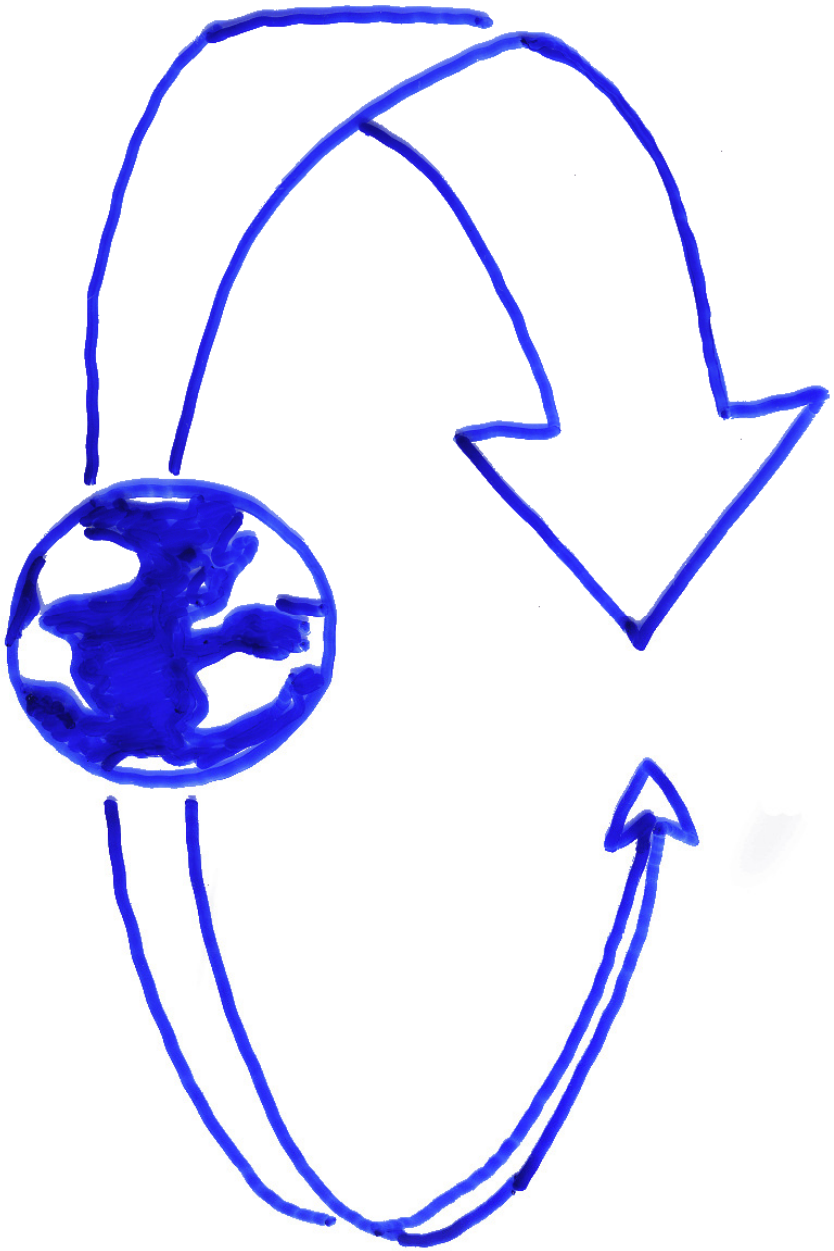
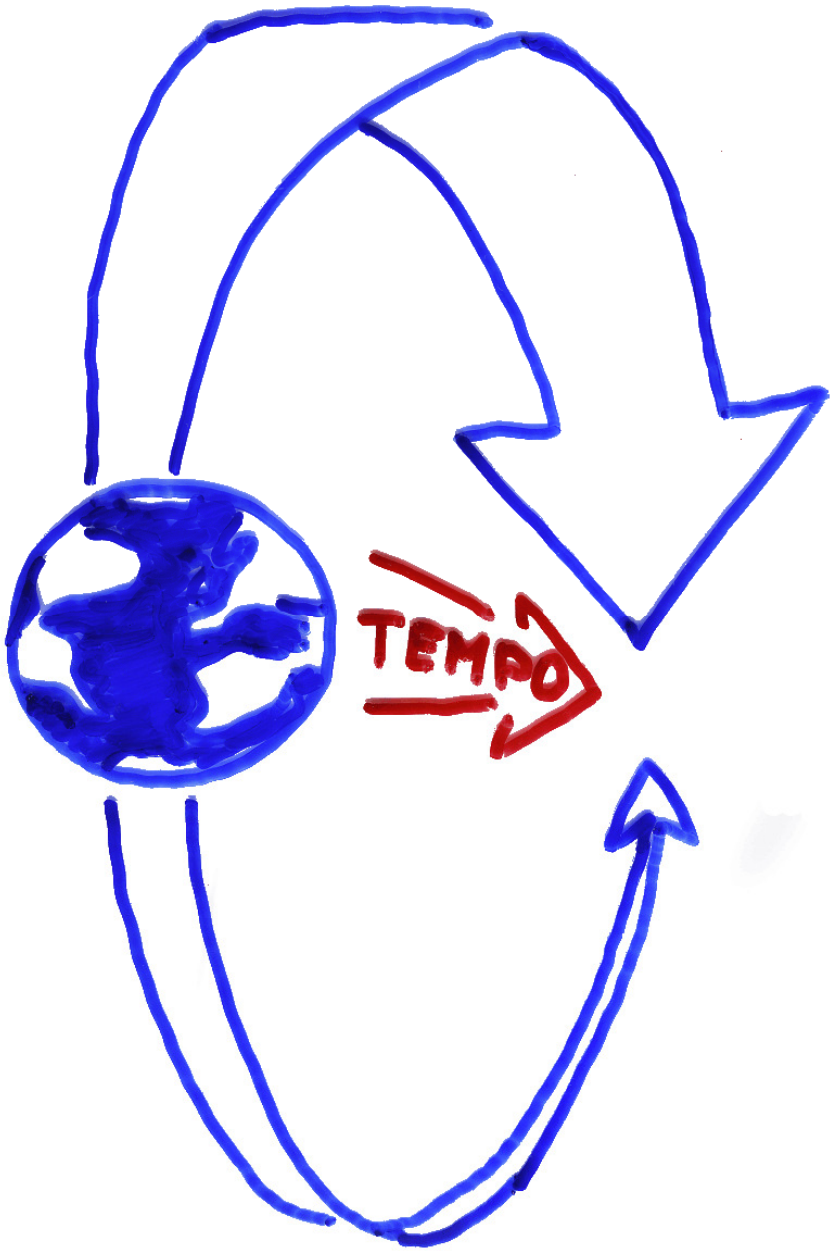
O LHC
E A MÁQUINA DO UNIVERSO

Jorge Dias de Deus, 2009

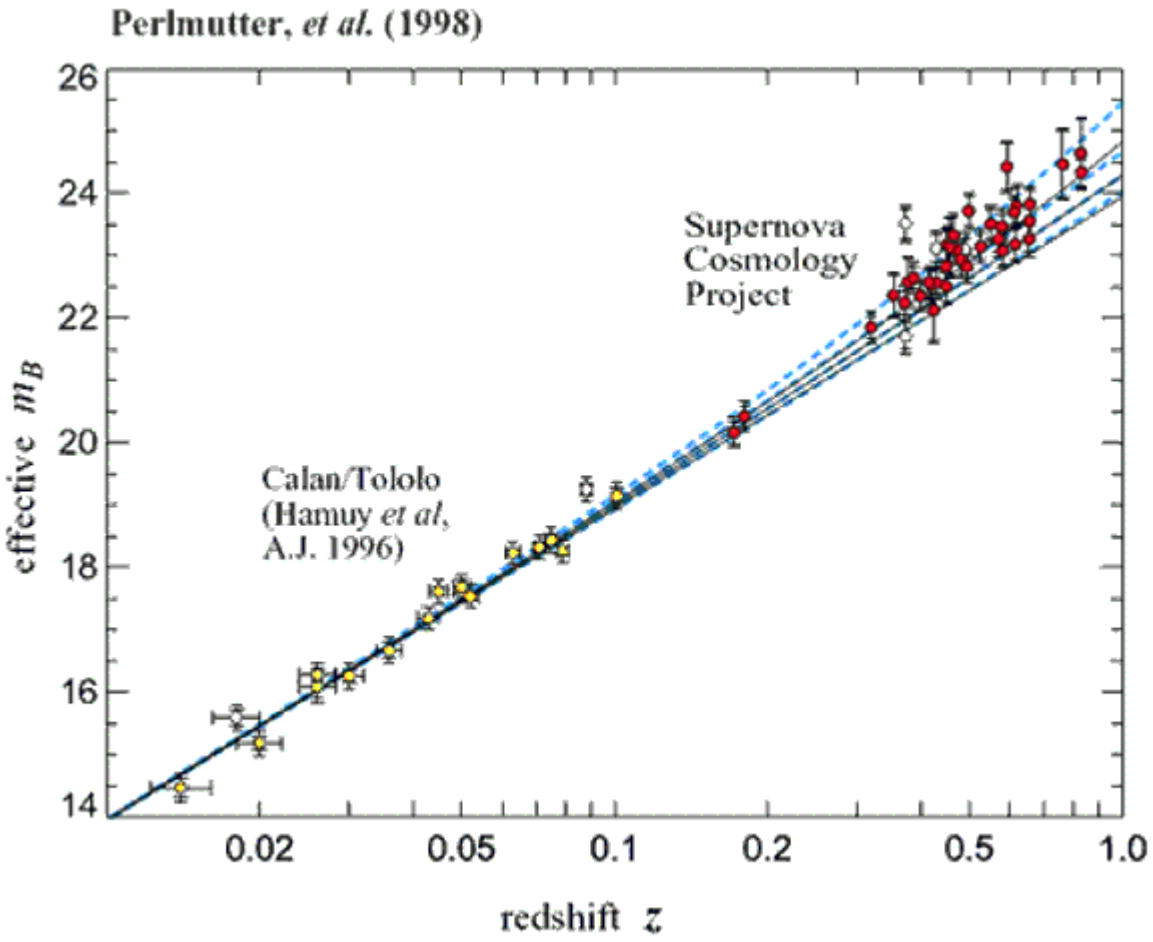



TEMPO

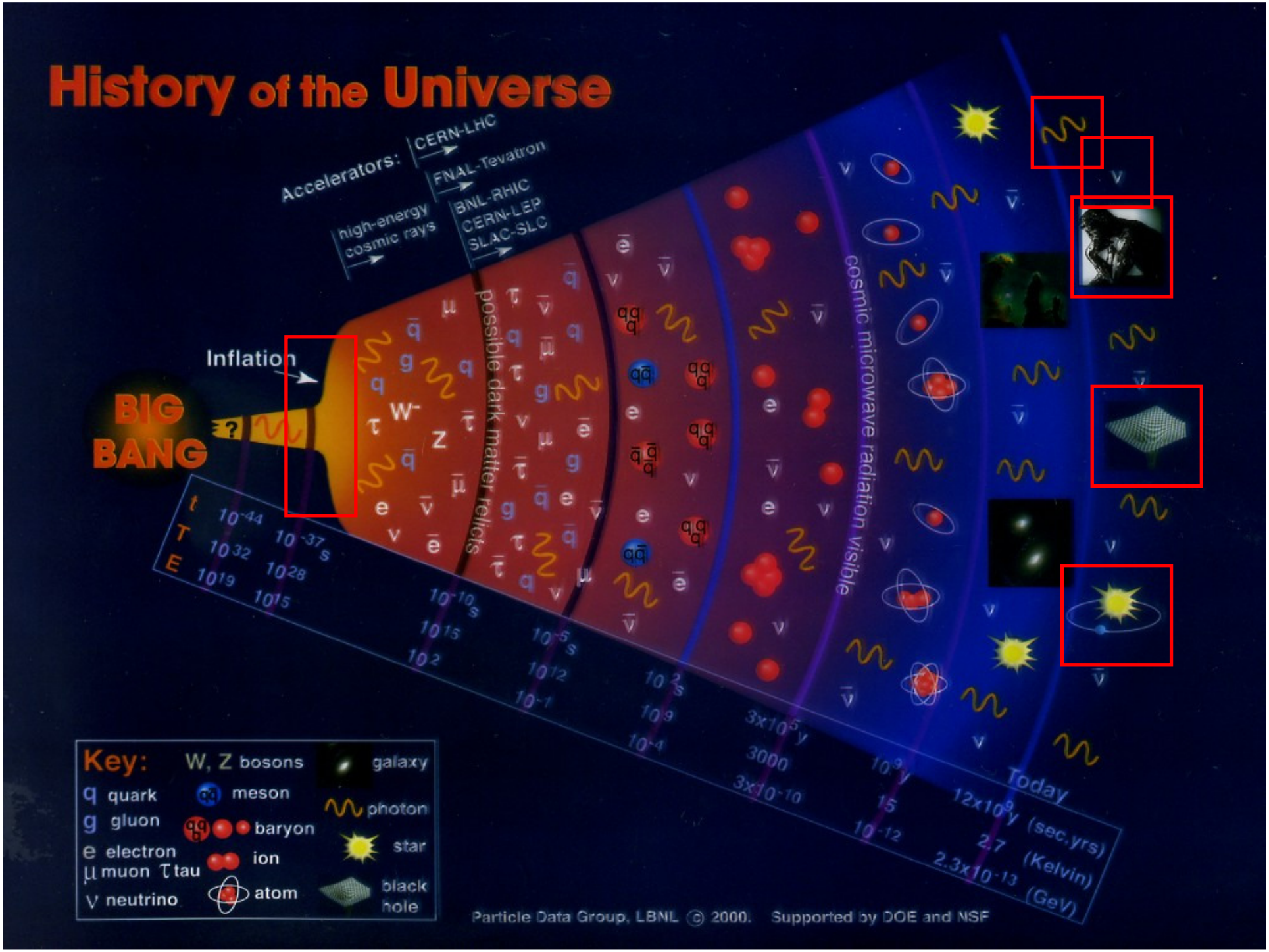

TEMPO
BIG
BANG

Edwin Hubble
(1889 – 1953)

O Universo em expansão




BIG
BANG


History of the Universe
Accelerators:
CERN-LHC
FNAL-Tevatron
BNL-RHIC
CERN-LEP
SLAC-SLC
high-energy cosmic rays
Inflation
BIG BANG
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possible dark matter relics
cosmic microwave radiation visible
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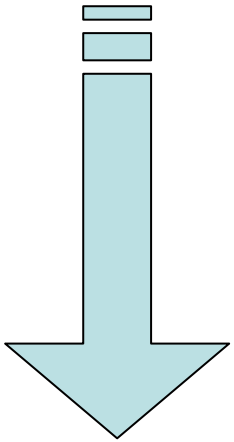
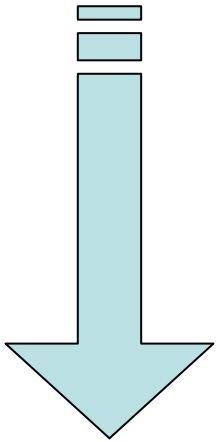
12x109 y (sec,yrs)
2.7 (Kelvin)
2.3x10-13 (GeV)
Key:
q quark
g gluon
e electron
μ muon τ tau
ν neutrino
W, Z bosons
meson
baryon
ion
atom
galaxy
photon
star
black hole
Particle Data Group, LBNL © 2000. Supported by DOE and NSF

ORDEM E DESORDEM

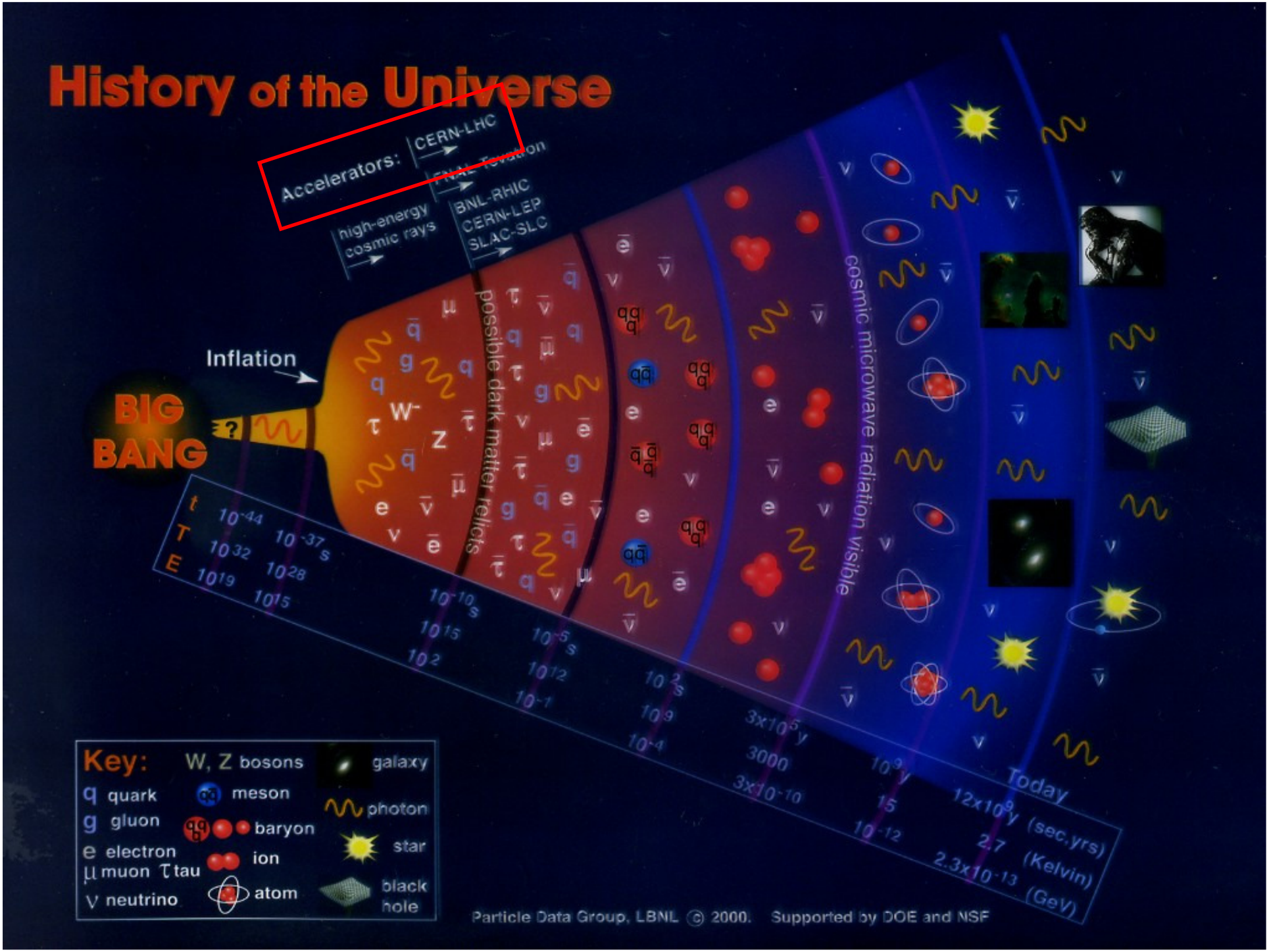




ENERGIA DE LIGAÇÃO

ENERGIA CINÉTICA (Temperatura)

INTERACÇÕES: FRACA
FORTE
ELECTROMAGNÉTICA
GRAVITACIONAL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Key:
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W, Z bosons
meson
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ion
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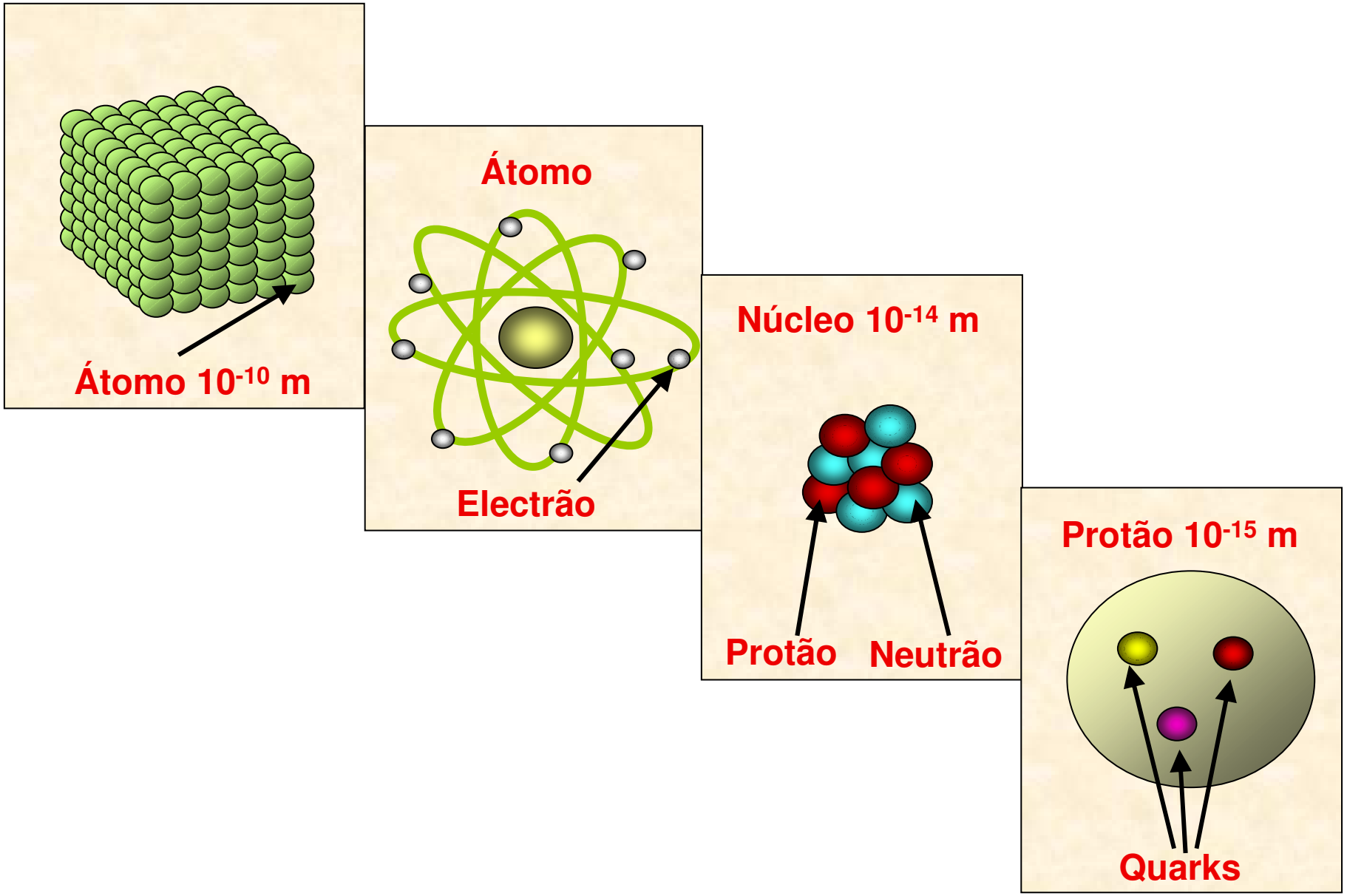
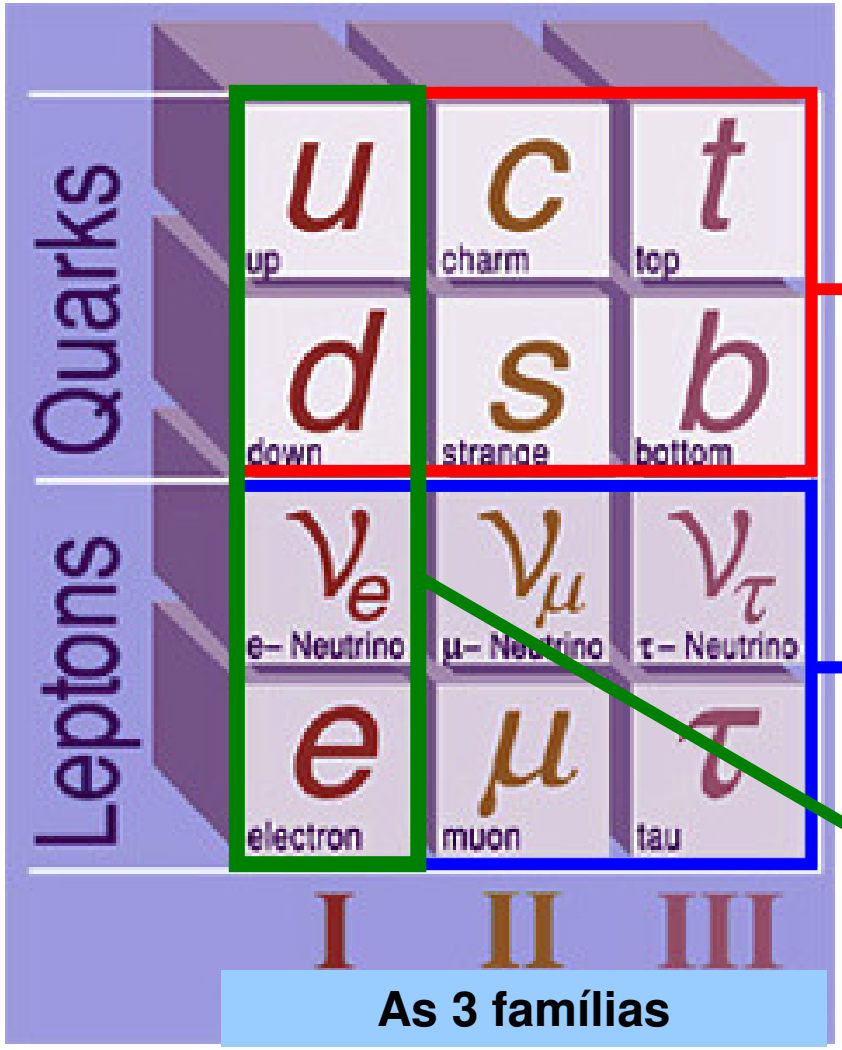
galaxy
photon
star
black hole
Particle Data Group, LBNL © 2000. Supported by DOE and NSF

O infinitamente pequeno...



As 3 famílias de partículas elementares



6 QUARKS

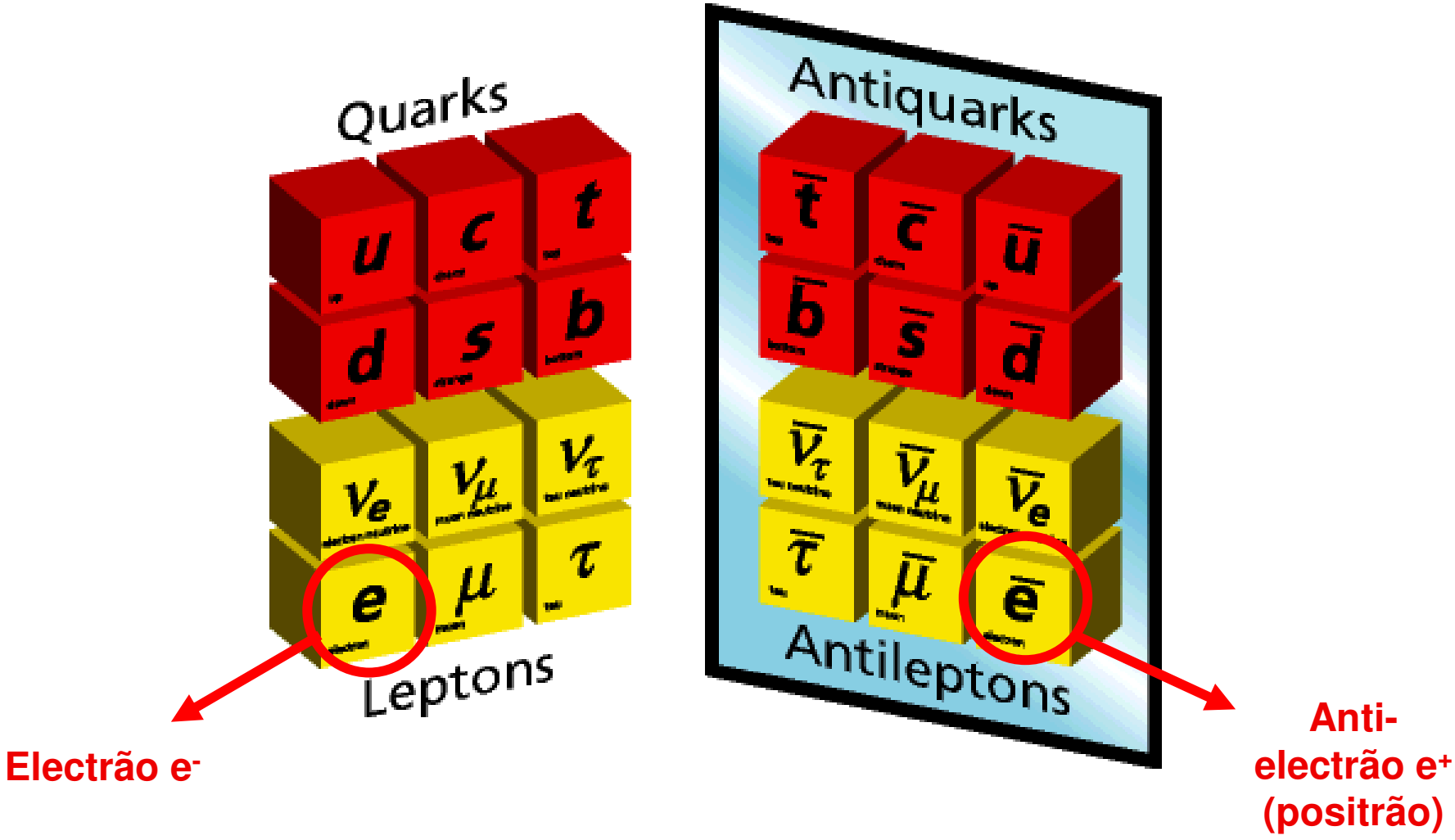
(Todos os hadrões são formados por combinações de $q\bar{q}$ o qqq)

6 LEPTÕES

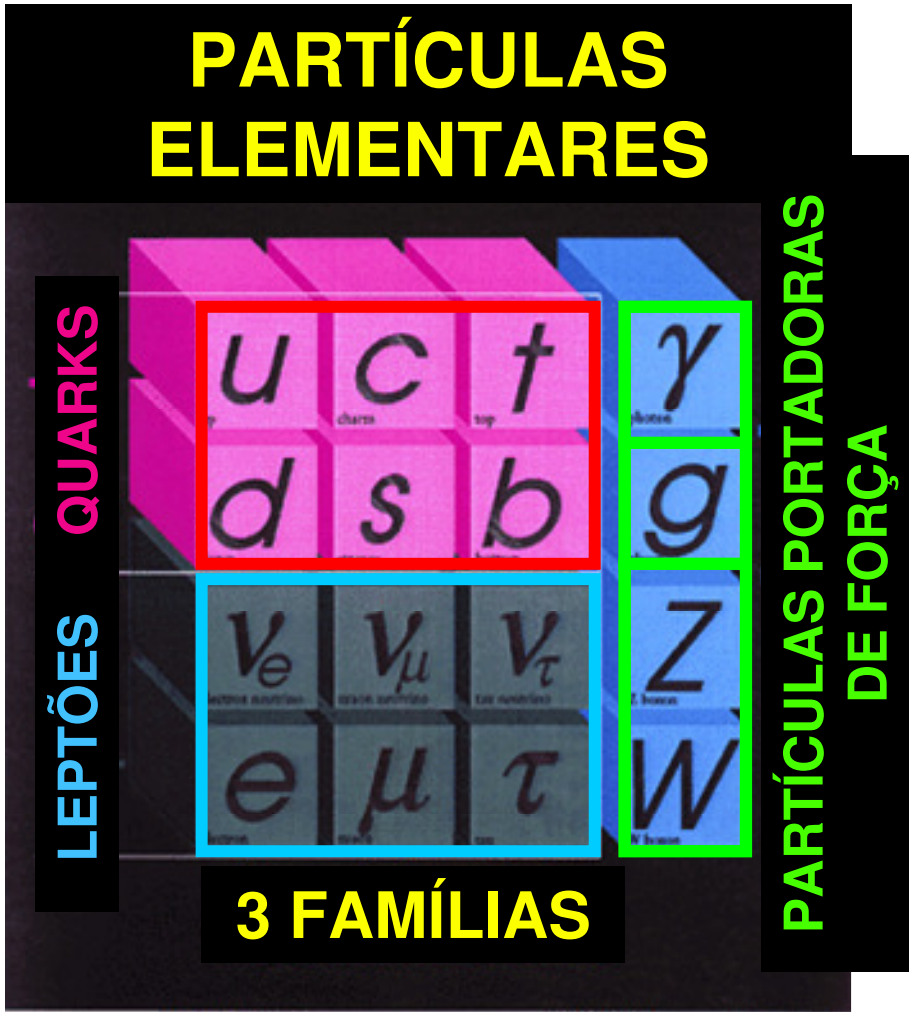
(Indivisíveis = elementares)

A matéria usual é formada por quarks *u* e *d*, e por *electrões*

Além disso, por cada partícula elementar há a sua antipartícula



MODELO STANDARD



INTERACÇÕES FUNDAMENTAIS

Fotão γ : Electromagnética

(quarks e leptões carregados)

Gluão g : Forte

(quarks)

W^+, W^-, Z^0: Fraco

(quarks e leptões)

partícula de Higgs

Ver o interior da matéria

Luz visível

Primeira radiografía da história.

Raio - X

Porque é queremos acelerar partículas a altas energias?

L. de Broglie (1924)

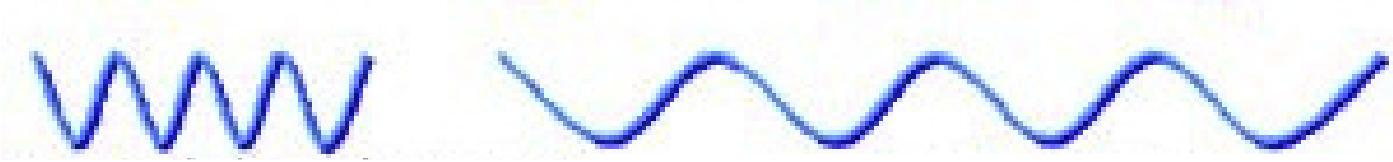
Equivalência ou dualidade onda-particula

$$E = h\,c / \lambda$$

$\Uparrow$ constante de Planck

$\Uparrow$ comprimento de onda

Quanto mais energia, mais pequeno é o comprimento de onda associado à partícula e poderemos ver estruturas mais pequenas (talvez o interior dos quarks?)



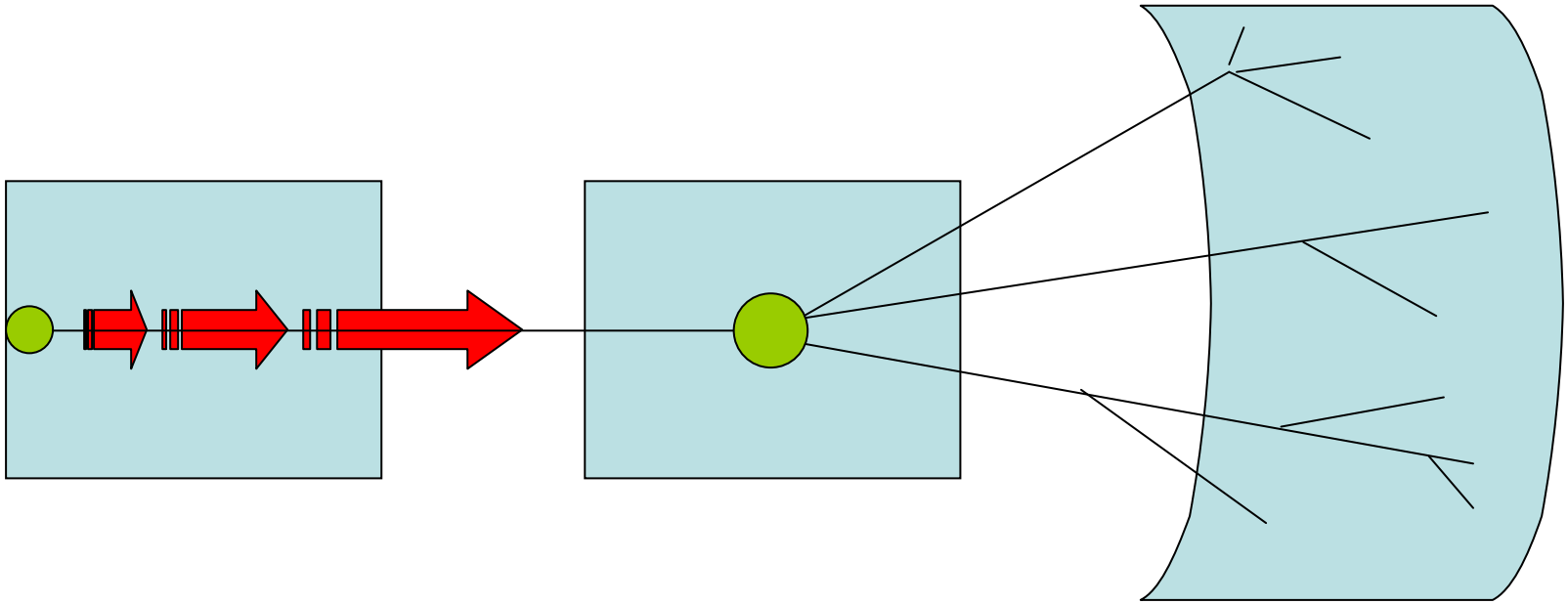
Comprimento de onda pequeno

Alta frequência

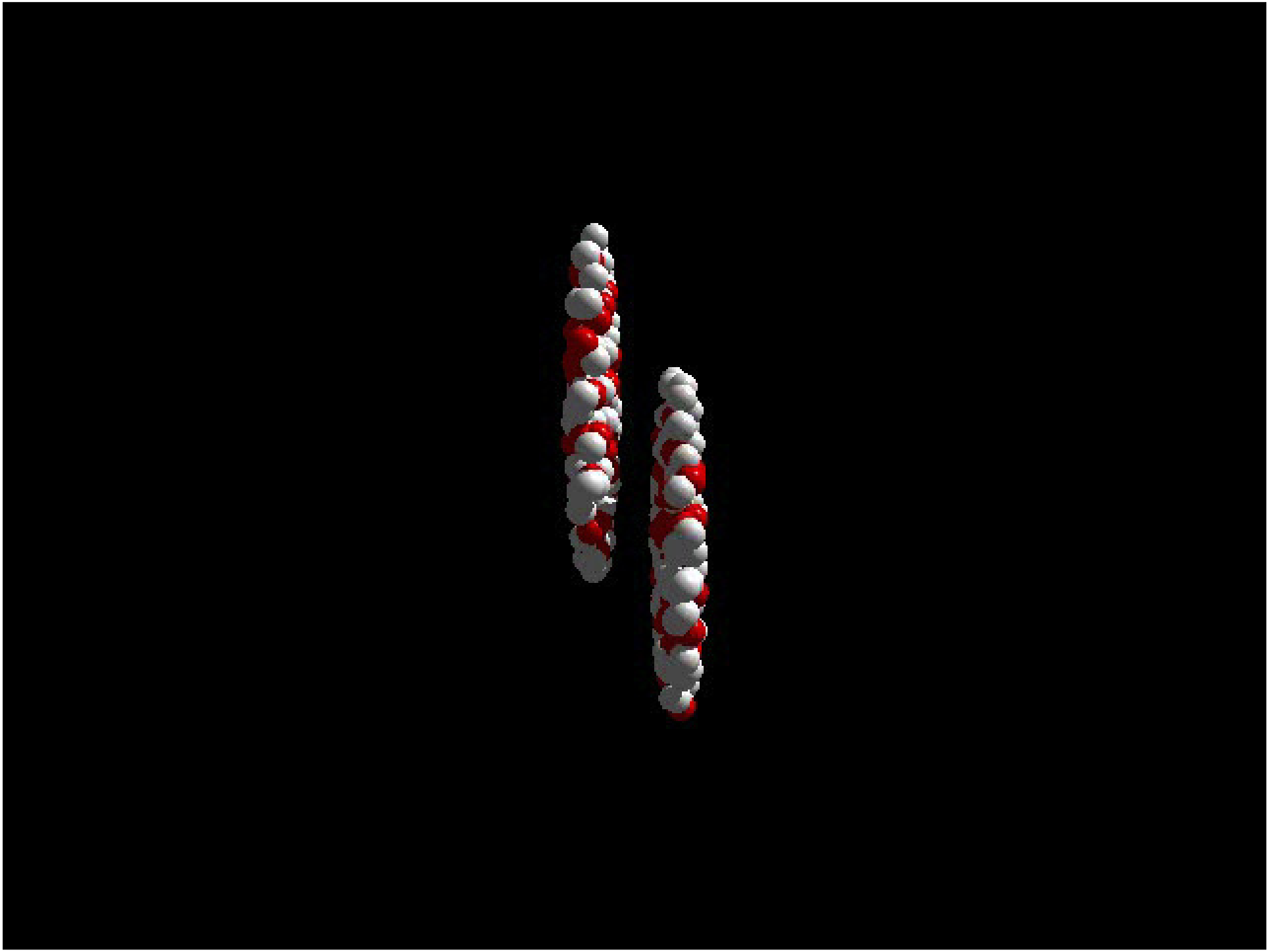
Comprimento de onda grande

Baixa frequência

ESQUEMA GERAL



ACELERAR COLIDIR DETECTAR

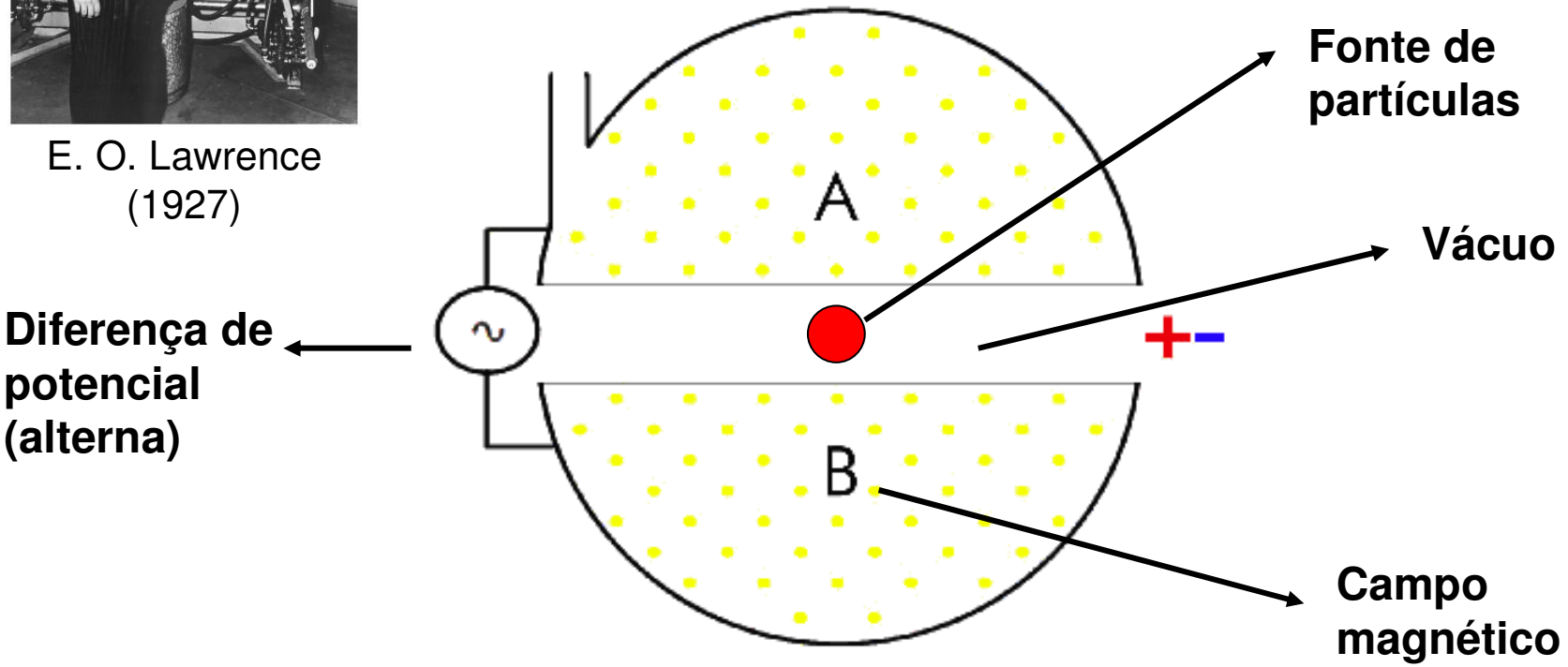


Aceleradores circulares

E. O. Lawrence
(1927)

O ciclotrão

(Utilizam-se hoje em dia nos hospitais)



Fonte de partículas

Vácuo

Diferença de potencial (alterna)

Campo magnético constante dirigido "para cima"

Em cada volta a partícula adquere energia. A energia máxima está limitada pelo tamanho do ciclotrão.

LHC – Large Hadron Collider

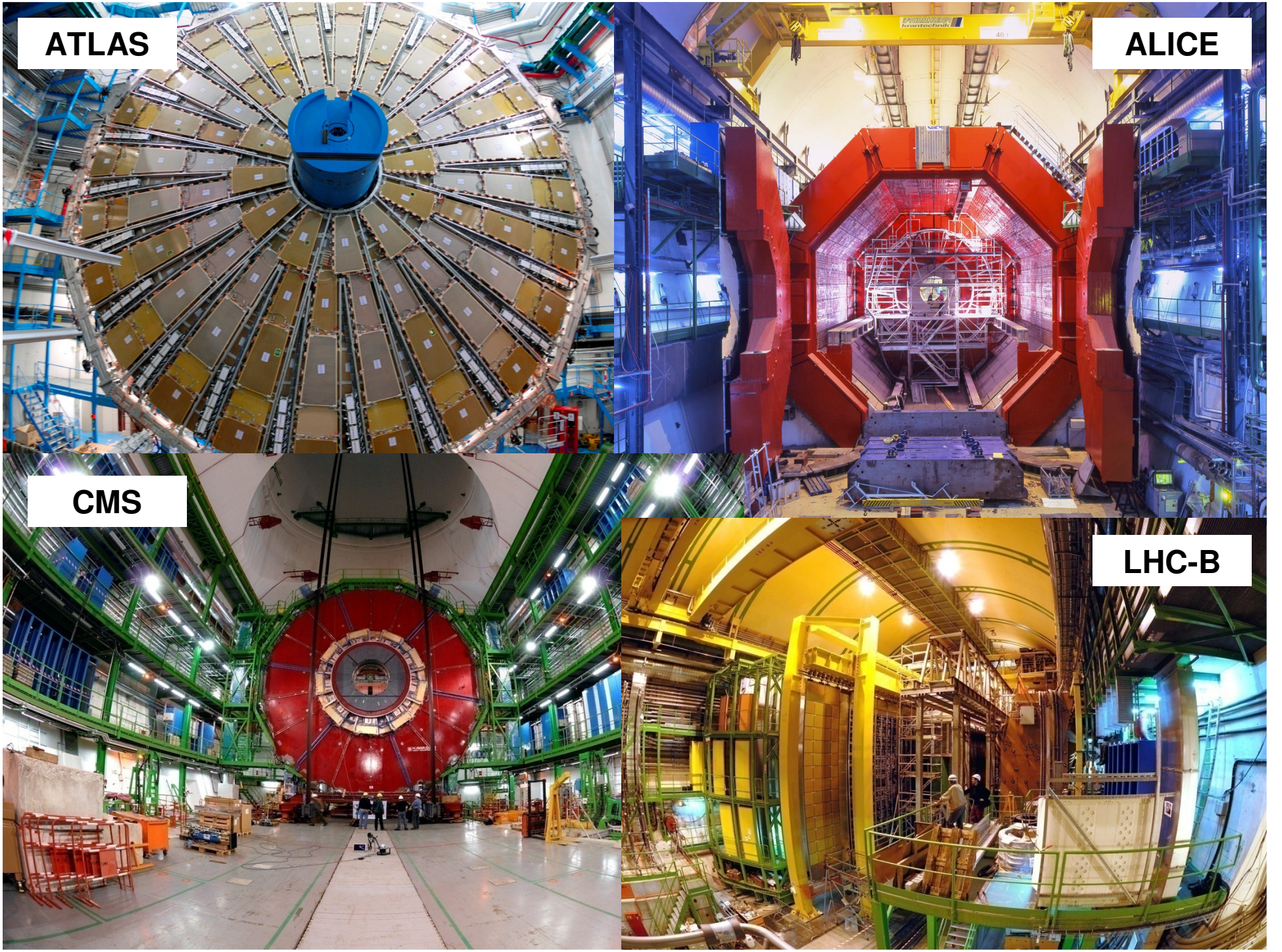
O túnel do LHC

Vários milhares de imans superconductores a baixa temperatura

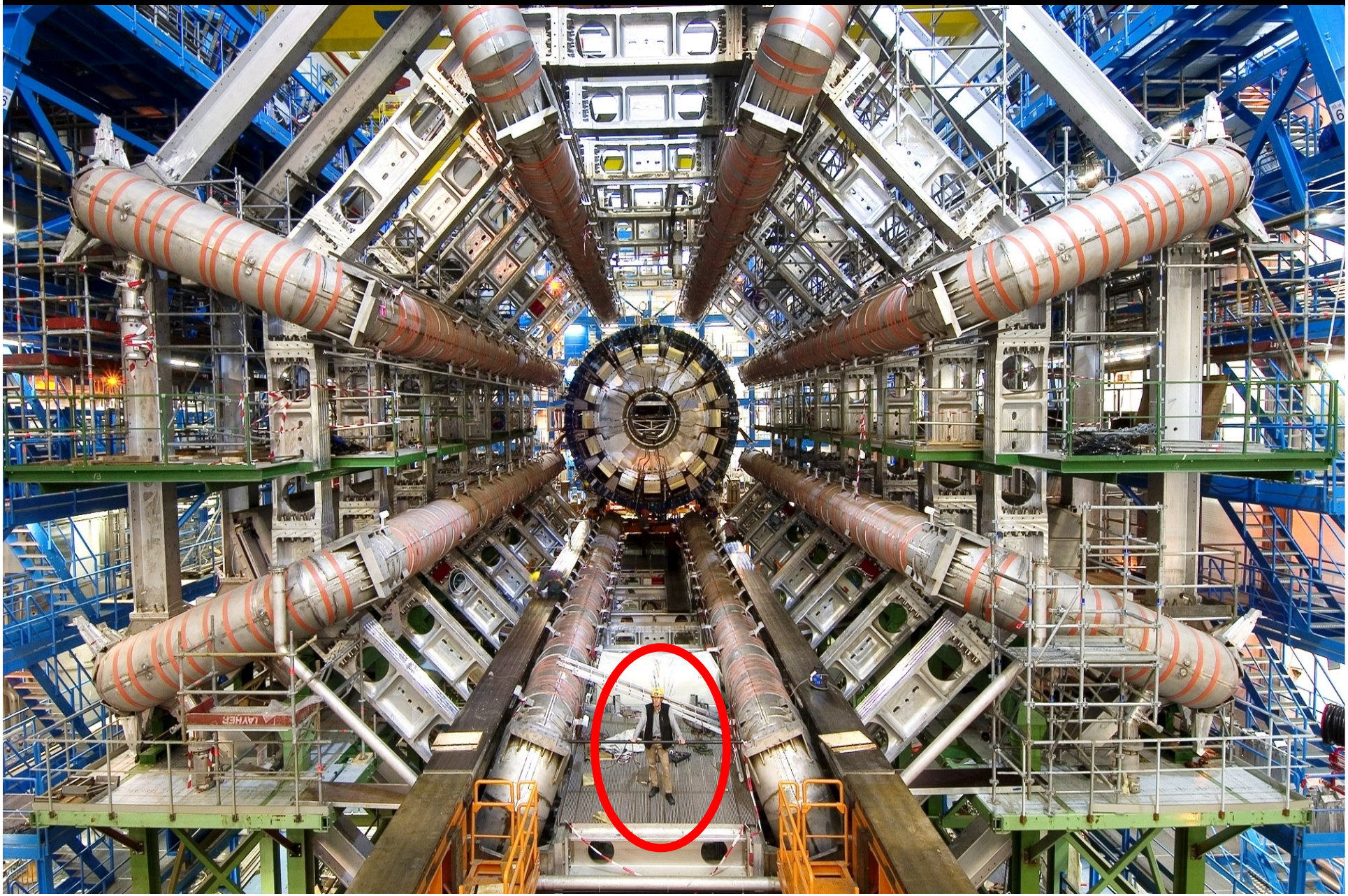
A temperatura é aprox. -271.3 ºC **Talvez o lugar mais frio do Universo !!!**

Os protões, deslocam-se quase à velocidade da luz (300.000 km/s)

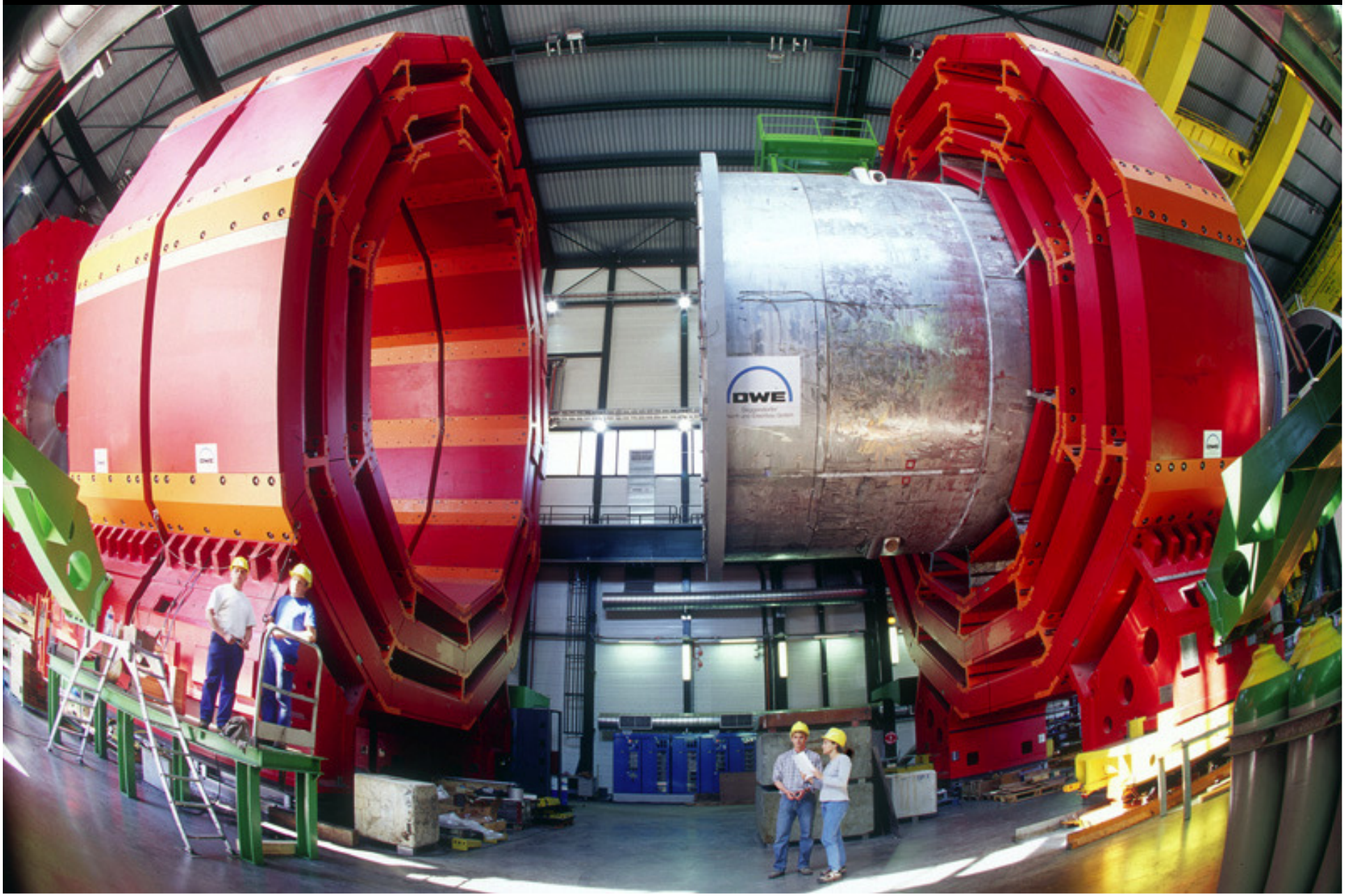
Dão mais de 10.000 voltas por segundo !!!


ATLAS
ALICE
CMS
LHC-B

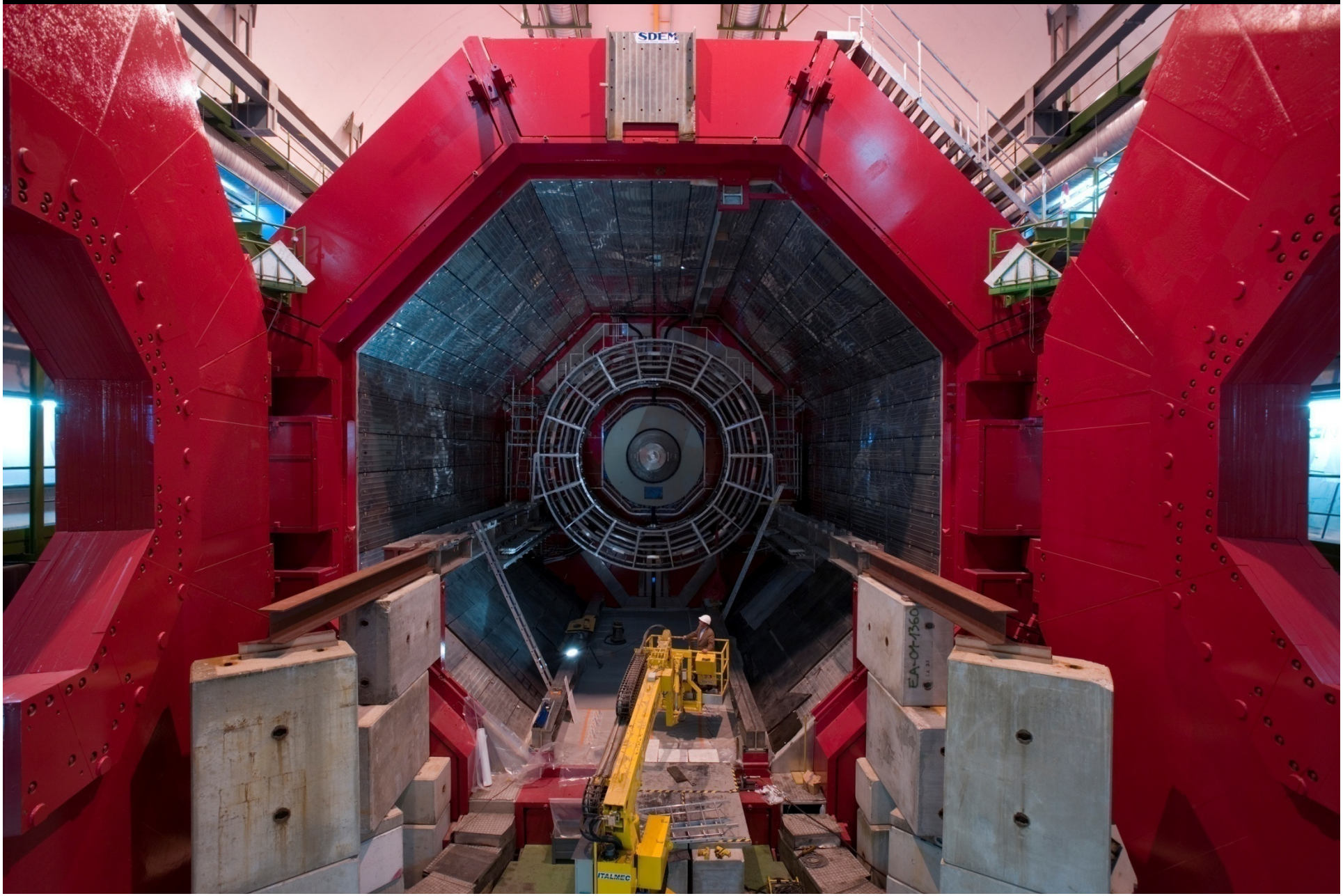
ATLAS



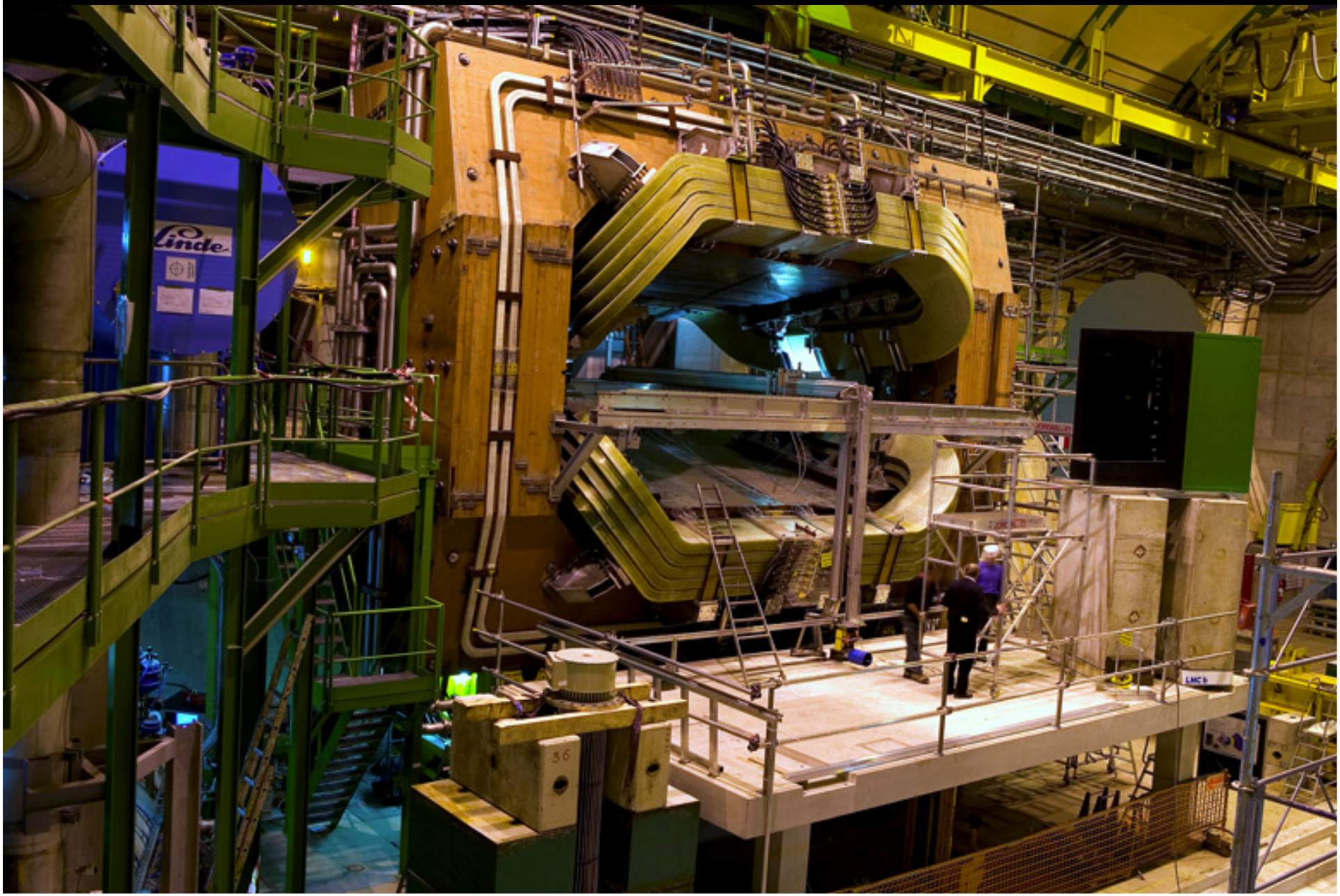
CMS

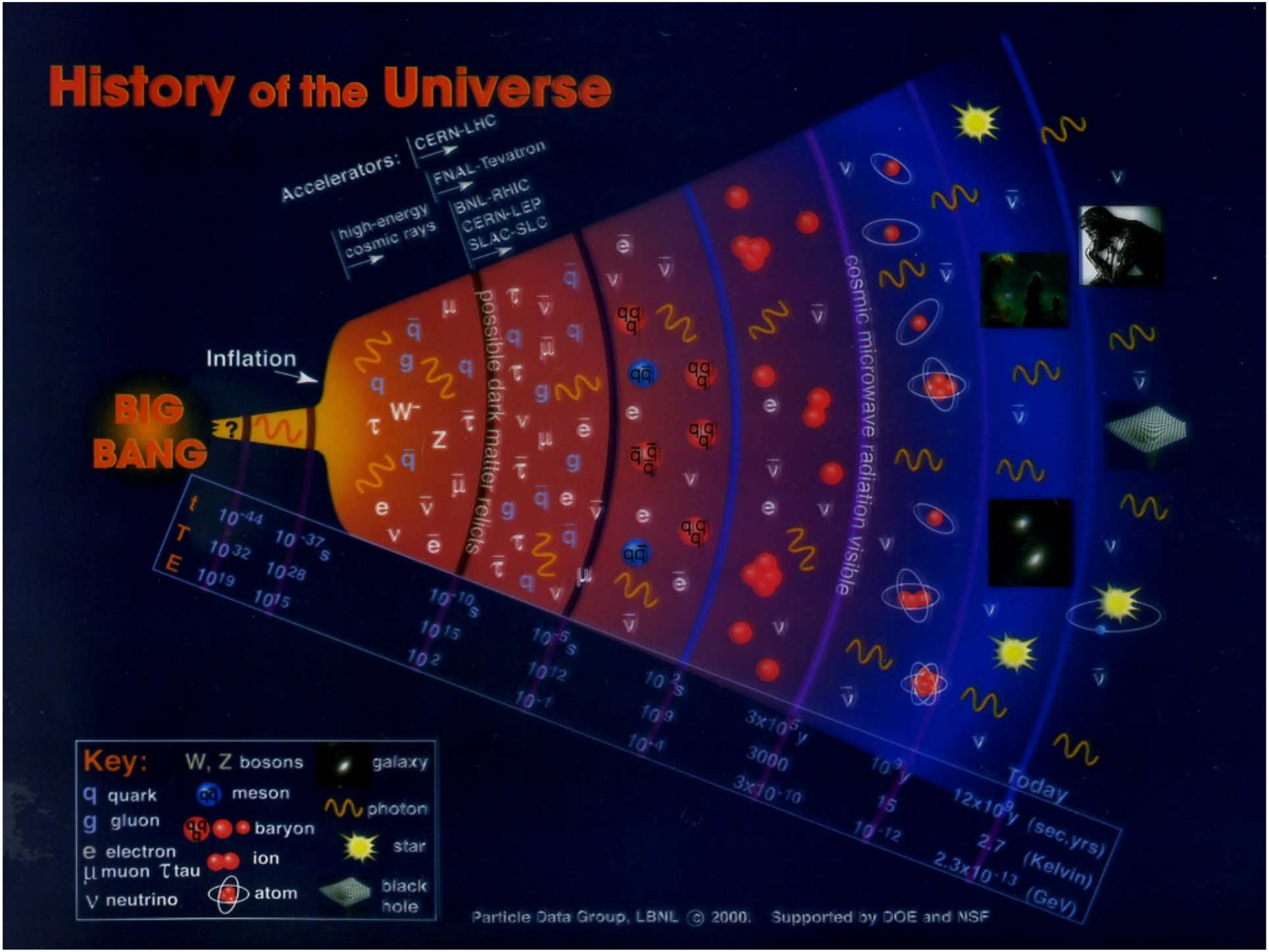


ALICE



LHC-B

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Today
Key:
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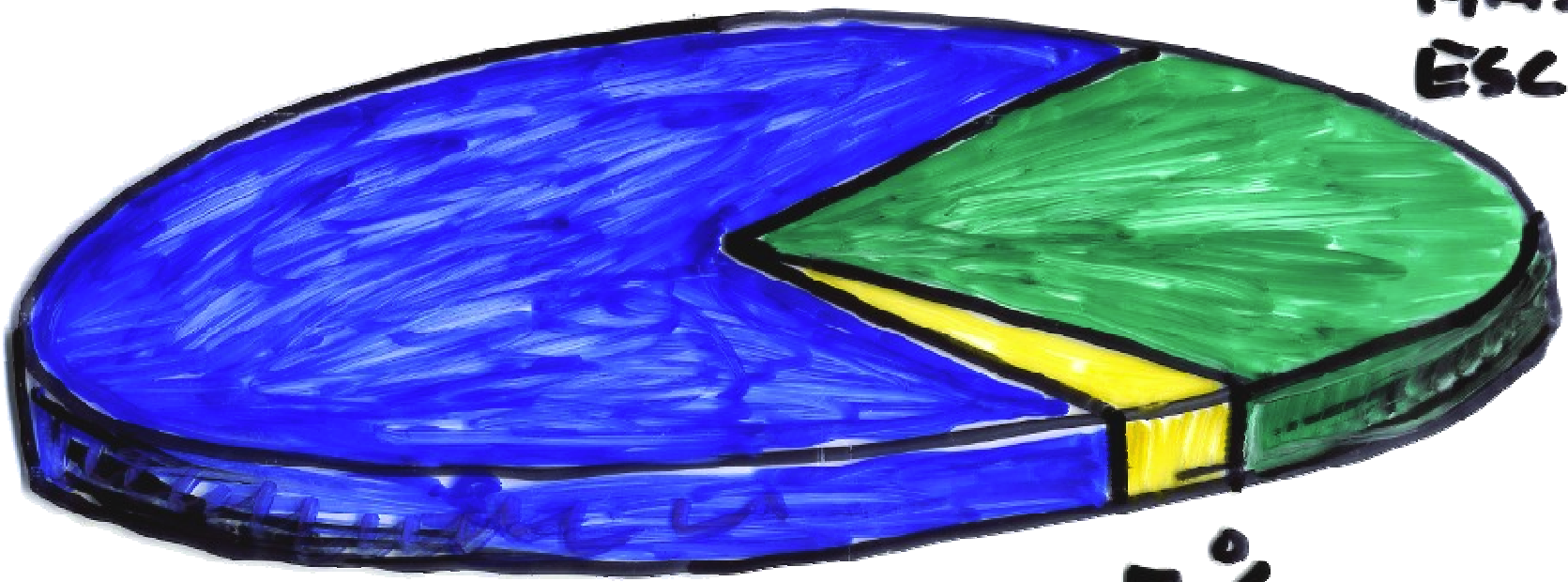
Particle Data Group, LBNL © 2000. Supported by DOE and NSF



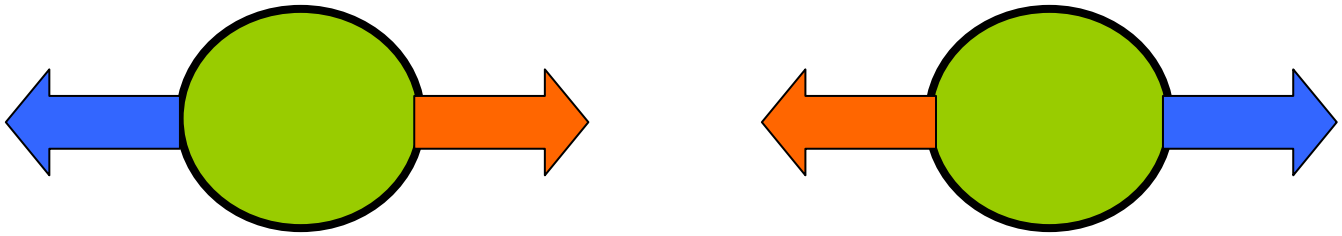
25% MASSA ESCURA

70% ENERGIA ESCURA

5% MASSA/ENERGIA NORMALS

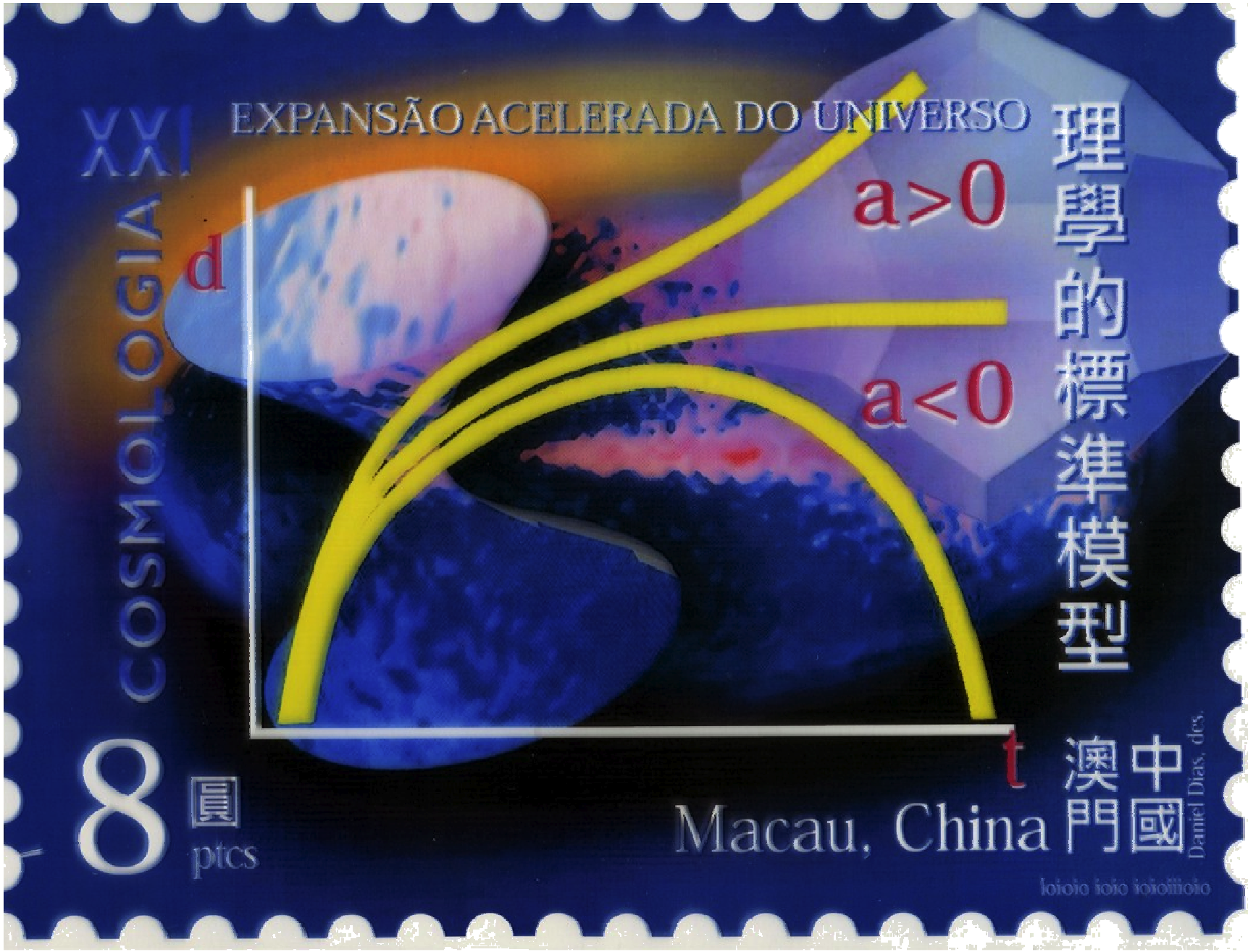
IDEIA DE EINSTEIN...

UNIVERSO ESTÁTICO (1920's)



CONSTANTE COSMOLÓGICA


FOI O MAIOR ERRO
DA MINHA VIDA


XXI COSMOLOGIA
EXPANSÃO ACELERADA DO UNIVERSO
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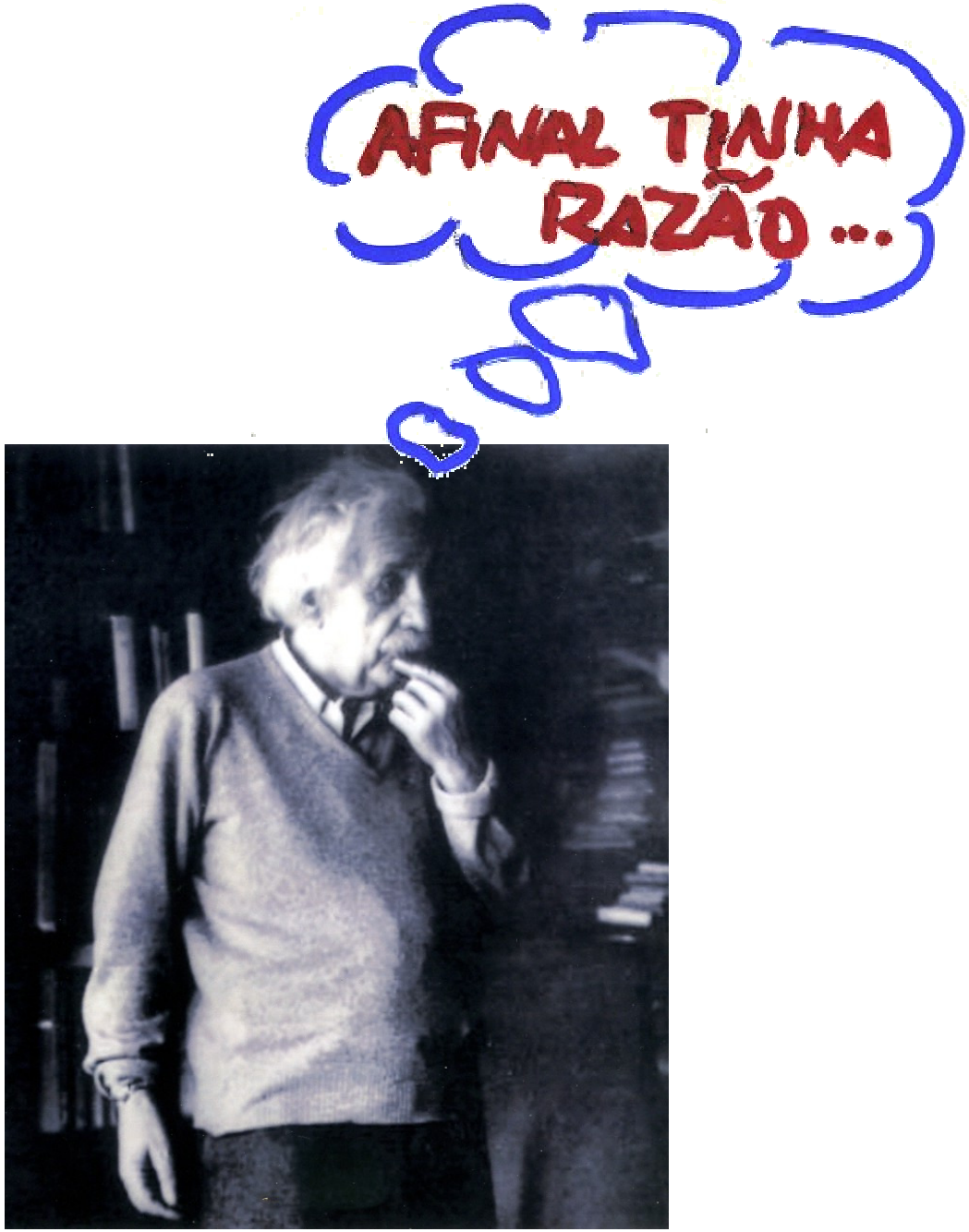
Daniel Dias, des.


AFINAL TINHA
RAZÃO...