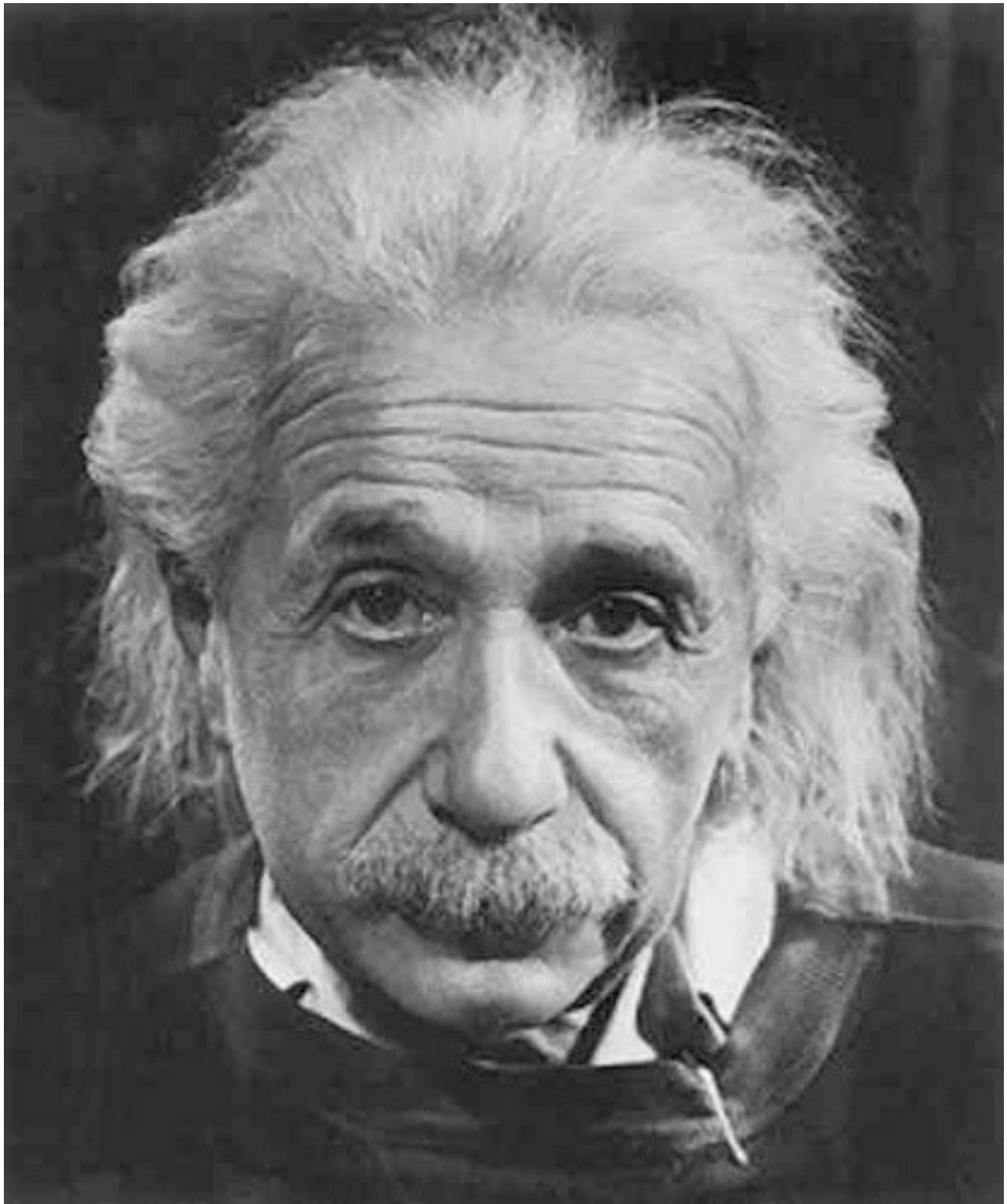
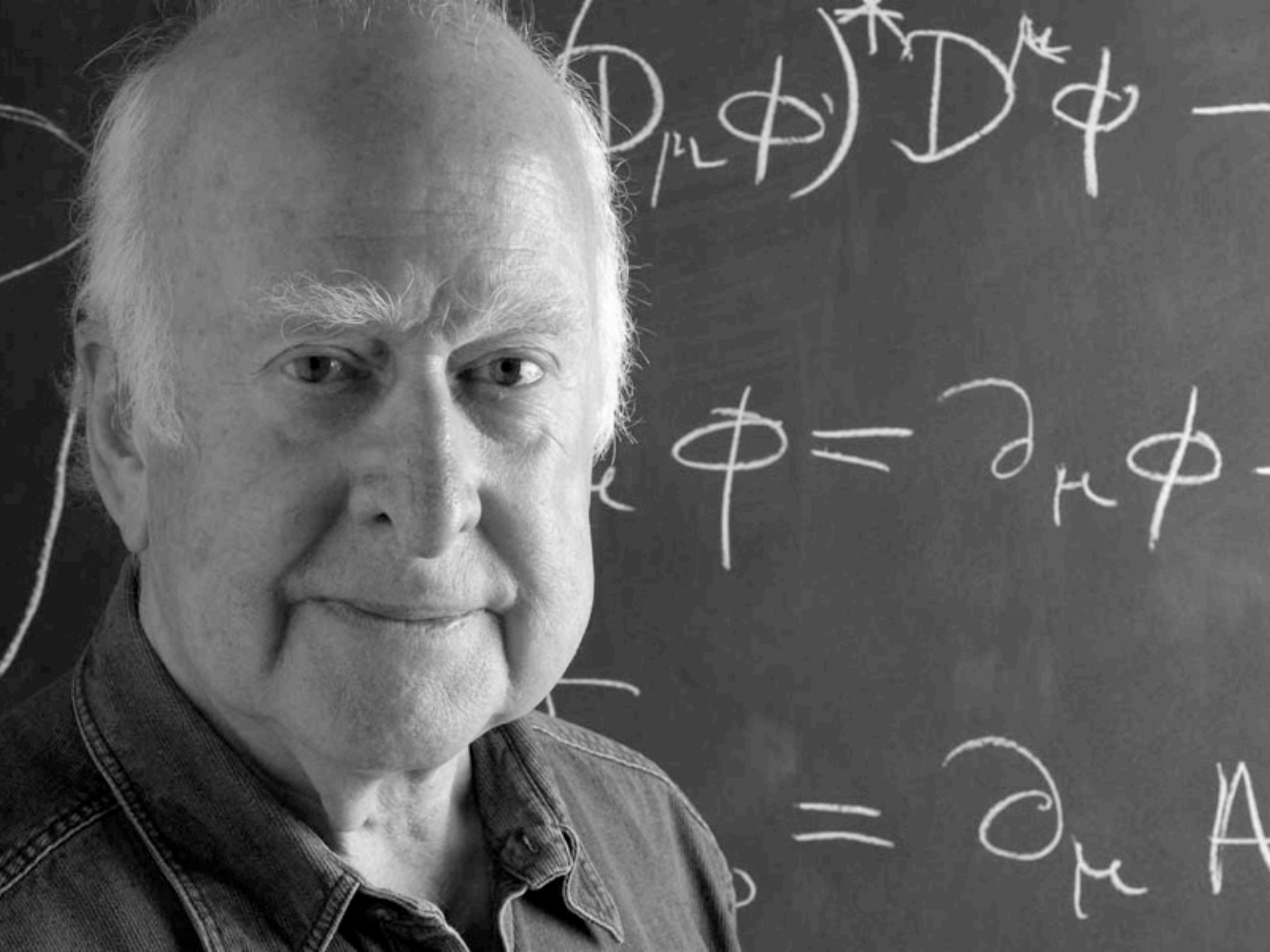
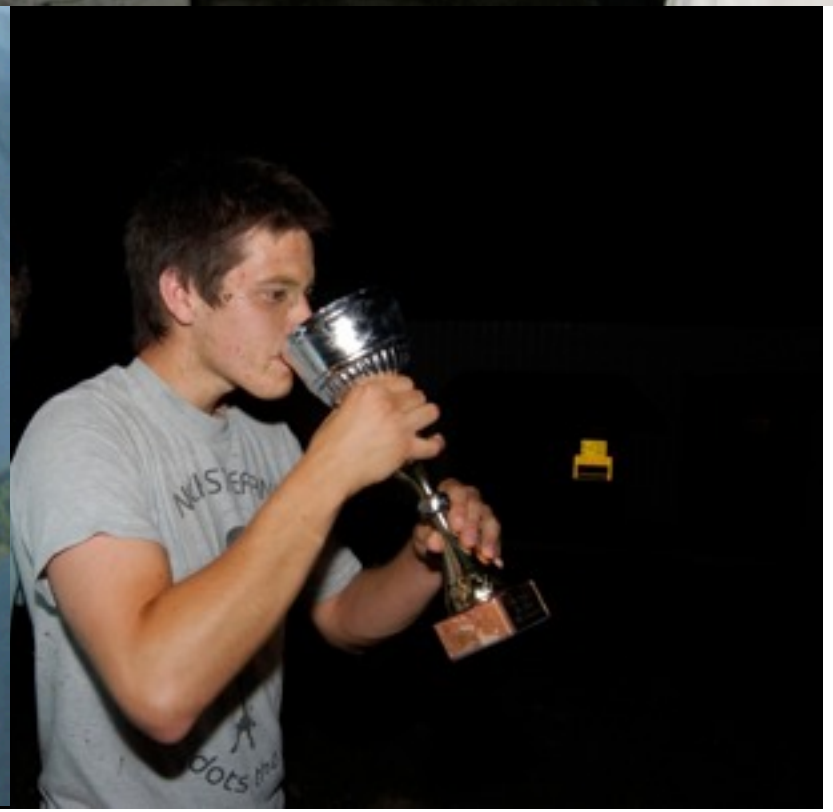




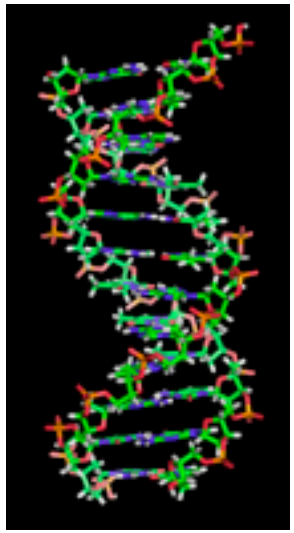




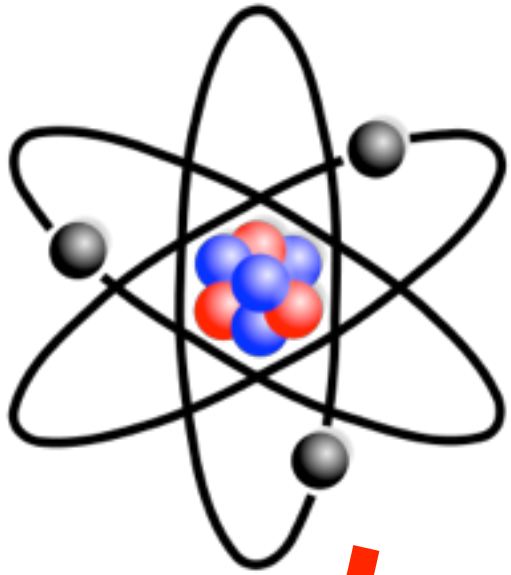
# What do Particle Physicists do ?

Everything

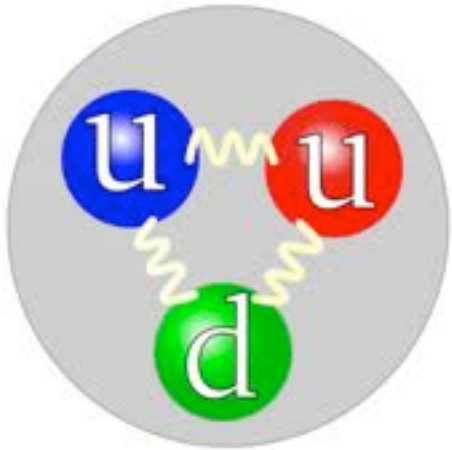
Molecules



Atoms



Protons




Quarks


No Body Knows

?

# What's in the Lunch Box ?

# What's in the Lunch Box ?


Look inside.

No Fun!

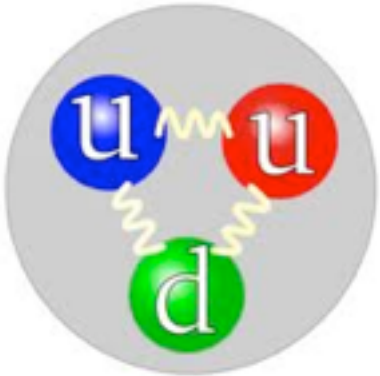
# What's in the Lunch Box ?

SMASH THEM!!!

# What's in the Lunch Box ?

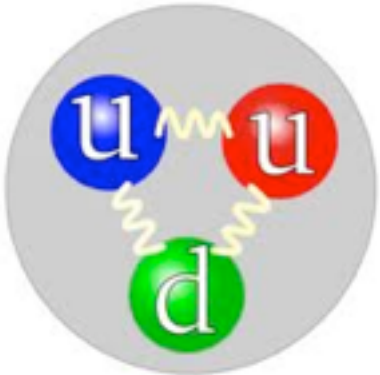
# What's in the Proton ?

Protons are Too small to look inside.

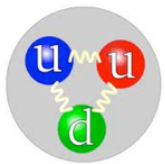


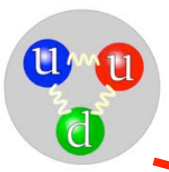
# What's in the Proton ?

Protons are Too
small to look inside.



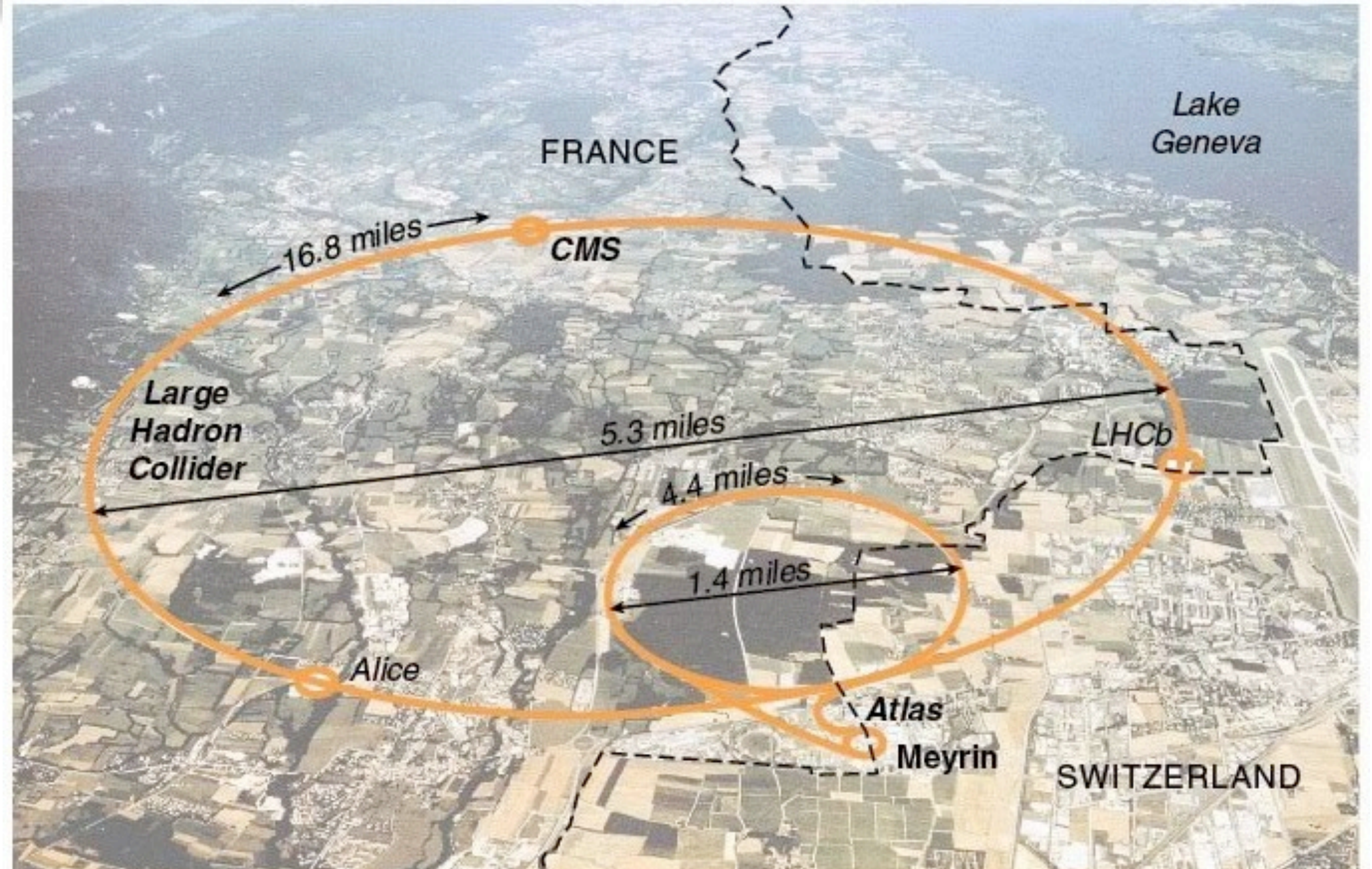

SMASH THEM!!!

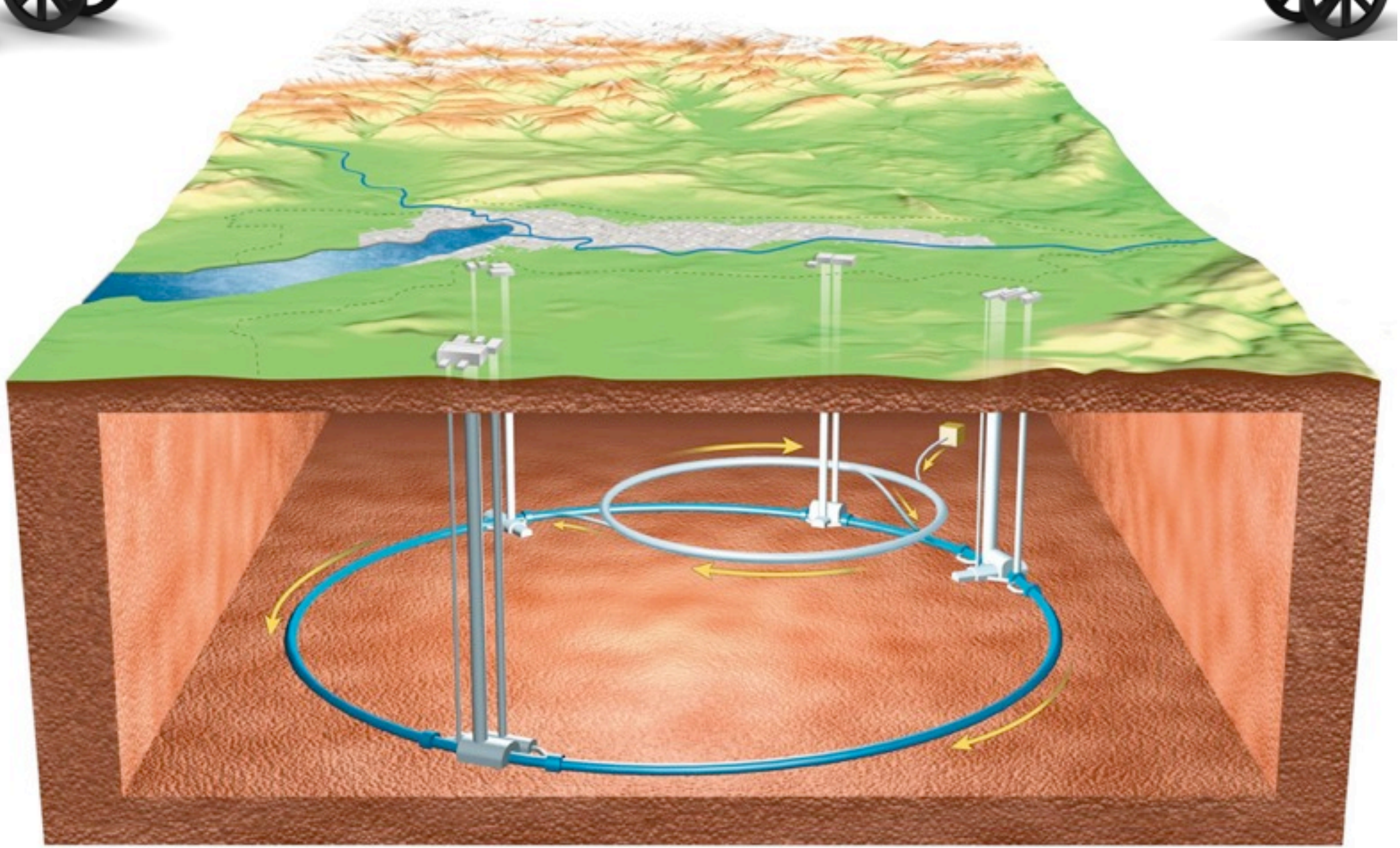

# The Worlds Biggest Cannon

# The Worlds Biggest Cannon

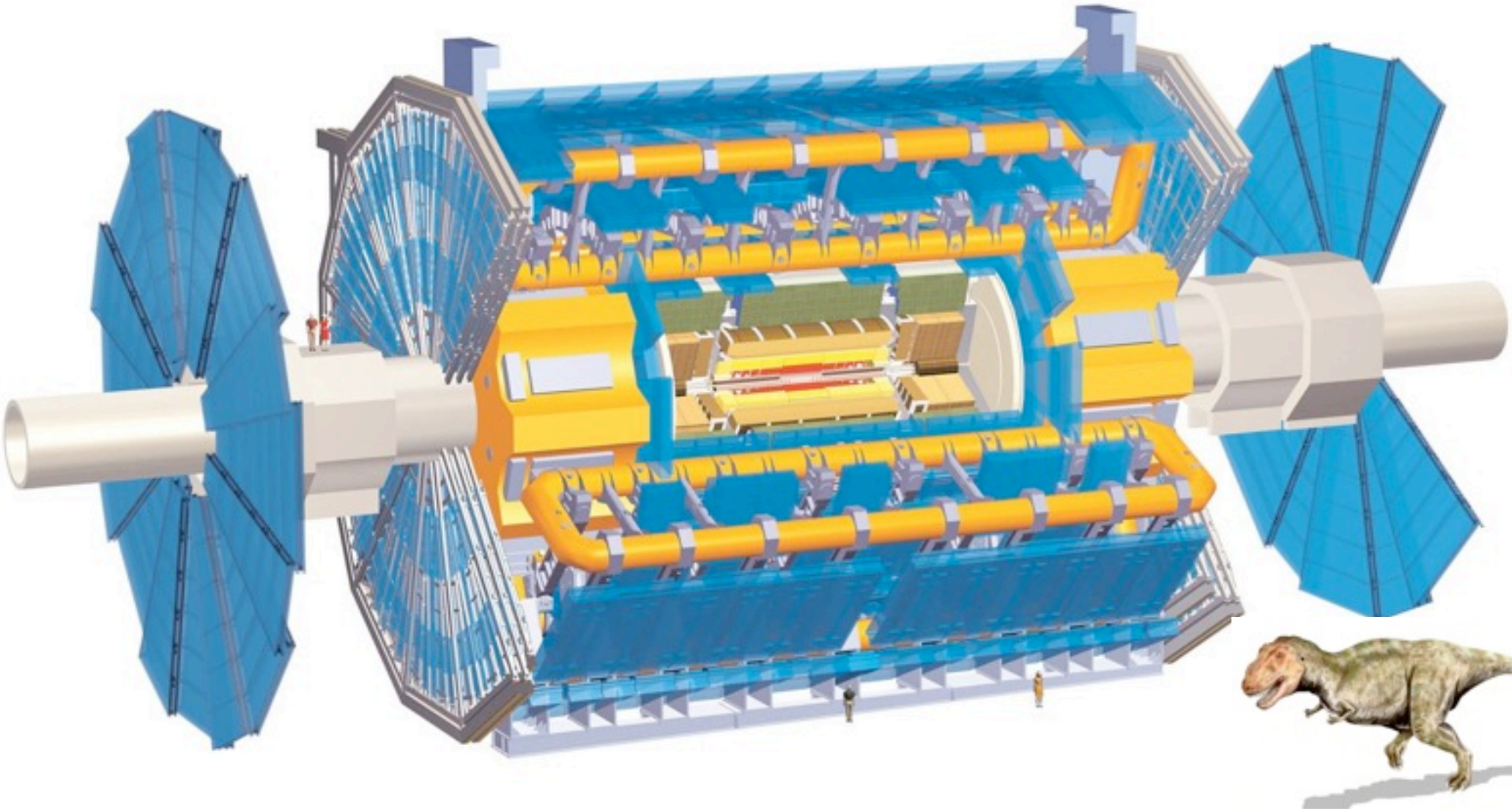


# The Worlds Biggest Cannon

# The Worlds Biggest Cannon

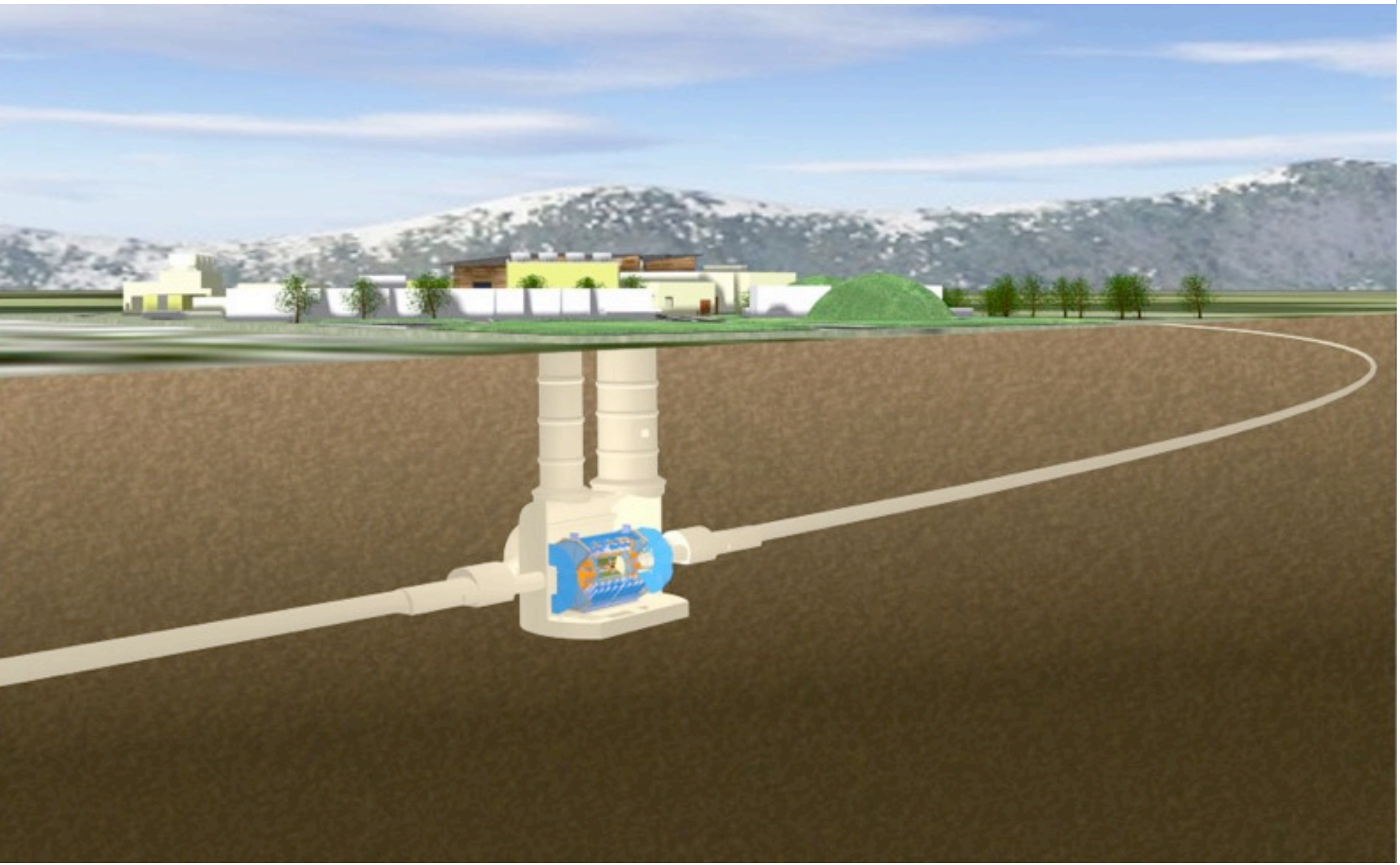


# Really Big Camera!!!

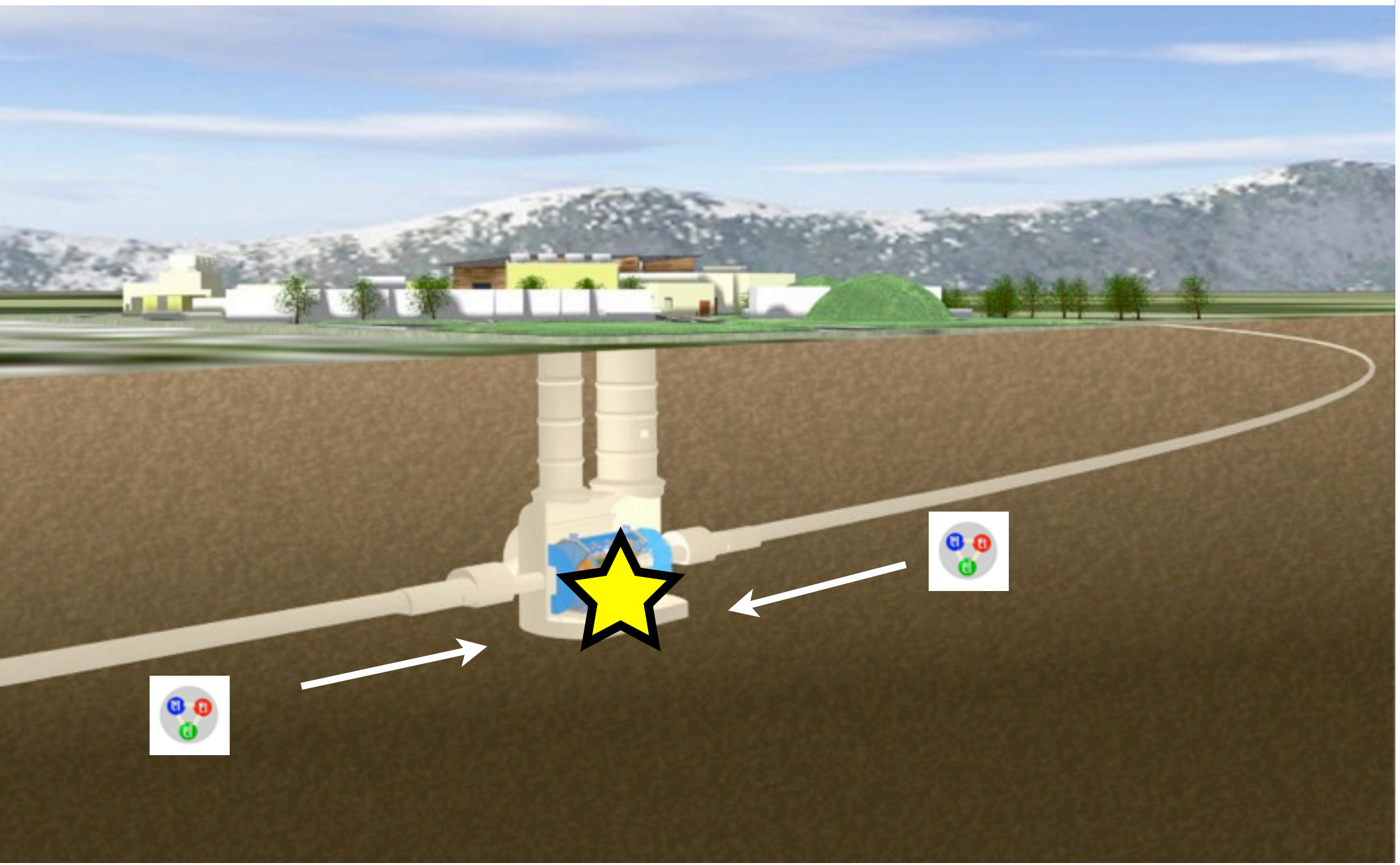


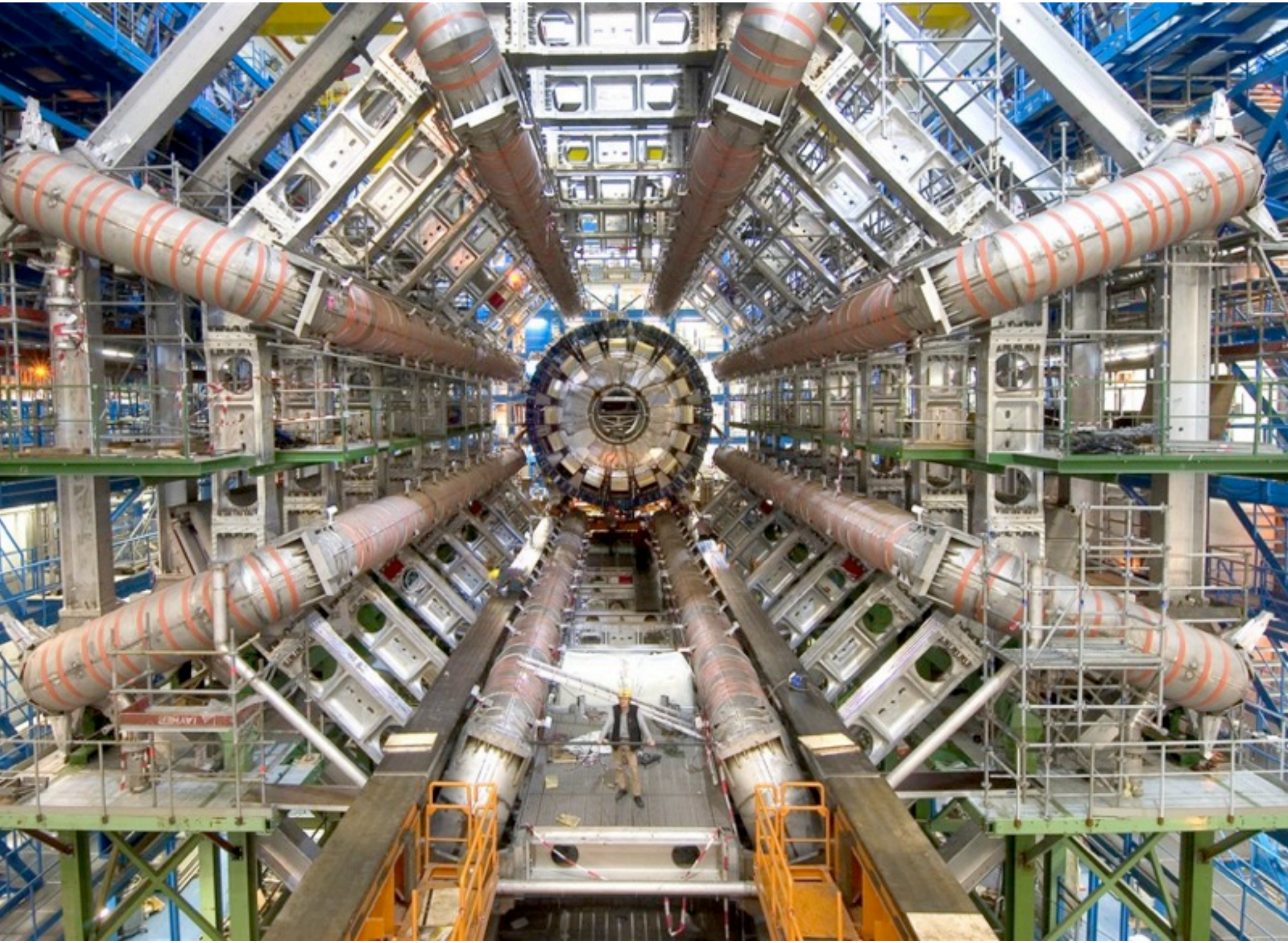
# Really Big Camera!!!

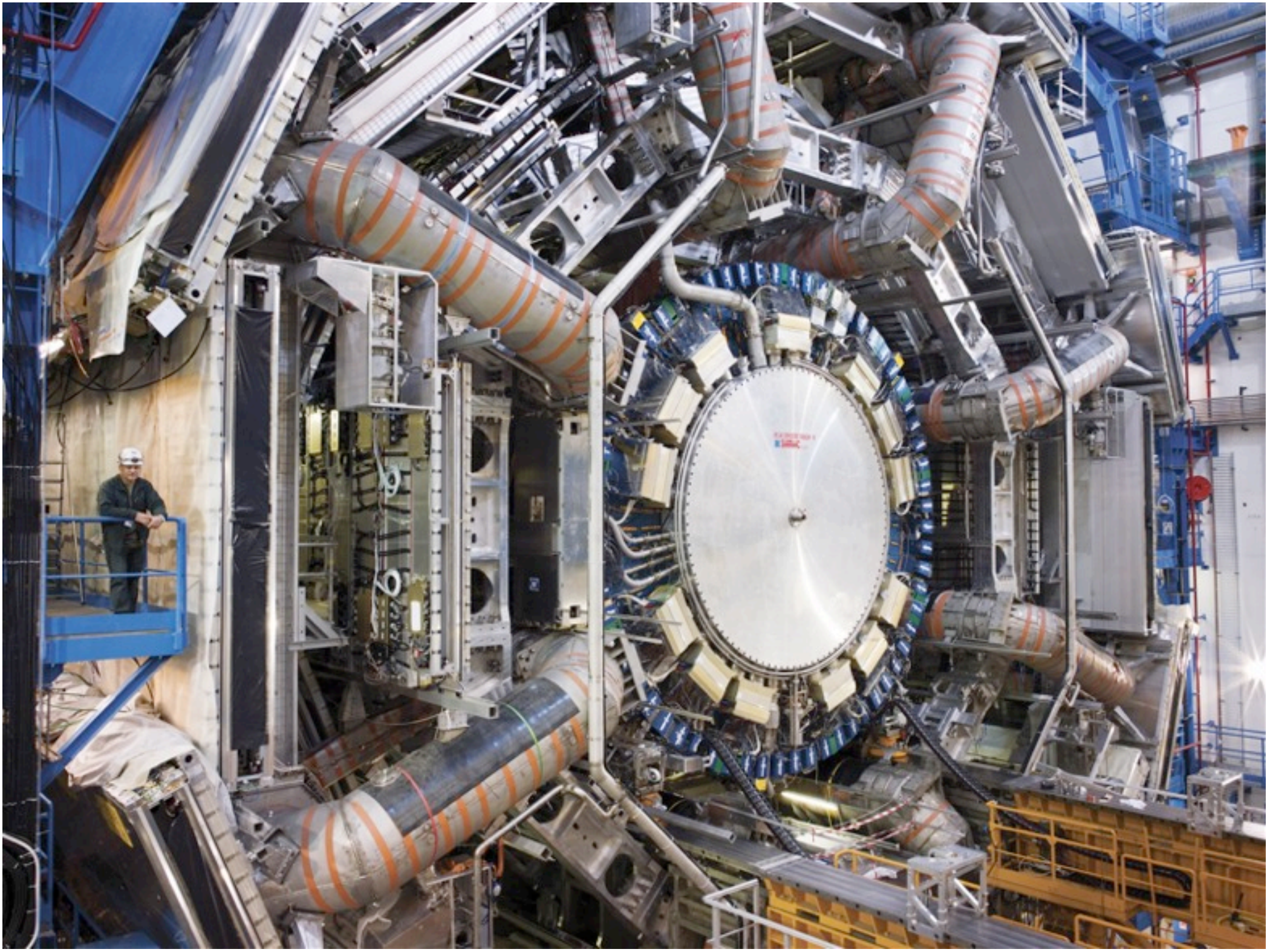
# Really Big Camera!!!

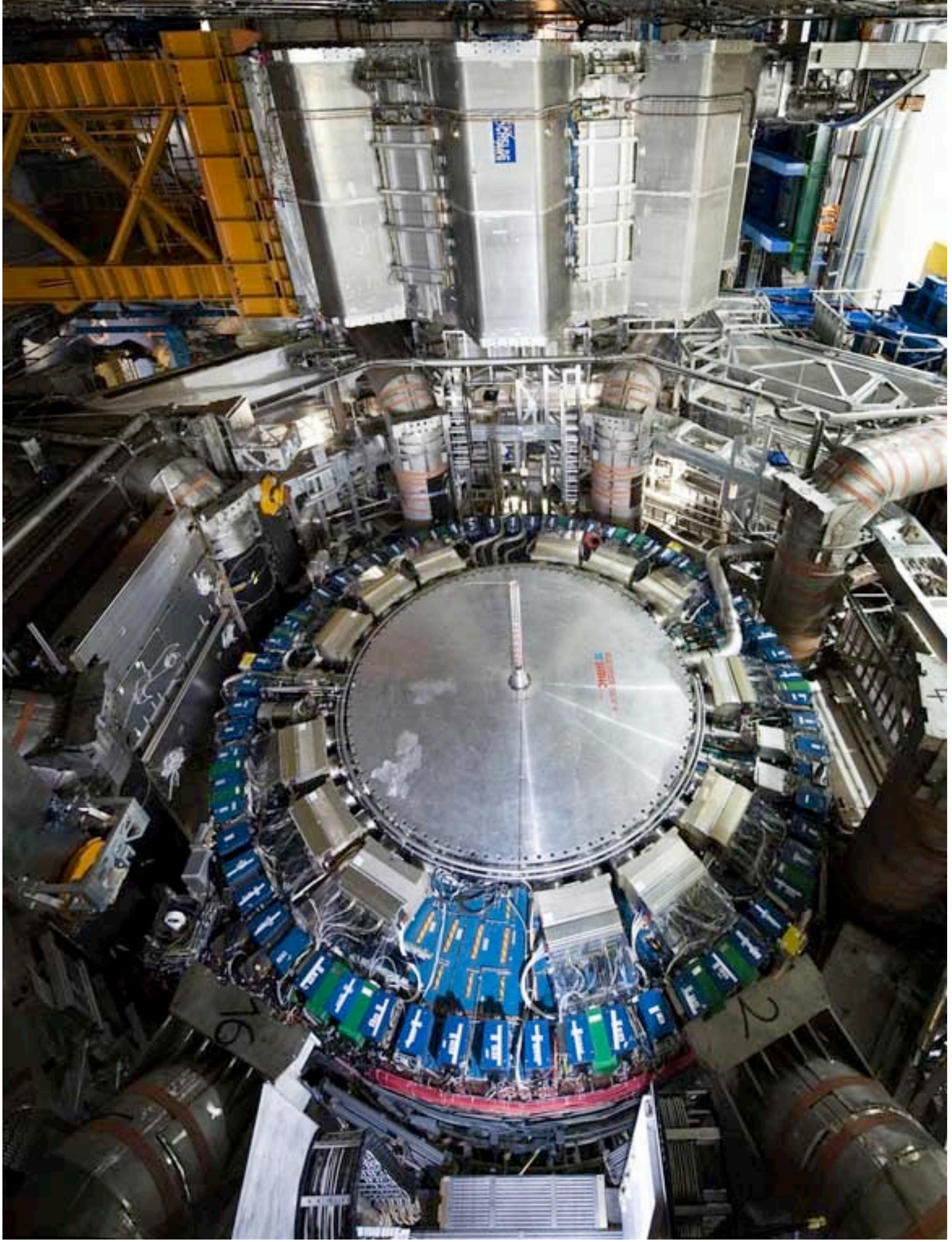


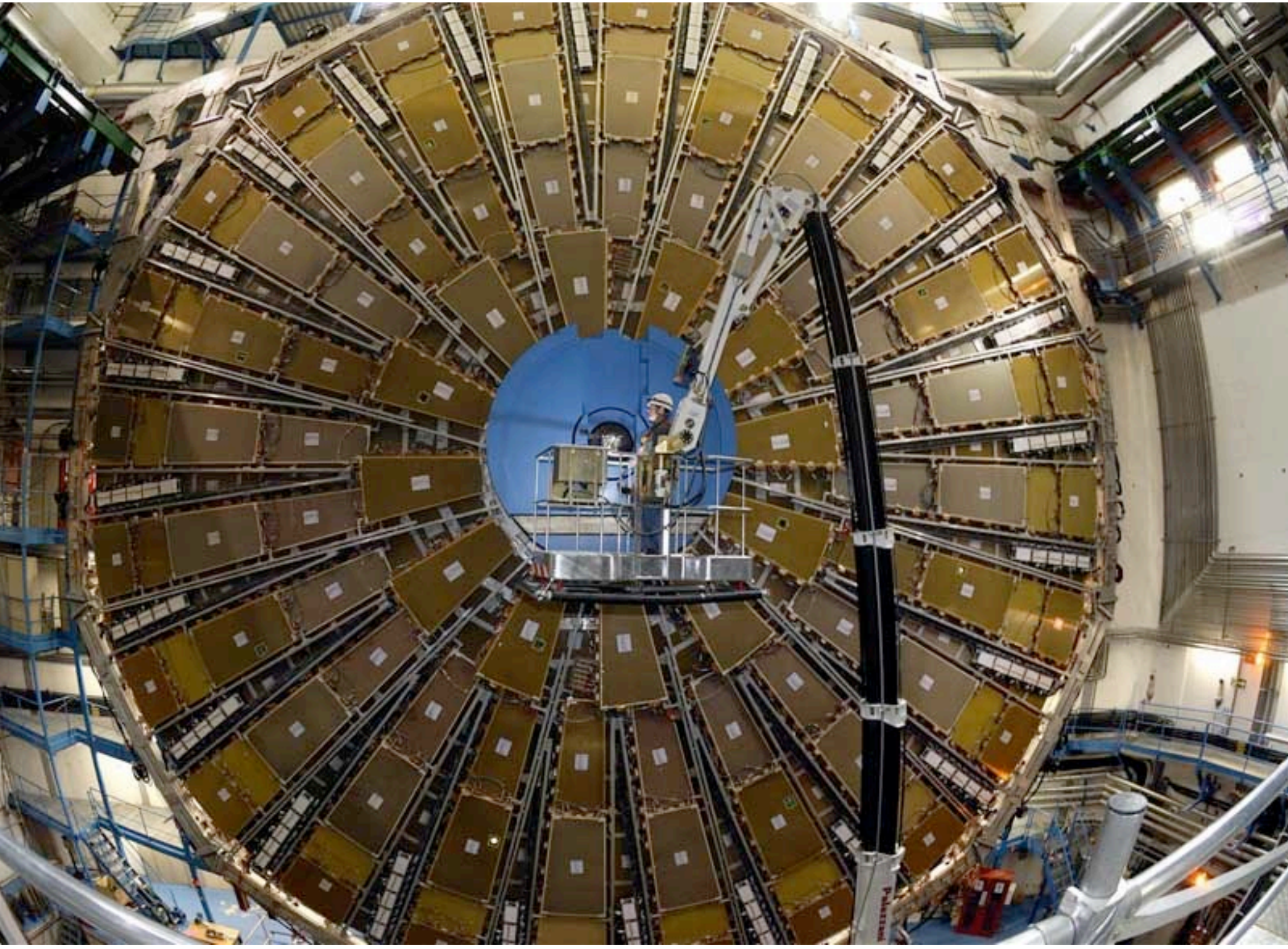
# Really Big Camera!!!



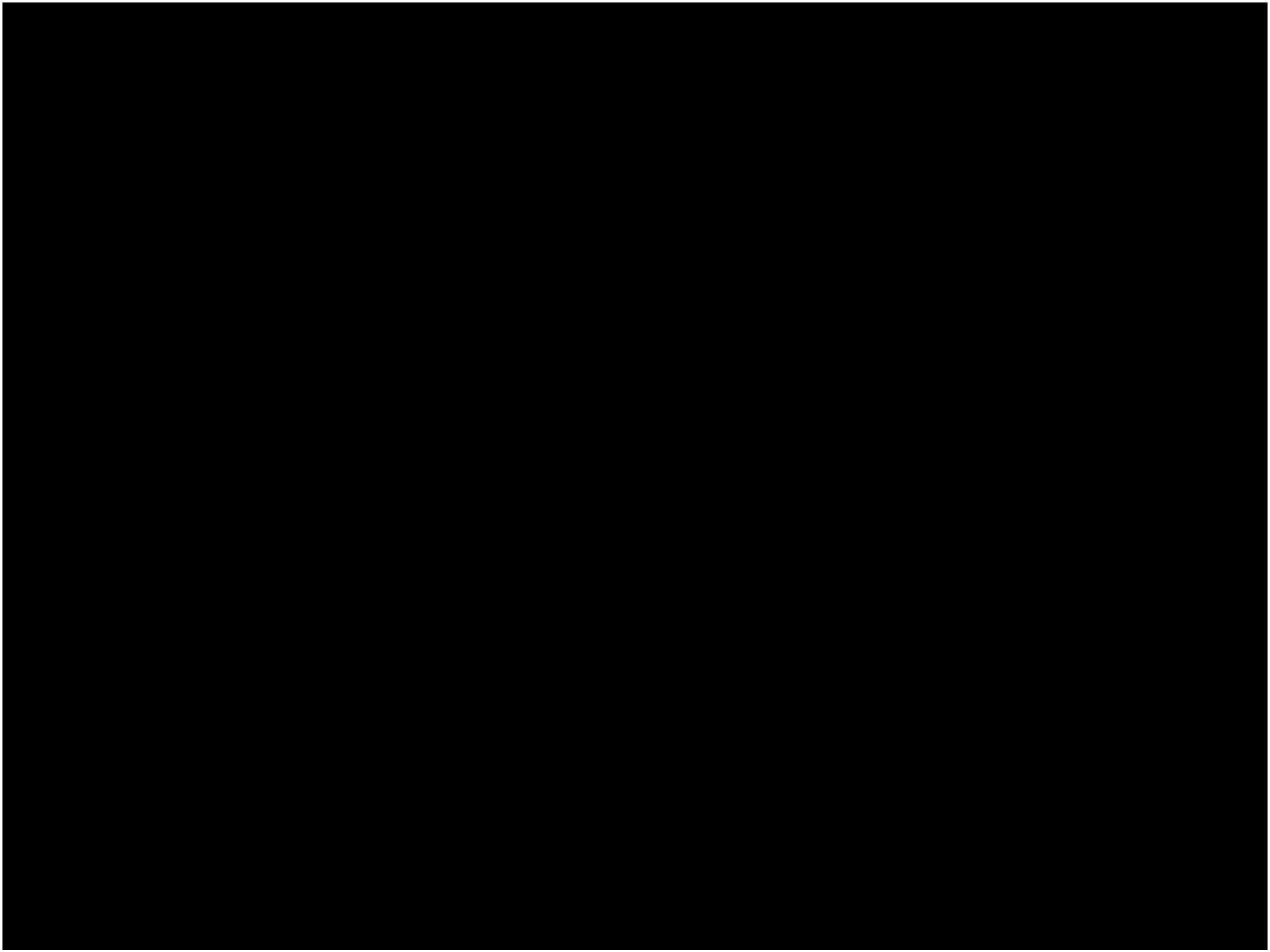


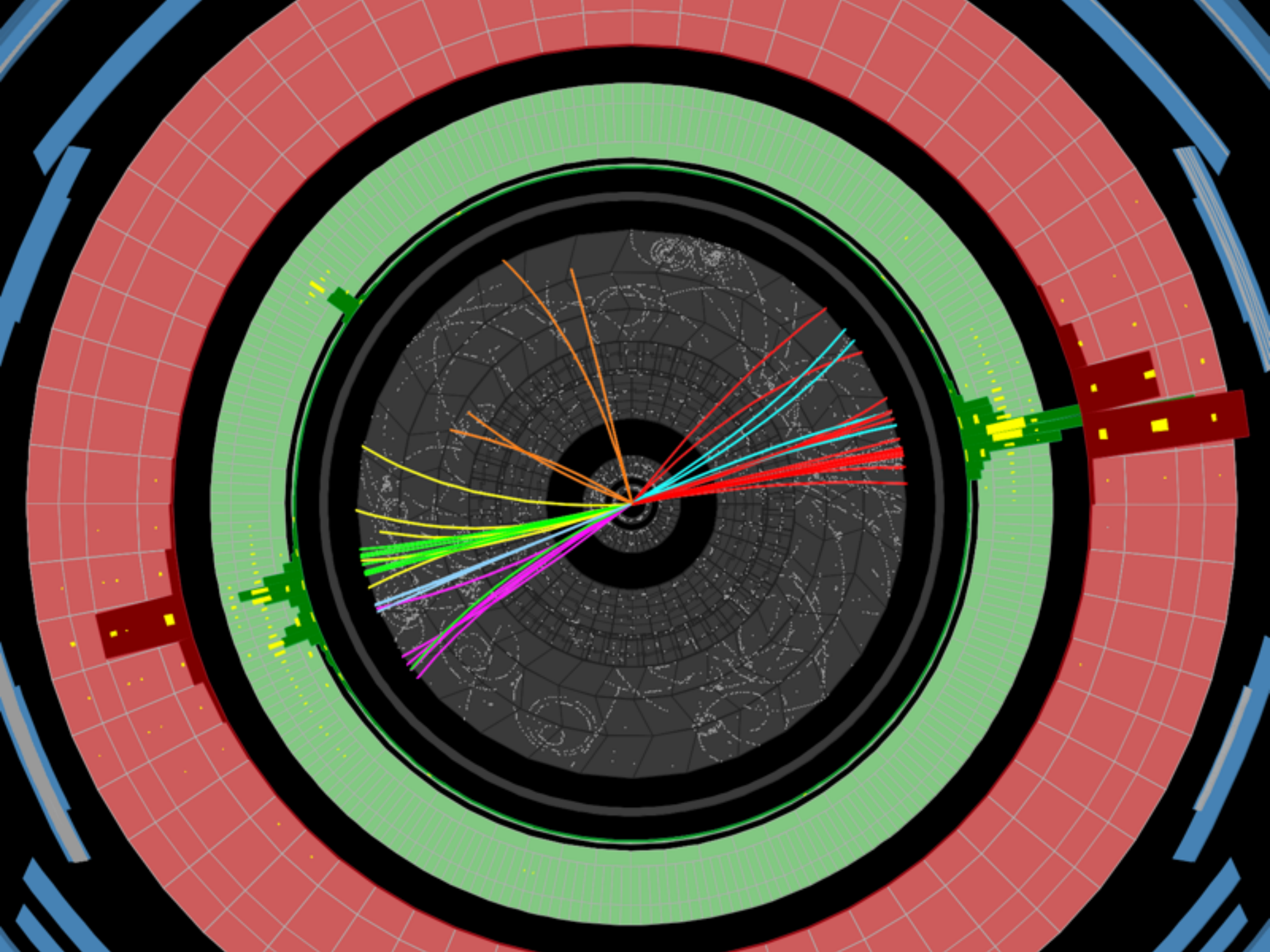


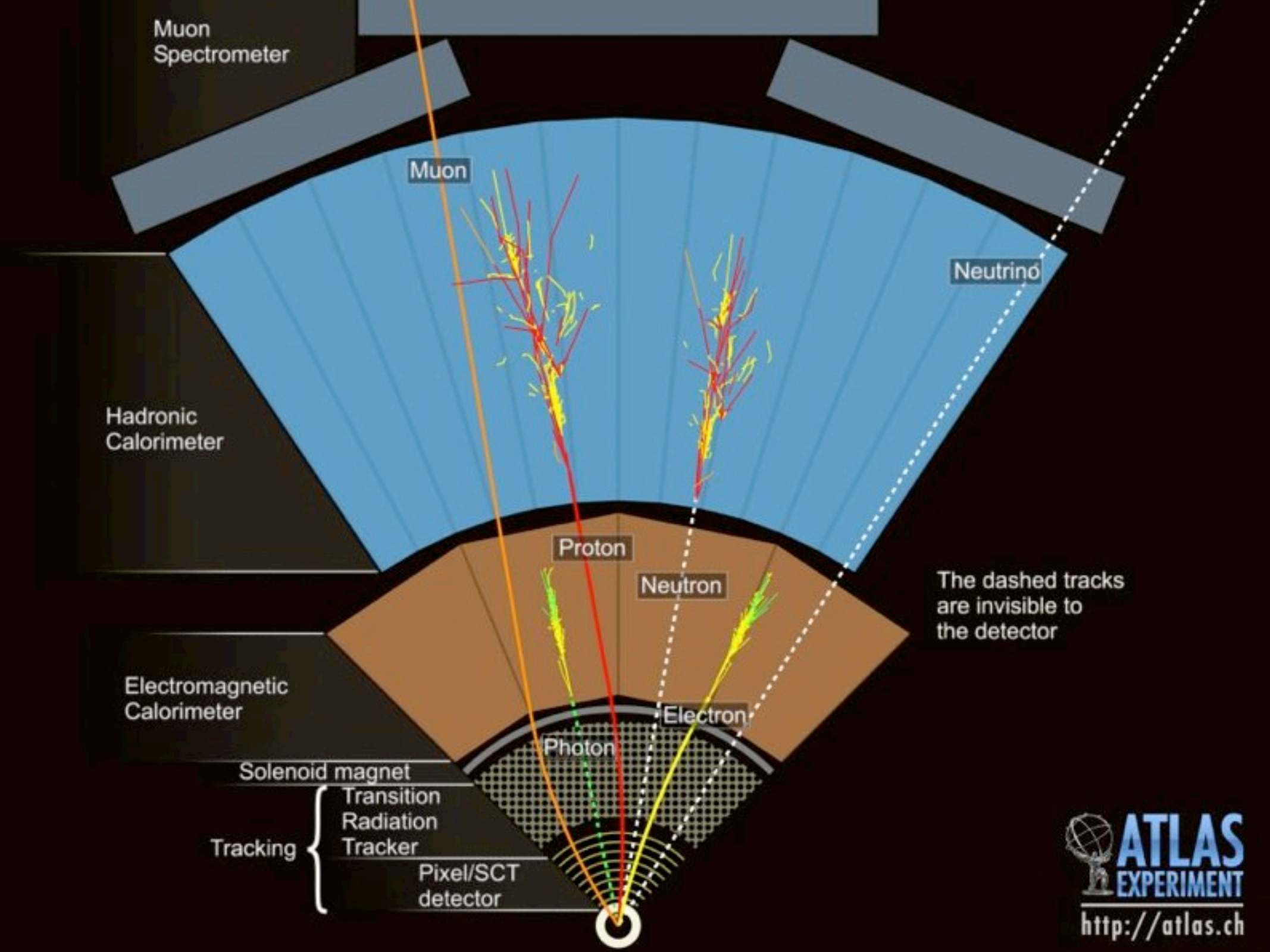


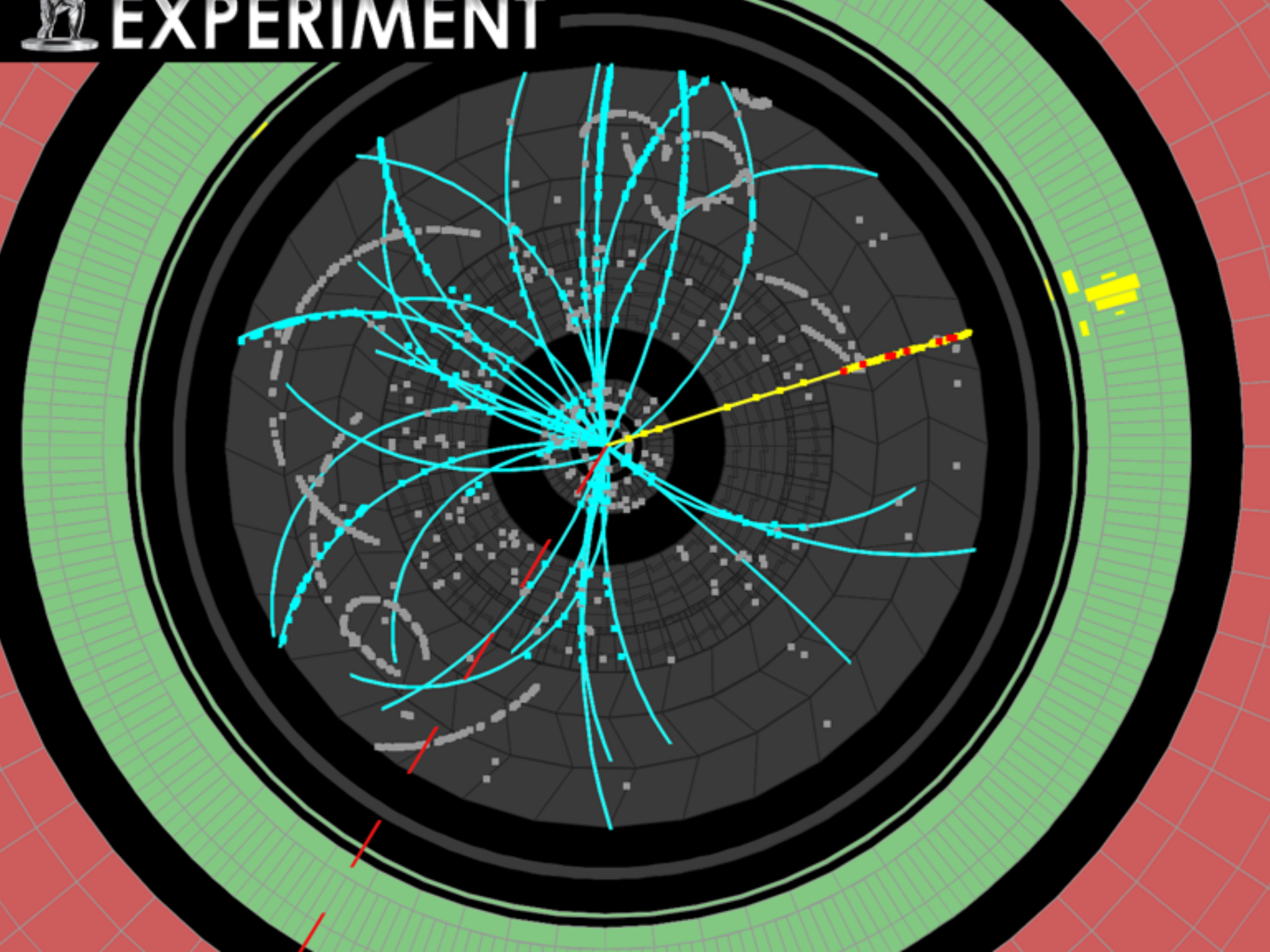


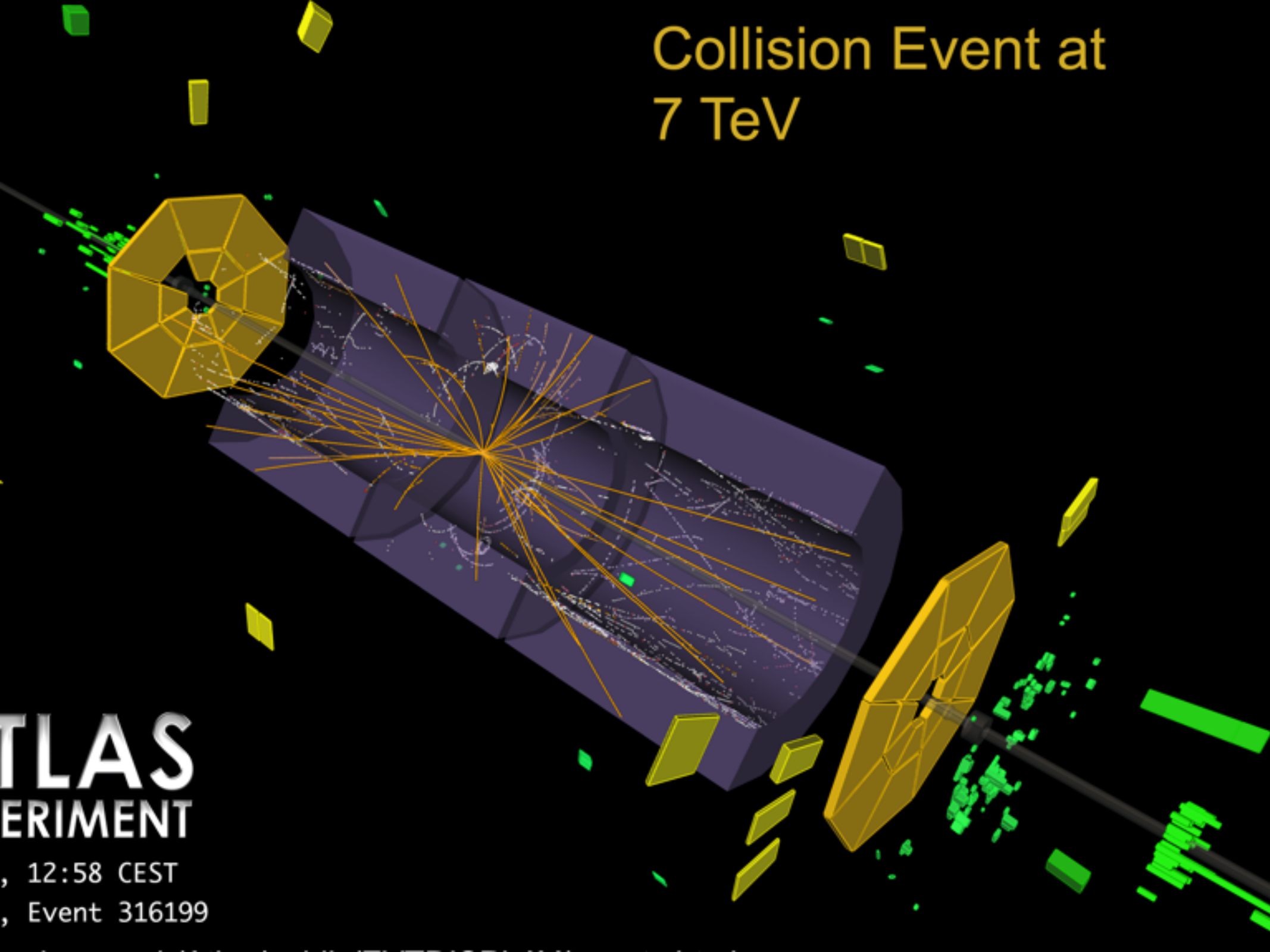

ATLAS
Collaboration

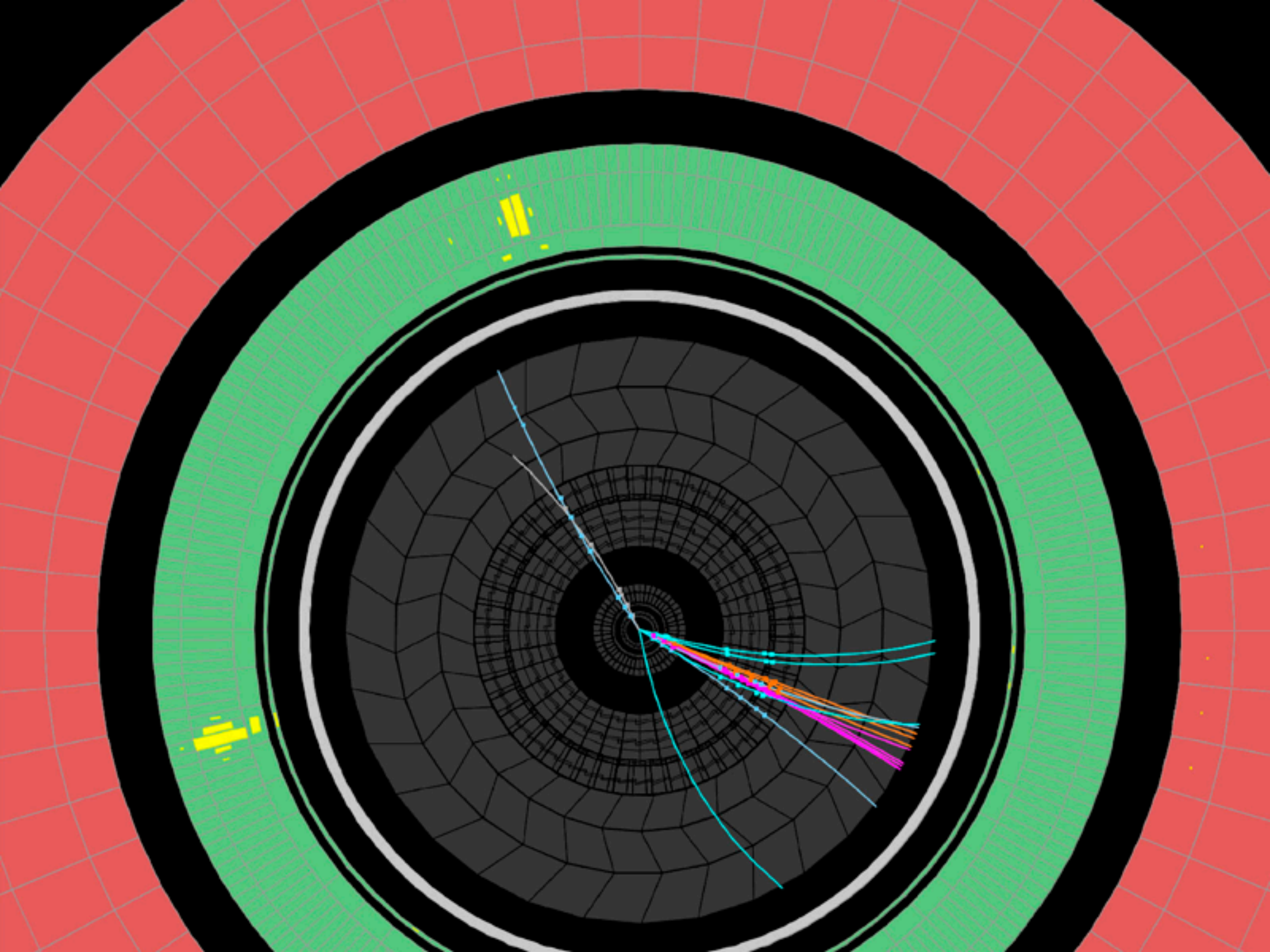


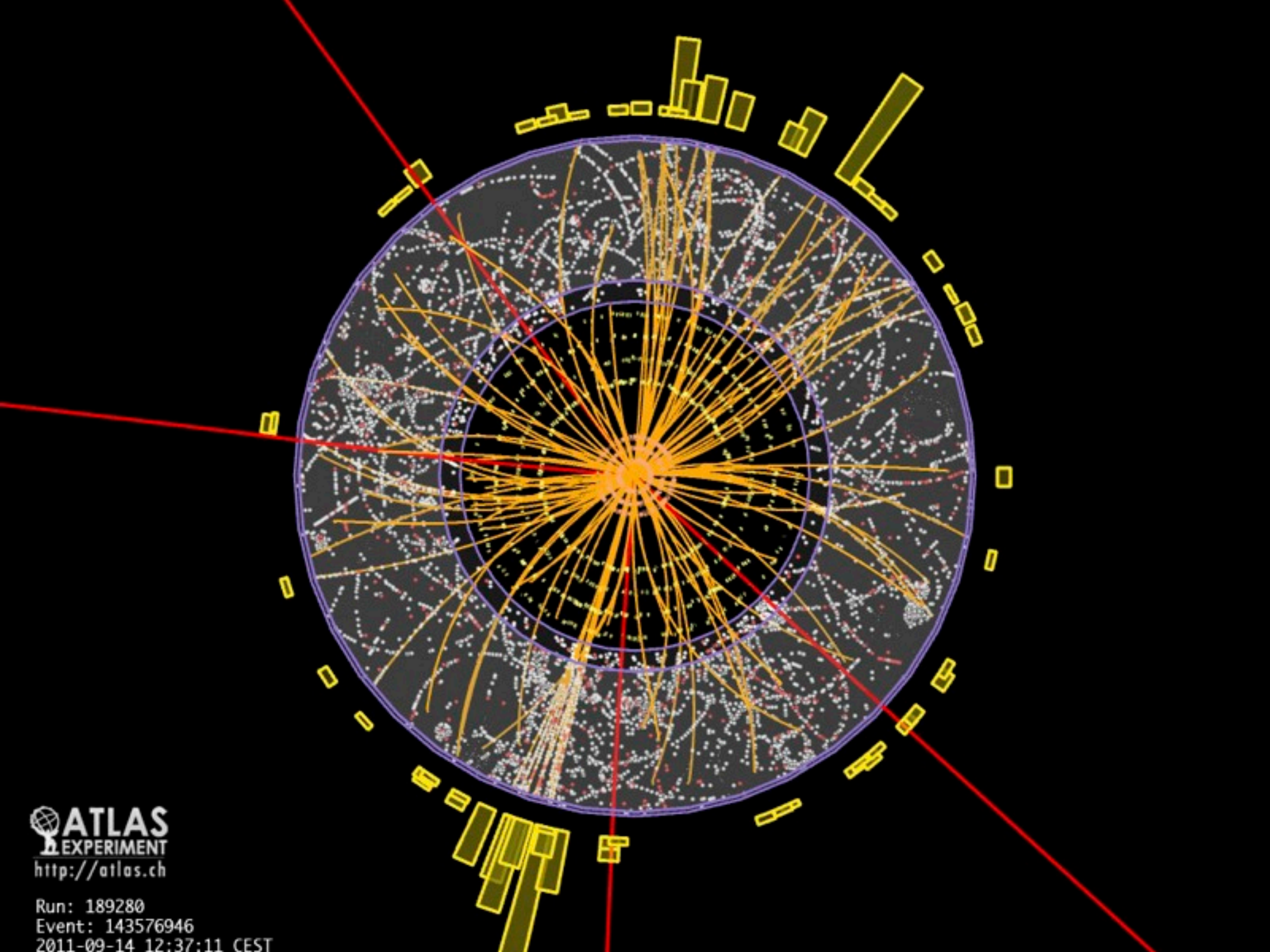



Muon
Spectrometer
Muon
Neutrino
Hadronic
Calorimeter
Proton
Neutron
The dashed tracks
are invisible to
the detector
Electromagnetic
Calorimeter
Electron
Photon
Solenoid magnet
Tracking
Transition
Radiation
Tracker
Pixel/SCT
detector
ATLAS
EXPERIMENT
http://atlas.ch


EXPERIMENT


Collision Event at
7 TeV
TLAS
ERIMENT
, 12:58 CEST
, Event 316199




ATLAS
EXPERIMENT
http://atlas.ch
Run: 189280
Event: 143576946
2011-09-14 12:37:11 CEST

# What do Particle Physicists really do ?

**Everything* that we know:**

Particles + Interactions

# The Particles

e - electron

ν - neutrino

u - up-quark

d - down-quark

γ / graviton / W / Z / gluon

# The Particles

e - electron

ν - neutrino

u - up-quark

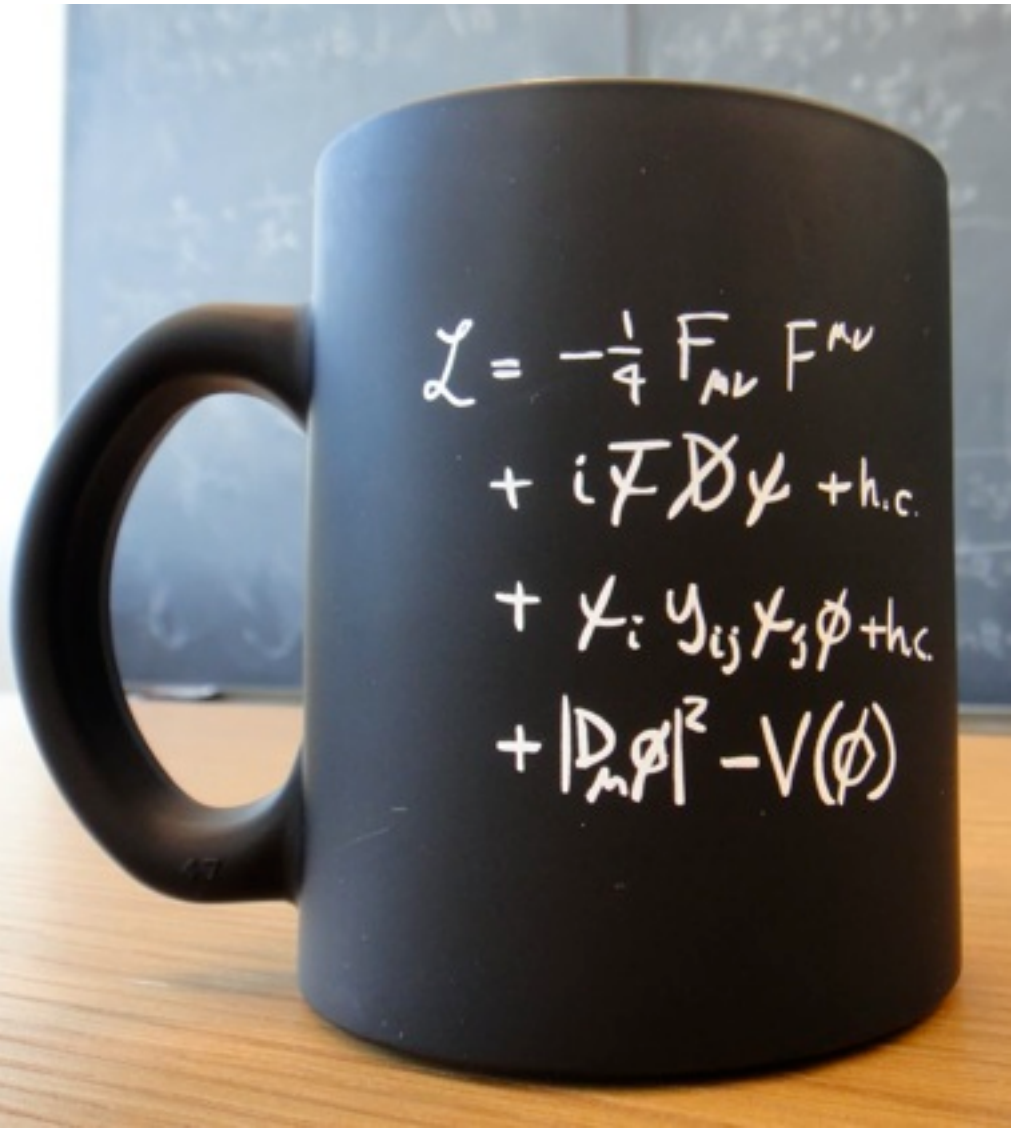
d - down-quark

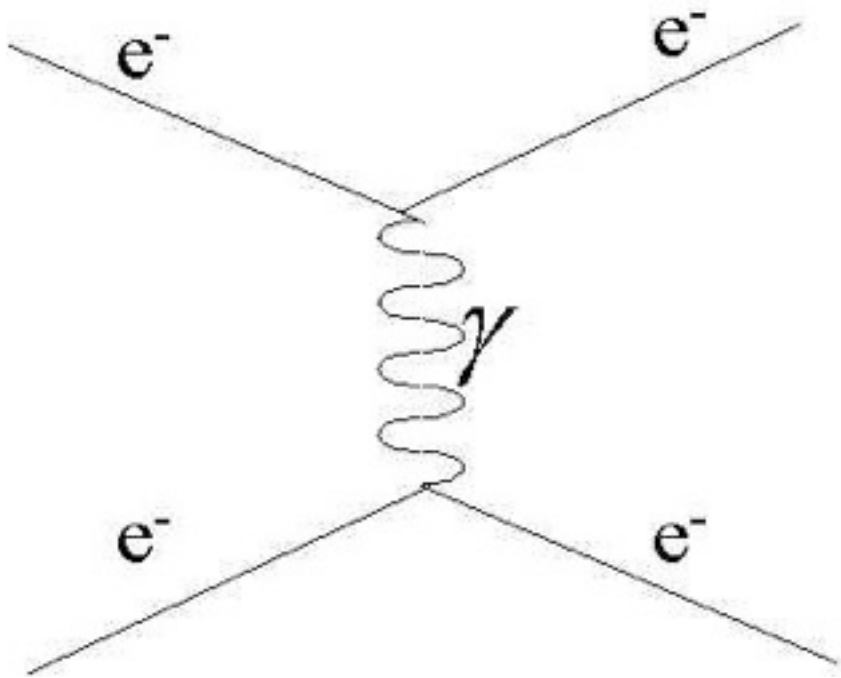
**Essentially all of everything that matters to you.**

- periodic table (chemistry/biology)
- light
- gravity.
- electricity
- mechanics

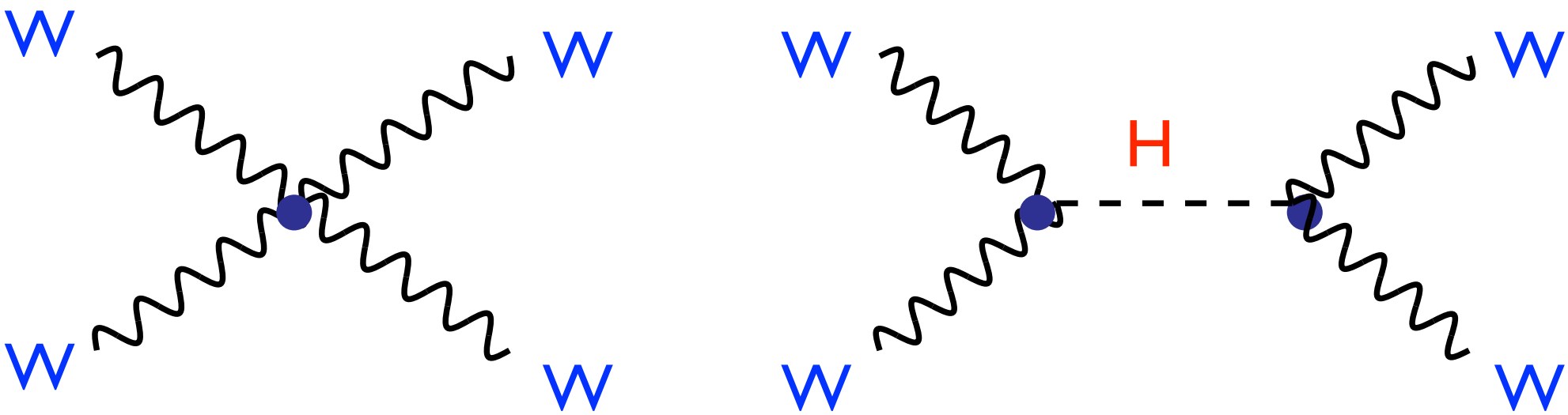
γ / graviton / W / Z / gluon

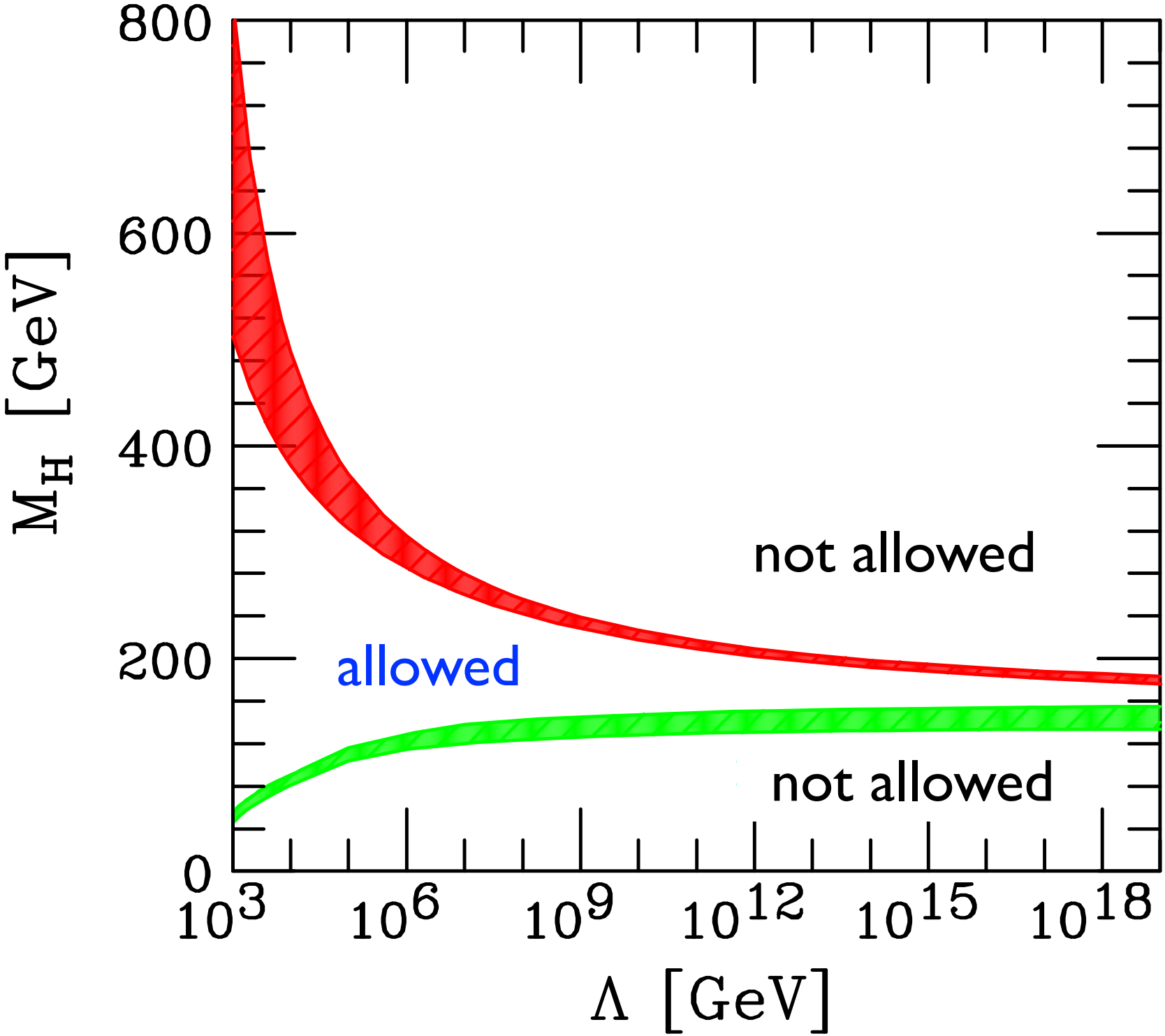
# The Interactions



# The Higgs




800
600
400
200
0
$M_H$ [GeV]
not allowed
allowed
not allowed
$10^3$
$10^6$
$10^9$
$10^{12}$
$10^{15}$
$10^{18}$
$\Lambda$ [GeV]

# The Particles

e - electron

ν - neutrino

u - up-quark

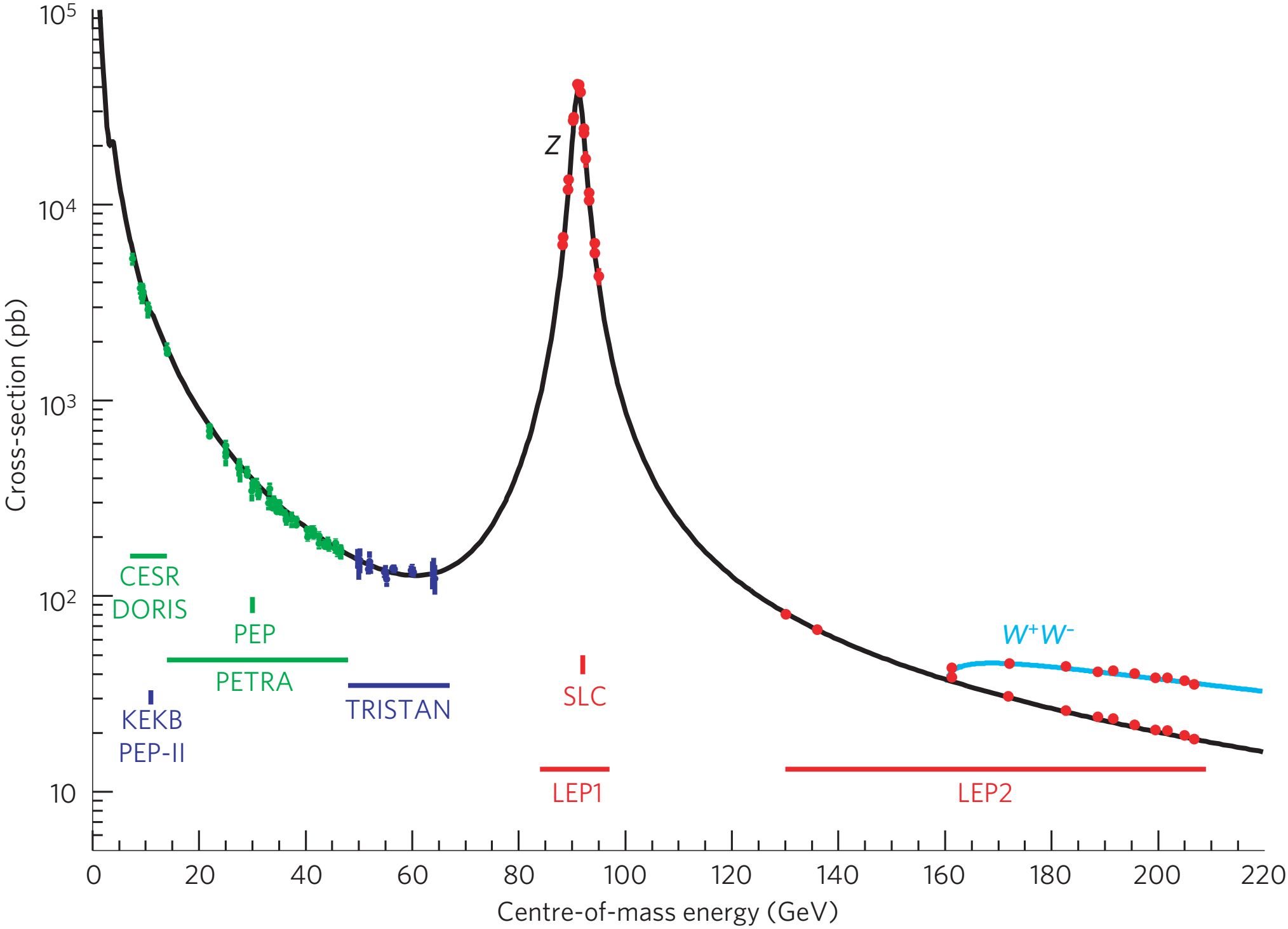
d - down-quark

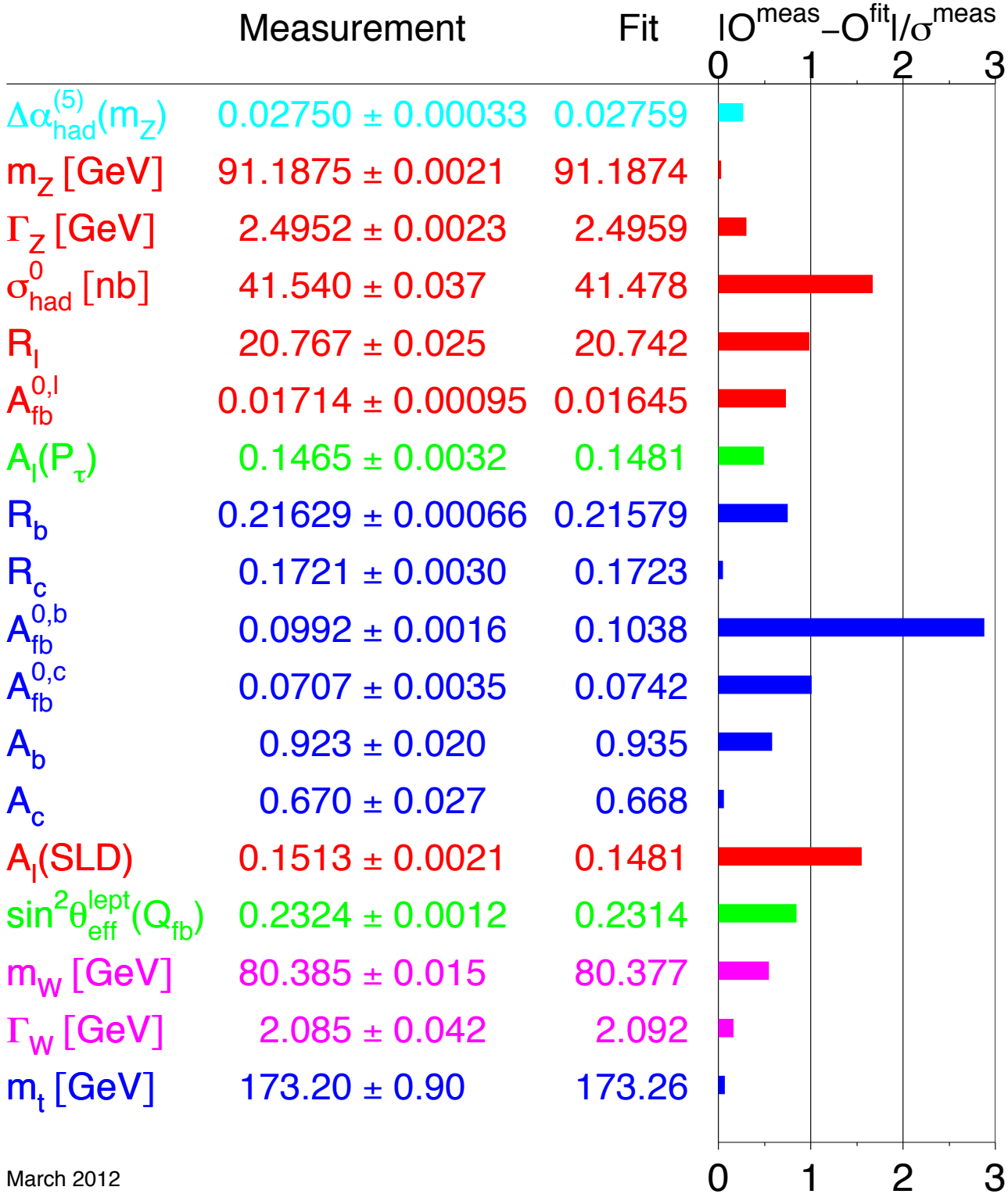
γ / graviton / W / Z / gluon / Higgs

# The Particles

| | | |
|---|---|---|
| e - electron | μ - muon | τ - tauon |
| ν - neutrino | ν - neutrino | ν - neutrino |
| u - up-quark | c - charm-quark | t - top-quark |
| d - down-quark | s - strange-quark | b - bottom-quark |

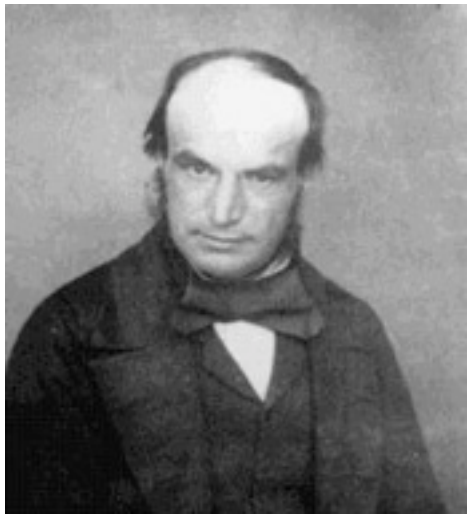
γ / graviton / W / Z / gluon / Higgs


Cross-section (pb)
$10^5$
$10^4$
$10^3$
$10^2$
10
Z
CESR
DORIS
PEP
PETRA
KEKB
PEP-II
TRISTAN
SLC
LEP1
LEP2
$W^+W^-$
0
20
40
60
80
100
120
140
160
180
200
220
Centre-of-mass energy (GeV)

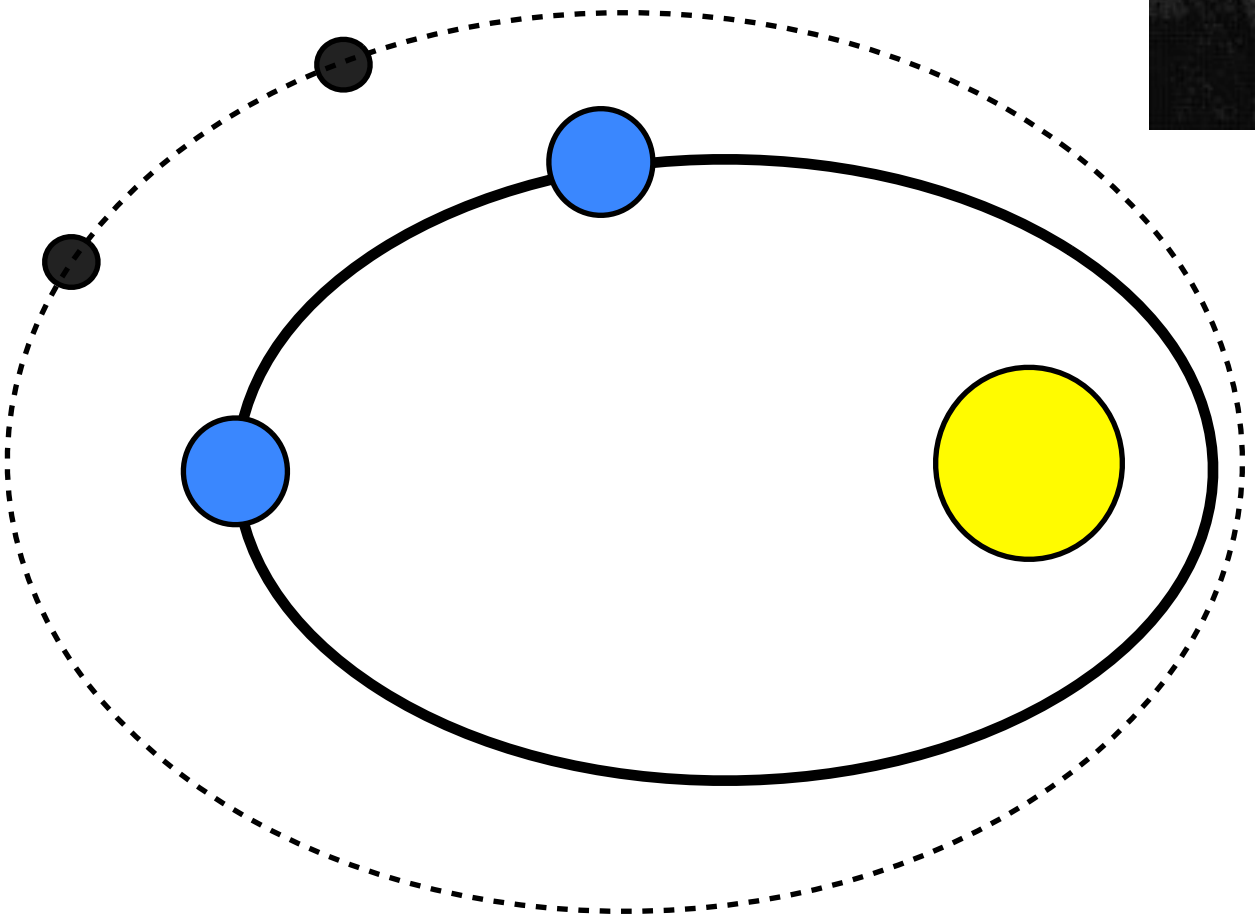

Measurement
Fit
$|O^{meas} - O^{fit}|/\sigma^{meas}$
0
1
2
3
$\Delta\alpha^{(5)}_{had}(m_Z)$ 0.02750 ± 0.00033 0.02759
$m_Z$ [GeV] 91.1875 ± 0.0021 91.1874
$\Gamma_Z$ [GeV] 2.4952 ± 0.0023 2.4959
$\sigma^0_{had}$ [nb] 41.540 ± 0.037 41.478
$R_l$ 20.767 ± 0.025 20.742
$A^{0,l}_{fb}$ 0.01714 ± 0.00095 0.01645
$A_l(P_\tau)$ 0.1465 ± 0.0032 0.1481
$R_b$ 0.21629 ± 0.00066 0.21579
$R_c$ 0.1721 ± 0.0030 0.1723
$A^{0,b}_{fb}$ 0.0992 ± 0.0016 0.1038
$A^{0,c}_{fb}$ 0.0707 ± 0.0035 0.0742
$A_b$ 0.923 ± 0.020 0.935
$A_c$ 0.670 ± 0.027 0.668
$A_l$(SLD) 0.1513 ± 0.0021 0.1481
$\sin^2\theta^{lept}_{eff}(Q_{fb})$ 0.2324 ± 0.0012 0.2314
$m_W$ [GeV] 80.385 ± 0.015 80.377
$\Gamma_W$ [GeV] 2.085 ± 0.042 2.092
$m_t$ [GeV] 173.20 ± 0.90 173.26
March 2012

# Neptune

John Couch Adams

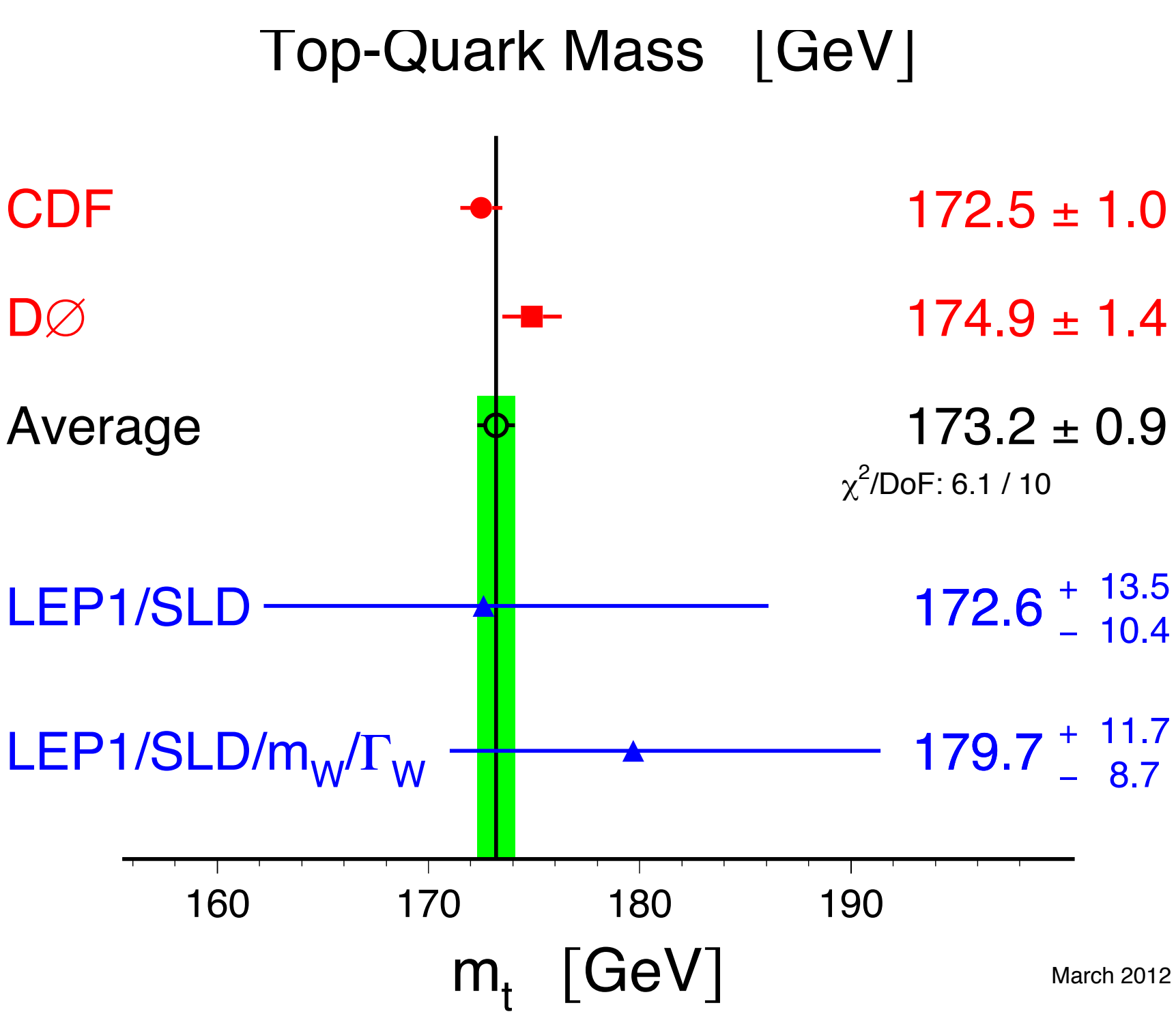


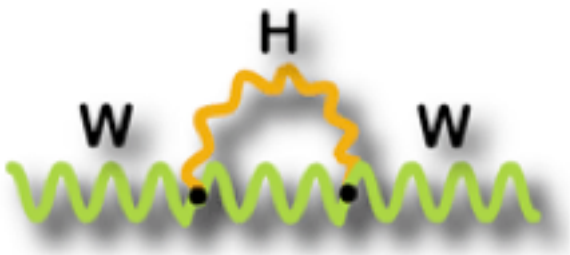
Urbain Jean-Joseph
Le Verrier

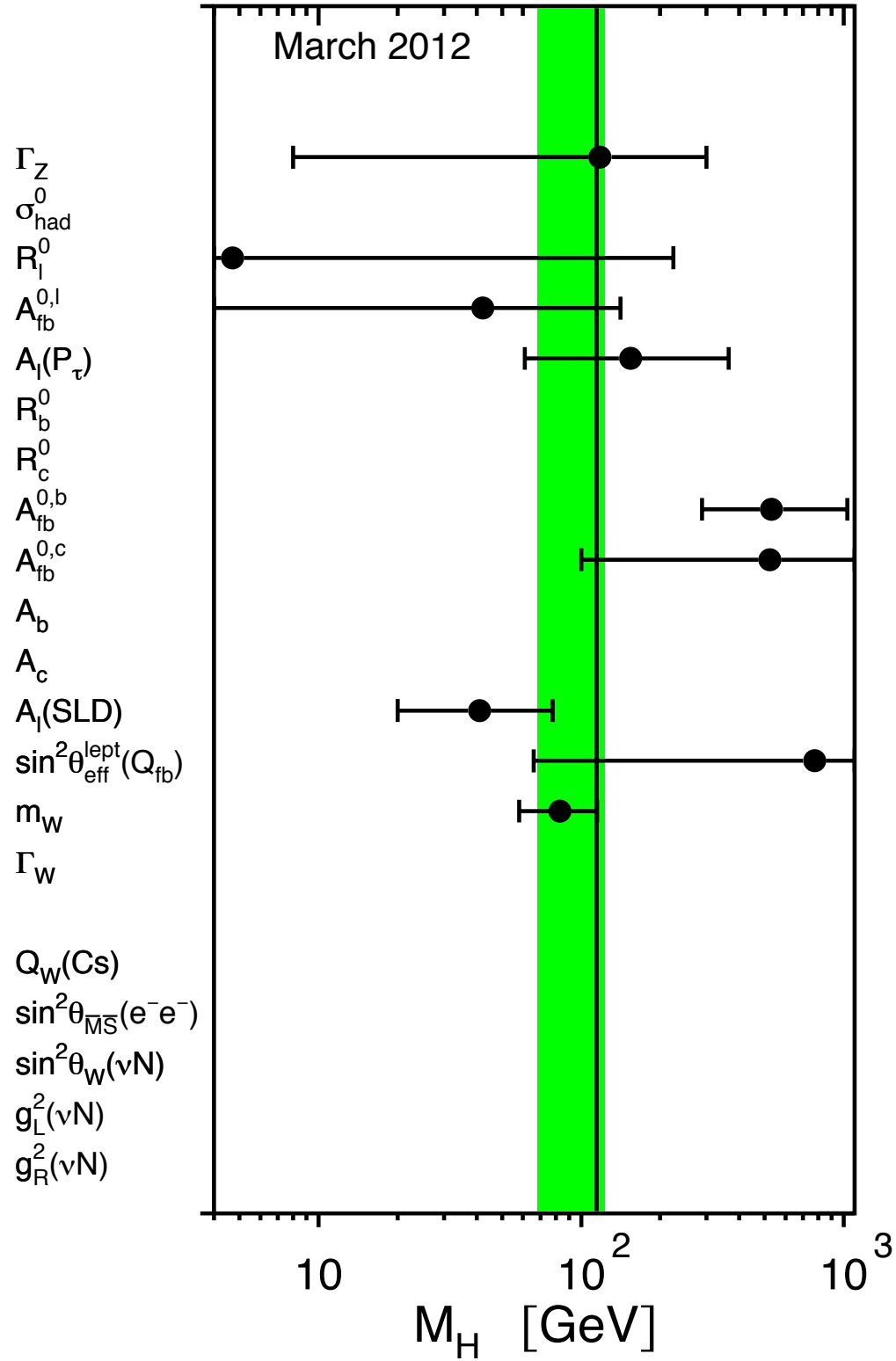


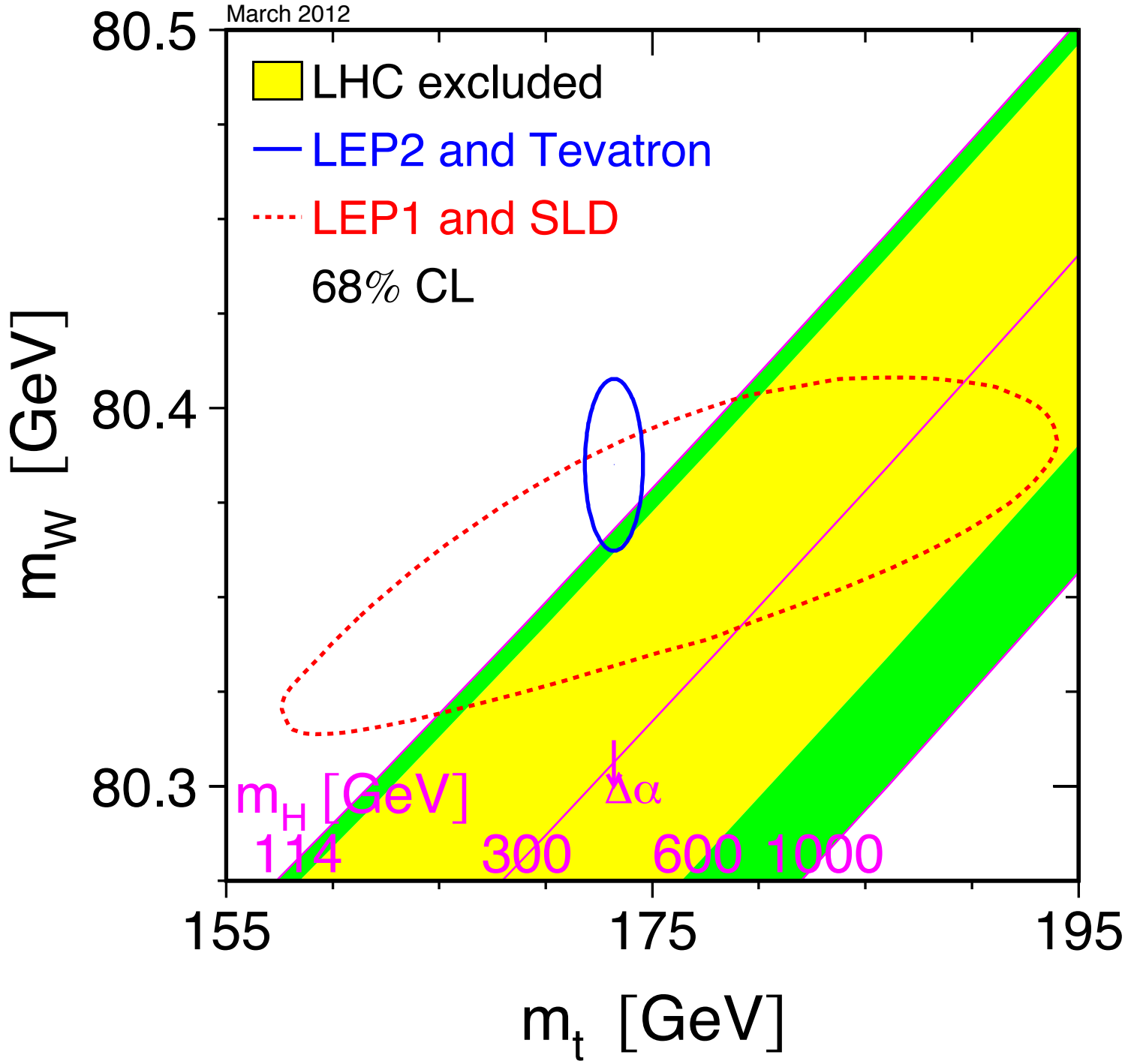
**Predicted 1845**

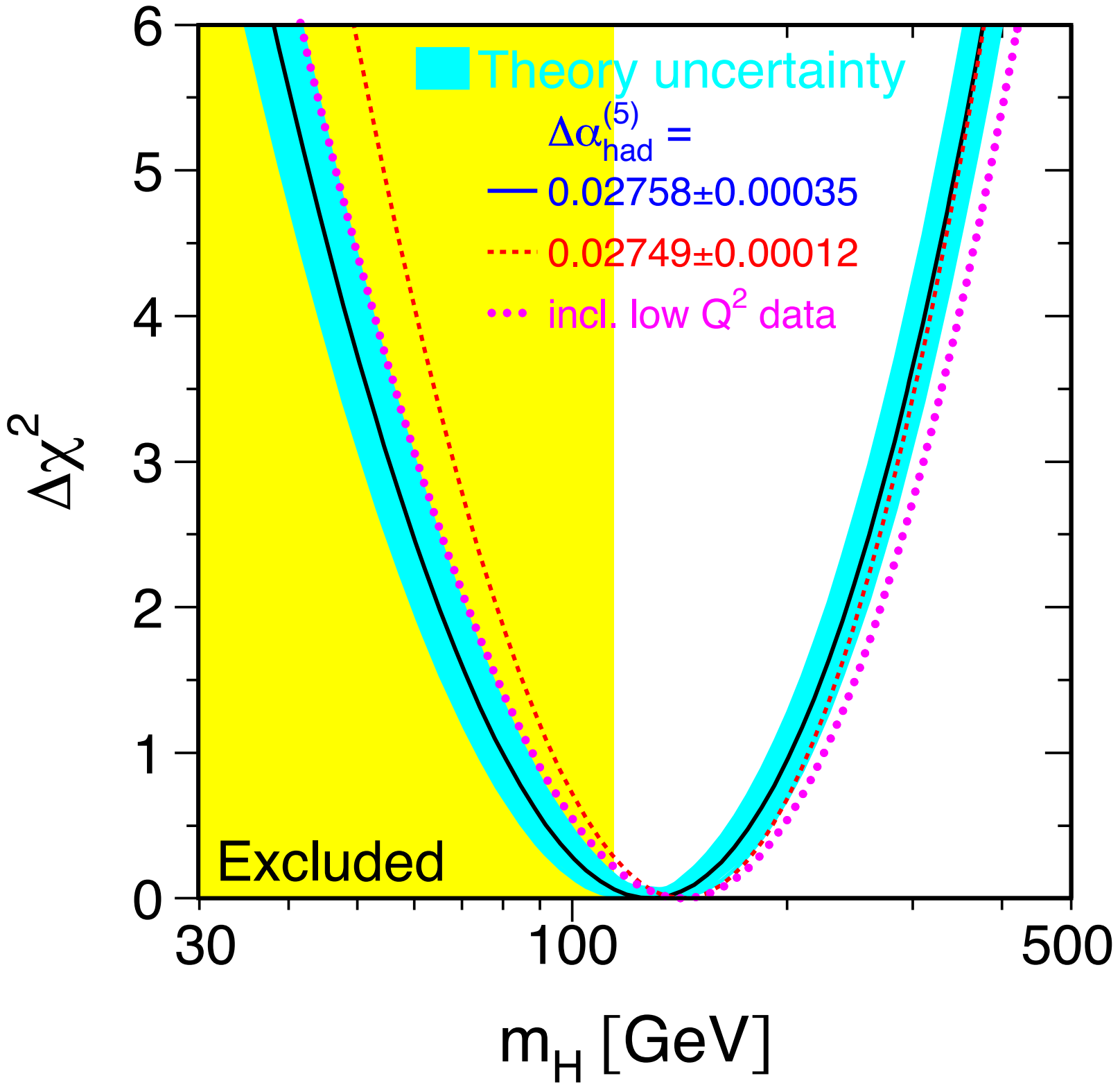
**Observed 1846**

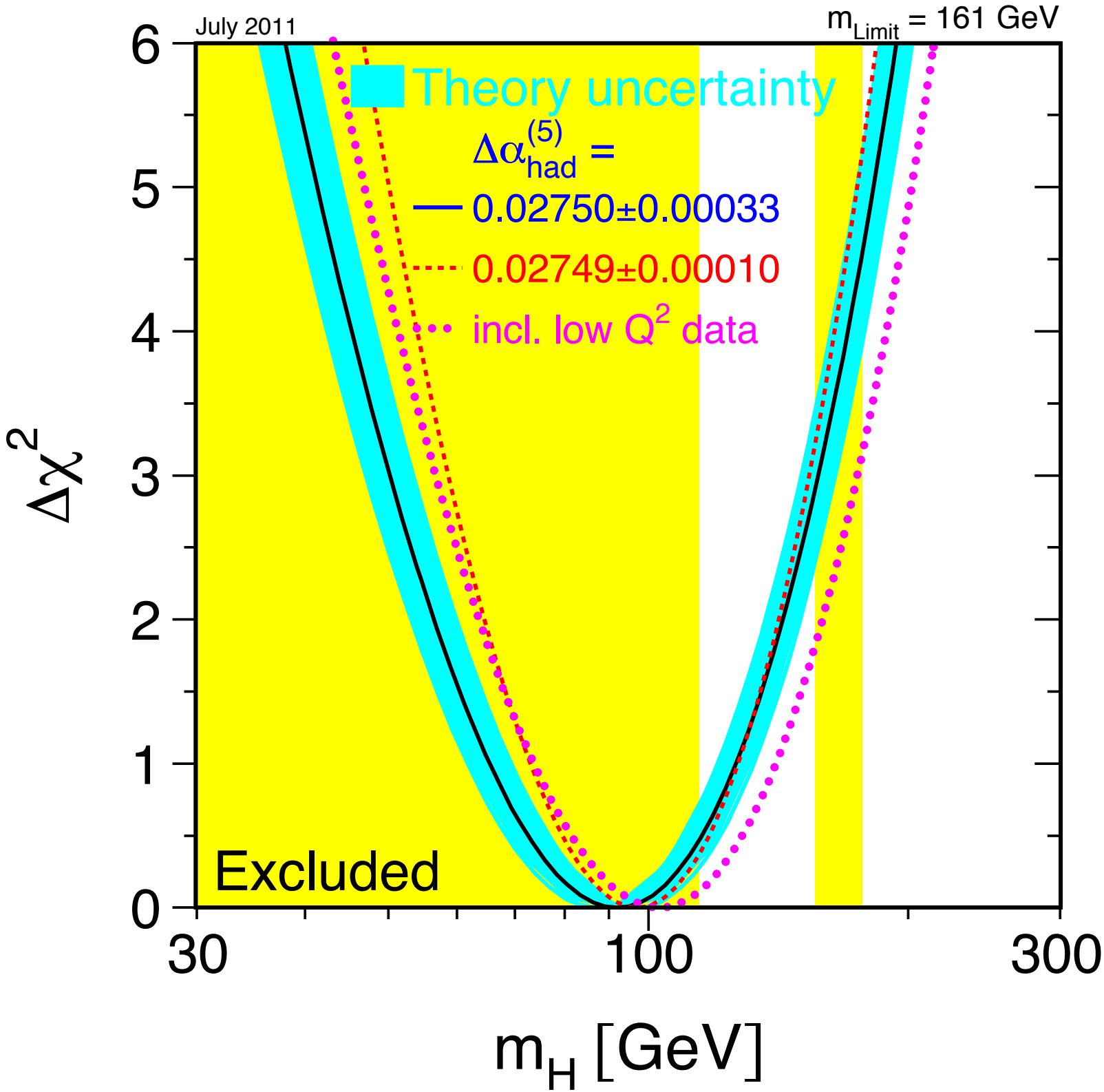

Top-Quark Mass [GeV]
CDF
172.5 ± 1.0
DØ
174.9 ± 1.4
Average
173.2 ± 0.9
χ2/DoF: 6.1 / 10
LEP1/SLD
172.6 + 13.5 − 10.4
LEP1/SLD/mW/ΓW
179.7 + 11.7 − 8.7
160
170
180
190
mt [GeV]
March 2012

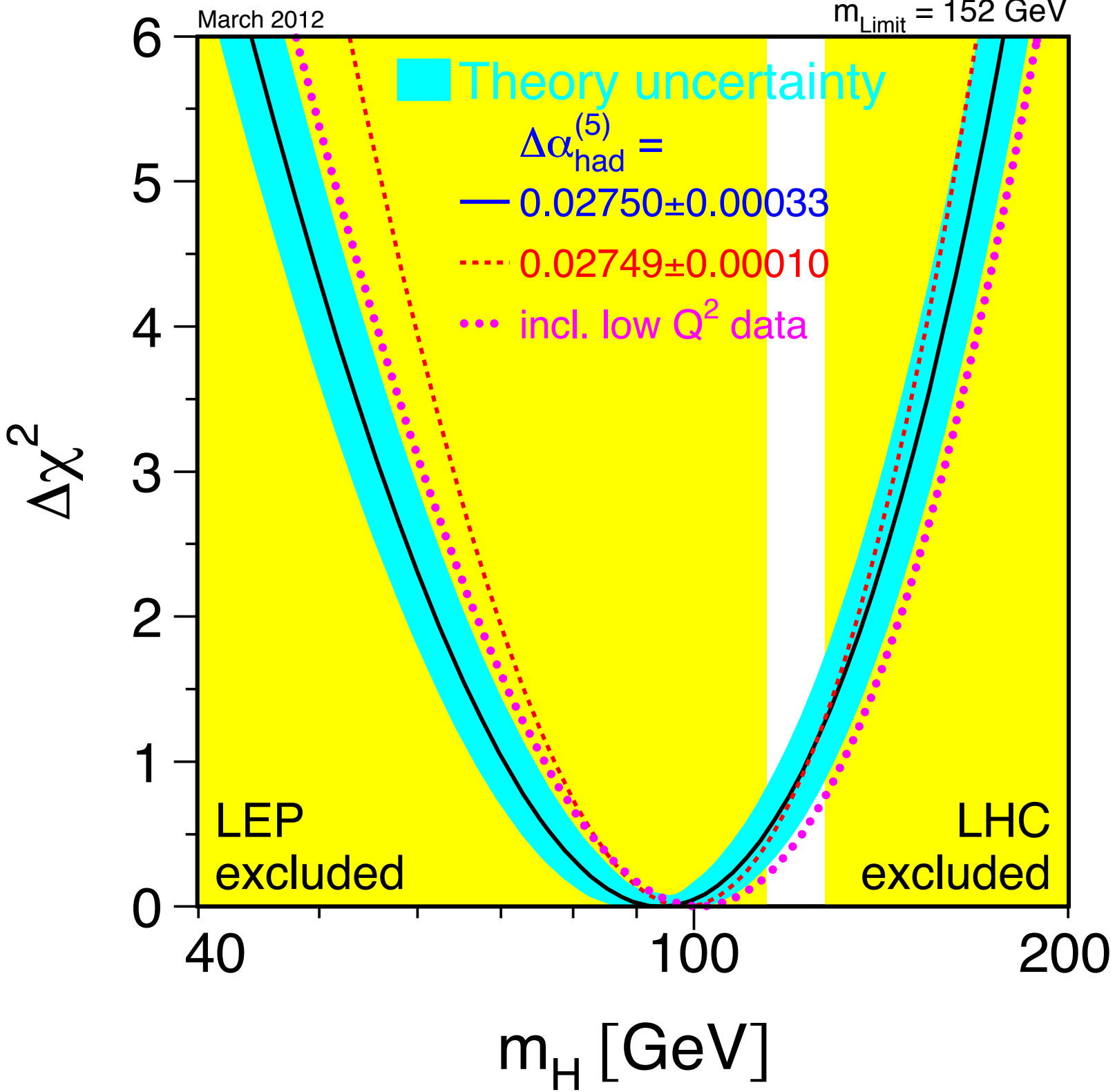

H
W
W

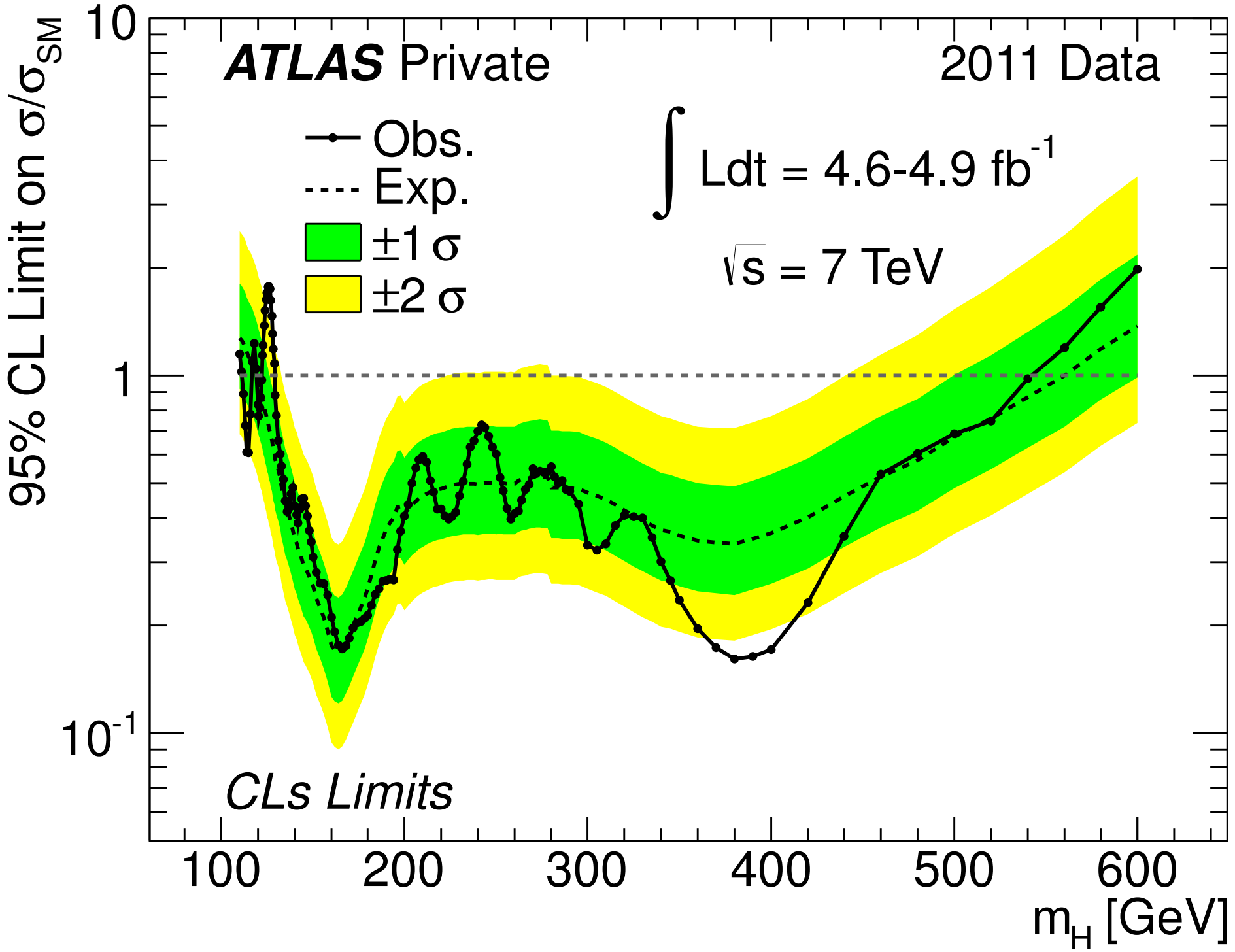

March 2012
$\Gamma_Z$
$\sigma^0_{had}$
$R^0_l$
$A^{0,l}_{fb}$
$A_l(P_\tau)$
$R^0_b$
$R^0_c$
$A^{0,b}_{fb}$
$A^{0,c}_{fb}$
$A_b$
$A_c$
$A_l$(SLD)
$\sin^2\theta^{lept}_{eff}(Q_{fb})$
$m_W$
$\Gamma_W$
$Q_W$(Cs)
$\sin^2\theta_{\overline{MS}}(e^-e^-)$
$\sin^2\theta_W(\nu N)$
$g^2_L(\nu N)$
$g^2_R(\nu N)$
10
$10^2$
$10^3$
$M_H$ [GeV]

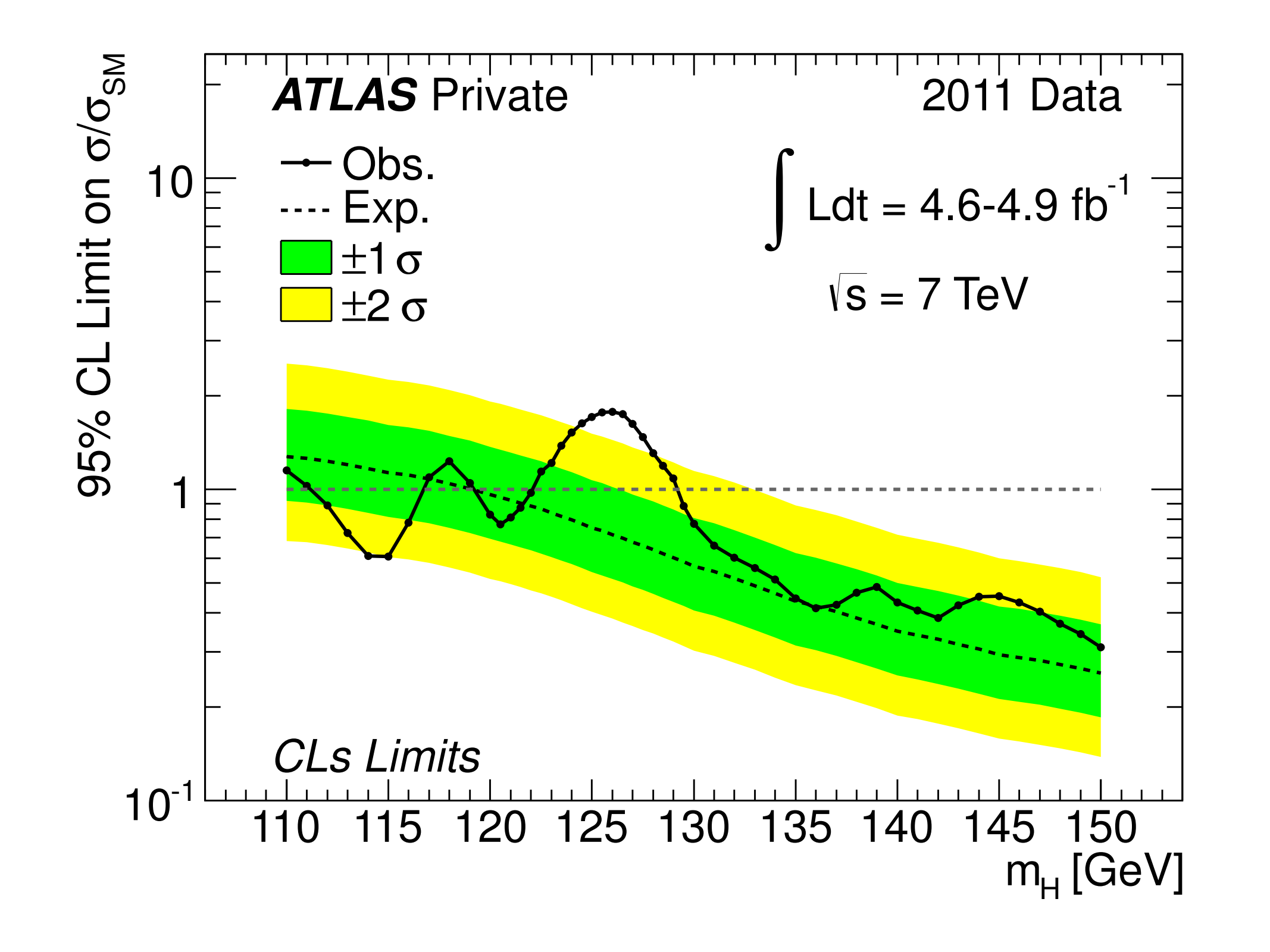

March 2012
80.5
80.4
80.3
LHC excluded
LEP2 and Tevatron
LEP1 and SLD
68% CL
m_W [GeV]
m_H [GeV]
114
300
600
1000
Δα
155
175
195
m_t [GeV]

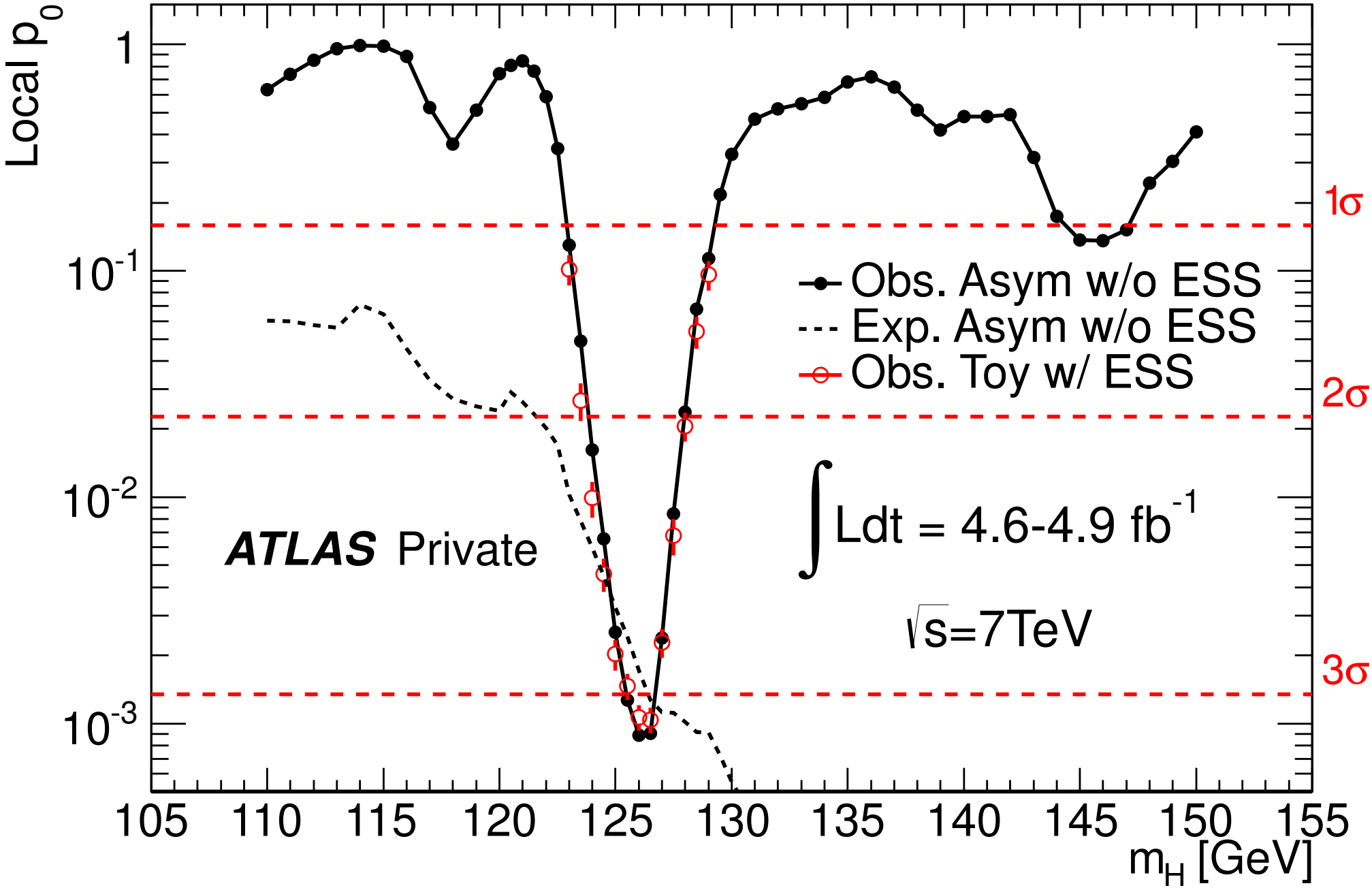

Theory uncertainty
$\Delta\alpha^{(5)}_{had}$ =
0.02758±0.00035
0.02749±0.00012
incl. low $Q^2$ data
Excluded
$\Delta\chi^2$
$m_H$ [GeV]
0
1
2
3
4
5
6
30
100
500

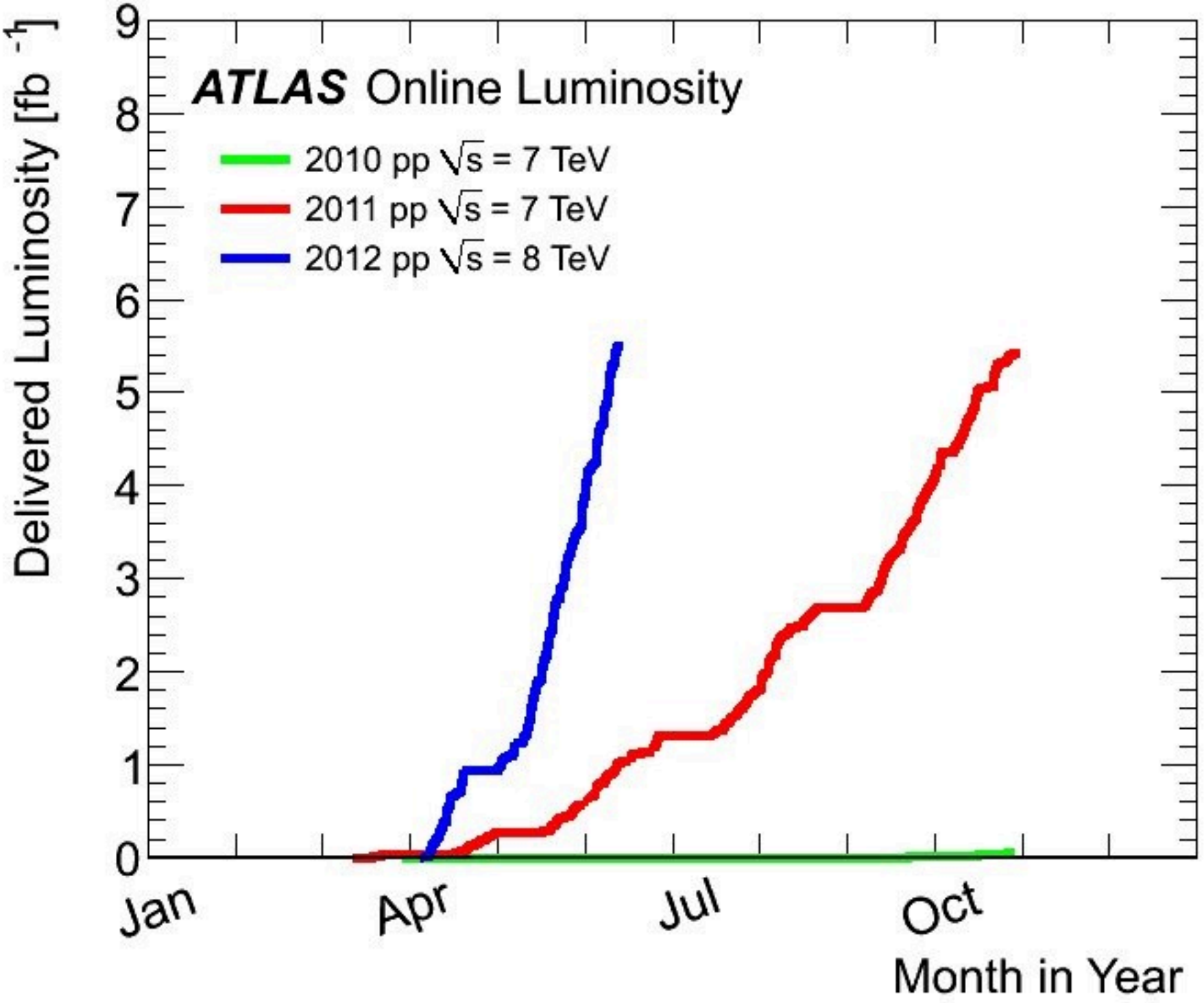

July 2011
$m_{Limit}$ = 161 GeV
Theory uncertainty
$\Delta\alpha^{(5)}_{had}$ =
0.02750±0.00033
0.02749±0.00010
incl. low $Q^2$ data
Excluded
$\Delta\chi^2$
$m_H$ [GeV]
0
1
2
3
4
5
6
30
100
300

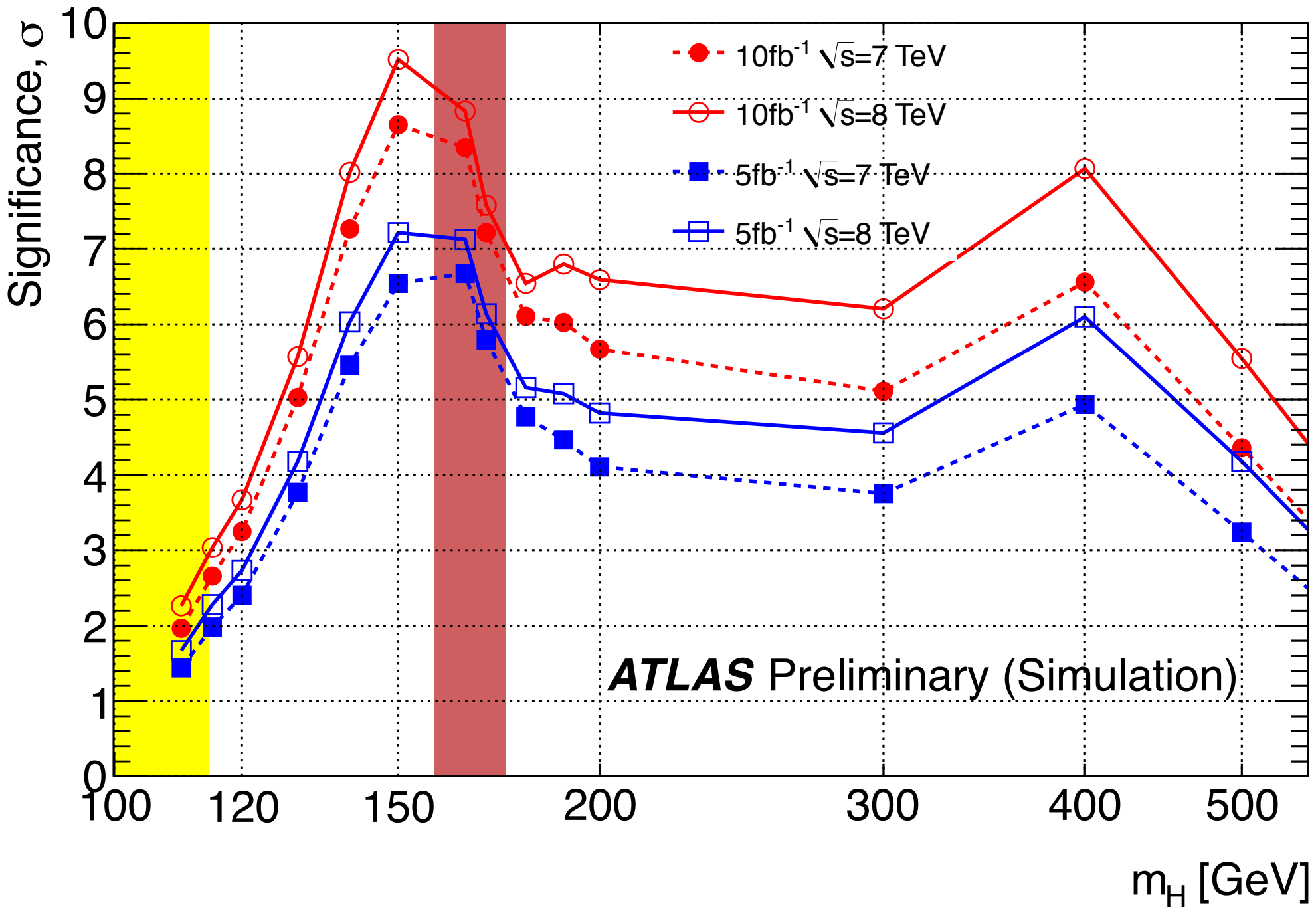

March 2012
$m_{Limit}$ = 152 GeV
Theory uncertainty
$\Delta\alpha^{(5)}_{had}$ =
0.02750±0.00033
0.02749±0.00010
incl. low $Q^2$ data
LEP
excluded
LHC
excluded
$\Delta\chi^2$
$m_H$ [GeV]
0
1
2
3
4
5
6
40
100
200

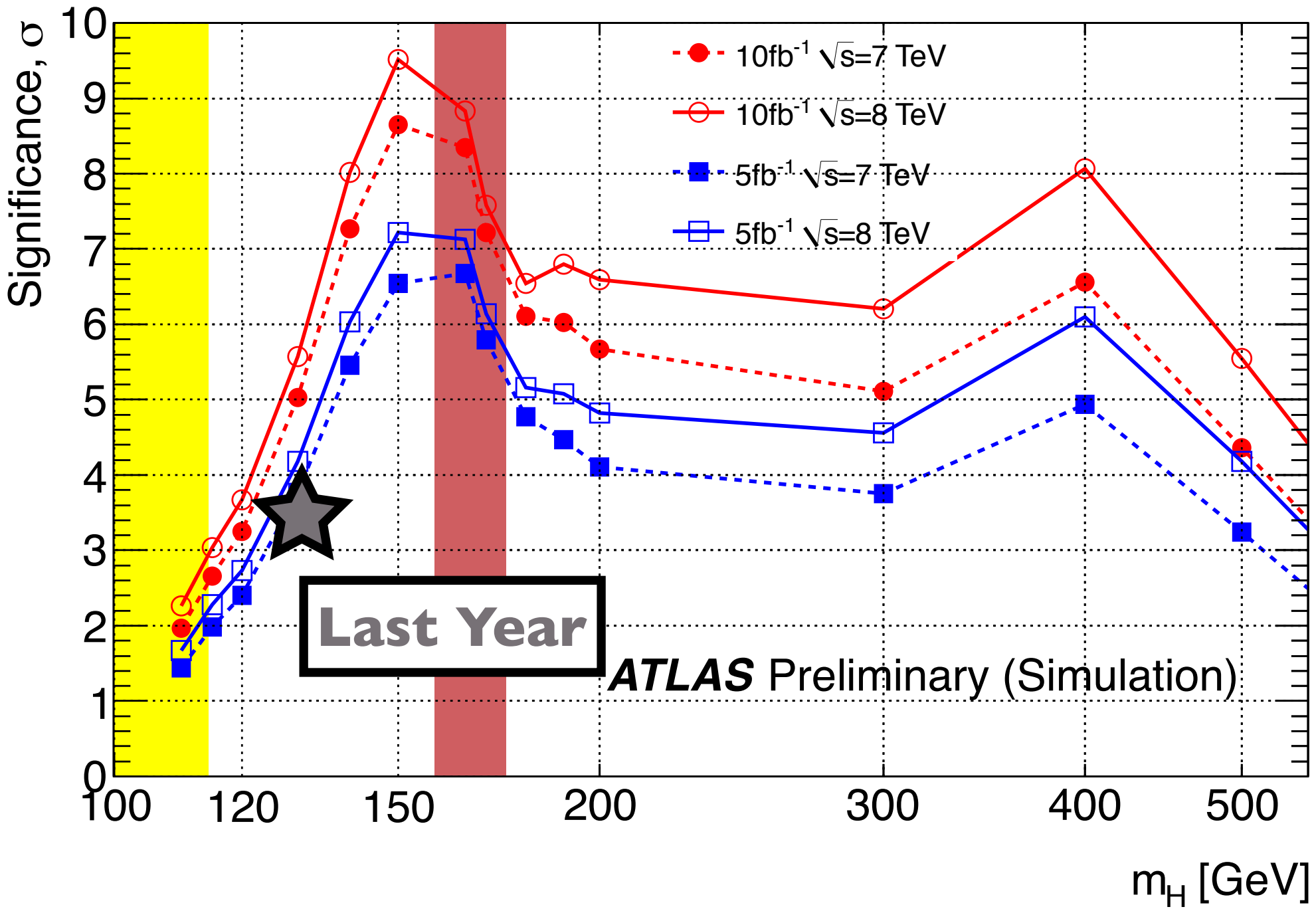

ATLAS Private
2011 Data
Obs.
Exp.
±1 σ
±2 σ
∫ Ldt = 4.6-4.9 fb-1
√s = 7 TeV
95% CL Limit on σ/σSM
10
1
10-1
CLs Limits
100
200
300
400
500
600
mH [GeV]

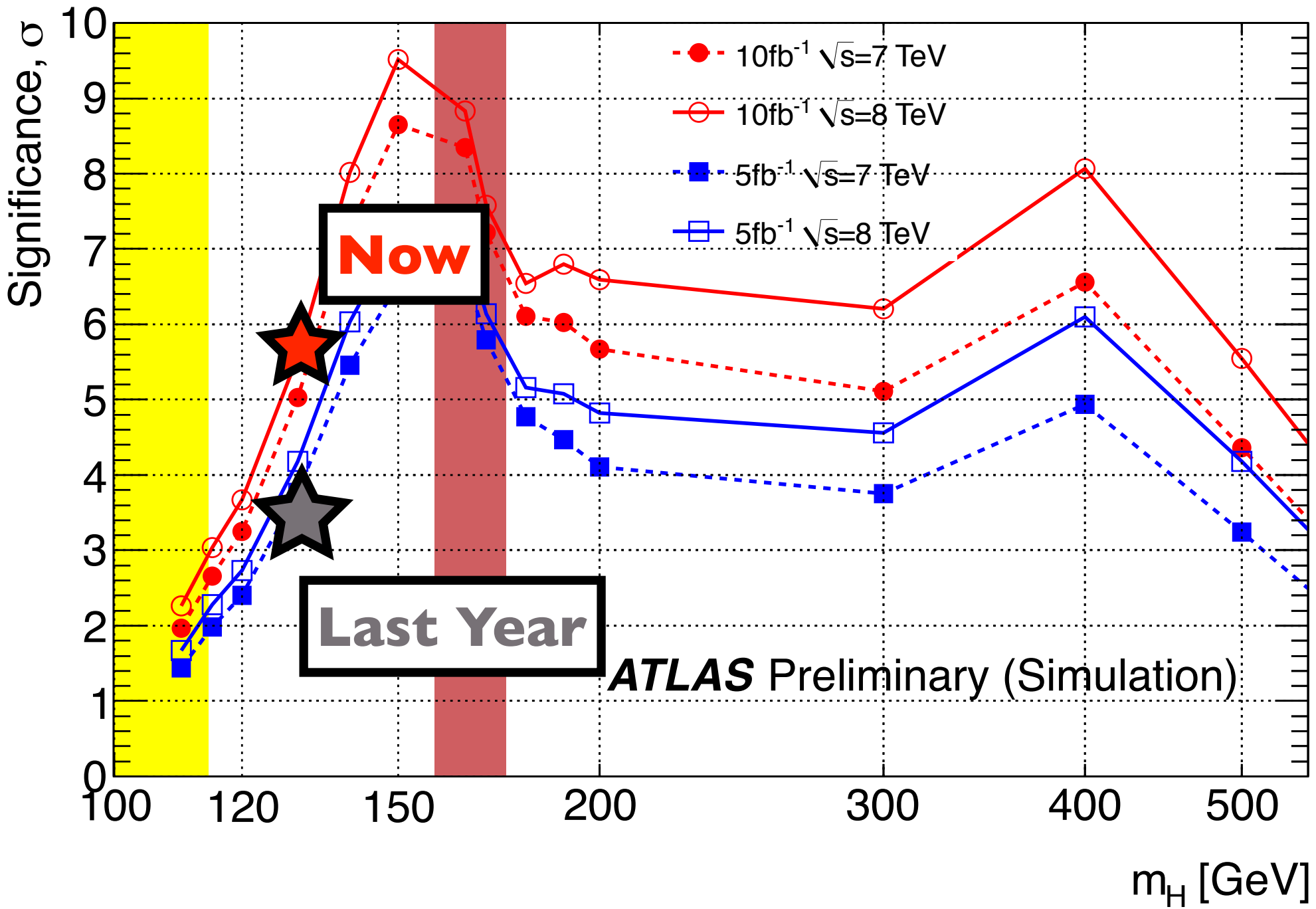

ATLAS Private
2011 Data
Obs.
Exp.
±1 σ
±2 σ
∫ Ldt = 4.6-4.9 fb-1
√s = 7 TeV
95% CL Limit on σ/σSM
CLs Limits
10
1
10-1
110
115
120
125
130
135
140
145
150
mH [GeV]


Local $p_0$
1
$10^{-1}$
$10^{-2}$
$10^{-3}$
1σ
2σ
3σ
Obs. Asym w/o ESS
Exp. Asym w/o ESS
Obs. Toy w/ ESS
ATLAS Private
$\int$ Ldt = 4.6-4.9 fb$^{-1}$
$\sqrt{s}$=7TeV
105 110 115 120 125 130 135 140 145 150 155
$m_H$ [GeV]


ATLAS Online Luminosity
2010 pp √s = 7 TeV
2011 pp √s = 7 TeV
2012 pp √s = 8 TeV
Delivered Luminosity [fb -1]
0
1
2
3
4
5
6
7
8
9
Jan
Apr
Jul
Oct
Month in Year


Significance, σ
10
9
8
7
6
5
4
3
2
1
0
100
120
150
200
300
400
500
$m_H$ [GeV]
10fb$^{-1}$ √s=7 TeV
10fb$^{-1}$ √s=8 TeV
5fb$^{-1}$ √s=7 TeV
5fb$^{-1}$ √s=8 TeV
ATLAS Preliminary (Simulation)


Significance, σ
10
9
8
7
6
5
4
3
2
1
0
100
120
150
200
300
400
500
$m_H$ [GeV]
10fb$^{-1}$ √s=7 TeV
10fb$^{-1}$ √s=8 TeV
5fb$^{-1}$ √s=7 TeV
5fb$^{-1}$ √s=8 TeV
Last Year
ATLAS Preliminary (Simulation)


Significance, σ
10
9
8
7
6
5
4
3
2
1
0
100
120
150
200
300
400
500
$m_H$ [GeV]
10fb$^{-1}$ √s=7 TeV
10fb$^{-1}$ √s=8 TeV
5fb$^{-1}$ √s=7 TeV
5fb$^{-1}$ √s=8 TeV
Now
Last Year
ATLAS Preliminary (Simulation)

# 4th of July