Projekt
Brána do vesmíru

Hvězdárna Valašské Meziříčí, p. o.
Krajská hvezdáreň v Žiline

HVĚZDÁRNA · VALAŠSKÉ · MEZIŘÍČÍ

PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
2007 2013
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA

EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC

KRAJSKÁ HVEZDÁREŇ

Zlínský kraj

ŽILINSKÝ samosprávny kraj

Udělení Nobelovy ceny za fyziku pro rok 2013 aneb Higgsův boson žije

Petr Kulhánek

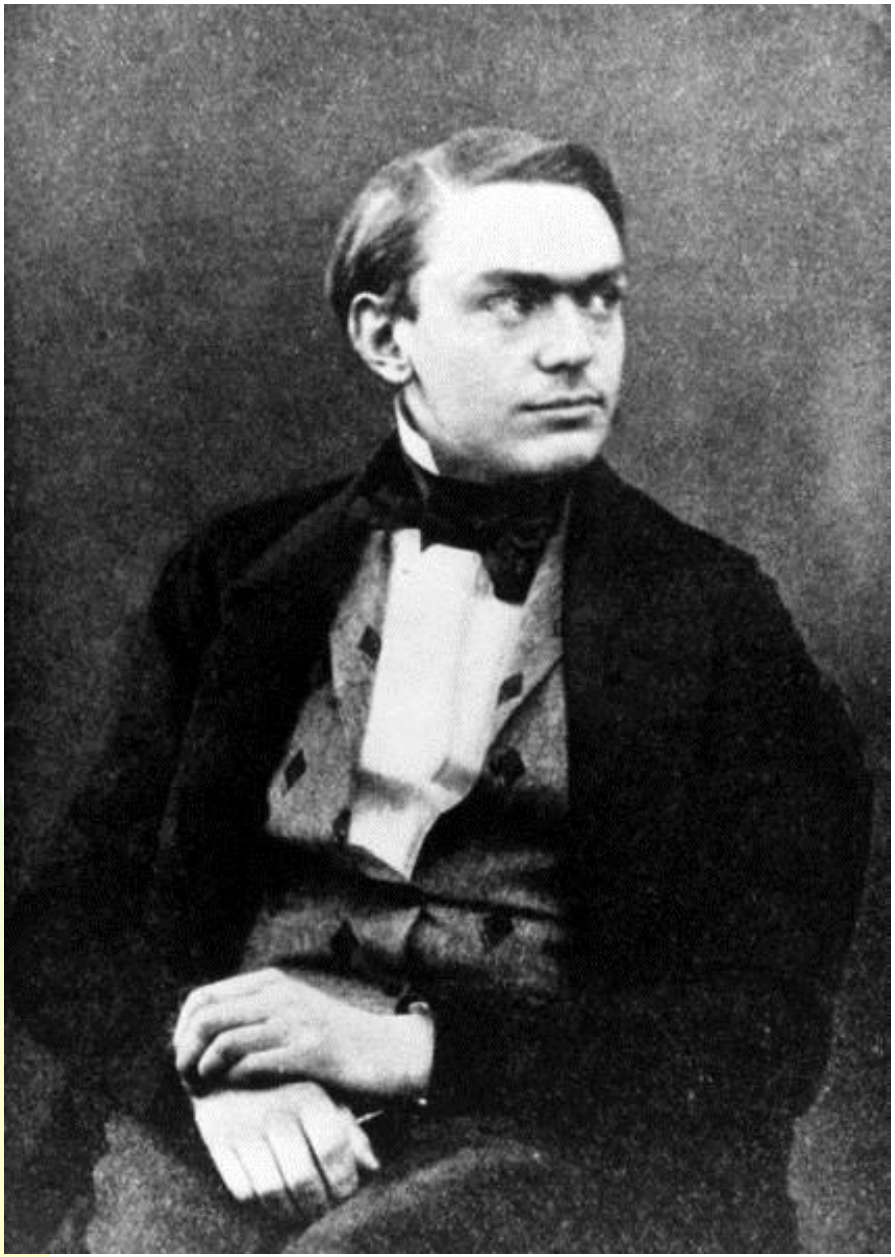
České vysoké učení technické v Praze
Aldebaran Group for Astrophysics
Hvězdárna a planetárium hl. m. Prahy

kulhanek@aldebaran.cz,
www.aldebaran.cz

Nobelova cena

Alfréd Bernhard Nobel (1833–1896)

- narozen ve Švédsku
- studia v Paříži a USA
- tragédie s nitroglycerinem
- umírá jeho mladší bratr
- zkouší bezpečnou výrobu
- loď na jezeře Mälaren
- vynalézá dynamit
- vynalézá rozbušku
- 355 patentů
- 90 továren ve 20 státech

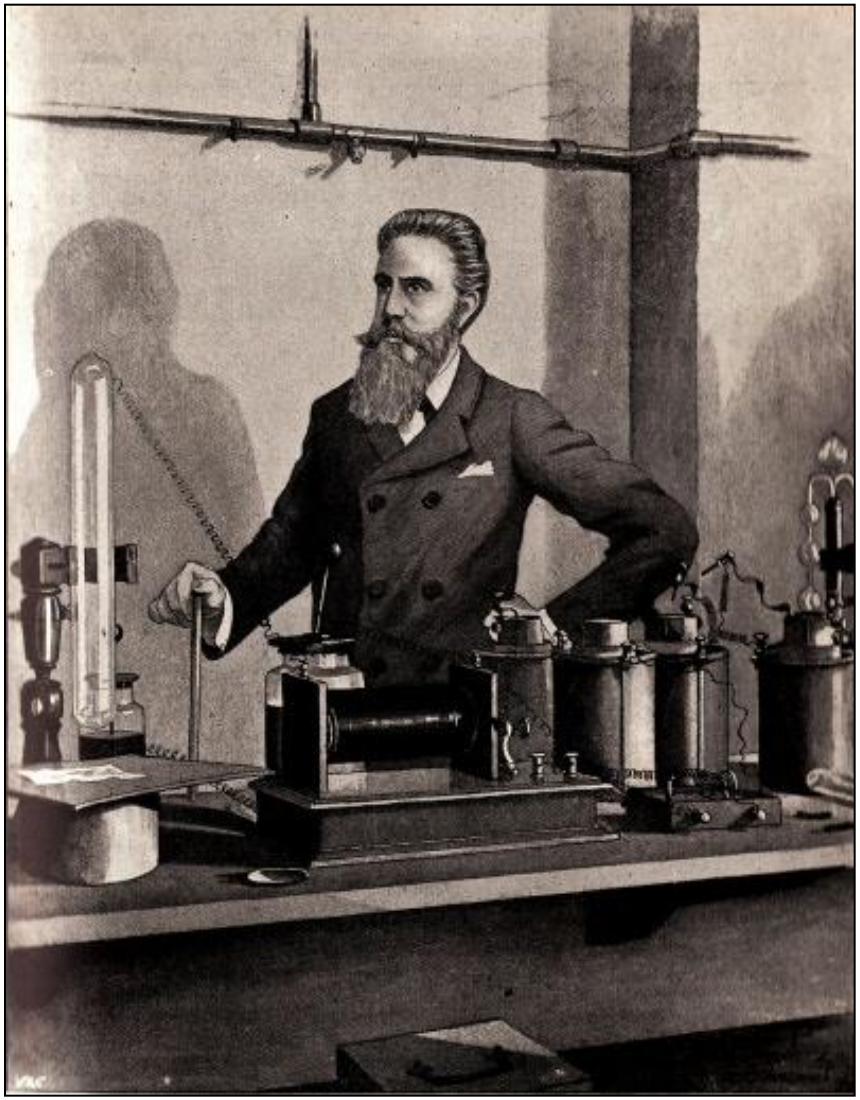


Nobelova cena

- 10 milionů švédských korun
- 25 milionů Kč
- vypláceno z úroků
- Nobelova nadace (1895)
- Švédská královská akademie

- fyzika
- chemie
- fyziologie a medicína
- literatura
- úsilí o mír

První udělená cena: 1901



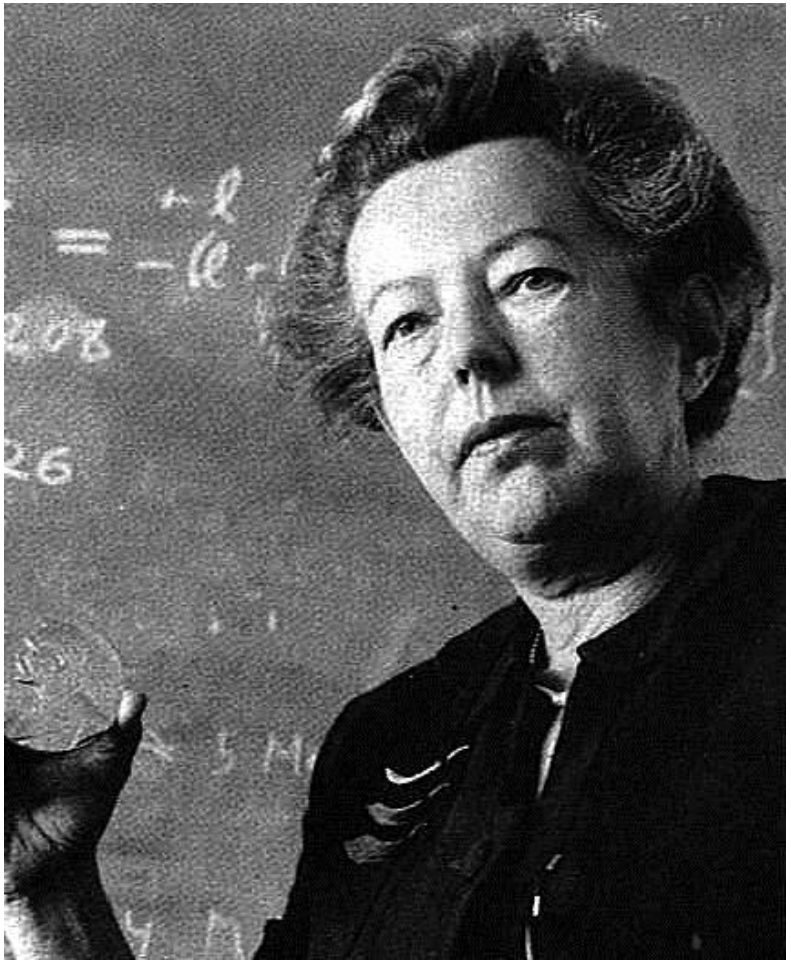
Wilhelm Conrad Röntgen (1845–1923)

Celkové počty

- uděleno 107 Nobelových cen
- oceněno 196 fyziků
- 47 cen jednomu jedinému vědci
- průměrný věk oceněných je 55 let

Nobelovy ceny za fyziku ženám

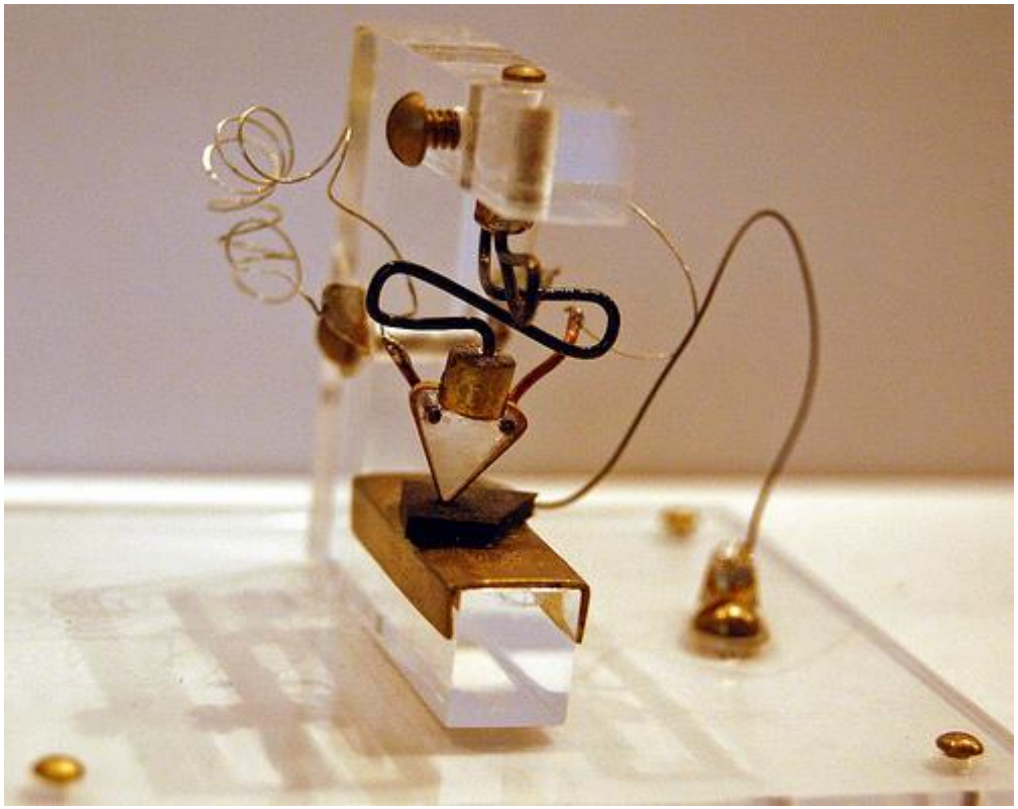
Marie Curie Skłodowska (1867–1934)
NC 1903: objev radioaktivity
NC 1911: za chemii



Maria Goeppert Mayer (1906–1972)
NC 1963: objev slupkové struktury jádra

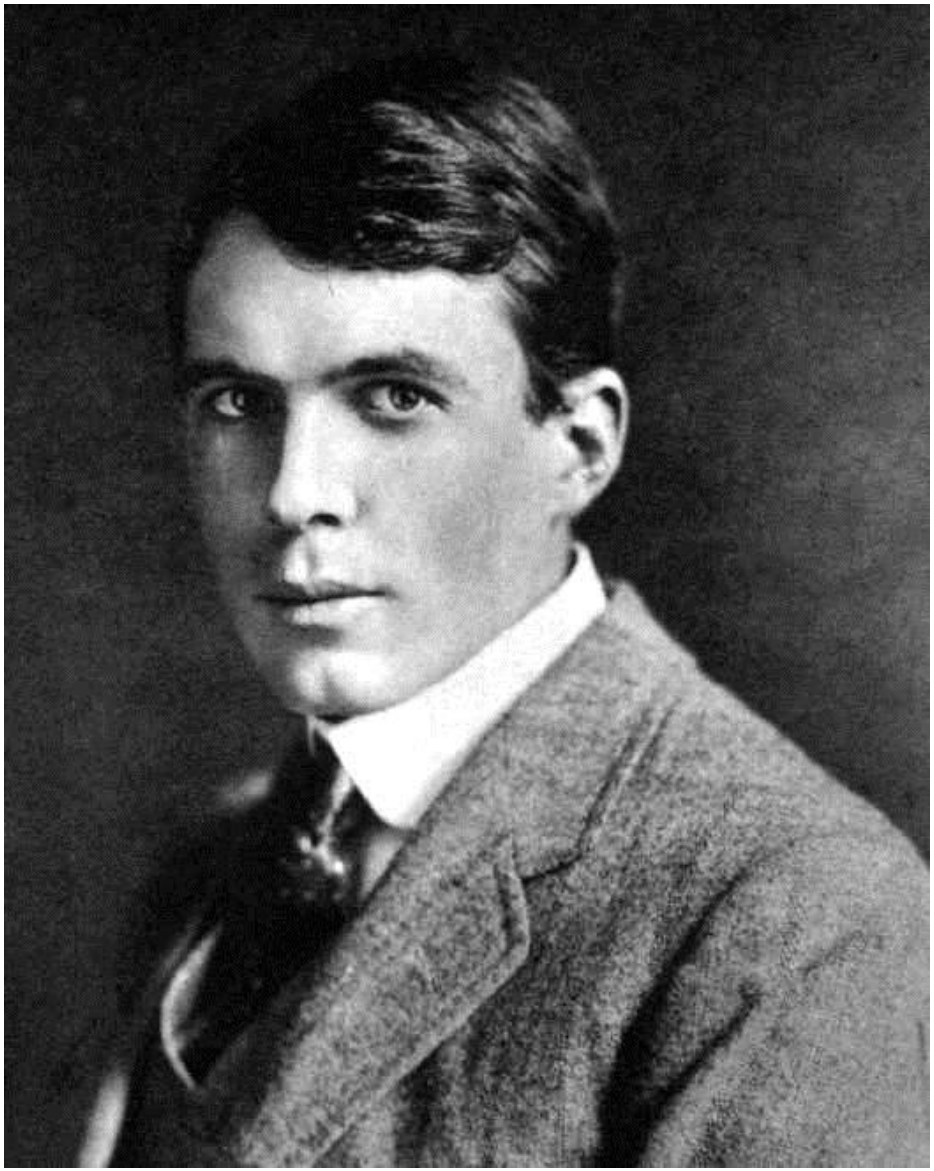
Nobelova cena za fyziku nadvakrát

John Bardeen (1908–1991)

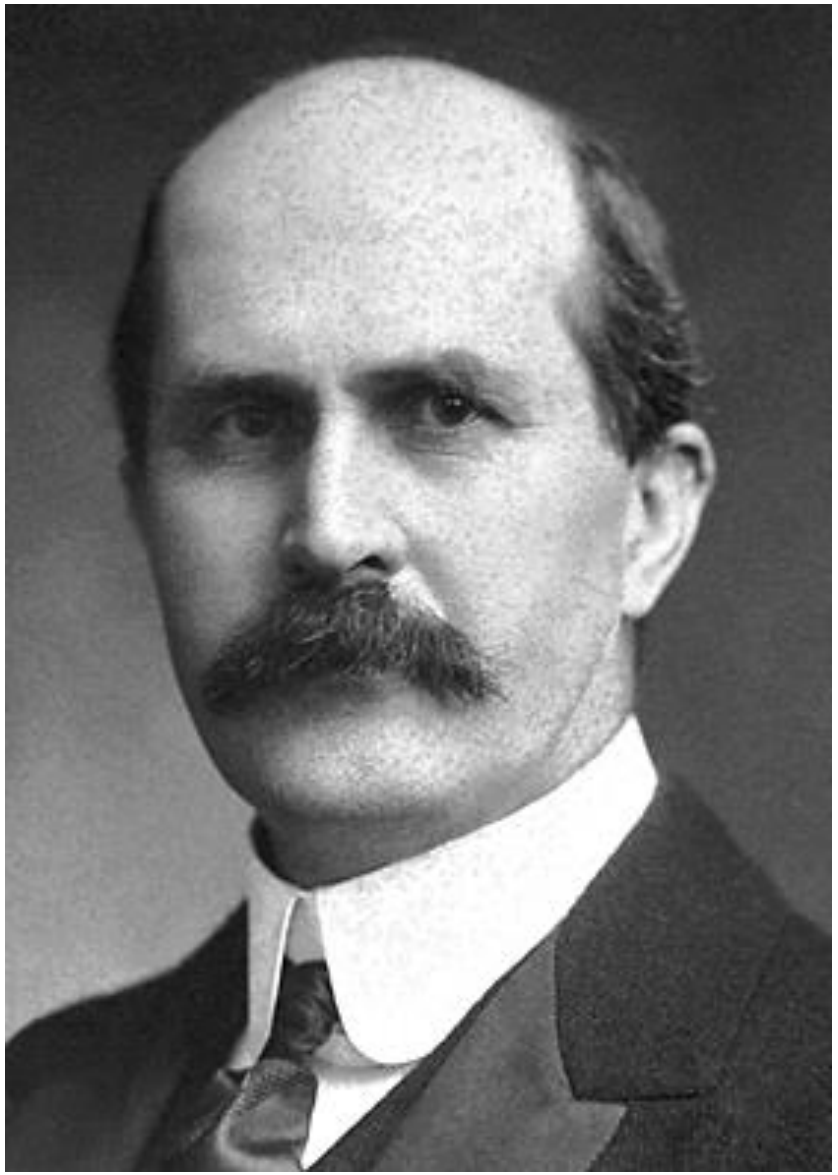


NC 1956: objev tranzistoru, NC 1972: teorie supravodivosti

Nejmladší nositel – výzkum krystalů pomocí RTG



Lawrence Bragg (1890–1971)
NC 1915



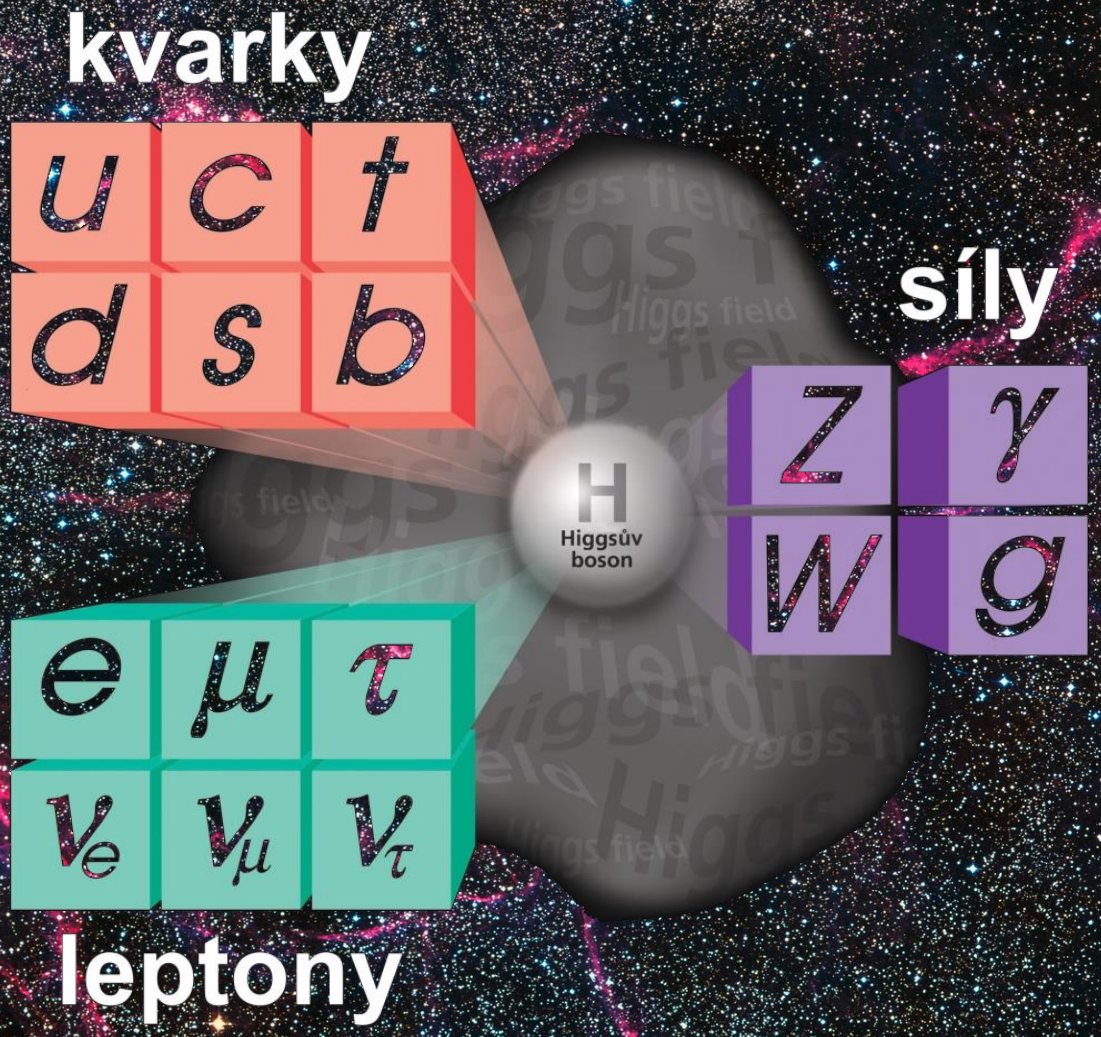
William Henry Bragg (1862–1942)
NC 1915

Léta bez ceny

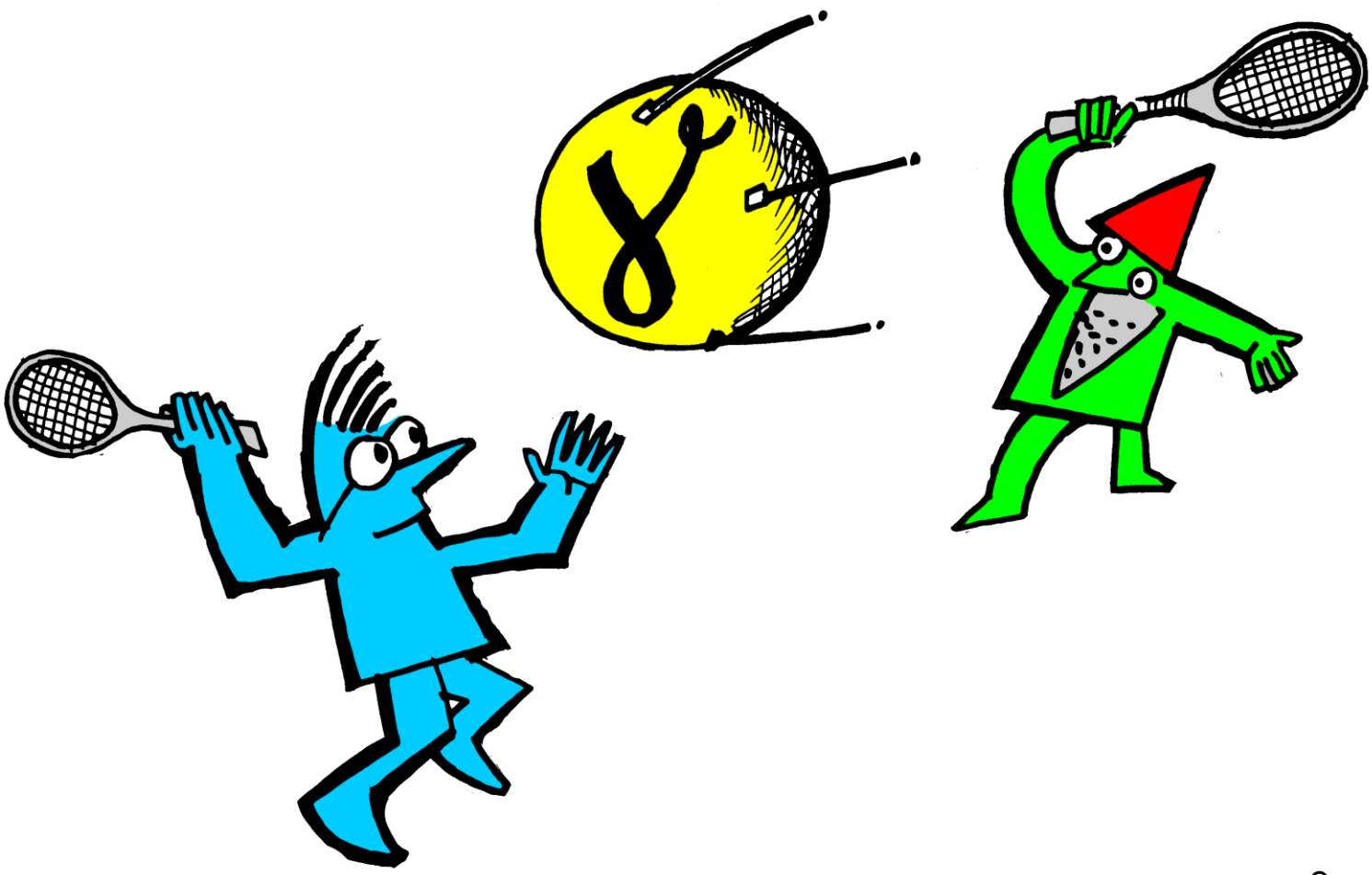
1916, 1931, 1934, 1940, 1941 a 1942

Standardní model

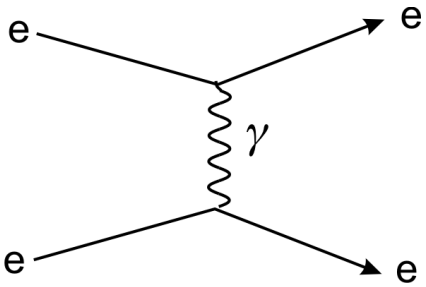
Standardní model



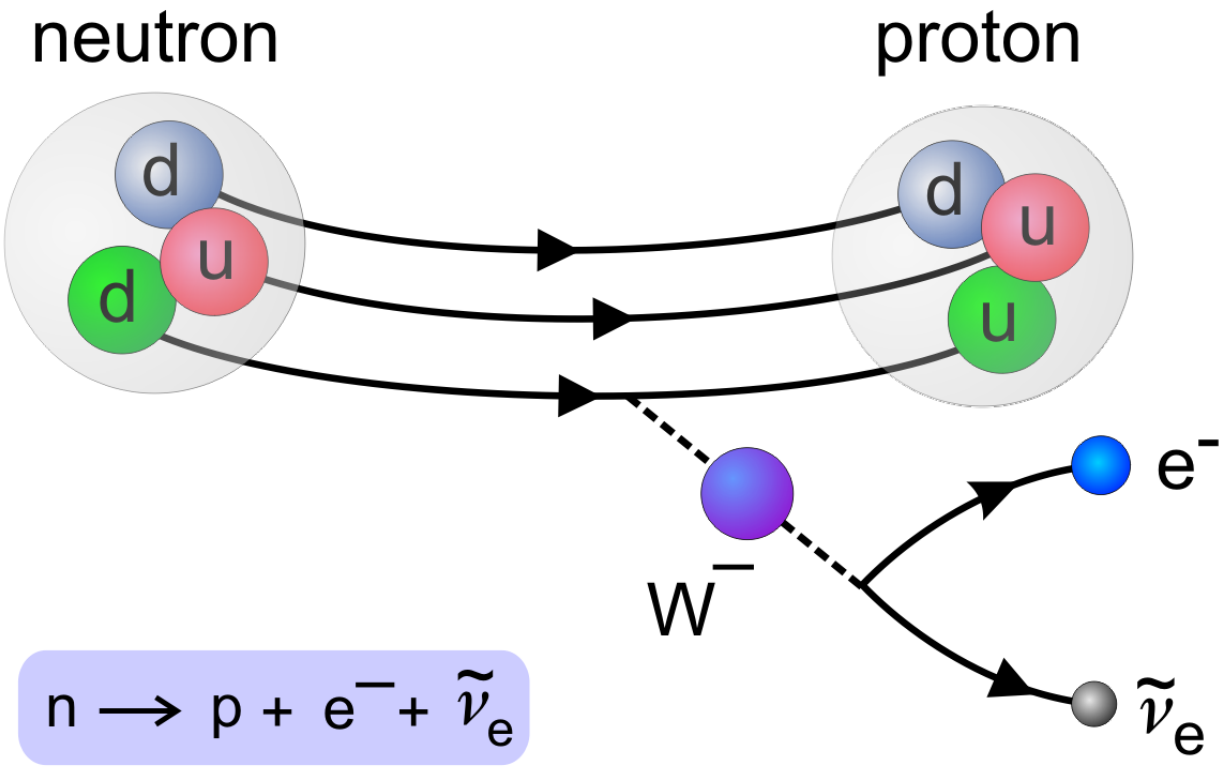
Elektromagnetická interakce



- na nabité částice
- nekonečný dosah
- U(1)loc symetrie



Slabá interakce



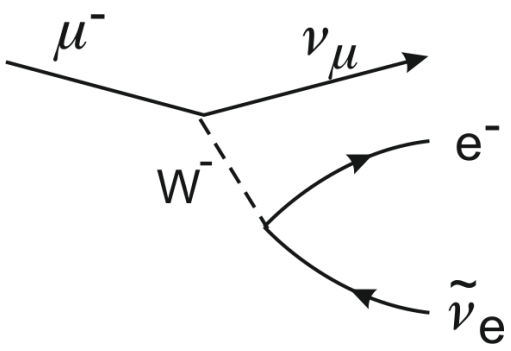
$n \longrightarrow p + e^{-} + \tilde{\nu}_e$

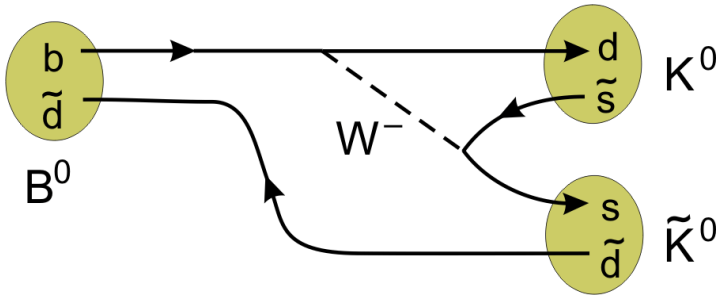
Slabá interakce

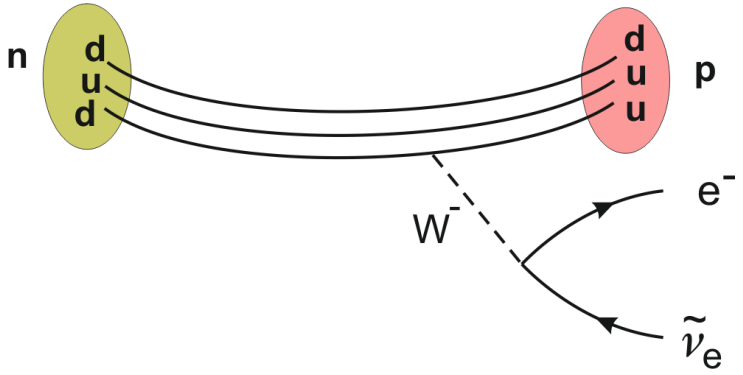
- na leptony a kvarky
- konečný dosah
- SU(2) symetrie

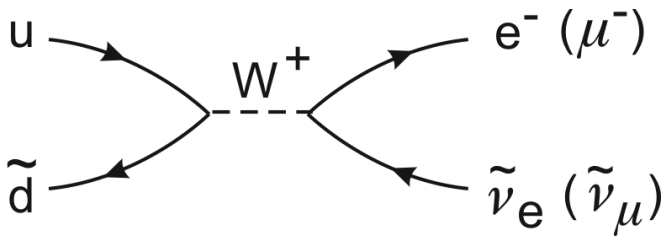
$$\begin{pmatrix} e^- \\ \nu_e \end{pmatrix} \quad \begin{pmatrix} \mu^- \\ \nu_\mu \end{pmatrix} \quad \begin{pmatrix} \tau^- \\ \nu_\tau \end{pmatrix}$$

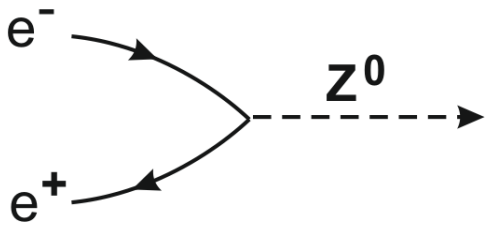
$$\begin{pmatrix} d \\ u \end{pmatrix} \quad \begin{pmatrix} s \\ c \end{pmatrix} \quad \begin{pmatrix} b \\ t \end{pmatrix}$$





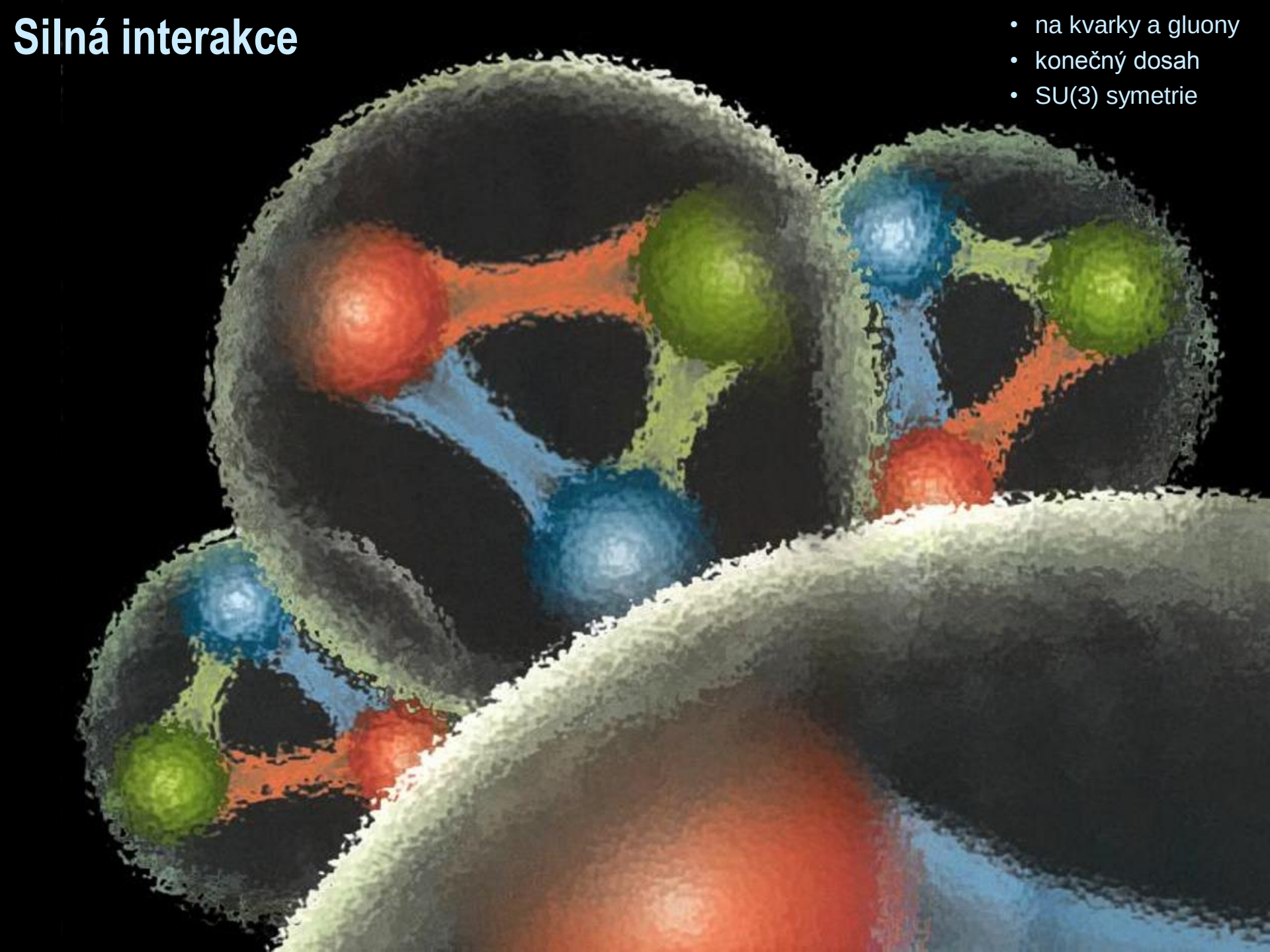






Silná interakce

- na kvarky a gluony
- konečný dosah
- SU(3) symetrie

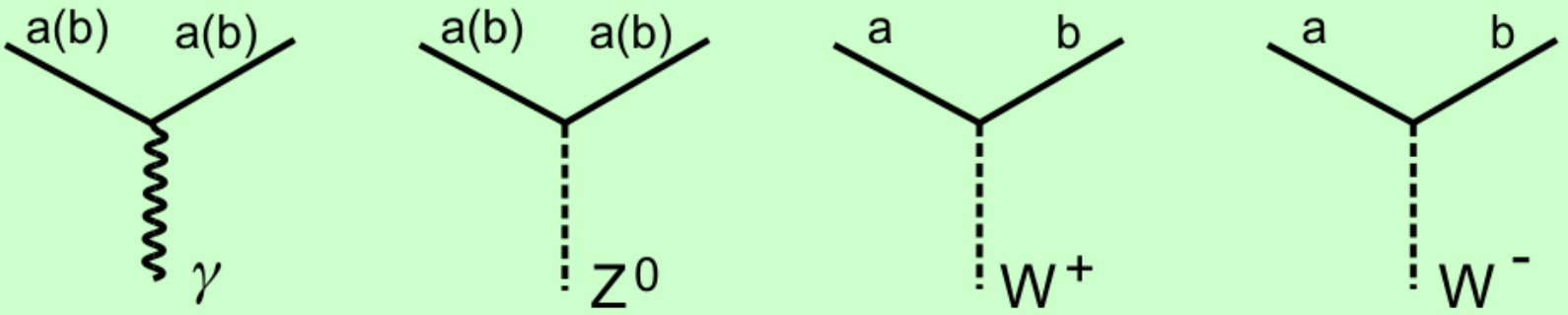


Elektroslabá inetrakce?

$$\begin{pmatrix} e^- \\ \nu_e \end{pmatrix} \quad \begin{pmatrix} \mu^- \\ \nu_\mu \end{pmatrix} \quad \begin{pmatrix} \tau^- \\ \nu_\tau \end{pmatrix}$$

$$\begin{pmatrix} d \\ u \end{pmatrix} \quad \begin{pmatrix} s \\ c \end{pmatrix} \quad \begin{pmatrix} b \\ t \end{pmatrix}$$

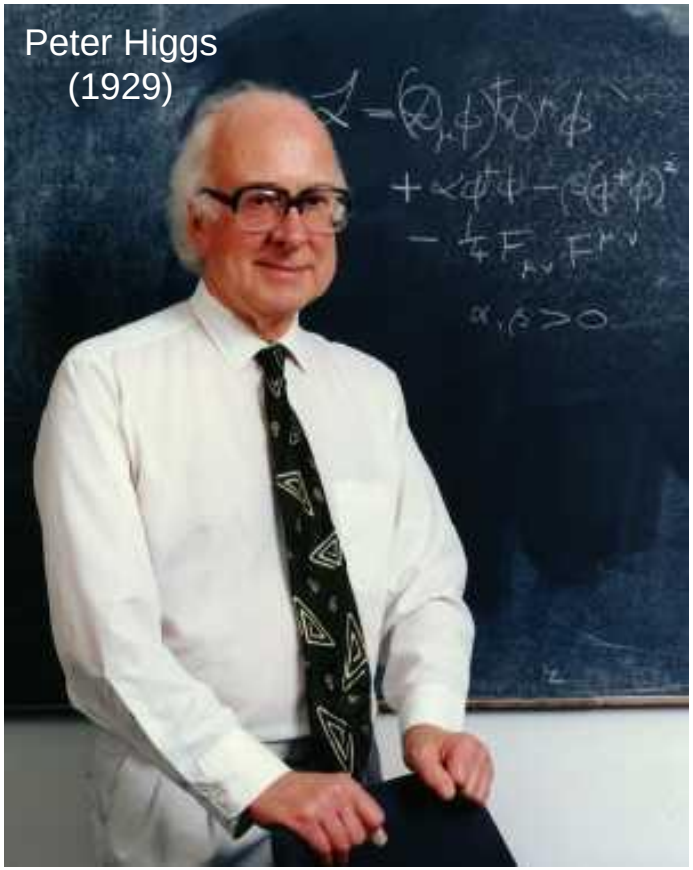
DIAGRAMY ELEKTROSLABÉ INTERAKCE $\begin{pmatrix} a \\ b \end{pmatrix}$



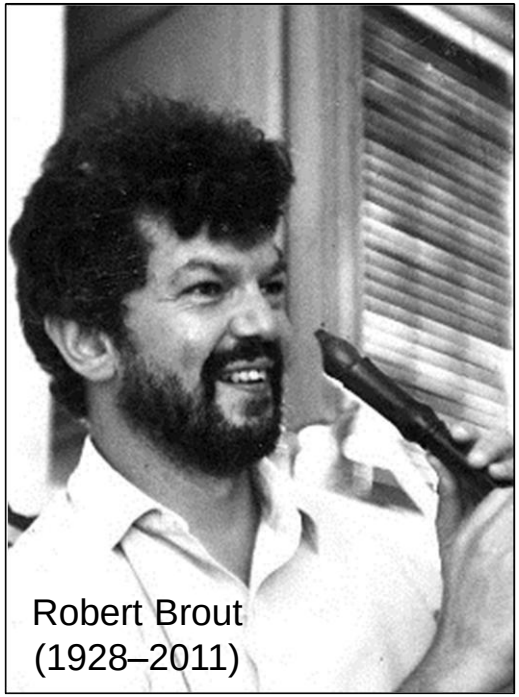
Higgsův mechanizmus (1964)

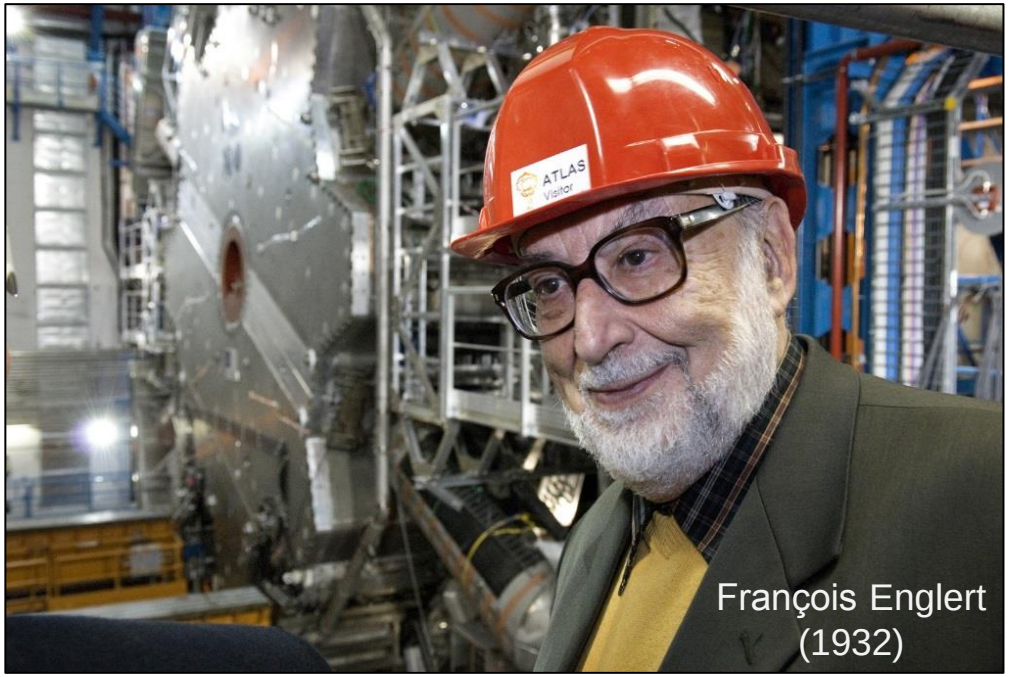
Higgsovy částice

- Částice v elektroslabé interakci, které zajišťují nenulovou hmotnost polních částic slabé interakce. Částice jsou pojmenovány podle skotského fyzika Petera Higgse.
- Nezávisle obdobný mechanizmus navrhnuli belgičtí teoretici Francois Englert a Robert Brout.
- Třetí skupina: Gerald Guralnik, Richard Hagen, Tom Kibble



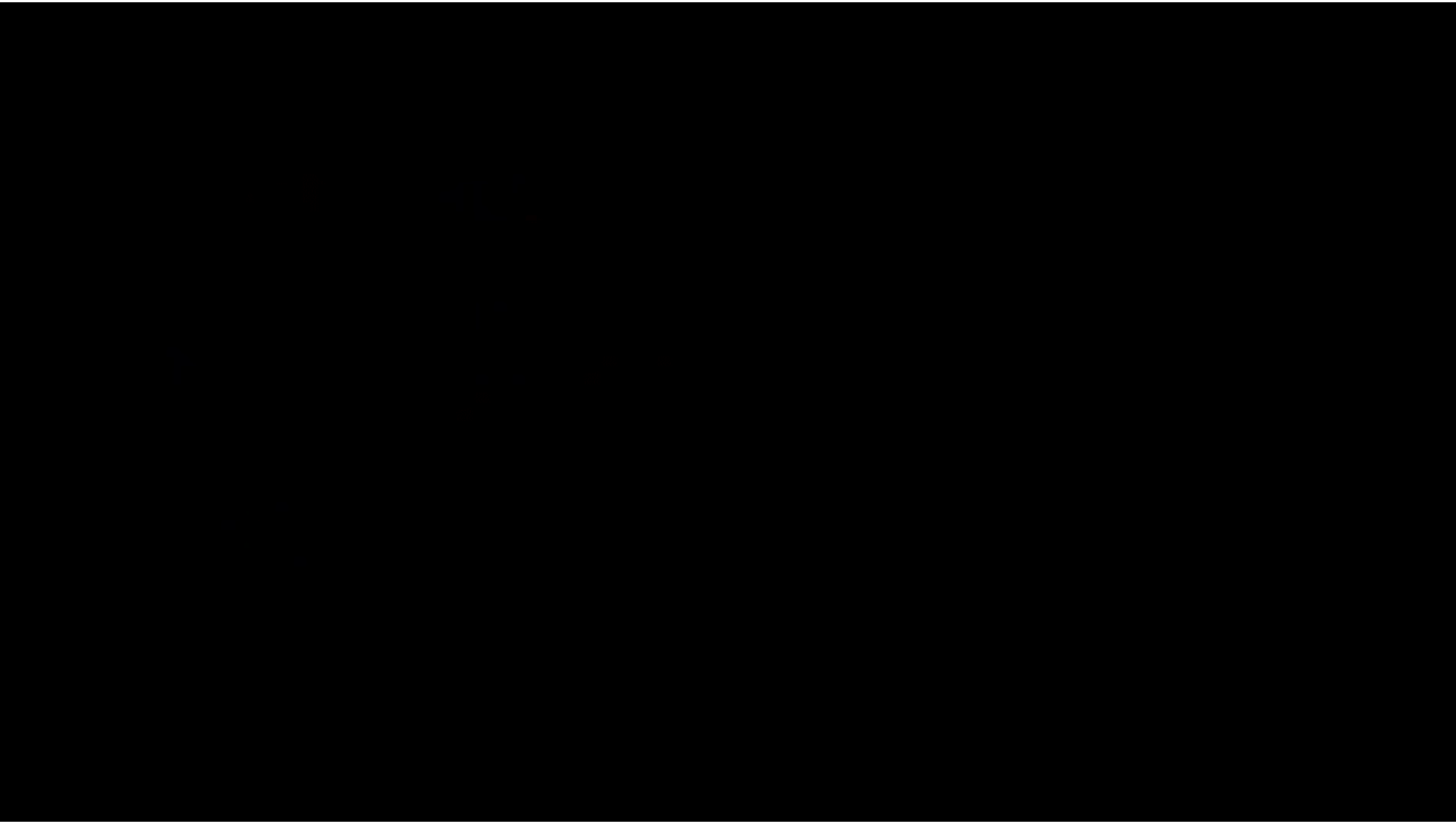
Gerald Guralnik,
Richard Hagen,
Tom Kibble





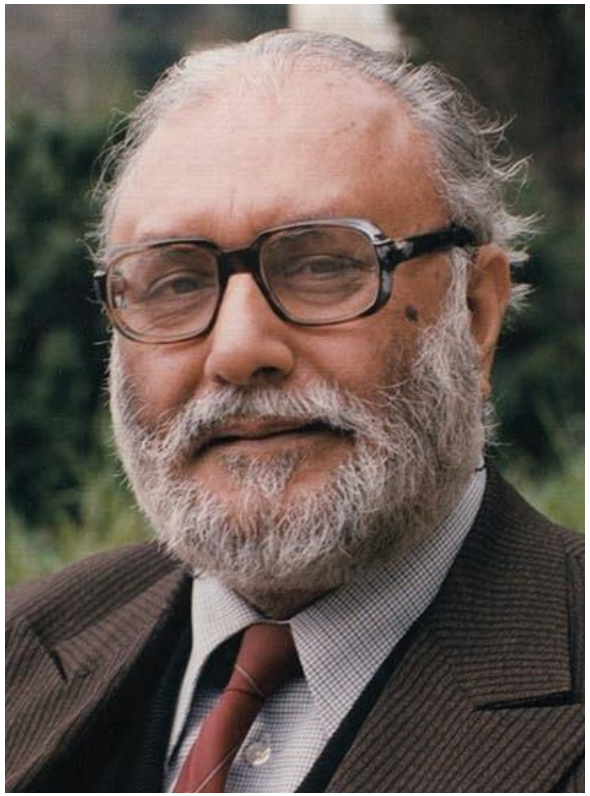
Příběh o výběrčím daní (1993)

Příběh o výběrčím daní (1993)

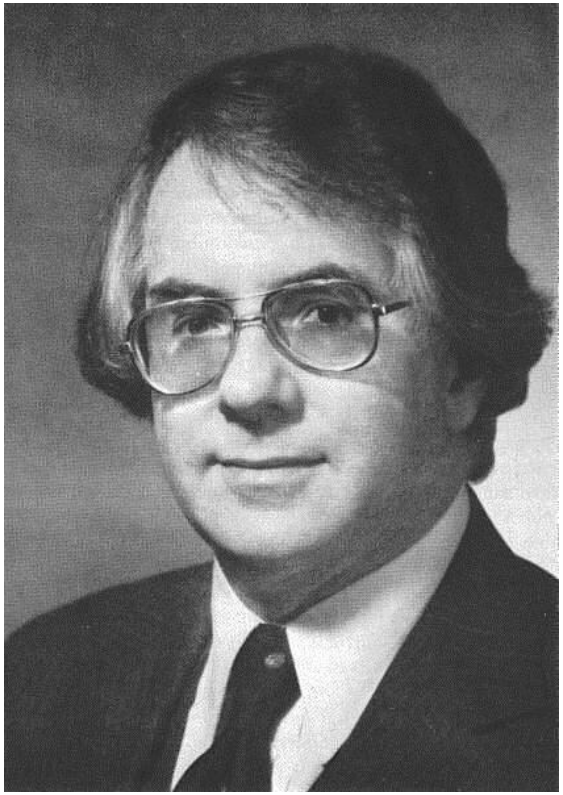


Elektroslabé sjednocení

Steven Weinberg



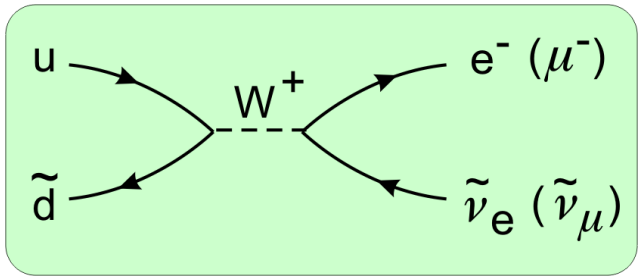
Abdus Salam



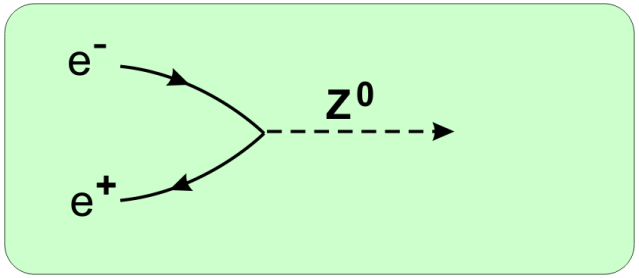
Sheldon Lee Glashow

Nobelova cena 1979

Polní částice slabé interakce



CERN, SPS, 1983, nabité toky



CERN, SPS, 1984, neutrální toky

Nobelova cena 1984

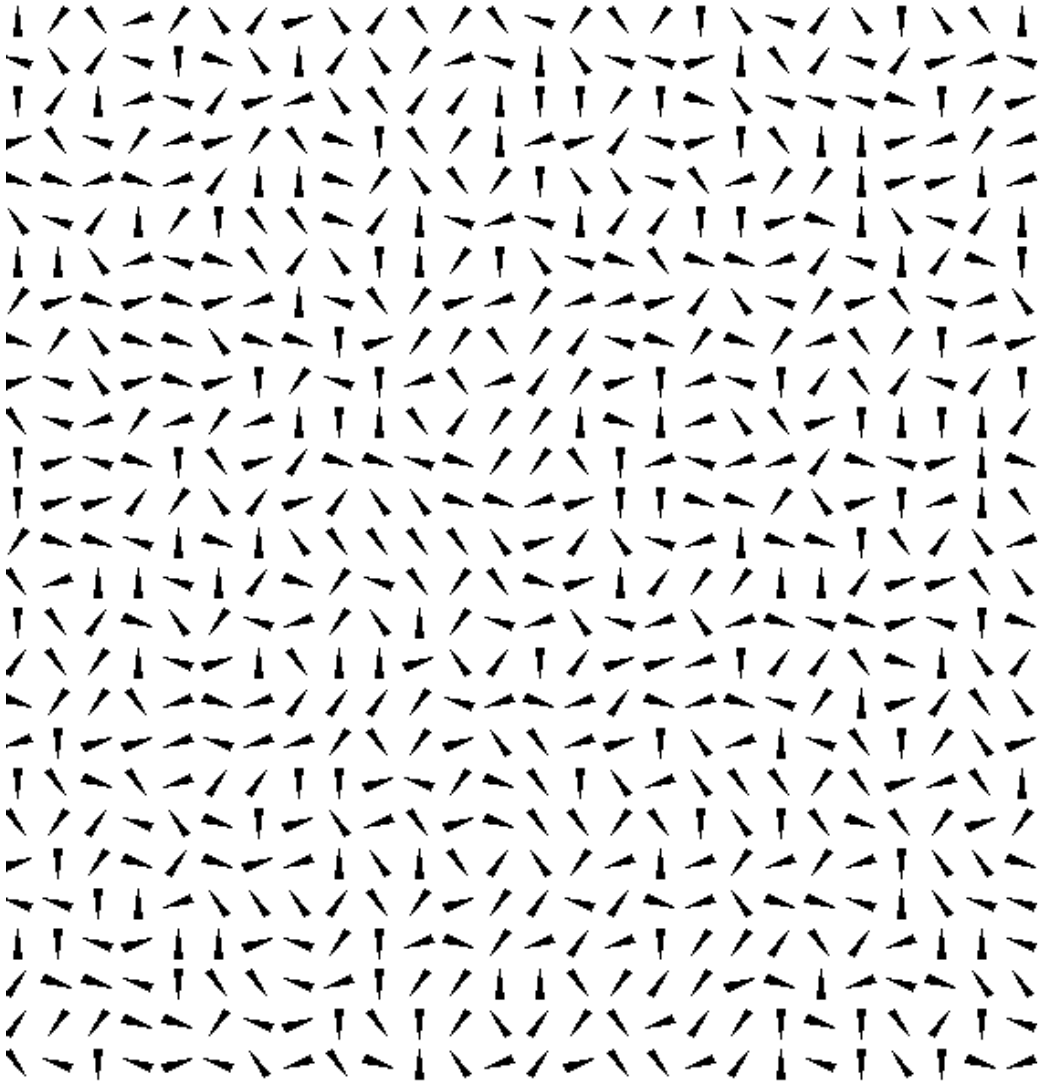
Carlo Rubbia

Simon van der Meer

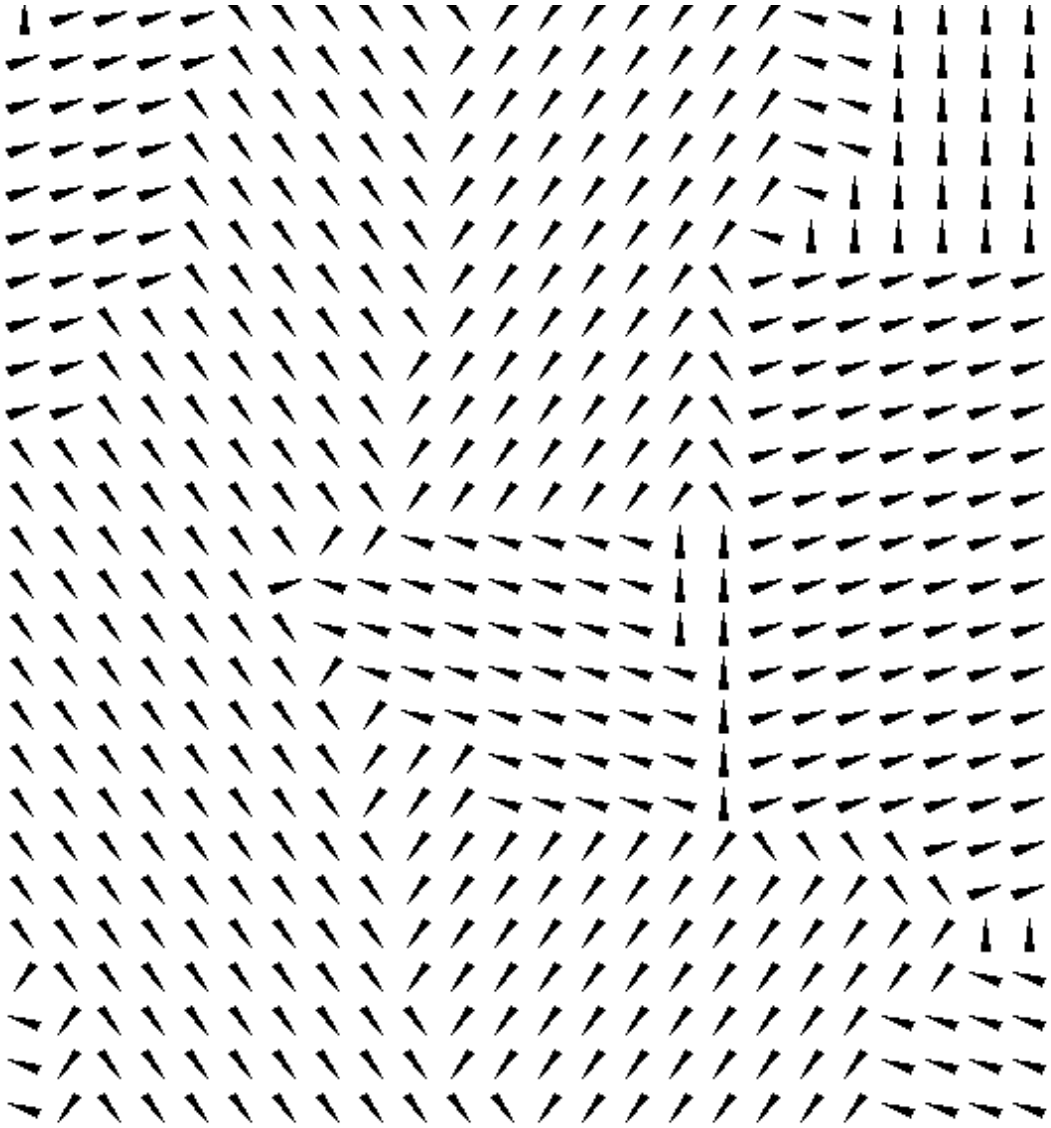
CERN

Spontánní narušení symetrie

Feromagnetikum

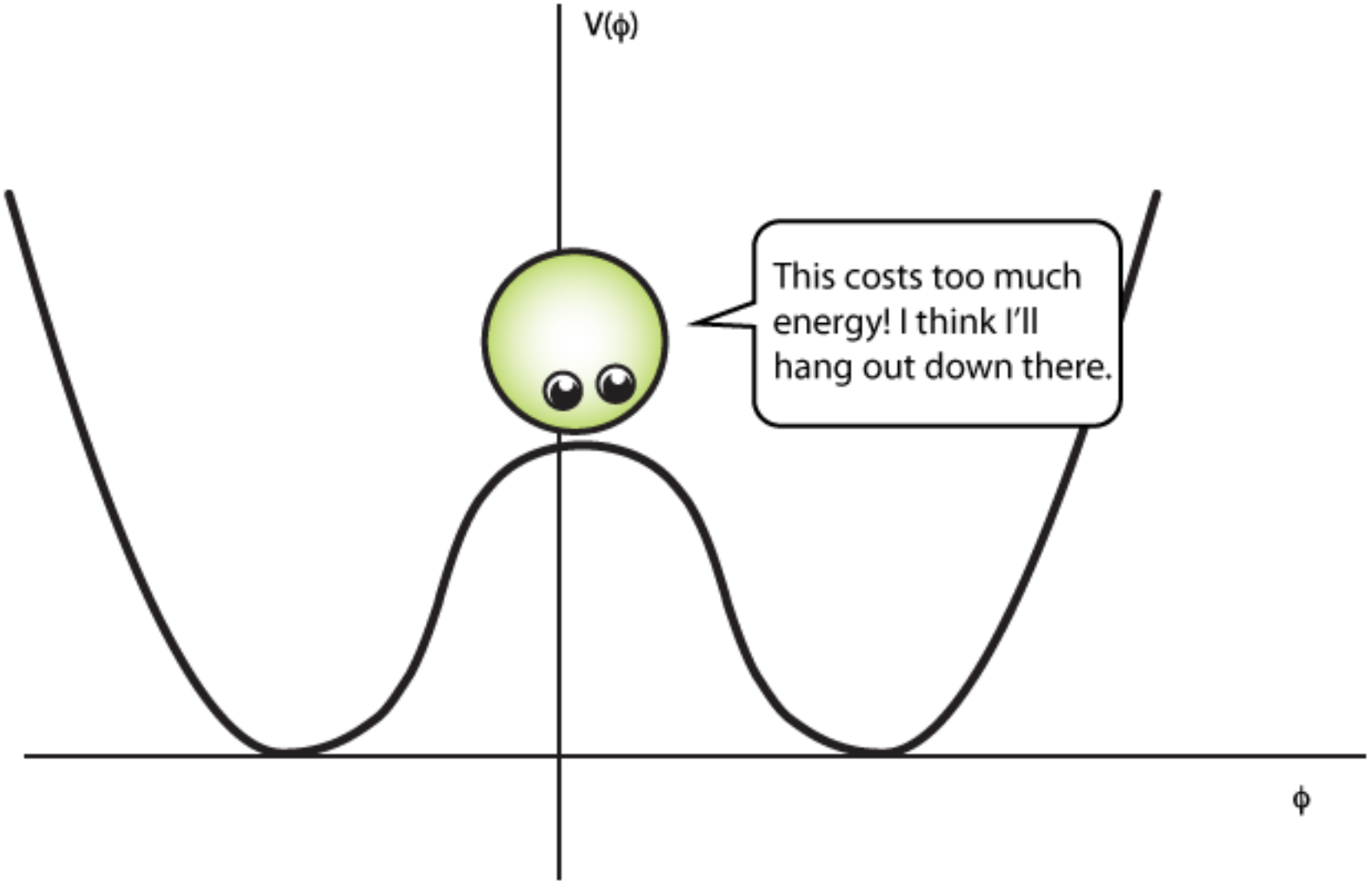


Feromagnetikum

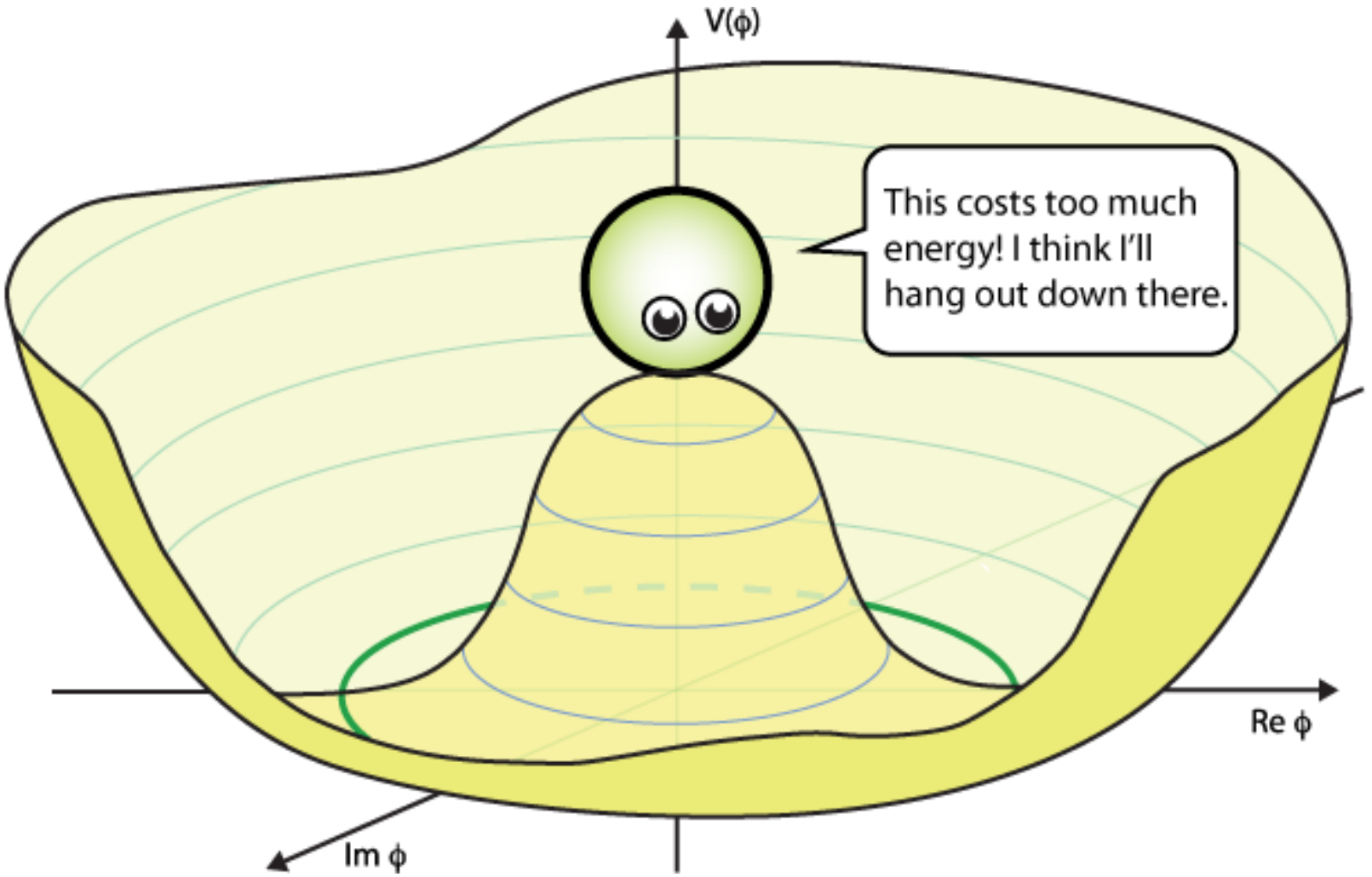


Jehla na špičce

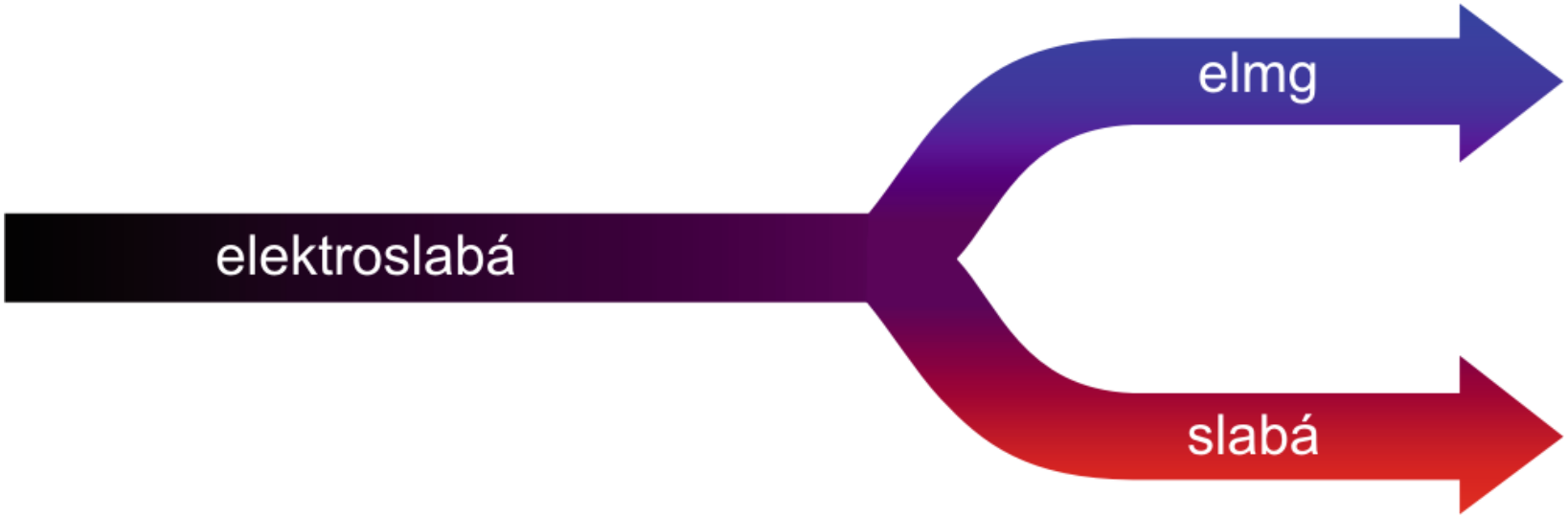
Potenciál Higgsova pole

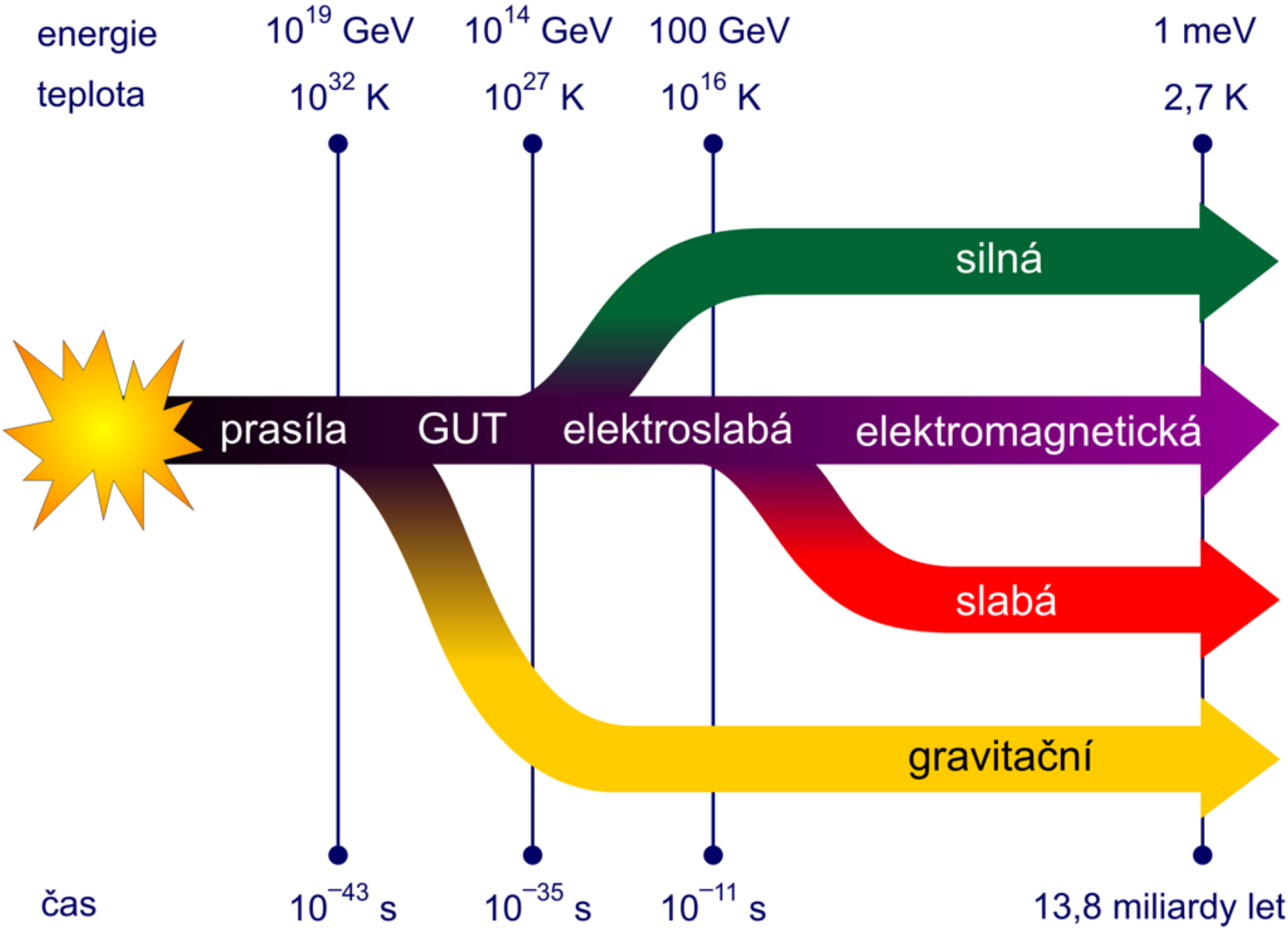


Potenciál Higgsova pole



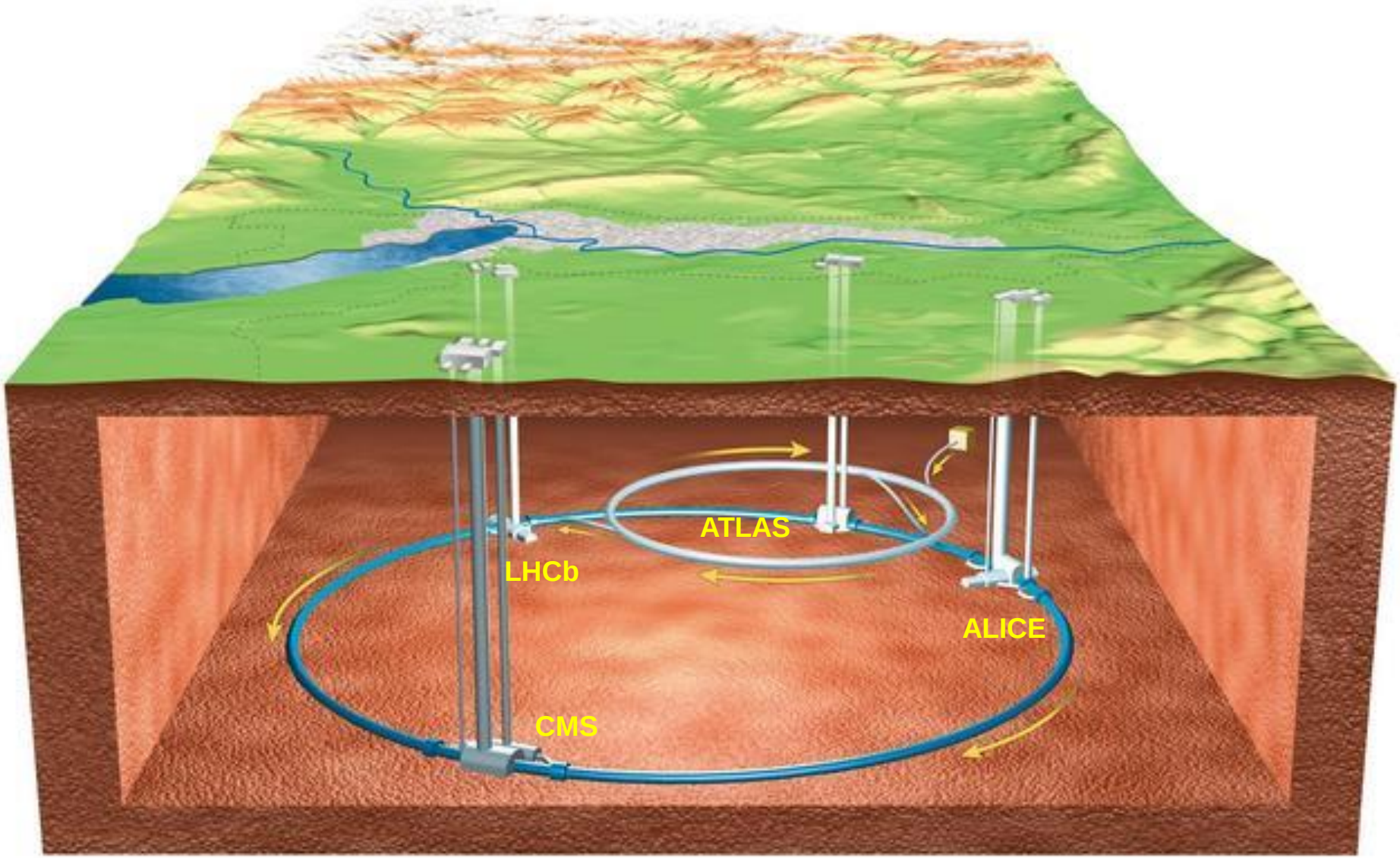
Narušení elektroslabé interakce

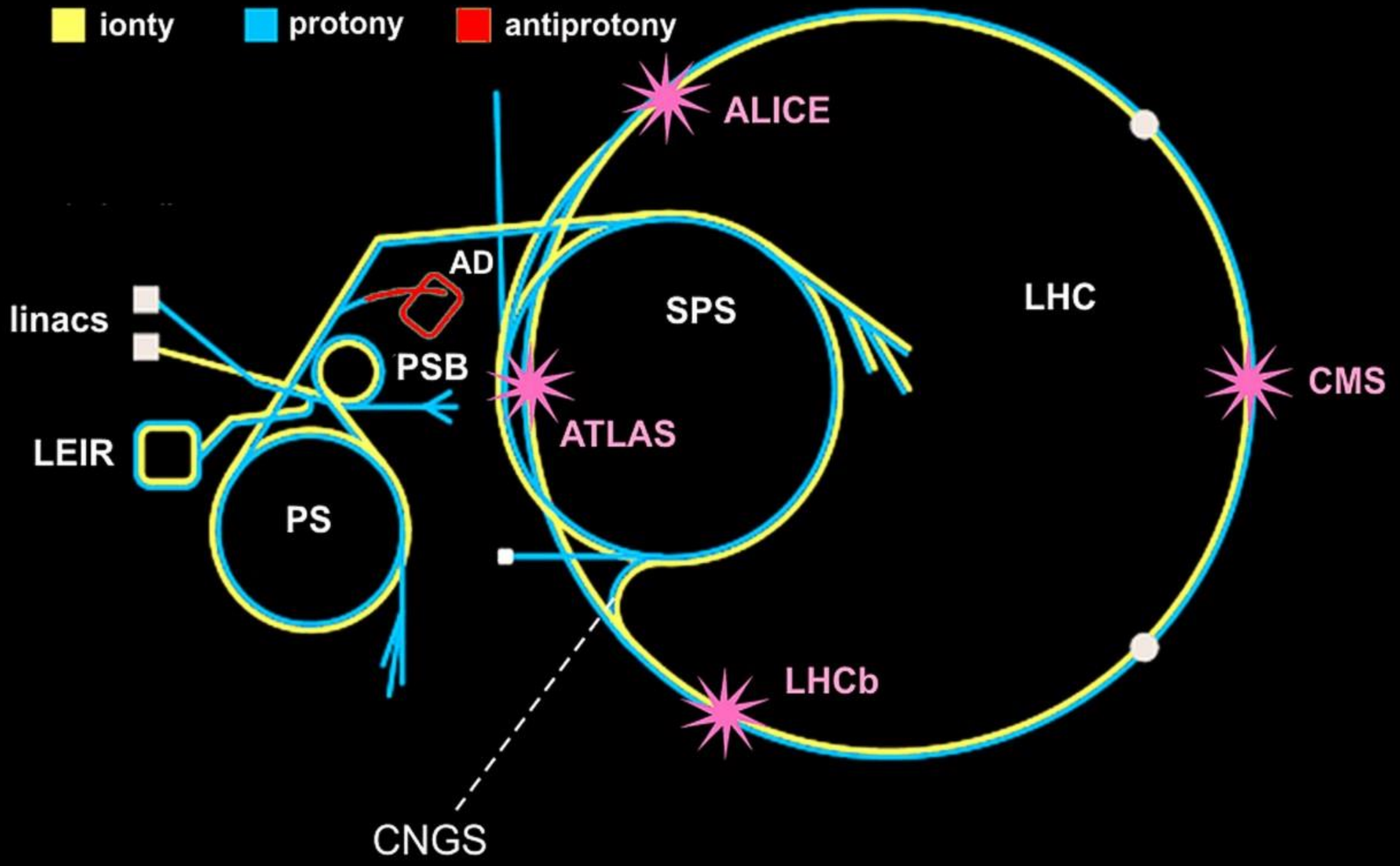



energie
10^{19} GeV
10^{14} GeV
100 GeV
1 meV
teplota
10^{32} K
10^{27} K
10^{16} K
2,7 K
silná
prasíla
GUT
elektroslabá
elektromagnetická
slabá
gravitační
čas
10^{-43} s
10^{-35} s
10^{-11} s
13,8 miliardy let

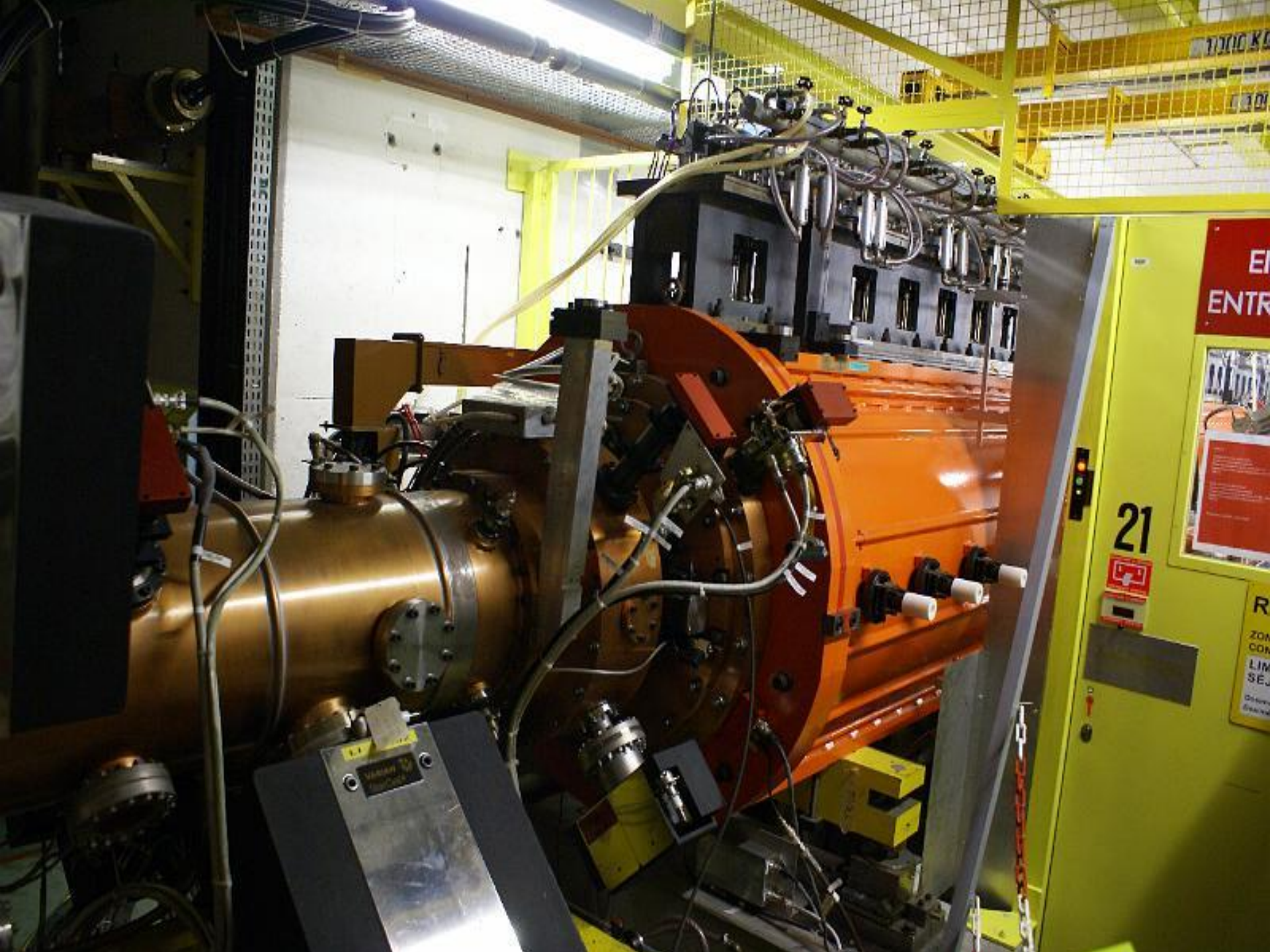
Objev Higgse

CERN


ATLAS
LHCb
ALICE
CMS


ionty
protony
antiprotony
ALICE
AD
linacs
SPS
LHC
PSB
CMS
ATLAS
LEIR
PS
LHCb
CNGS

DANGER
H2
Flammable gas - Gaz inflammable


21

ENTREE INTERDITE
ENTRANCE FORBIDDEN

21

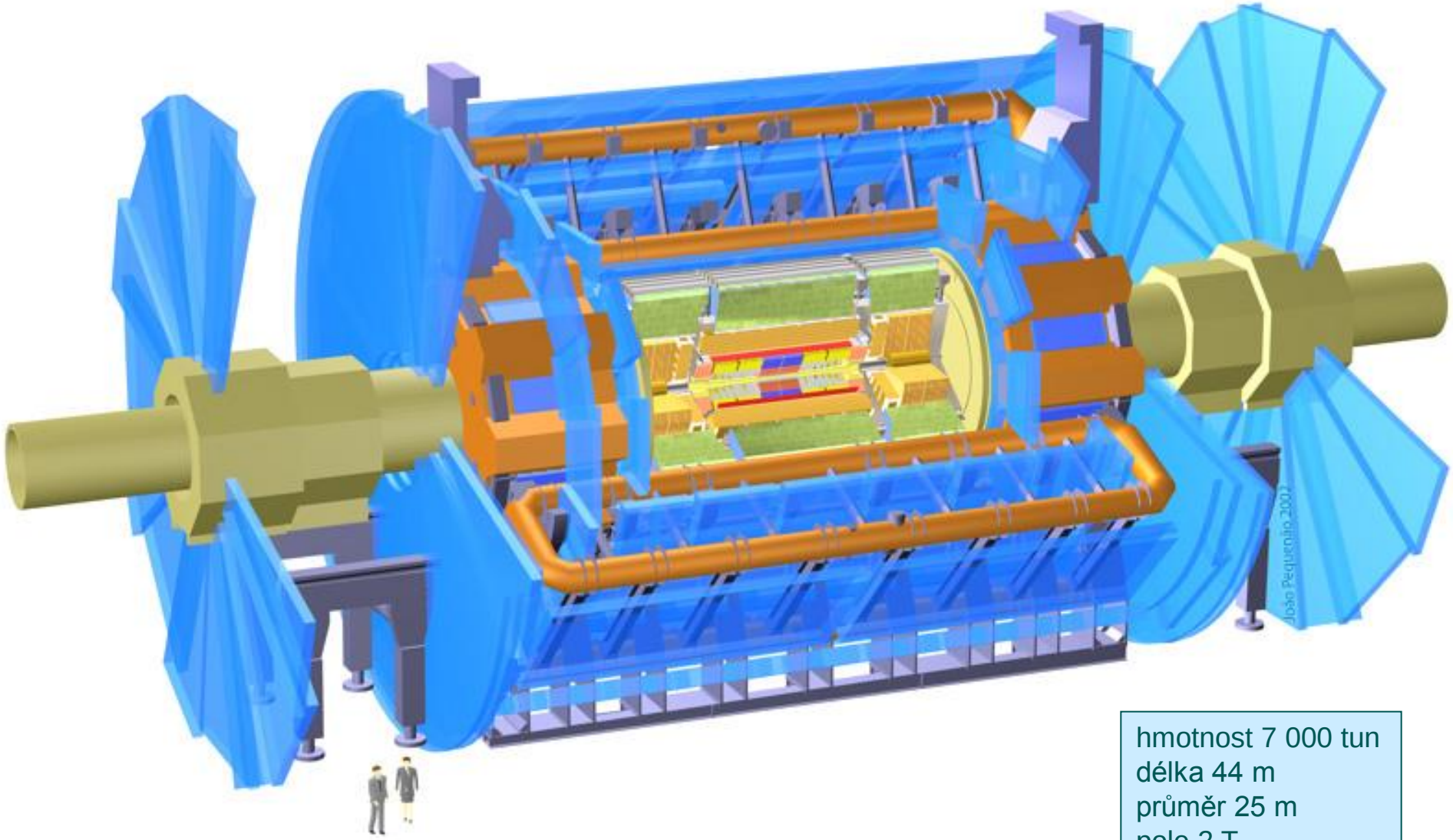
RADIATION

ZONE CONTRÔLÉE

CONTROLLED AREA

LIMITED STAY
SÉJOUR LIMITÉ

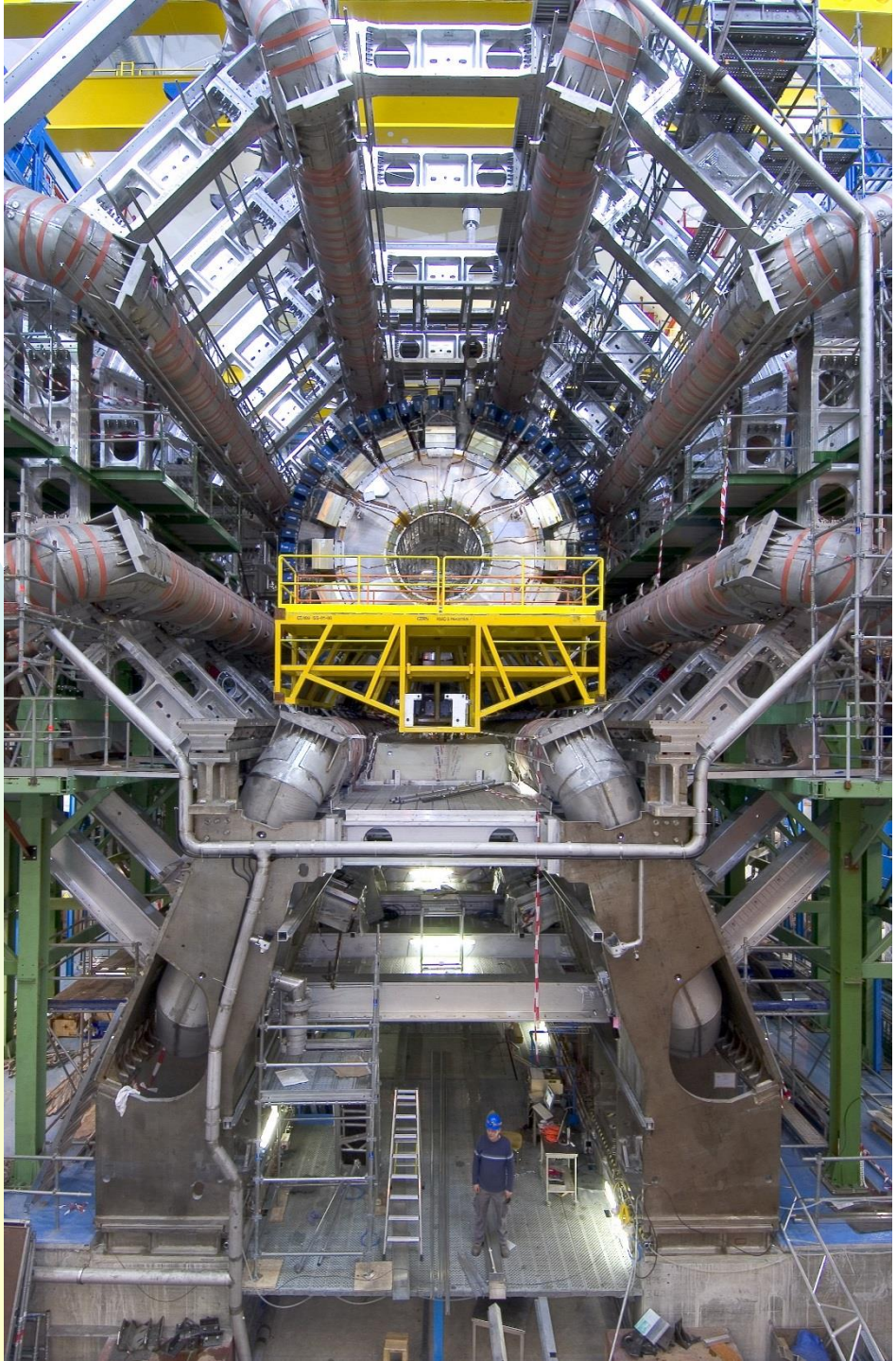
ATLAS

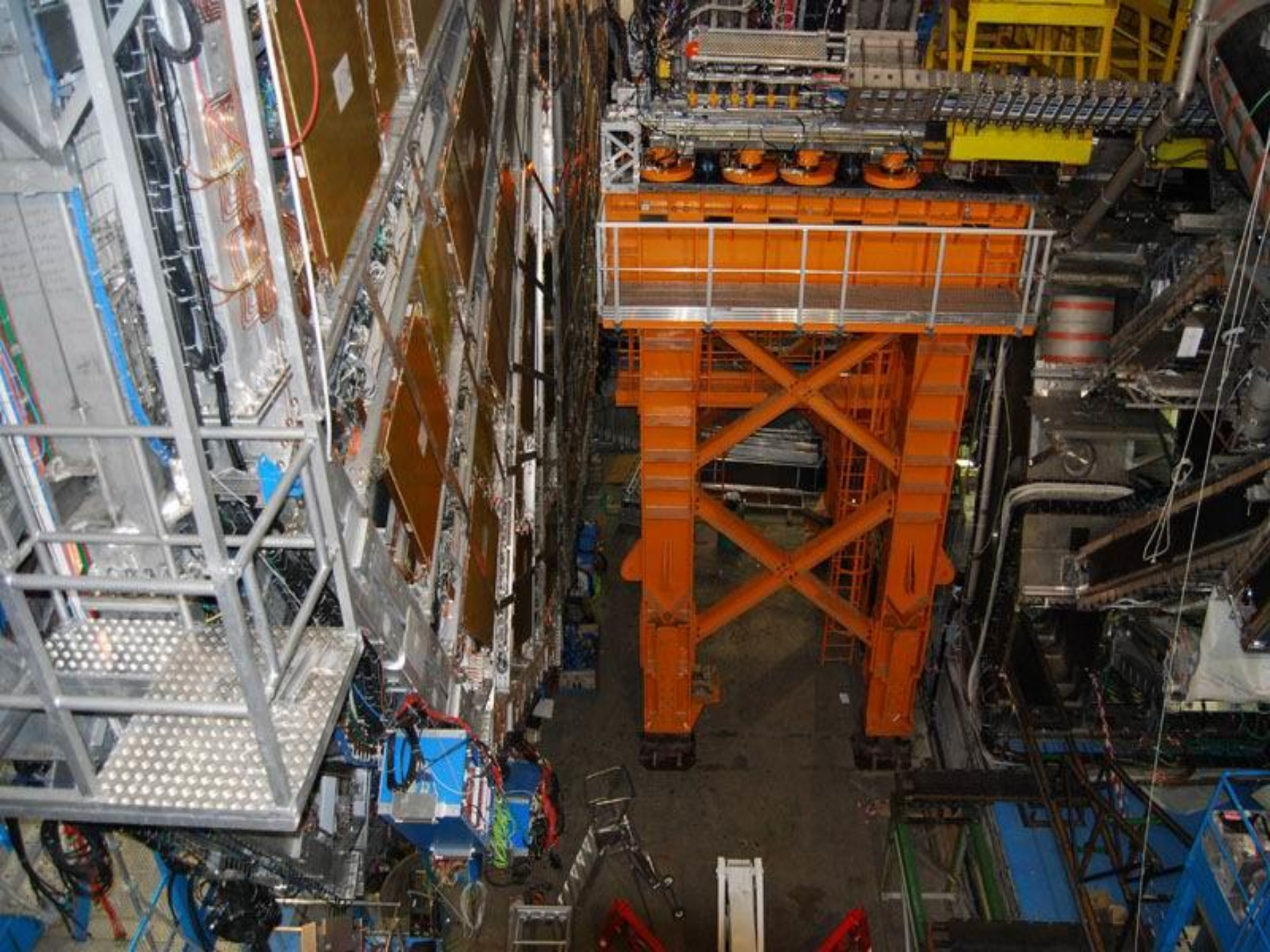


hmotnost 7 000 tun
délka 44 m
průměr 25 m
pole 2 T

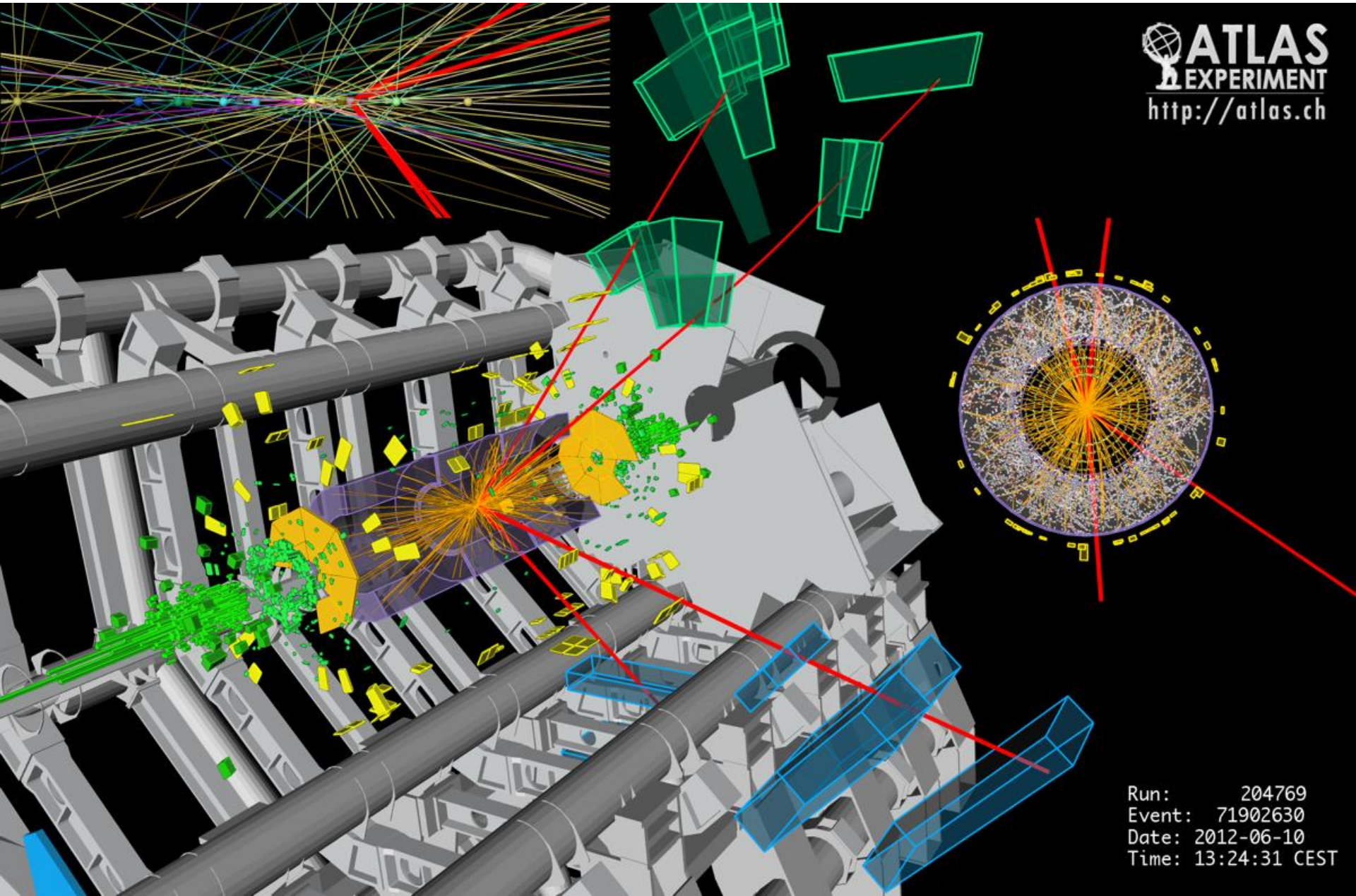
ATLAS

Atlas





LHC/ATLAS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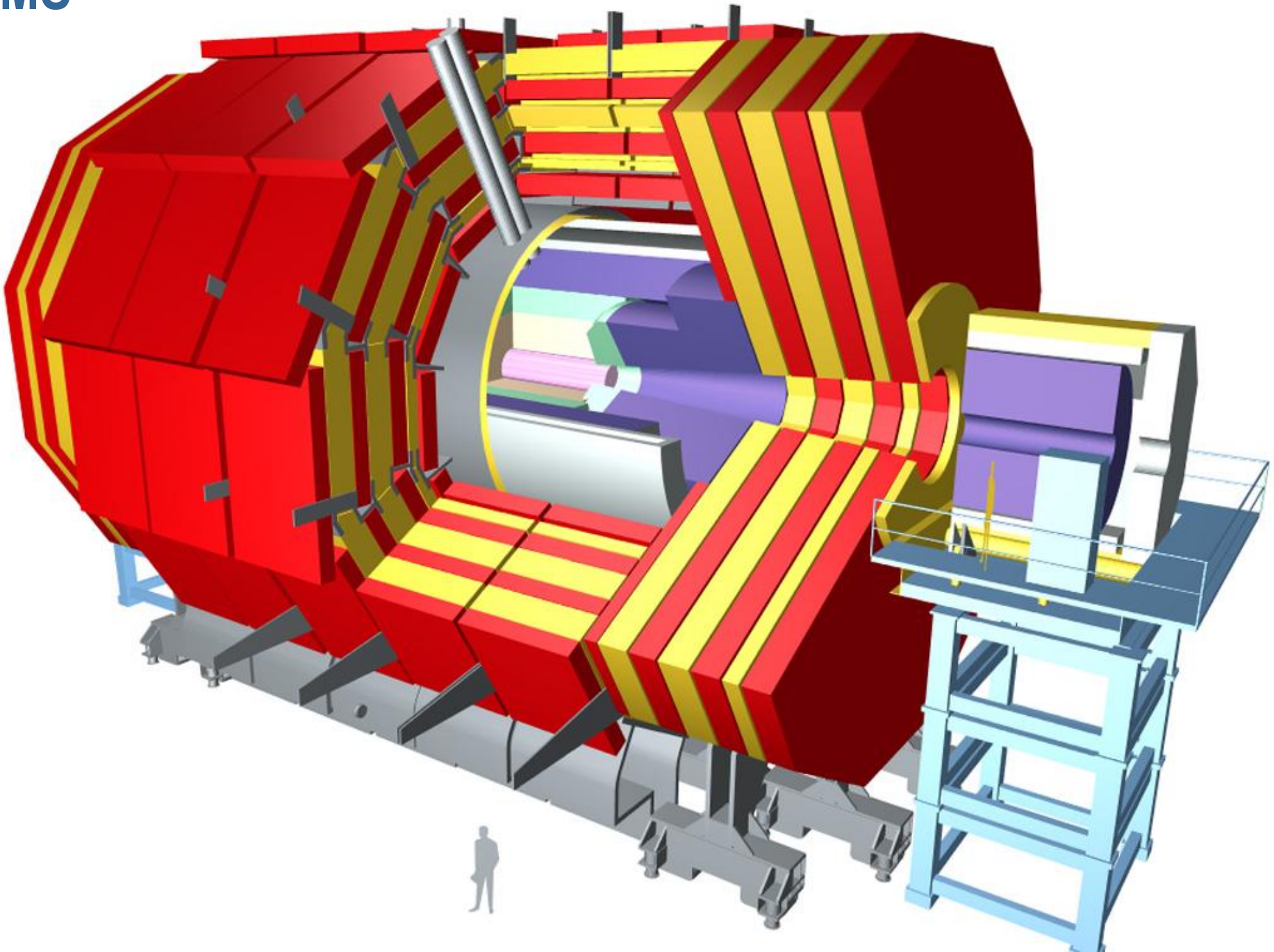

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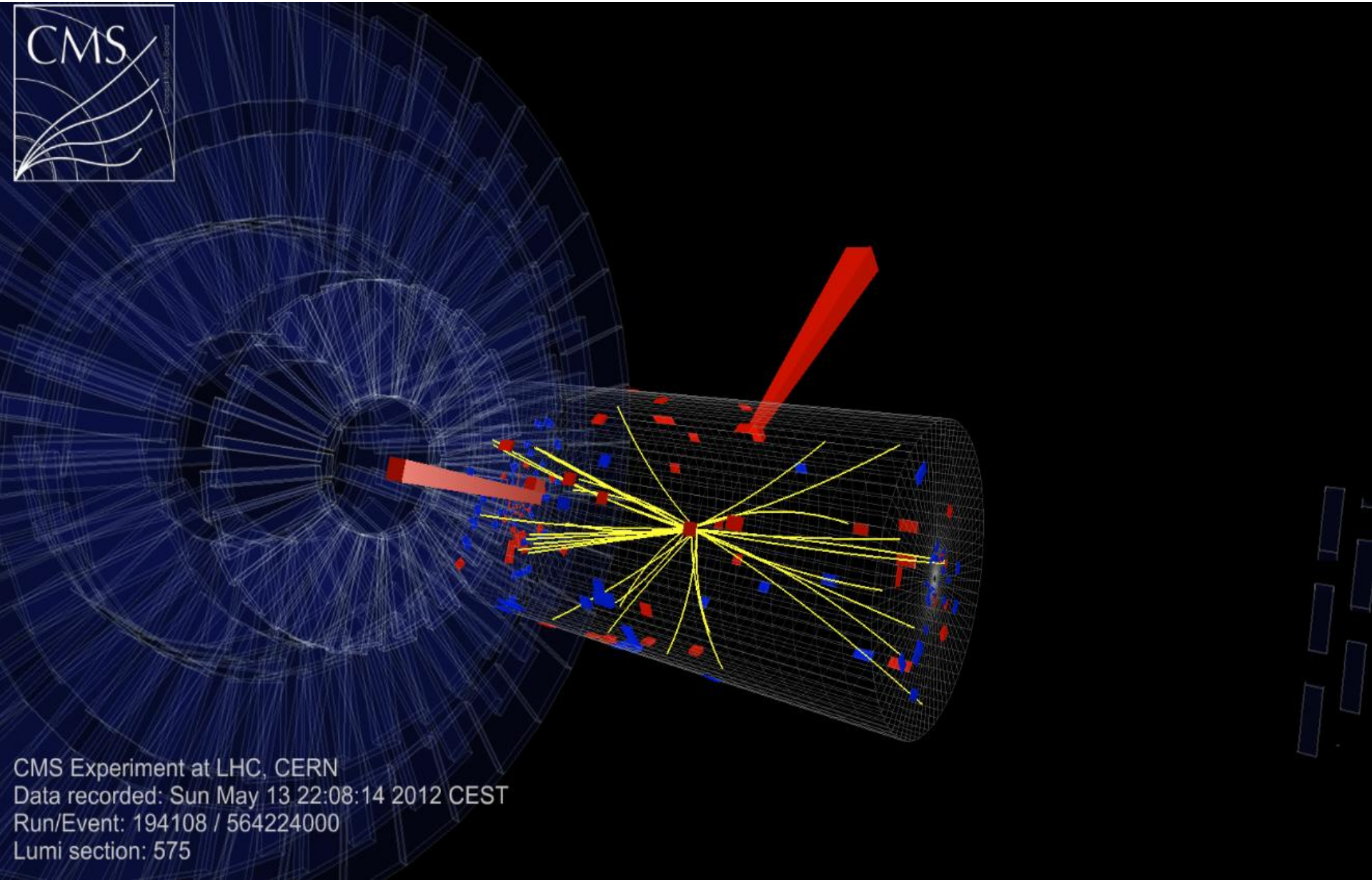
LHC/CMS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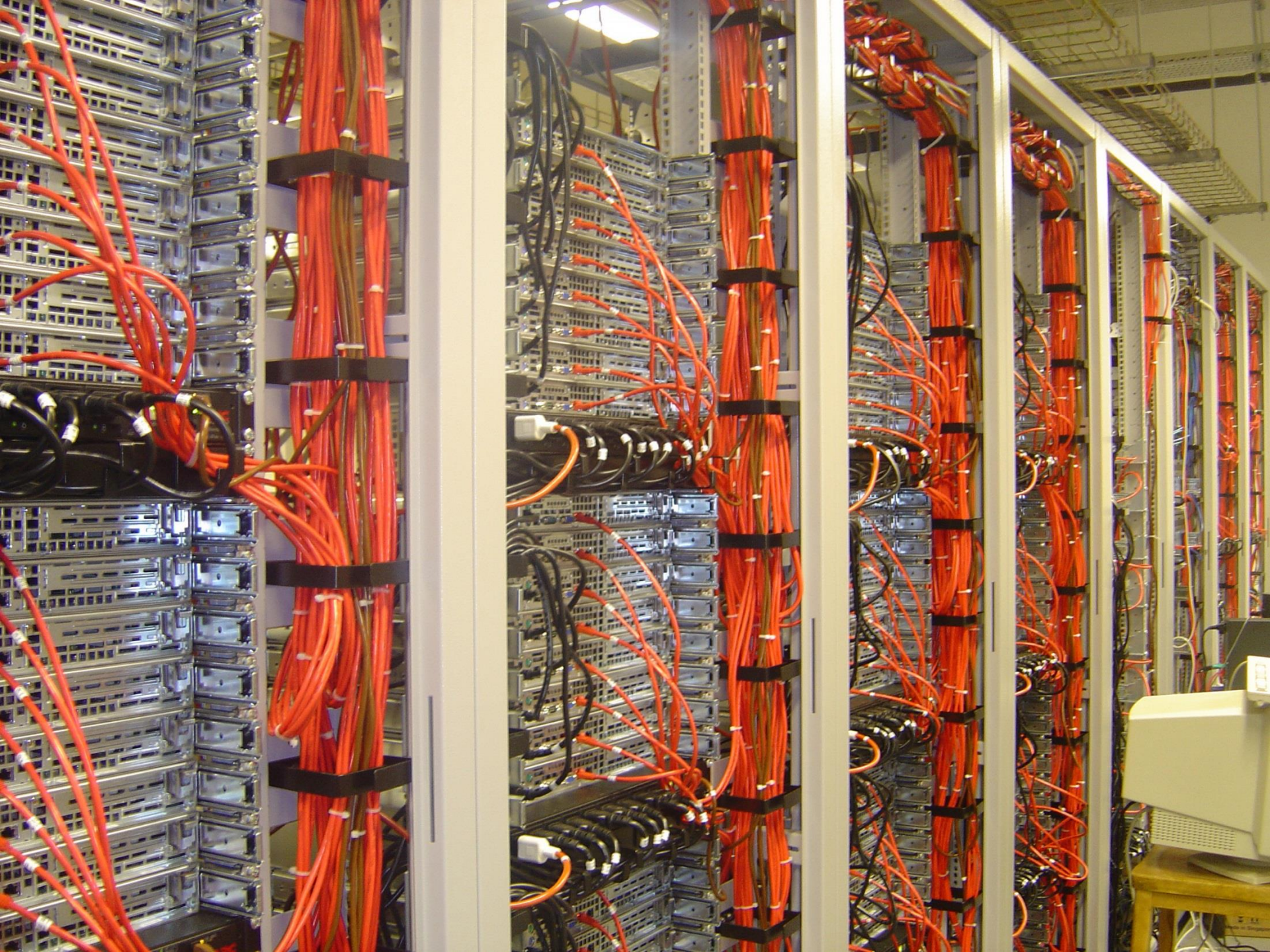
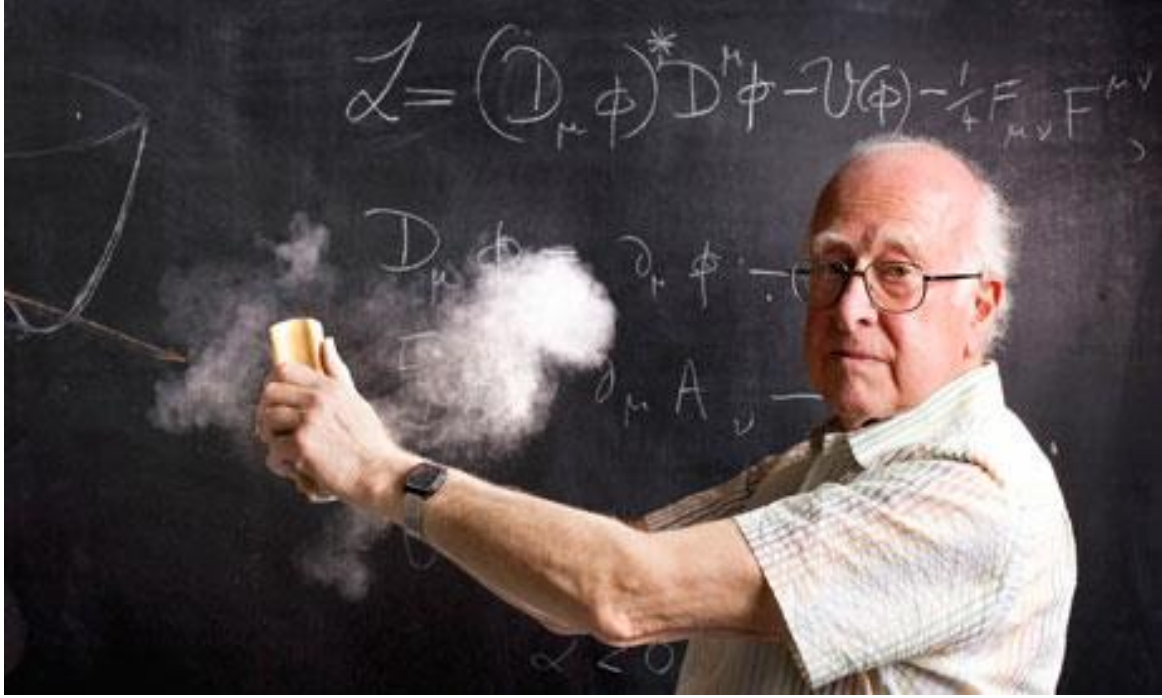
Data recorded: Sun May 13 22:08:14 2012 CEST
Run/Event: 194108 / 564224000
Lumi section: 575



Higgsova částice

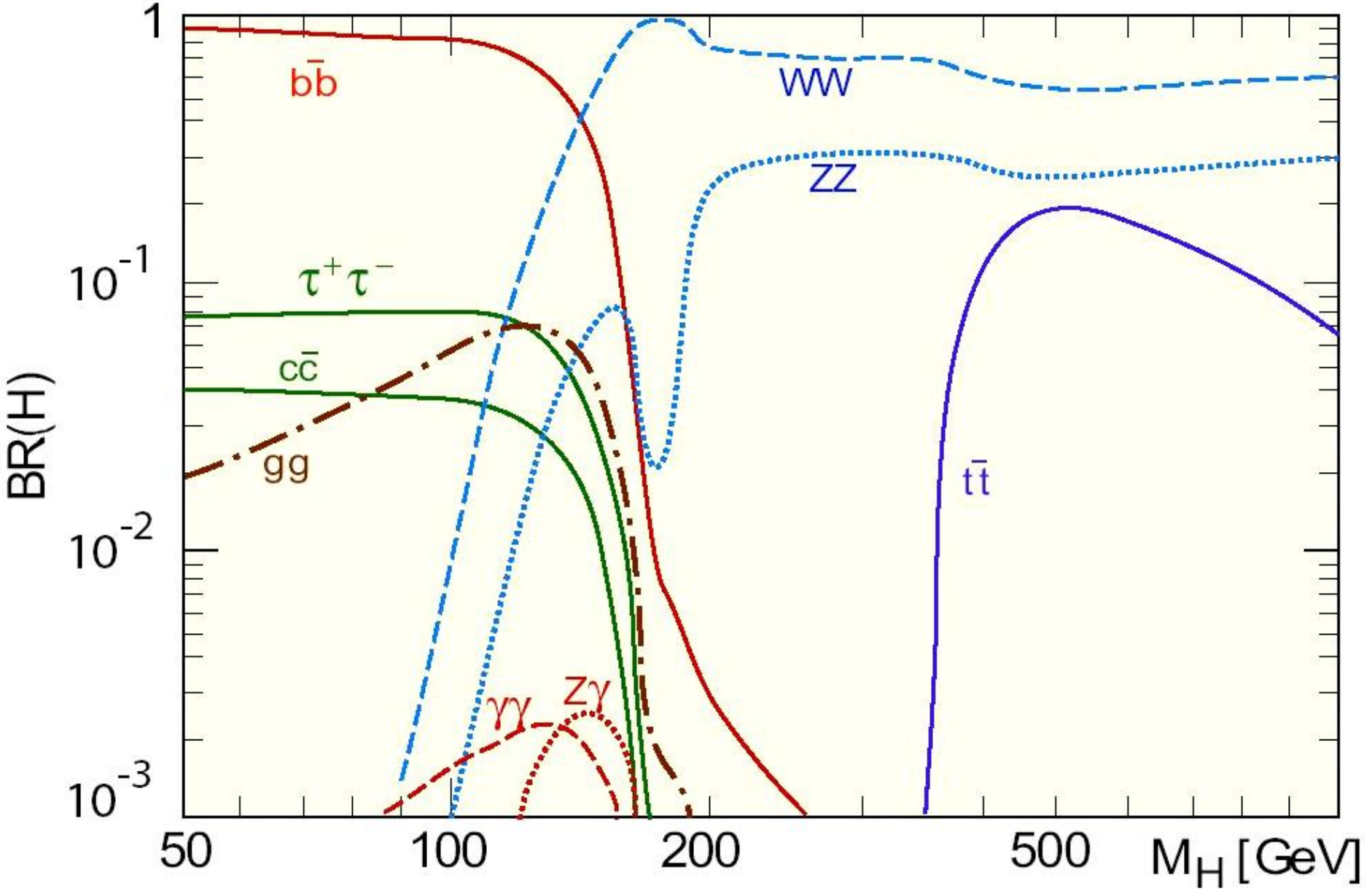
předpověď: 1964
objev: 2012



Peter Higgs (*1929)

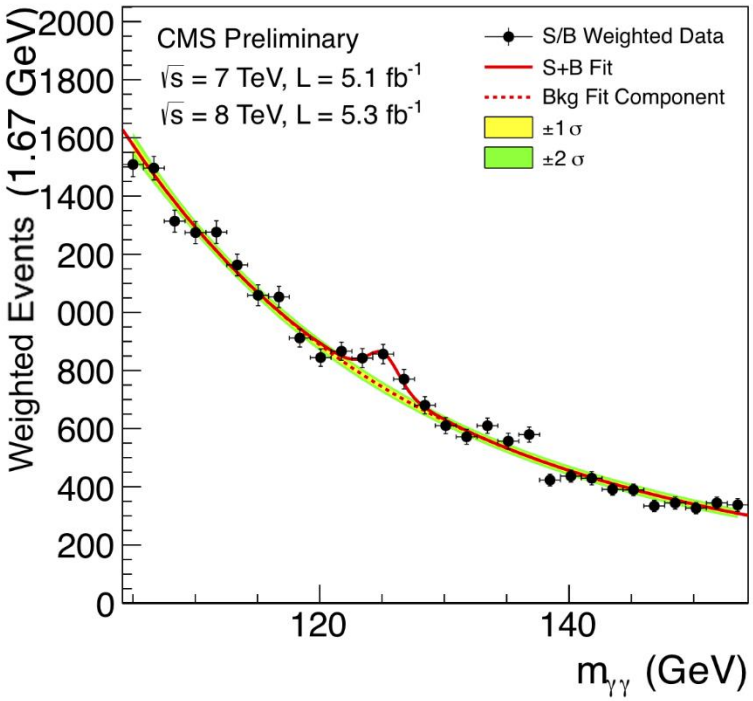
šťastný Peter Higgs

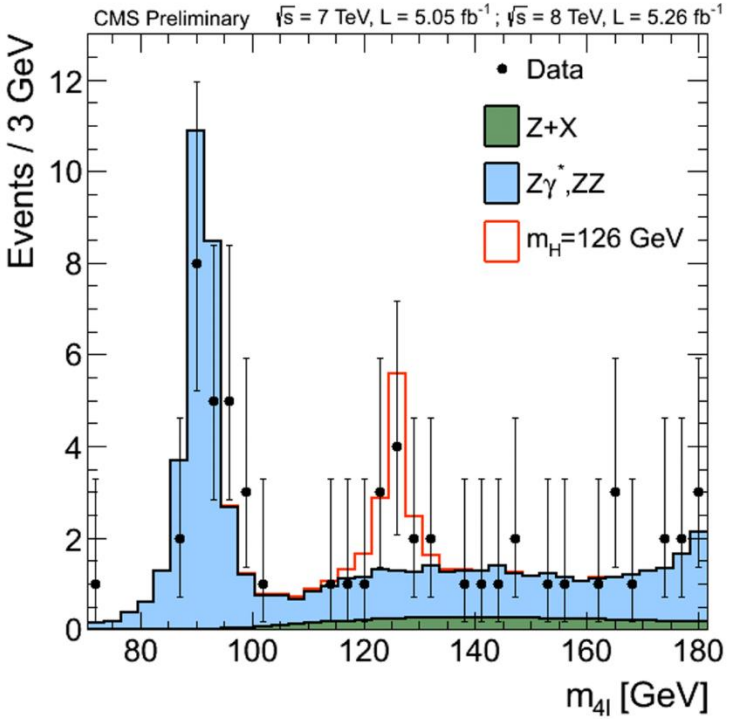
Higgsova častice – rozpadové kanály

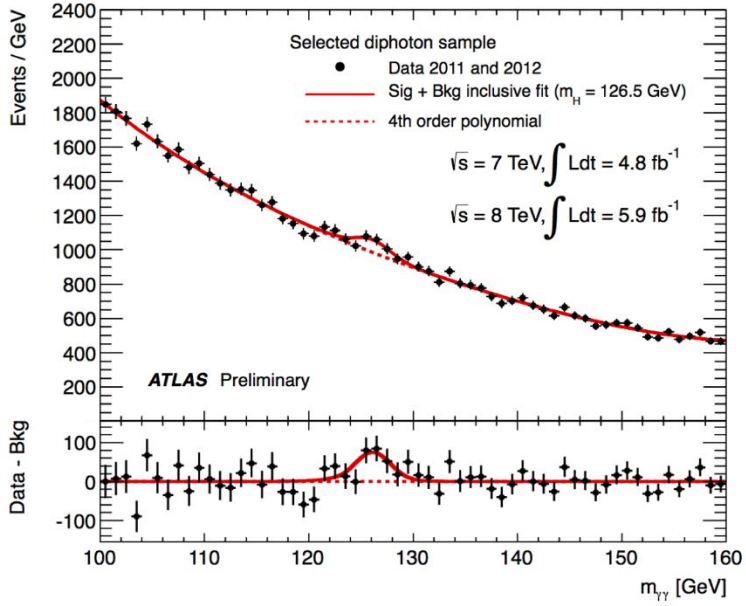


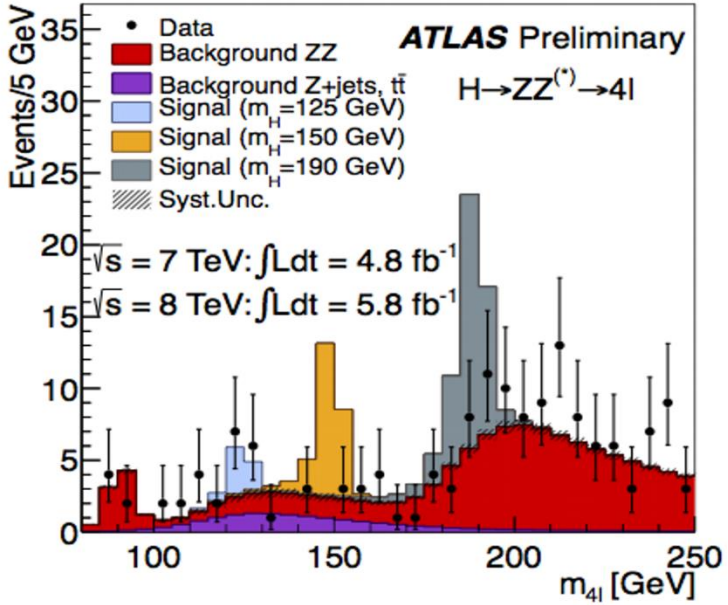
Higgs

126 GeV





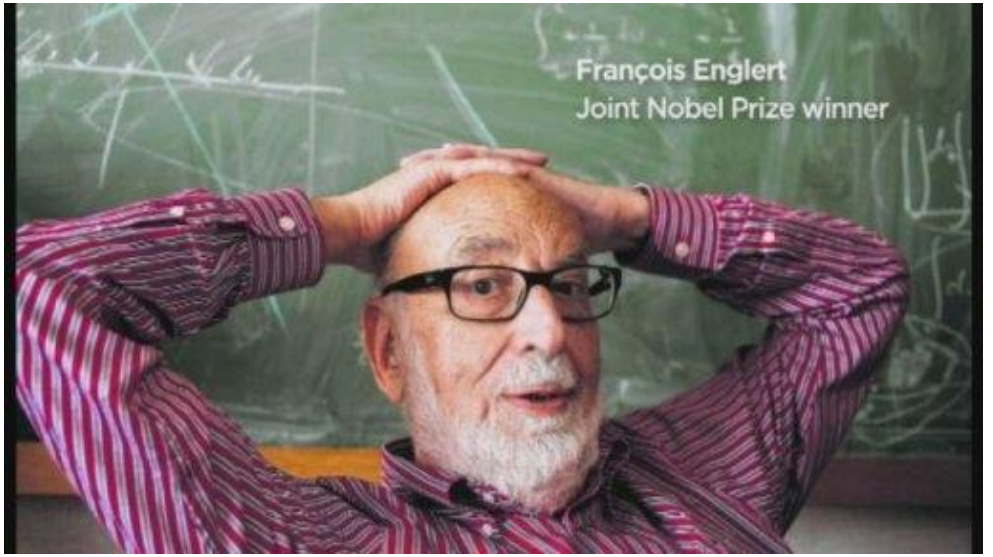




Nobelova cena

François Englert
Petr Higgs

THE UNIVERSITY OF EDINBURGH


François Englert
Joint Nobel Prize winner