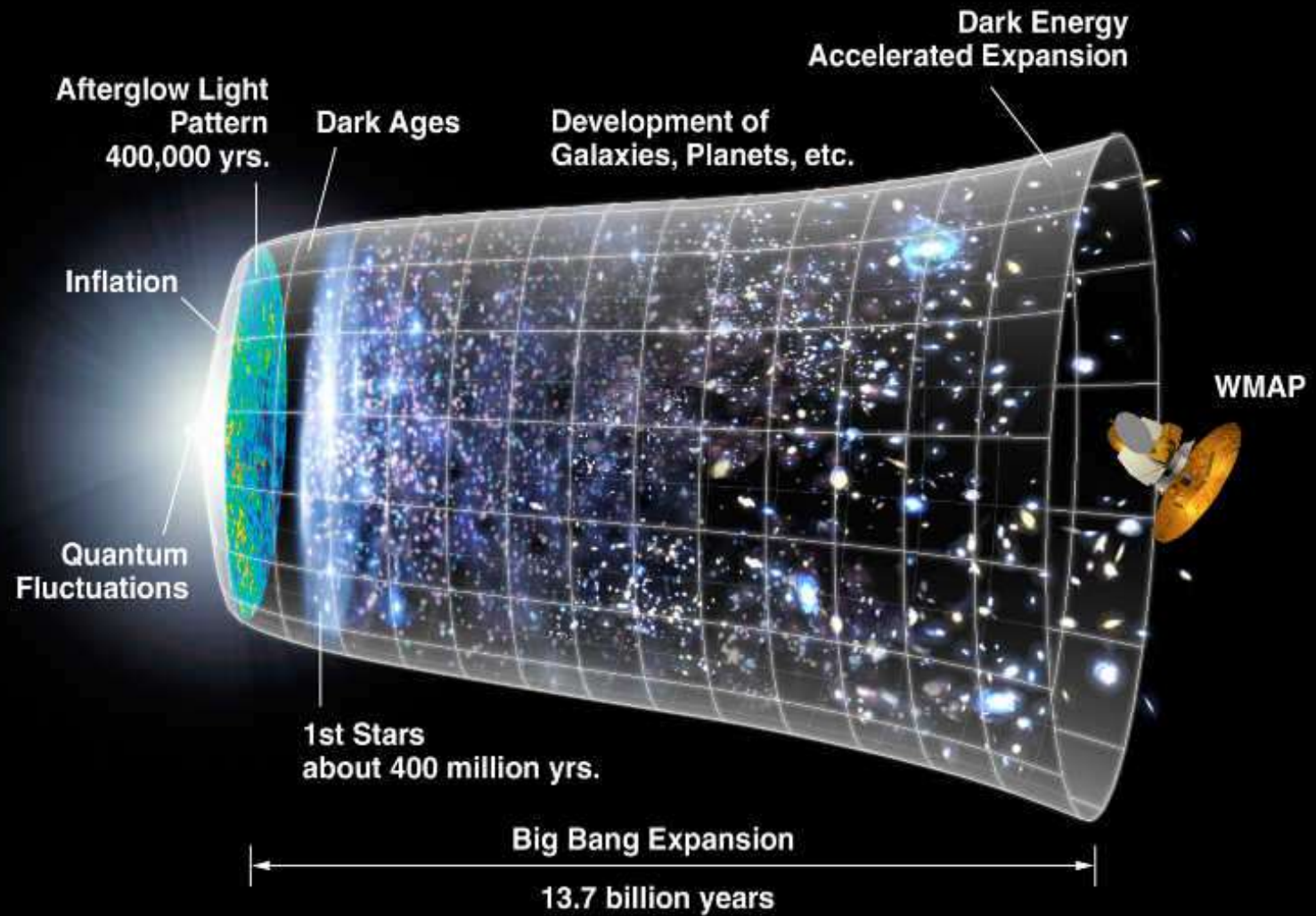






Zoom In x15

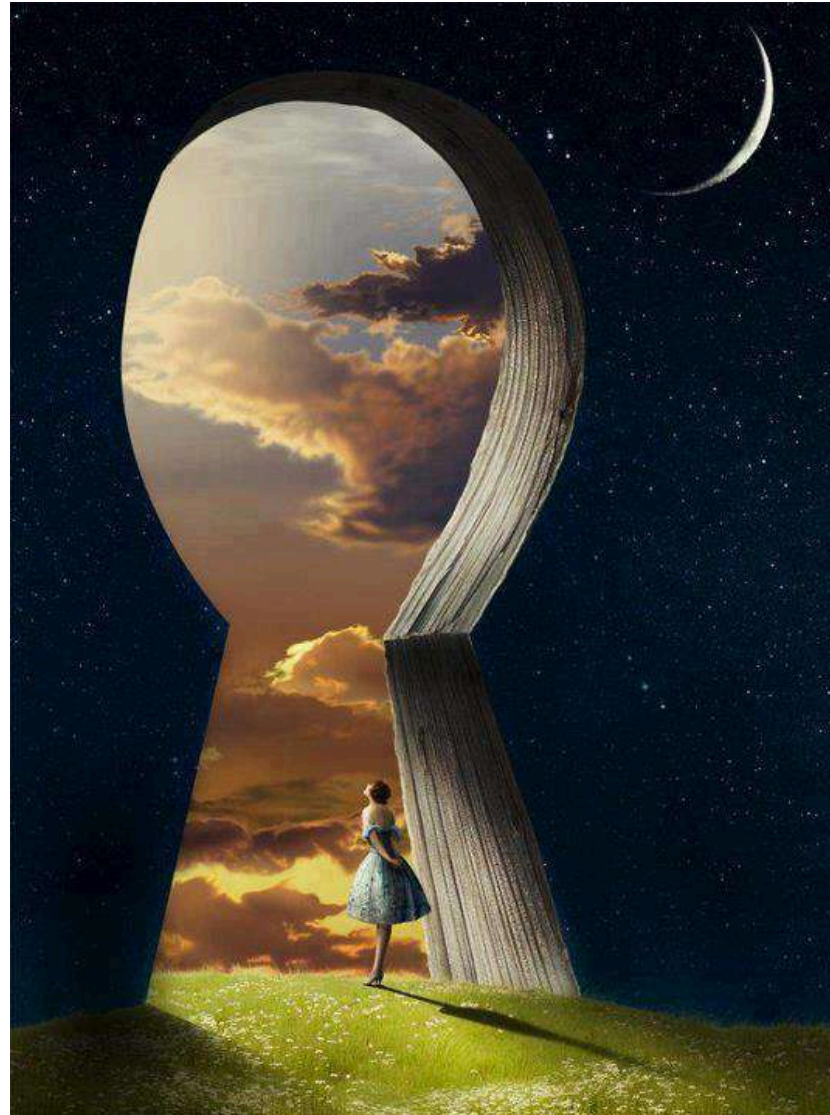
The Big Bang Model

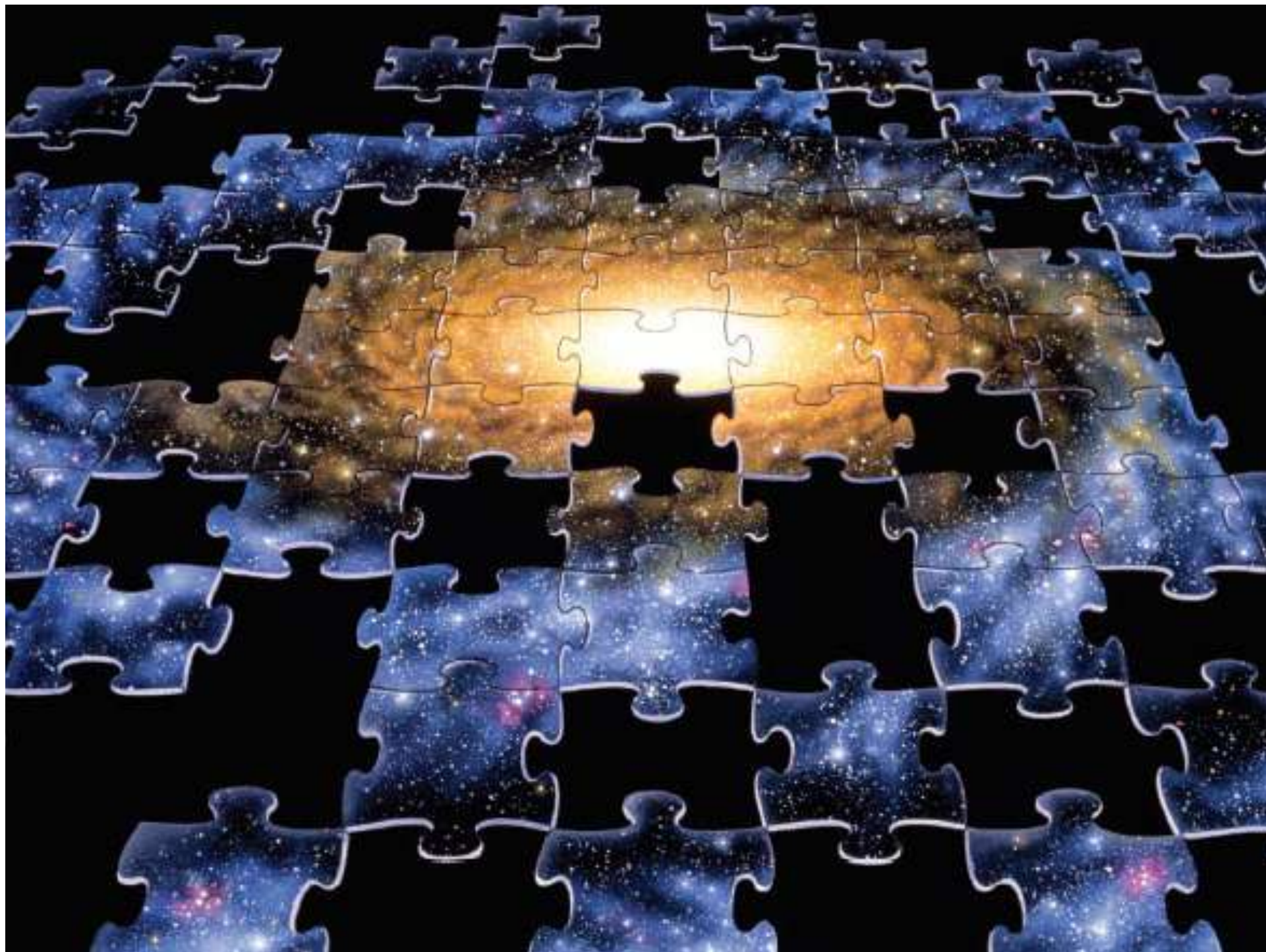


Abbiamo dunque capito l'Universo?

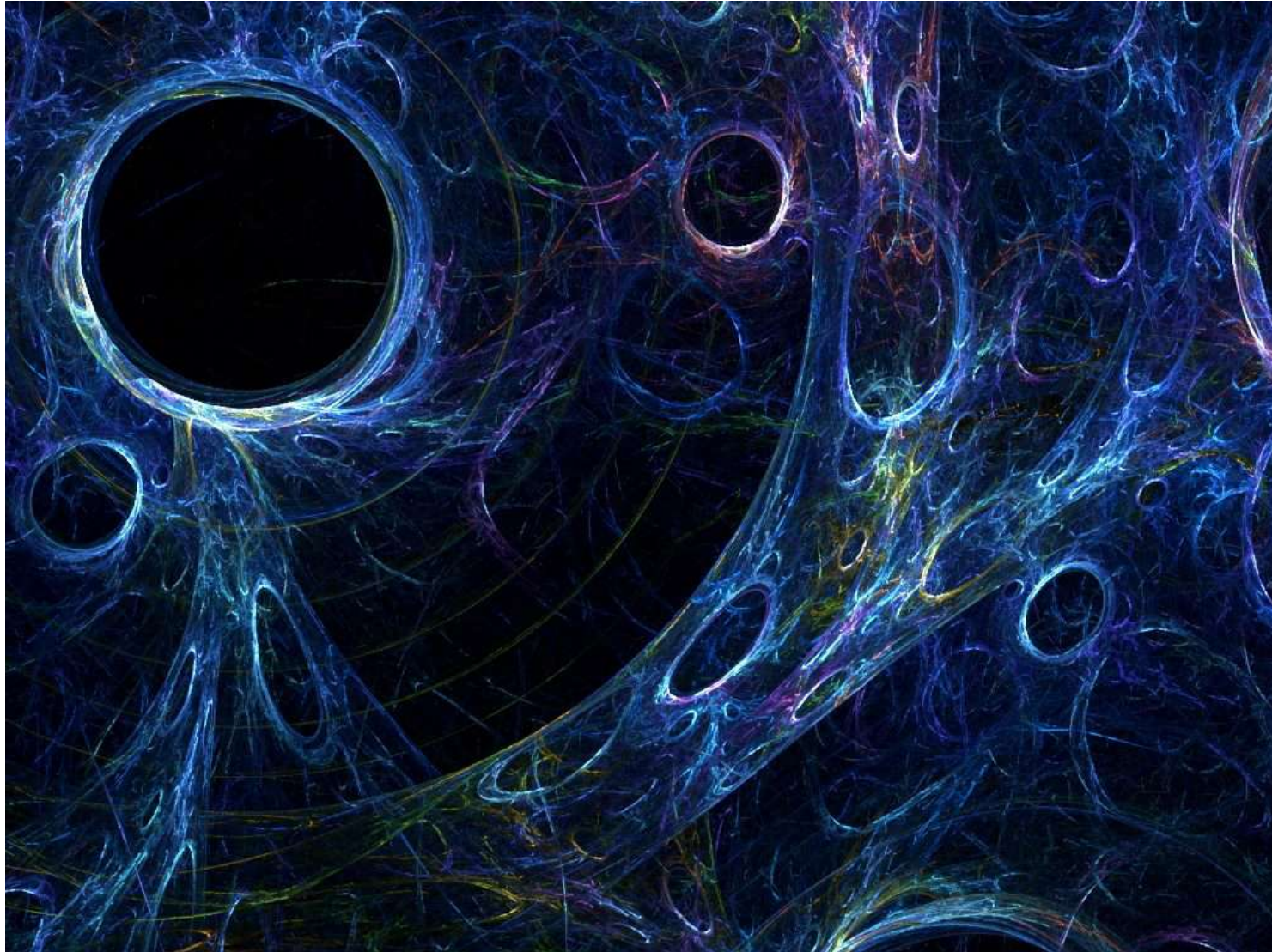


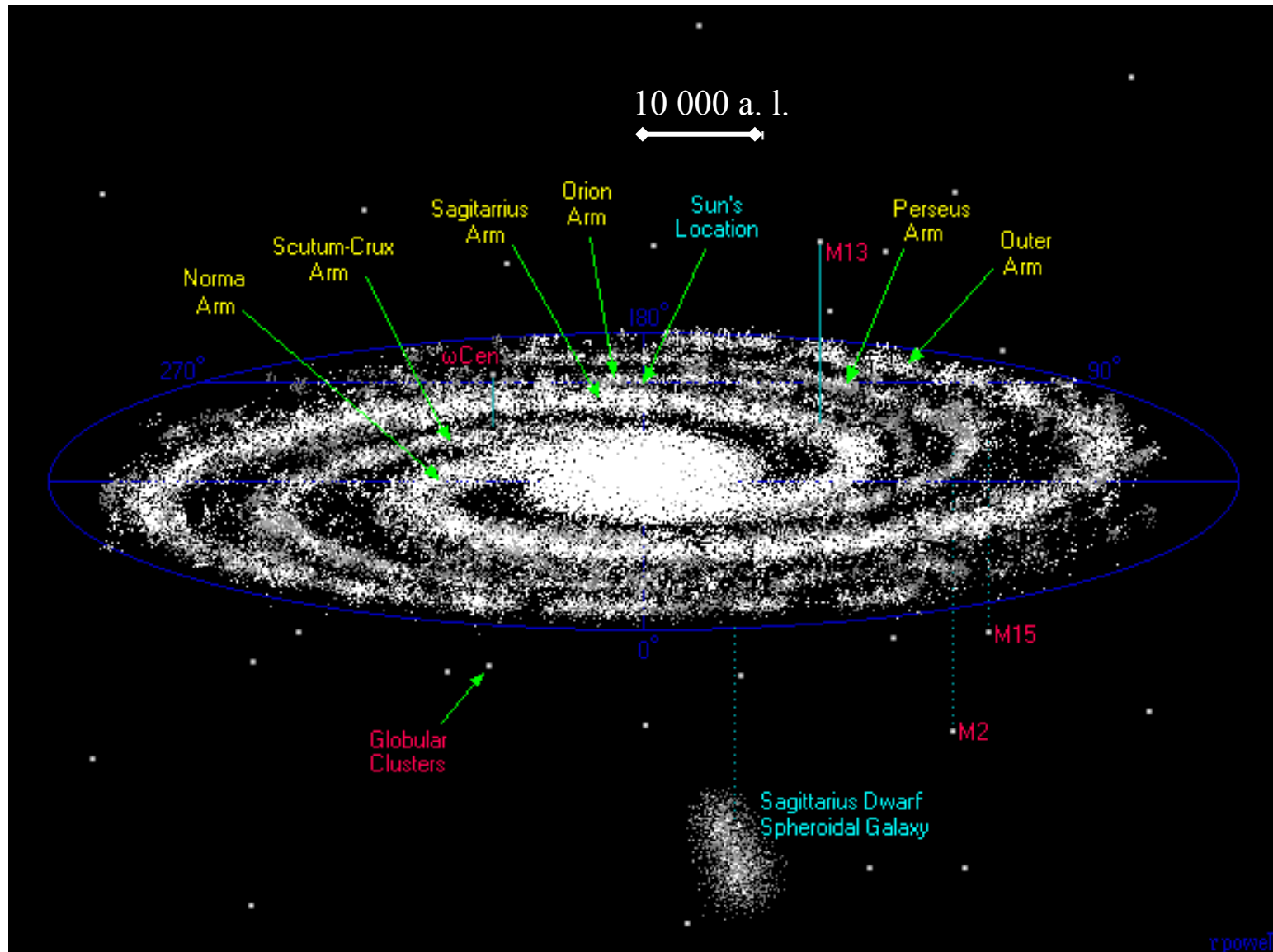
...invece...Terra Incognita della
Fisica Moderna!





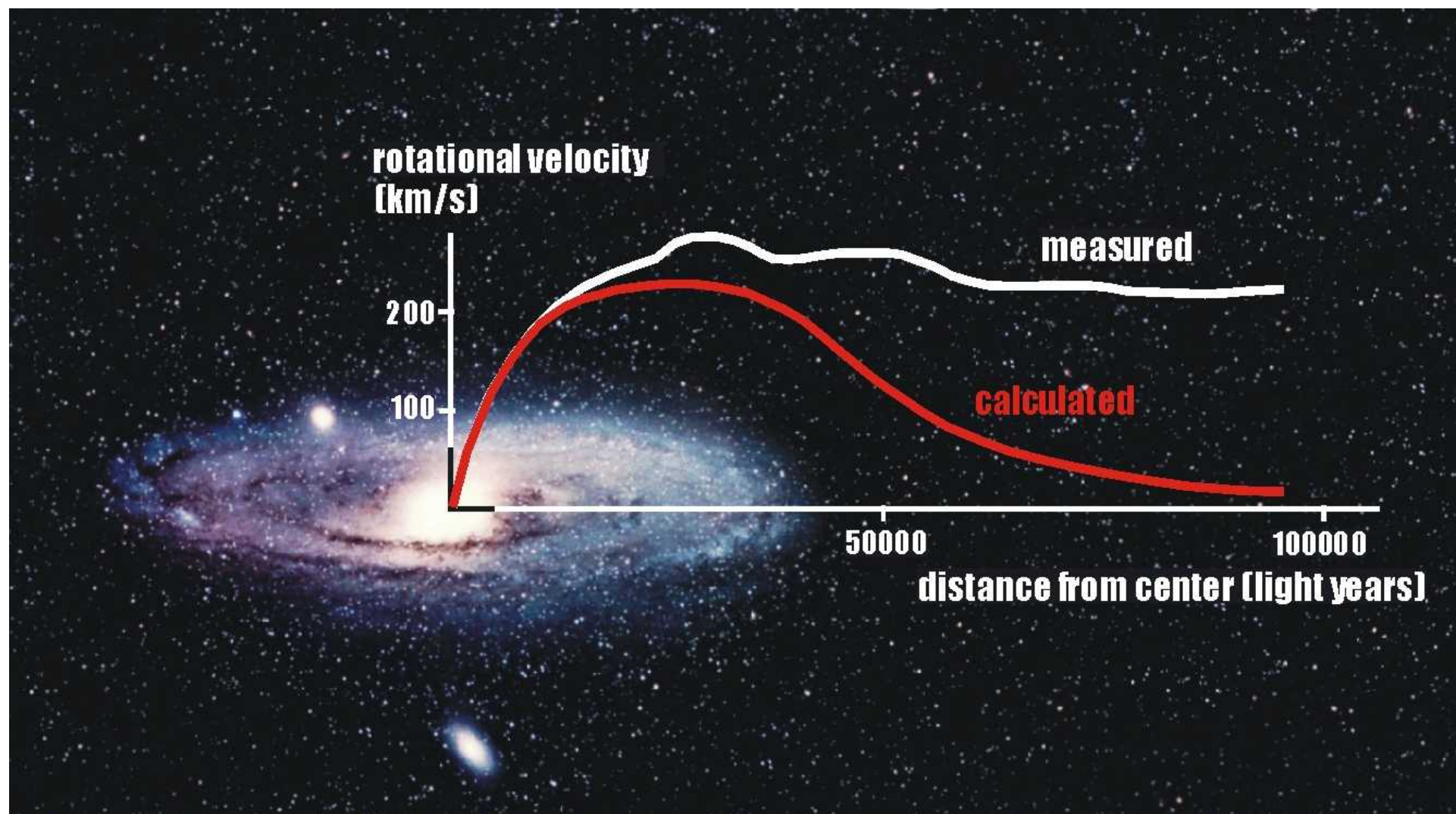
Energia e materia

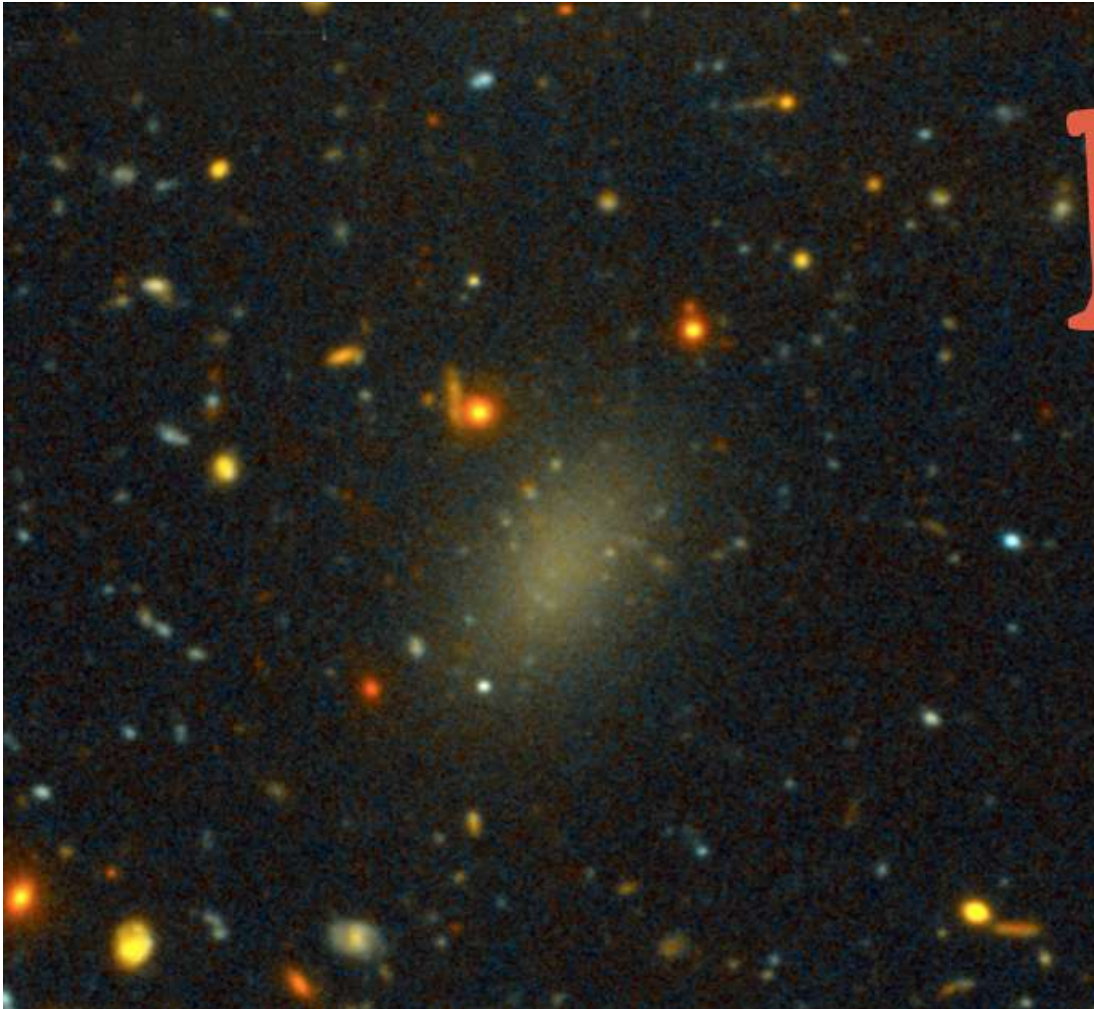




Zoom In x10

Zoom Out x10

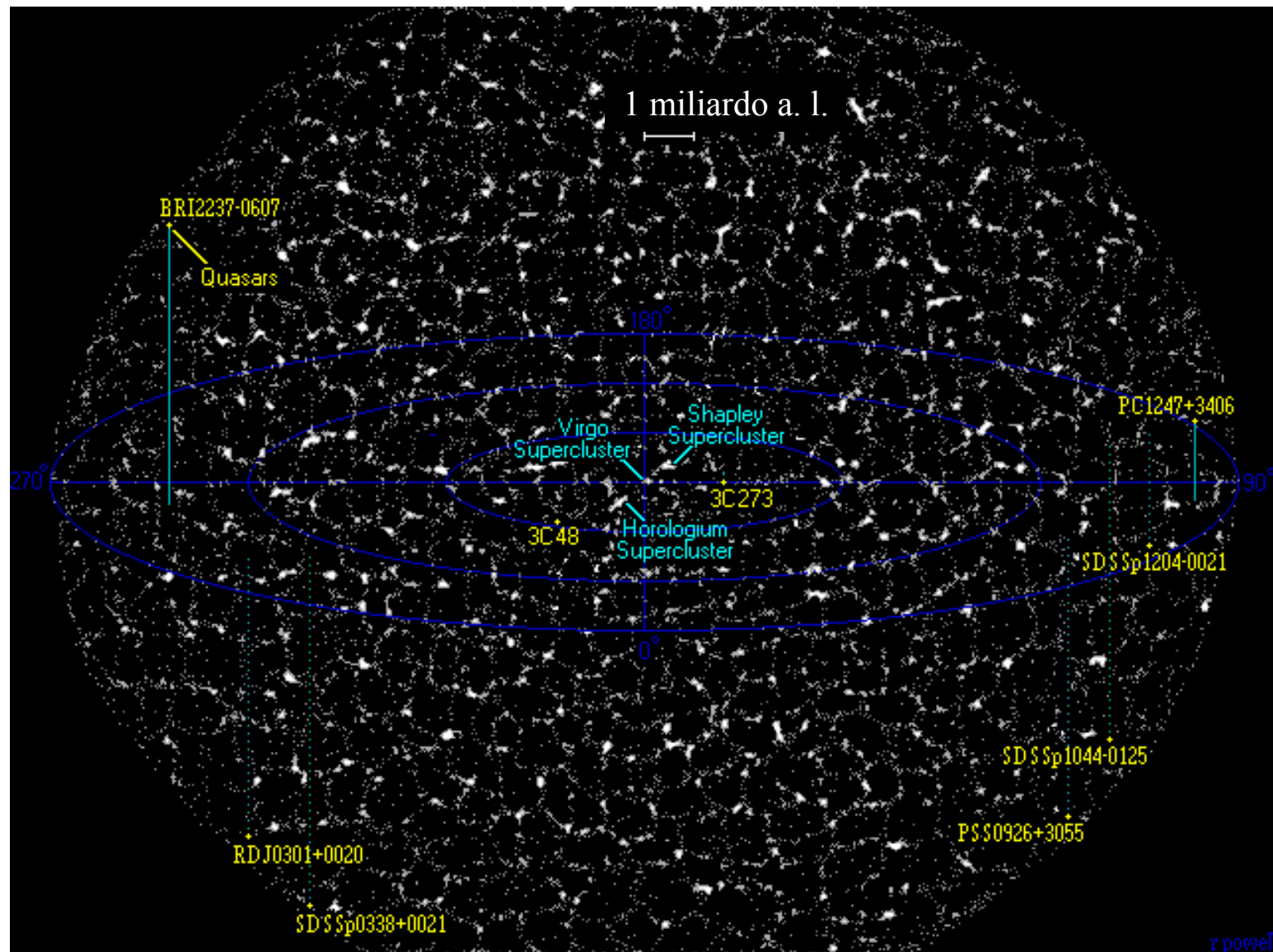




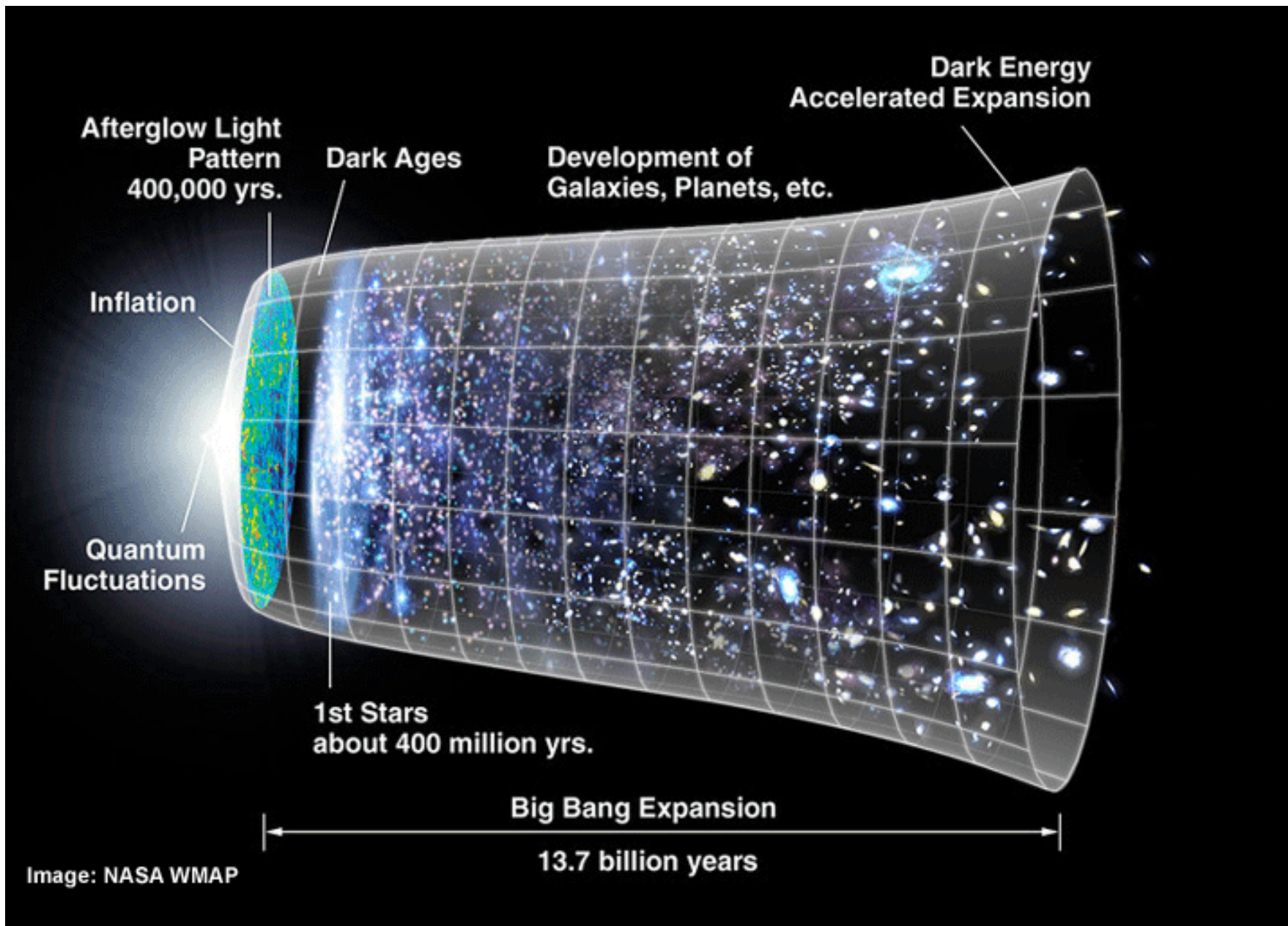
FOUND

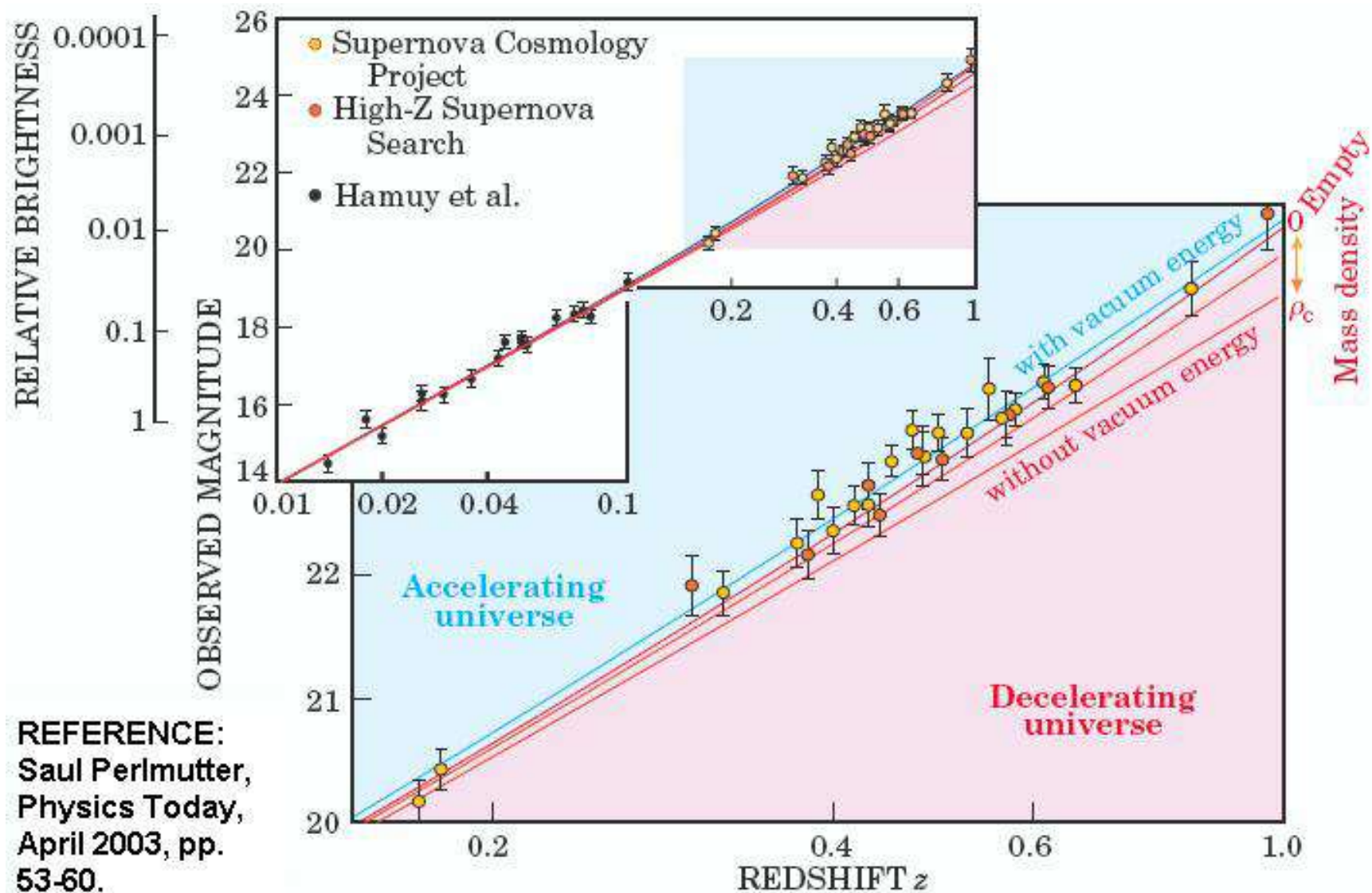
99.9%

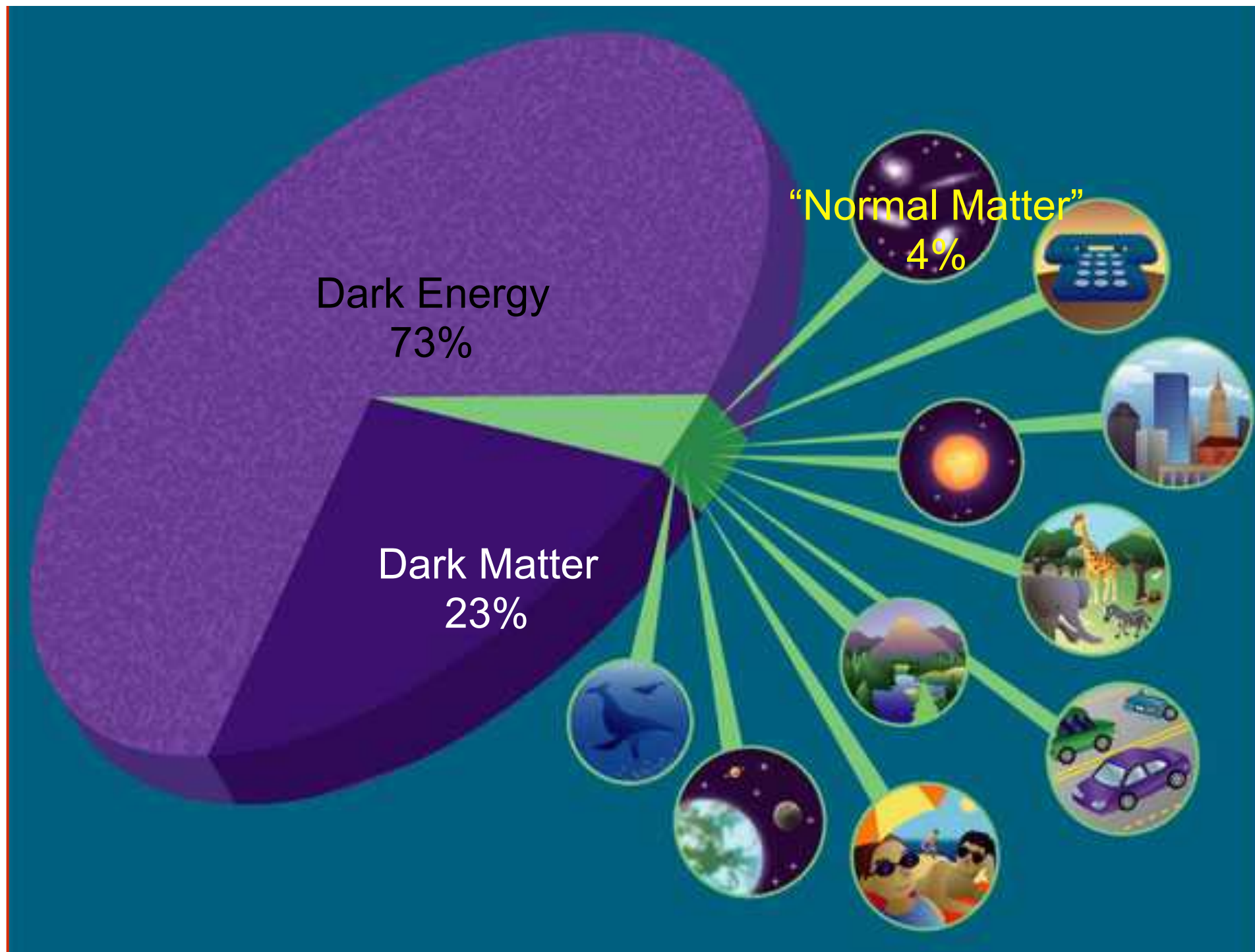
DARK MATTER
GALAXY



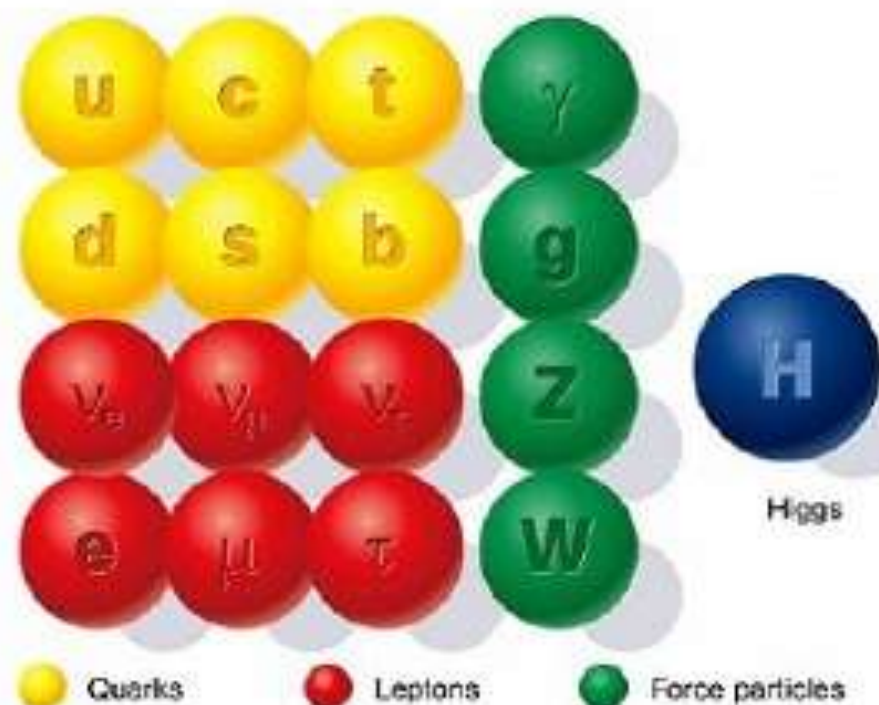
Zoom In x15



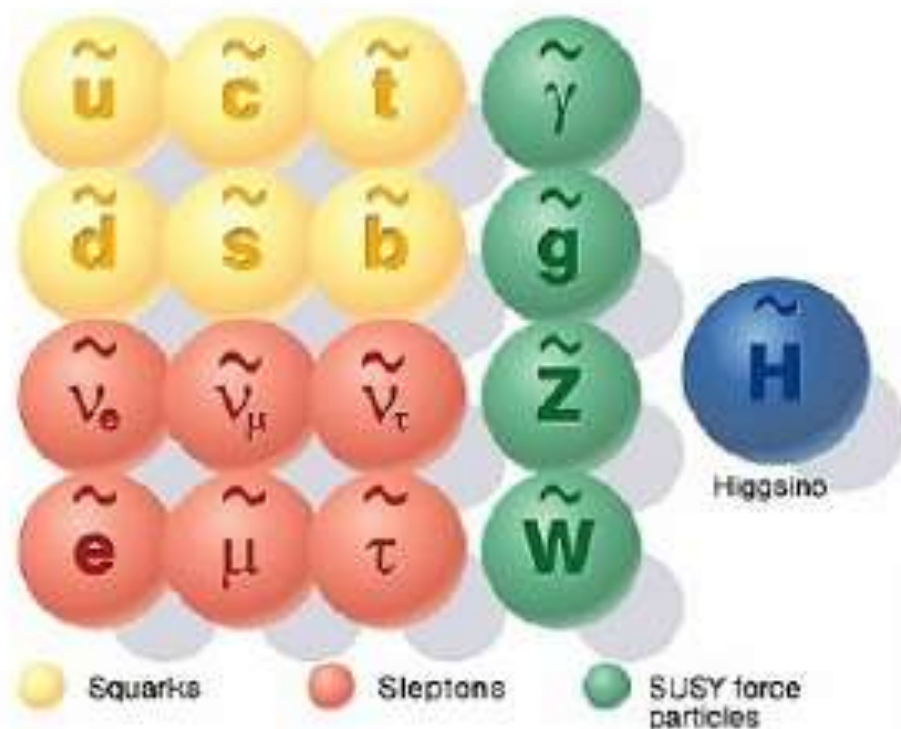




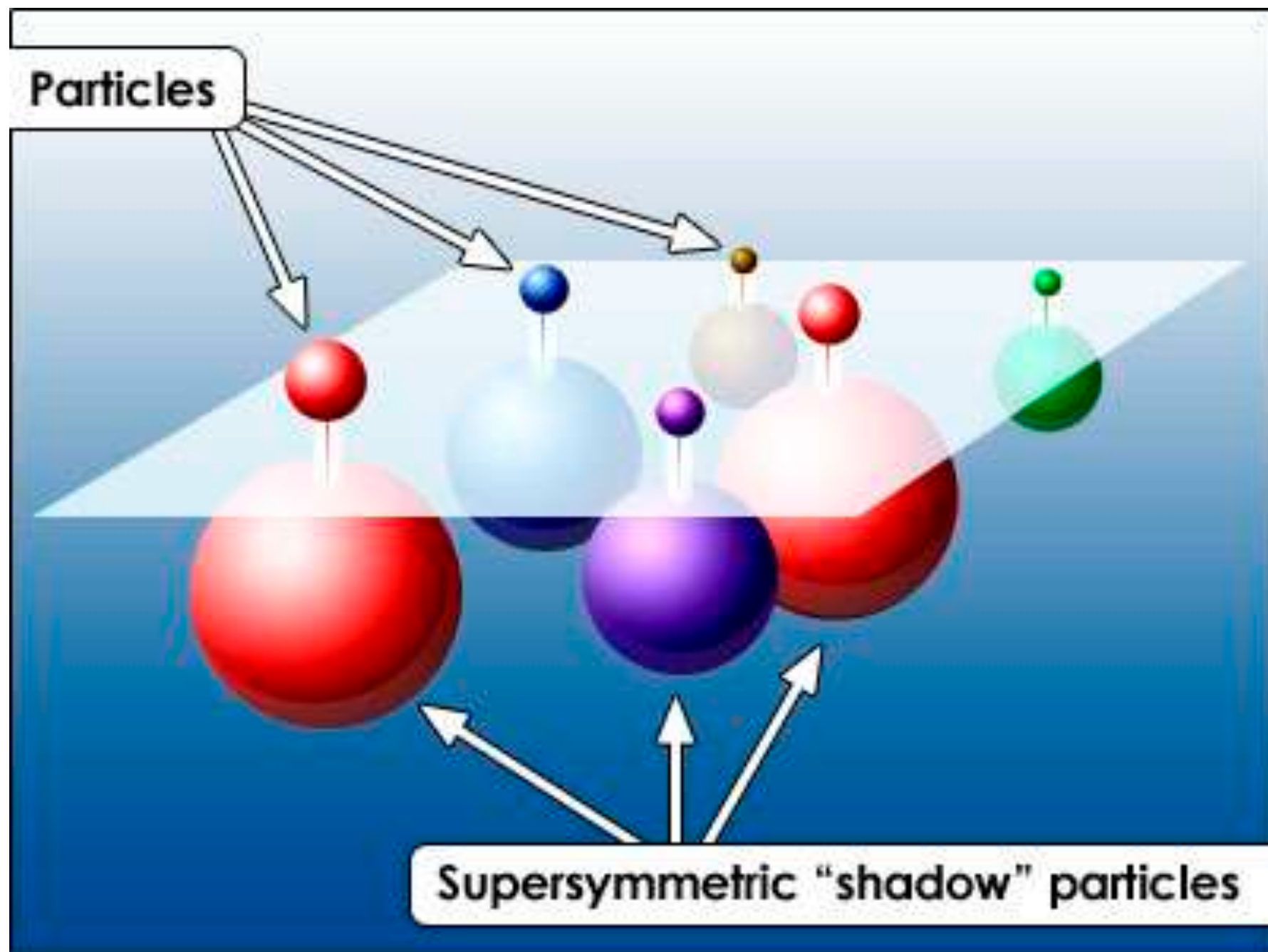
SUPERSYMMETRY



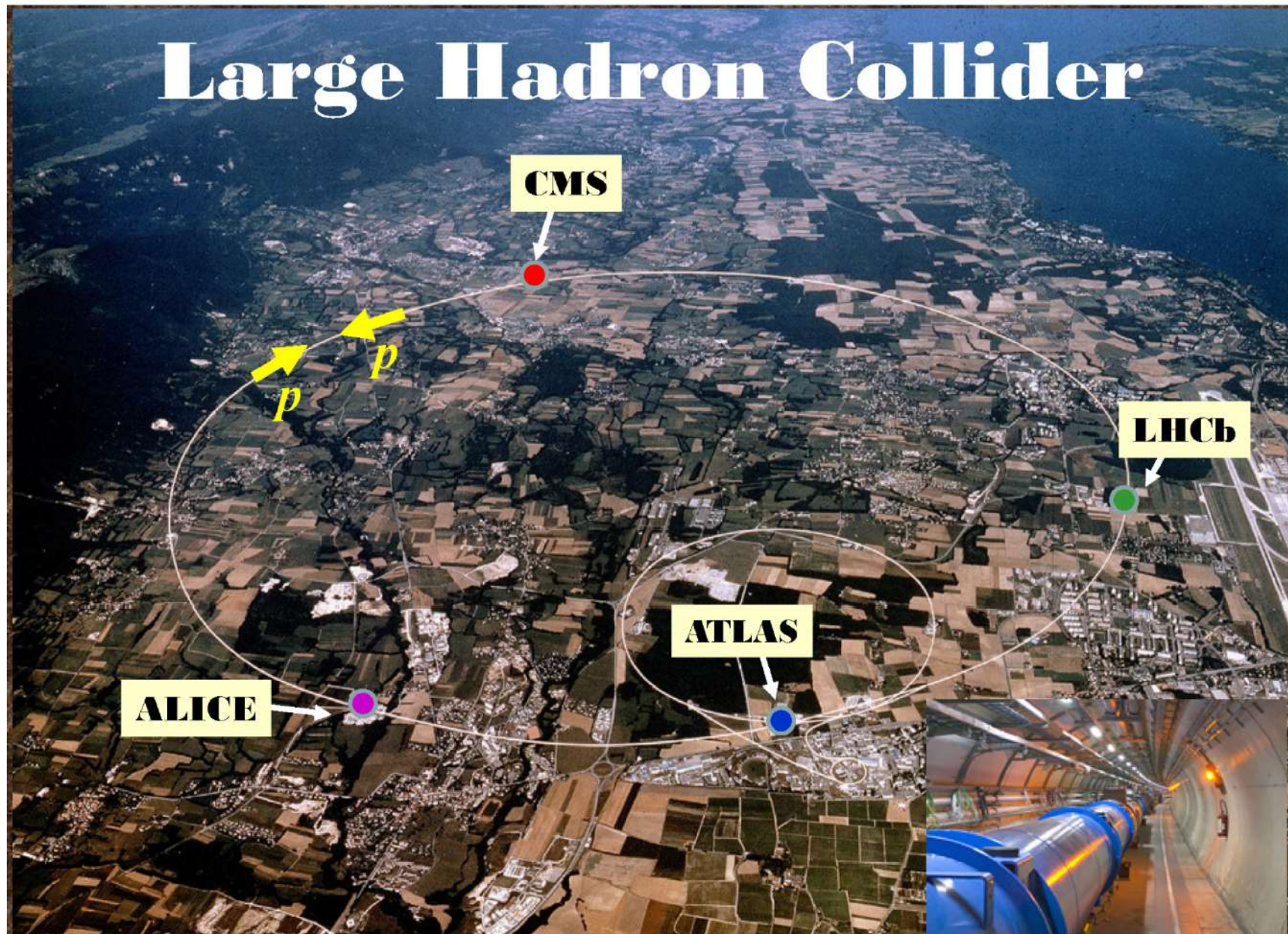
Standard particles



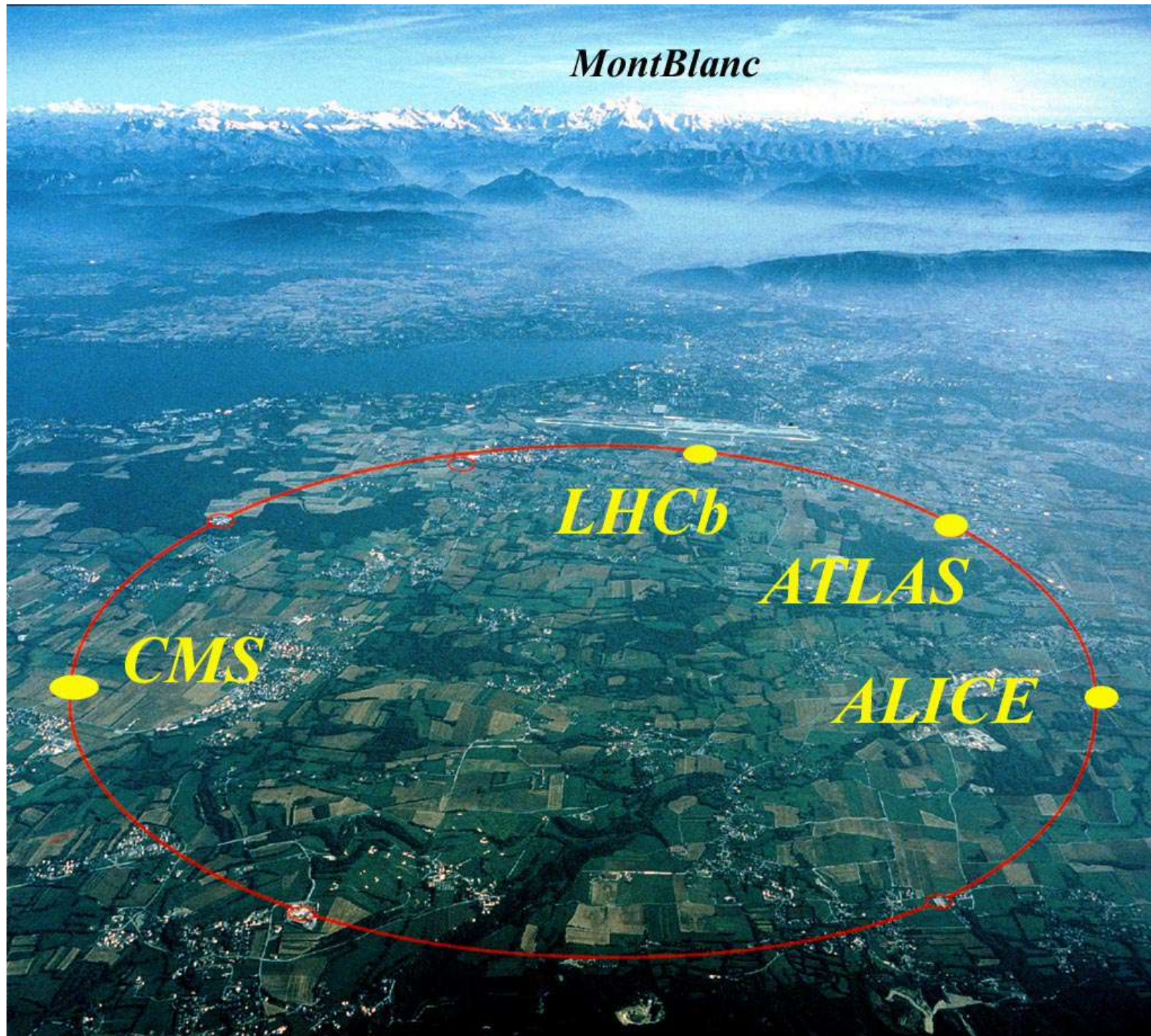
SUSY particles



A caccia di particelle di materia oscura



MontBlanc



LHCb

ATLAS

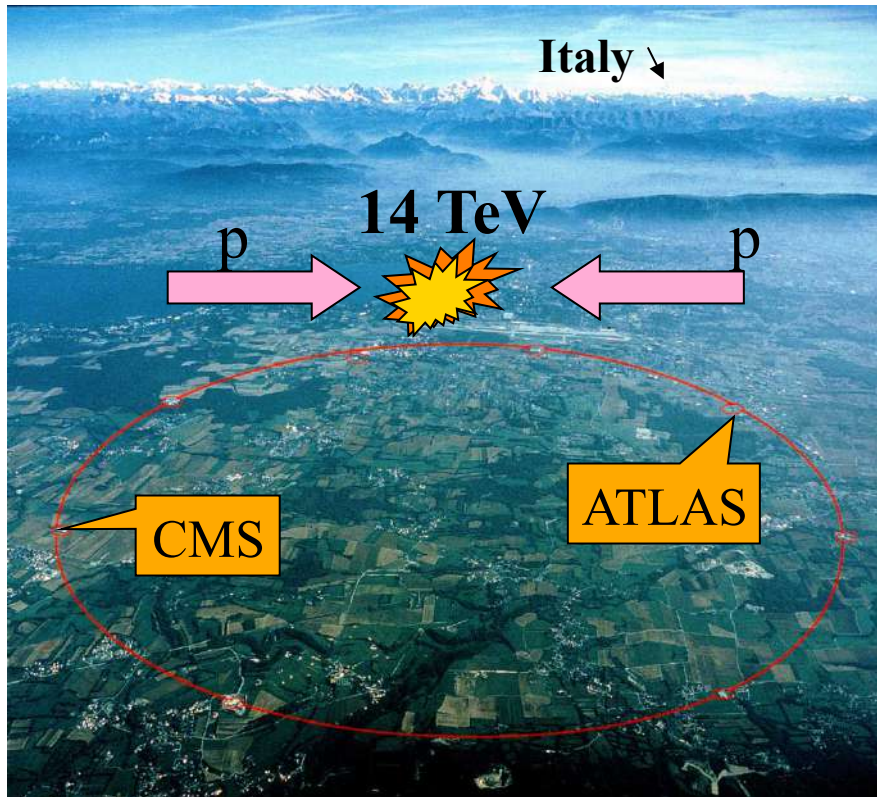
CMS

ALICE

This is a 27 km-particle accelerator where protons travel at close to the speed of light



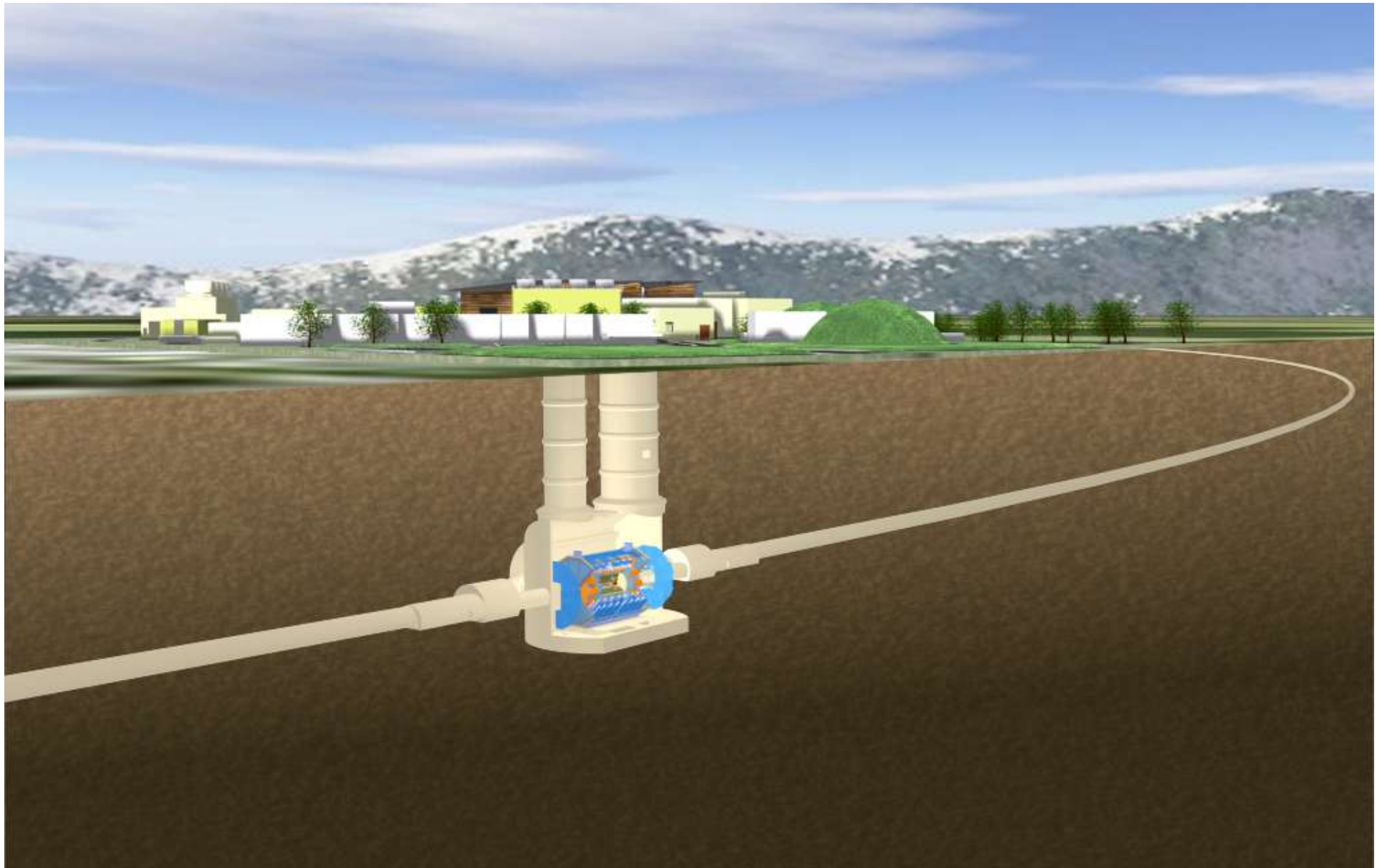
Large Hadron Collider at CERN



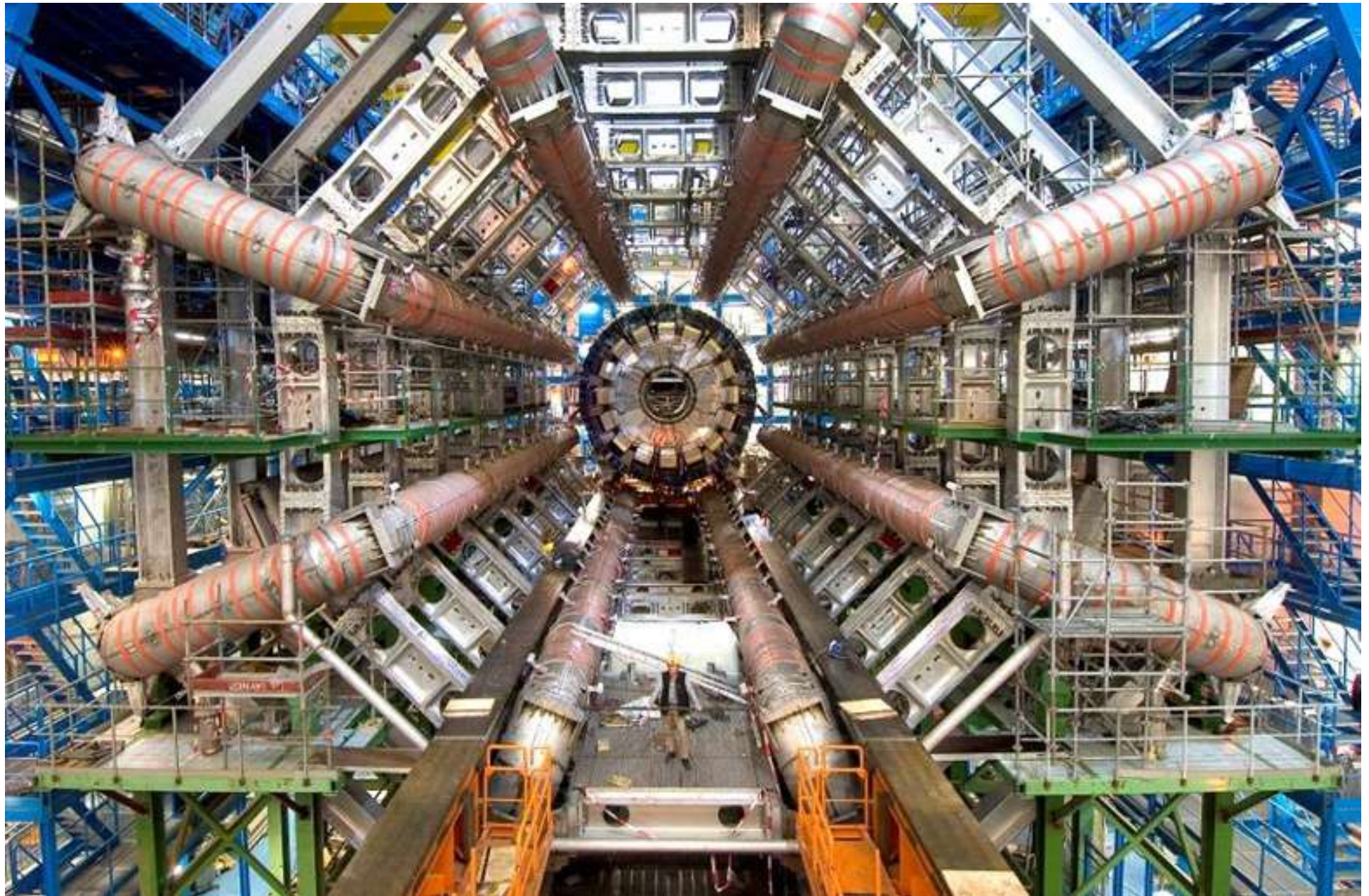
Luminosity target: $10^{34} \text{cm}^{-2} \text{s}^{-1}$

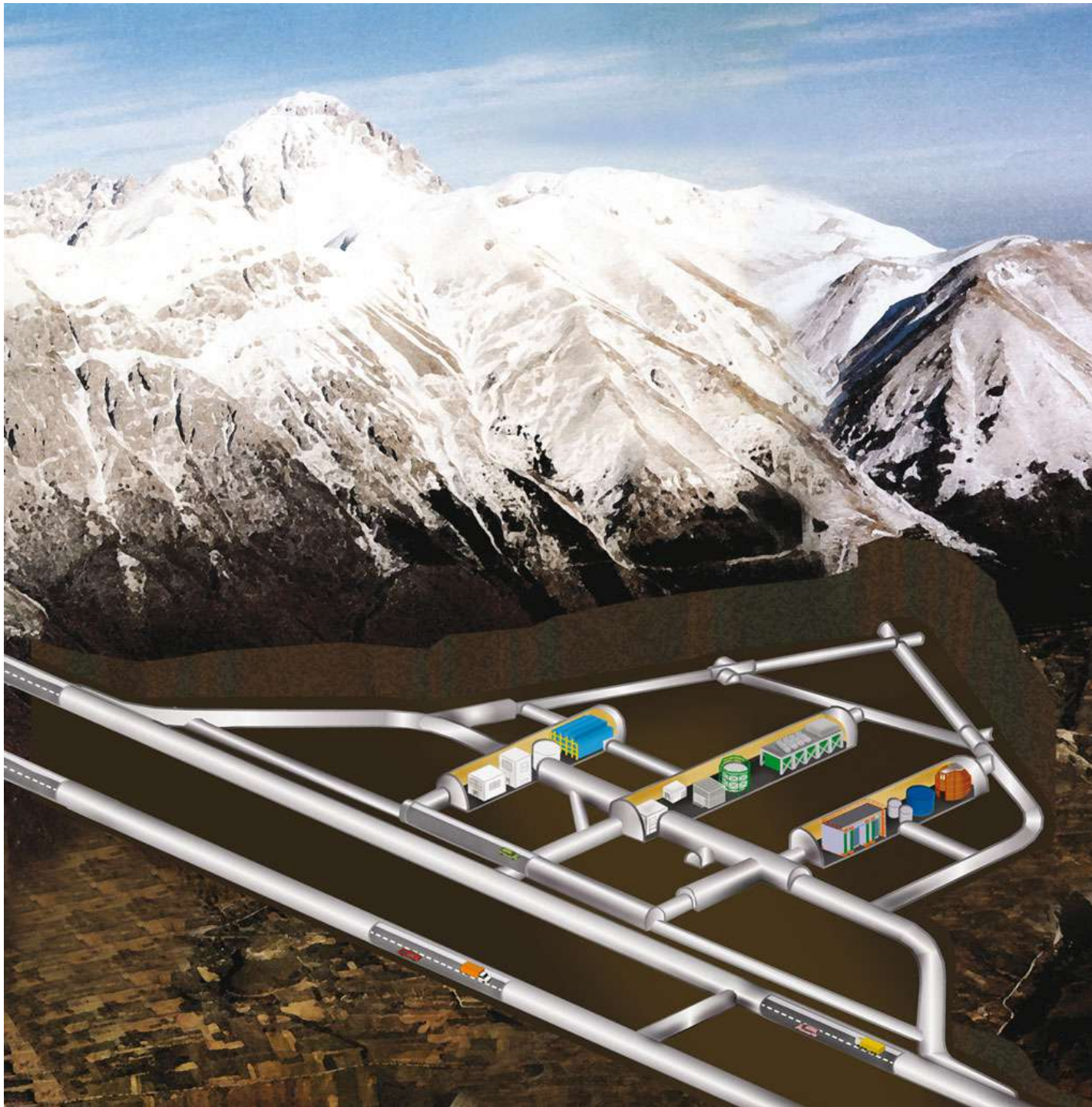
Increased production of heavy particles like Higgs, top quark

More particles at **higher** energy
requires new detector design
and technology











Una forza che

si oppone alla gravità

Antigravità

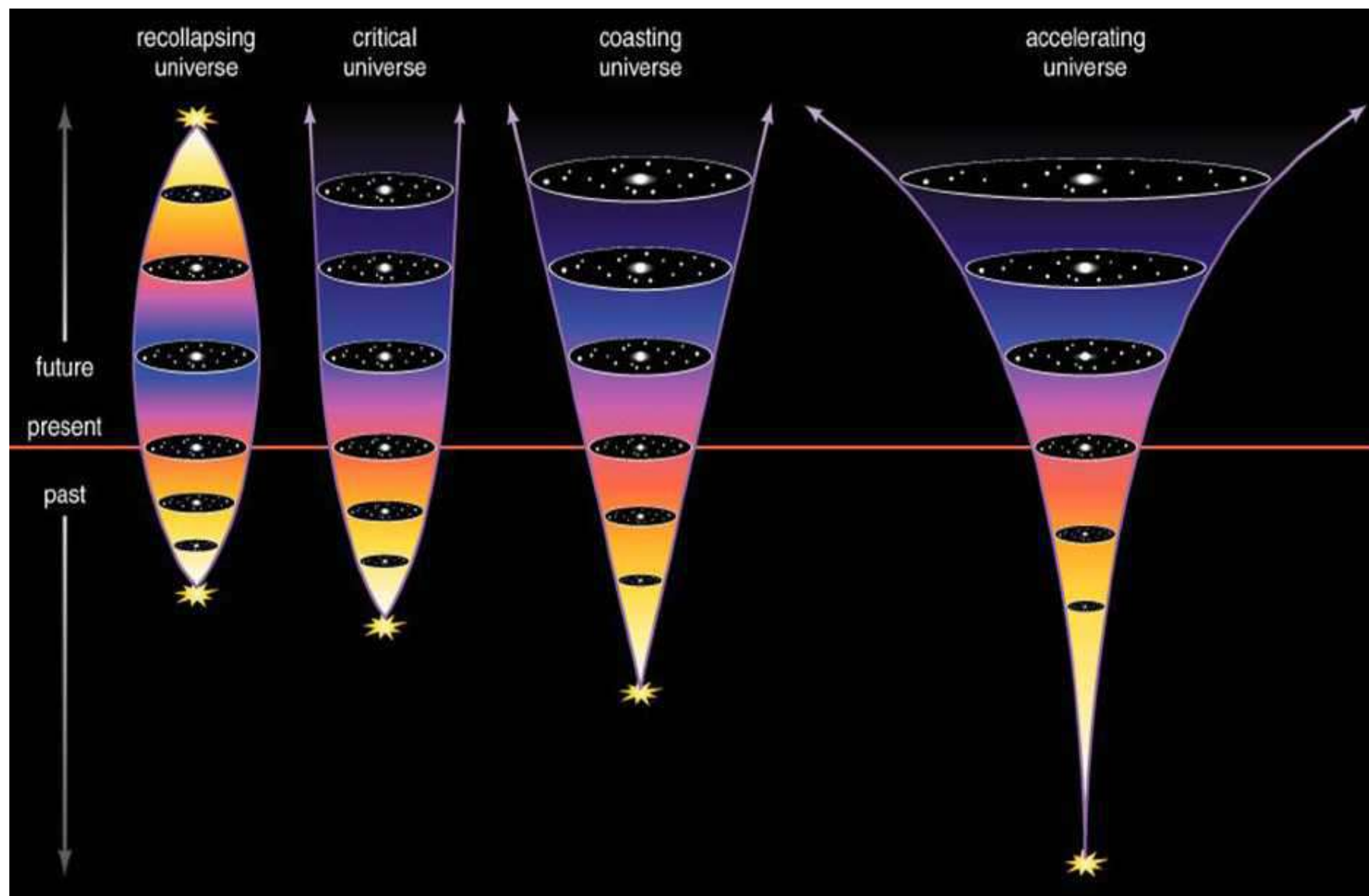
Quintessenza

Costante

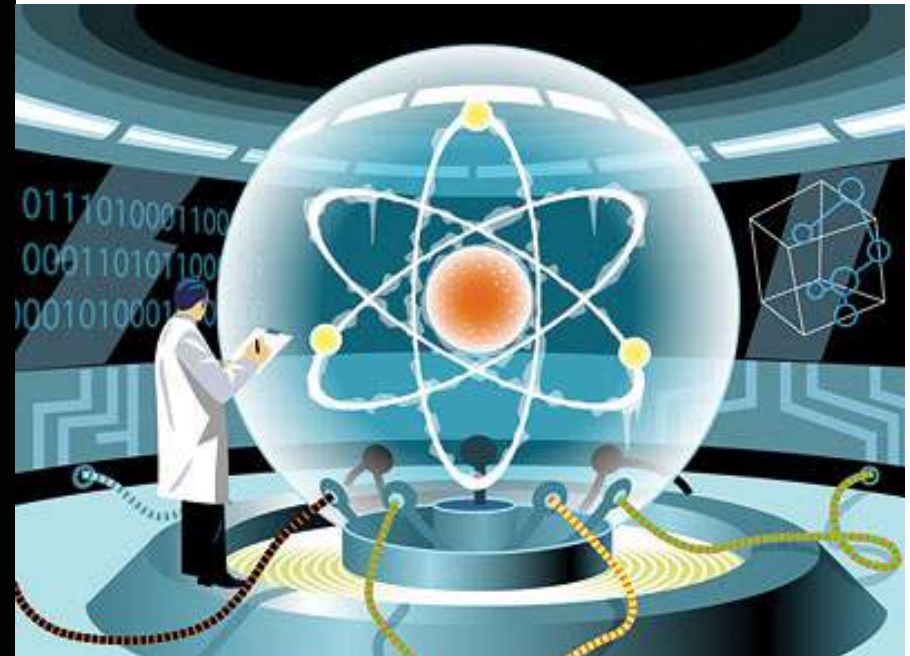
cosmologica

Energia oscura

Come si evolverà il nostro Universo?



Quantum Technologies







Underground Gran Sasso laboratory



John
Templeton
Foundation



Quantum Technologies in Space

COST Action CA15220 e TEQ

