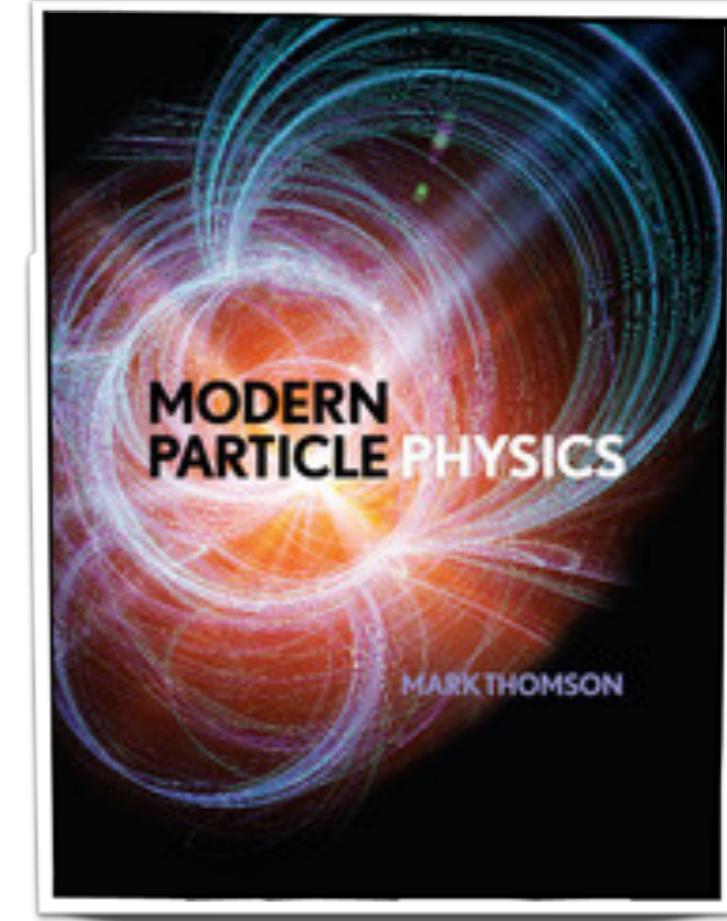


Particle Physics – Winter Term 2017/18 [Dunford]

- 1 Introduction
- 2 Underlying Concepts
- 3 Decay Rates and Cross Sections
- 4 Dirac Equation
- 5 Interaction by Particle Exchange
- 6 Electron-Positron Annihilation
- 7 Electron-Positron Elastic Scattering
- 8 Deep-inelastic Scattering
- 9 Symmetries and Quark Model
- 10 Quantum Chromodynamics
- 11 The Weak Interaction
- 12 The Weak Interaction of Leptons
- 13 Neutrinos and Neutrino Oscillations
- 14 CP Violation and Weak Hadronic Interactions
- 15 Electroweak Unification
- 16 Tests of the Standard Model
- 17 The Higgs Boson
- 18 The Standard Model and Beyond



Titel: Modern particle physics
Author: Mark Thomson
Verlag: Cambridge University Press
ISBN: 978-1-107-03426-6
1-107-03426-4

[Available in Library]

Quarks

u	c	t
up	charm	top

d	s	b
down	strange	bottom

Forces

H	Z	γ
Higgs boson	Z boson	photon

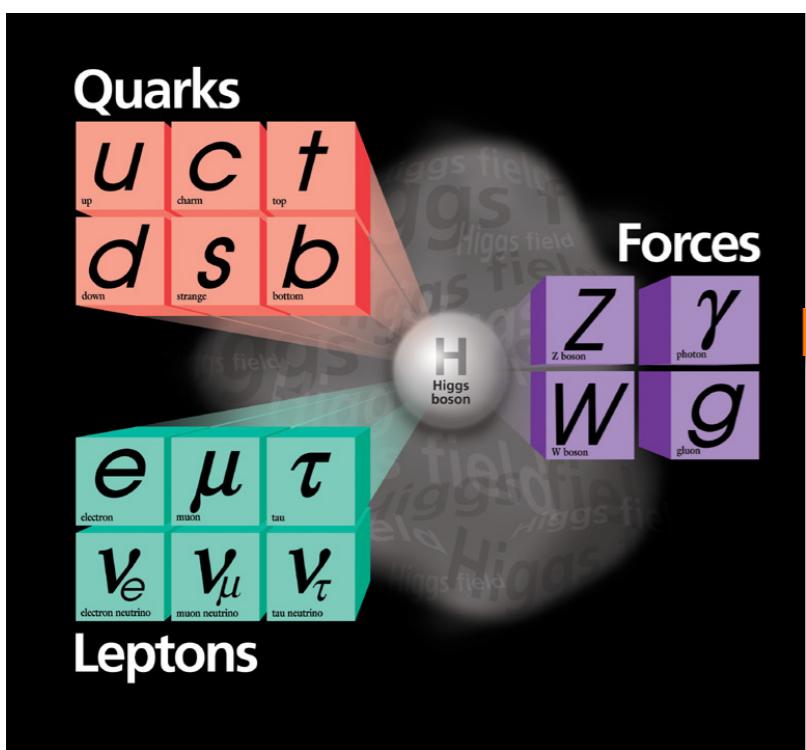
W	g
W boson	gluon

e	μ	τ
electron	muon	tau

ν_e	ν_μ	ν_τ
electron neutrino	muon neutrino	tau neutrino

Leptons

What particle physics is not...



Particles

PERIODIC TABLE OF THE ELEMENTS

<http://www.ktf-split.hr/periodni/en/>

Legend:

- Metal
- Semimetal
- Nonmetal
- Alkali metal
- Alkaline earth metal
- Transition metals
- Chalcogens element
- Halogens element
- Noble gas
- Lanthanide
- Aclinide

STANDARD STATE (25 °C; 101 kPa)

- Ne - gas
- Fe - solid
- Ga - liquid
- Tc - synthetic

Periodic Table Data:

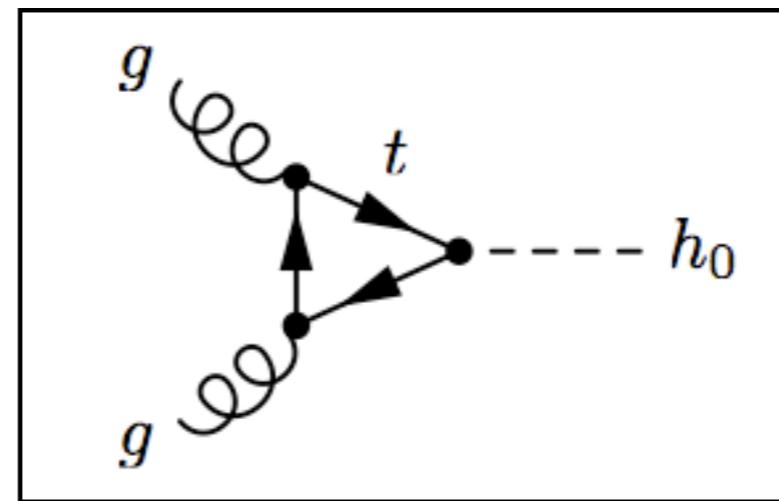
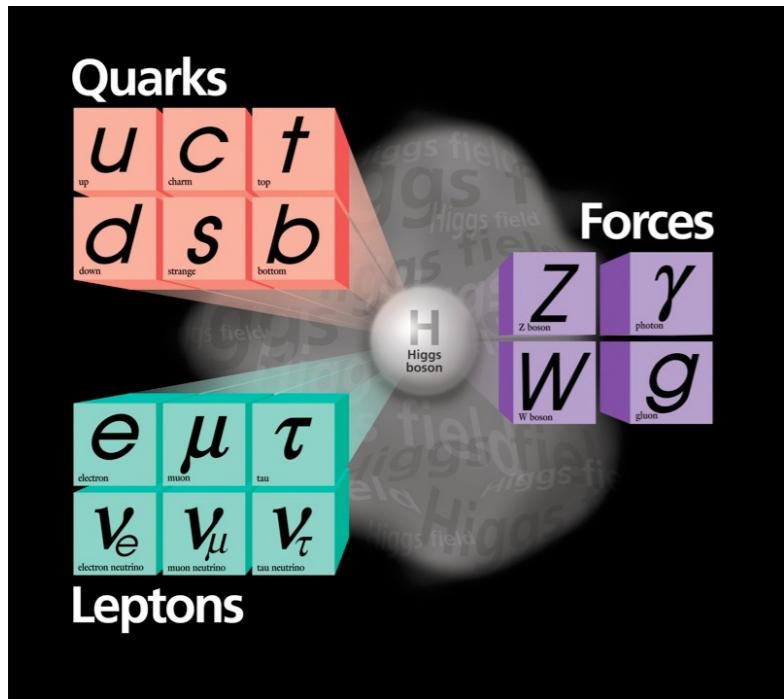
Element	Symbol	Atomic Number	Relative Atomic Mass (1)
Hydrogen	H	1	1.0079
Helium	He	2	4.0026
Boron	B	5	10.811
Carbon	C	6	12.011
Nitrogen	N	7	14.007
Oxygen	O	8	15.999
Fluorine	F	9	18.998
Neon	Ne	10	20.180
Boron	B	13	10.811
Carbon	C	14	12.011
Nitrogen	N	15	14.007
Oxygen	O	16	15.999
Fluorine	F	17	18.998
Neon	Ne	18	20.180
Aluminum	Al	13	26.982
Silicon	Si	14	28.086
Phosphorus	P	15	30.974
Sulfur	S	16	32.065
Chlorine	Cl	17	35.453
Argon	Ar	18	39.948
Gallium	Ga	31	69.723
Germanium	Ge	32	72.64
As	As	33	74.922
Selenium	Se	34	78.96
Bromine	Br	35	79.904
Krypton	Kr	36	83.80
Tin	Tl	50	118
Sulfur	Sn	53	126
Iodine	Te	54	127.60
Atmospheric	I	55	126
Radon	Rn	85	126
Ununquadium	Uuq	114	289
Ununnilium	Uuu	110	281
Ununtrium	Uub	111	272
Ununpentium	Uup	112	285
Ununhexium	Uuh	113	288
Ununseptium	Uus	114	291
Ununoctium	Uuo	115	294
Actinium	Ac	89	(227)
Rutherfordium	Rf	90	232.04
Dubnium	Db	91	231.04
Seaborgium	Sg	92	238.03
Bohrium	Bh	93	(237)
Meitnerium	Mt	94	(244)
Ununnilium	Uum	95	(243)
Ununtrium	Uuu	96	(247)
Ununpentium	Uup	97	(247)
Ununtrium	Uub	98	(251)
Ununhexium	Uuh	99	(252)
Ununpentium	Uus	100	(257)
Ununoctium	Uuo	101	(258)
Mendelevium	Md	102	(259)
Nobelium	No	103	(262)
Lawrencium	Lr	104	(261)

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(1) Pure Appl. Chem., 73, No. 4, 667-683 (2001)
Relative atomic mass is shown with five significant figures. For elements have no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.
However three such elements (Th, Pa, and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated.

Editor: Aditya Vardhan (adivar@netlinx.com)

Particles are the key to principles



- How do particles get mass?
- Why are quark masses so different?
- Why are neutrinos so light?
- What is dark matter?
- Dark energy?
- etc, etc

Particles

Properties

Principles



ν_e e^-

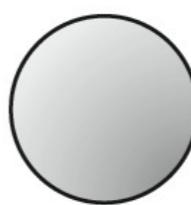
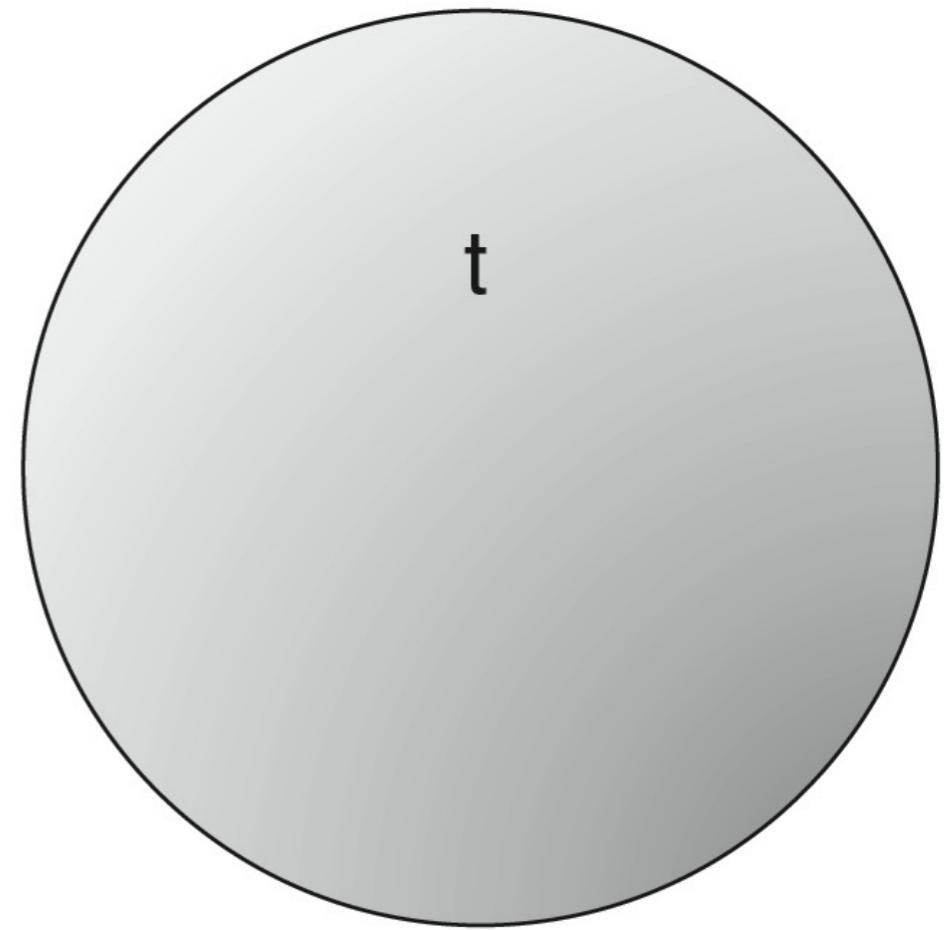
.

 d

.

 u

.

 ν_μ μ^-  s  c  ν_τ τ^-  b  t 

Which of these are allowed?

(a) e^-



e^-

(b) ν_e



ν_e

(c) e^-



e^+

(d) ν_e



ν_e

(e) e^-

μ^-

(f) e^-



ν_e

(g) e^-



τ^-

(h) e^-

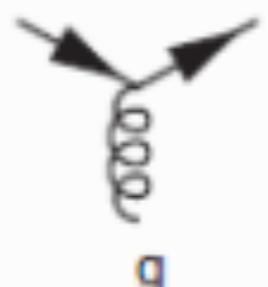


ν_μ

(i) e^-

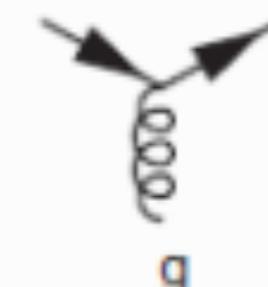
e^-

(j) b



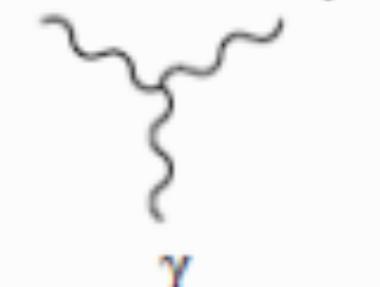
b

(k) d



s

(l) γ

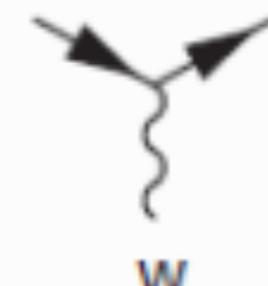


γ

(m) u

u

(n) u



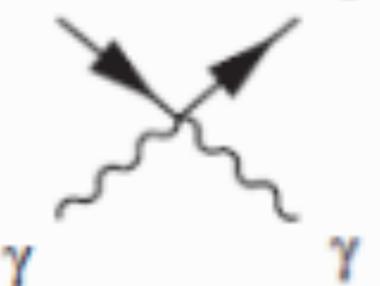
d

(o) d



t

(p) e^-



e^-

**spin- $\frac{1}{2}$
baryons**

**more
spin- $\frac{1}{2}$
baryons**

**spin- $\frac{3}{2}$
baryons**

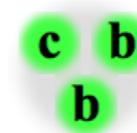
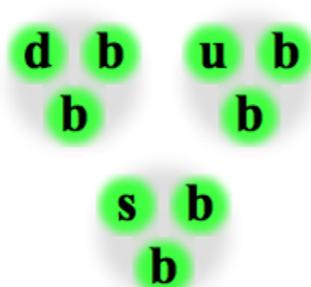
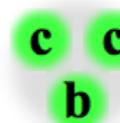
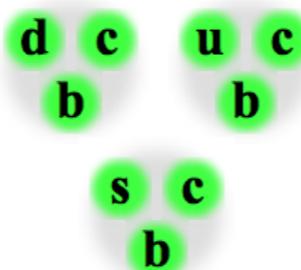
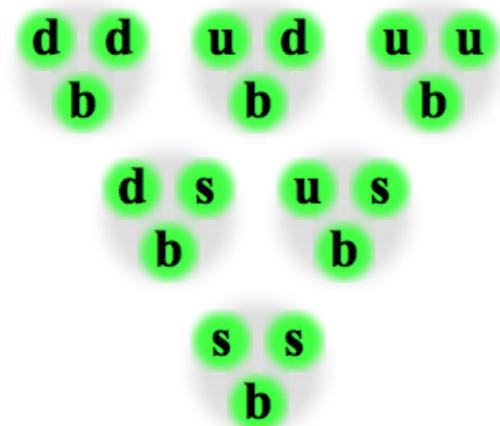
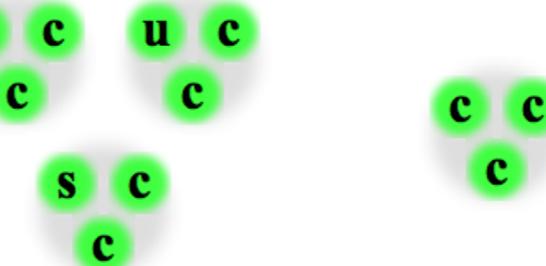
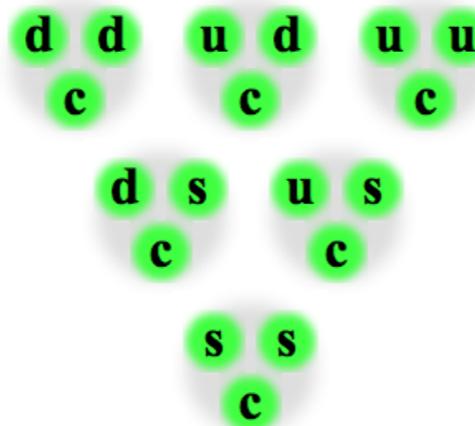
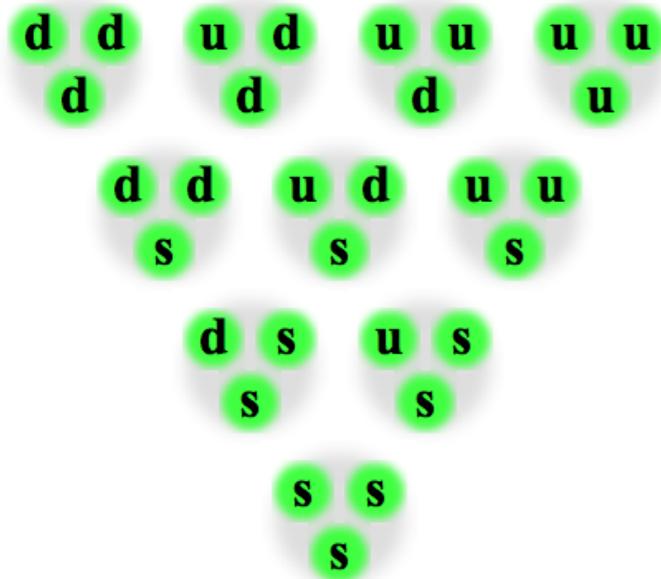
**quarks
in
baryons**

**spin- $\frac{1}{2}$
anti-
baryons**

**more
spin- $\frac{1}{2}$
anti-
baryons**

**spin- $\frac{3}{2}$
anti-
baryons**

**anti-
quarks
in anti-
baryons**



Baryons

<http://www.thingsmadethinkable.com/item/baryons.php>

spin- $\frac{1}{2}$
baryons

more
spin- $\frac{1}{2}$
baryons

spin- $\frac{3}{2}$
baryons

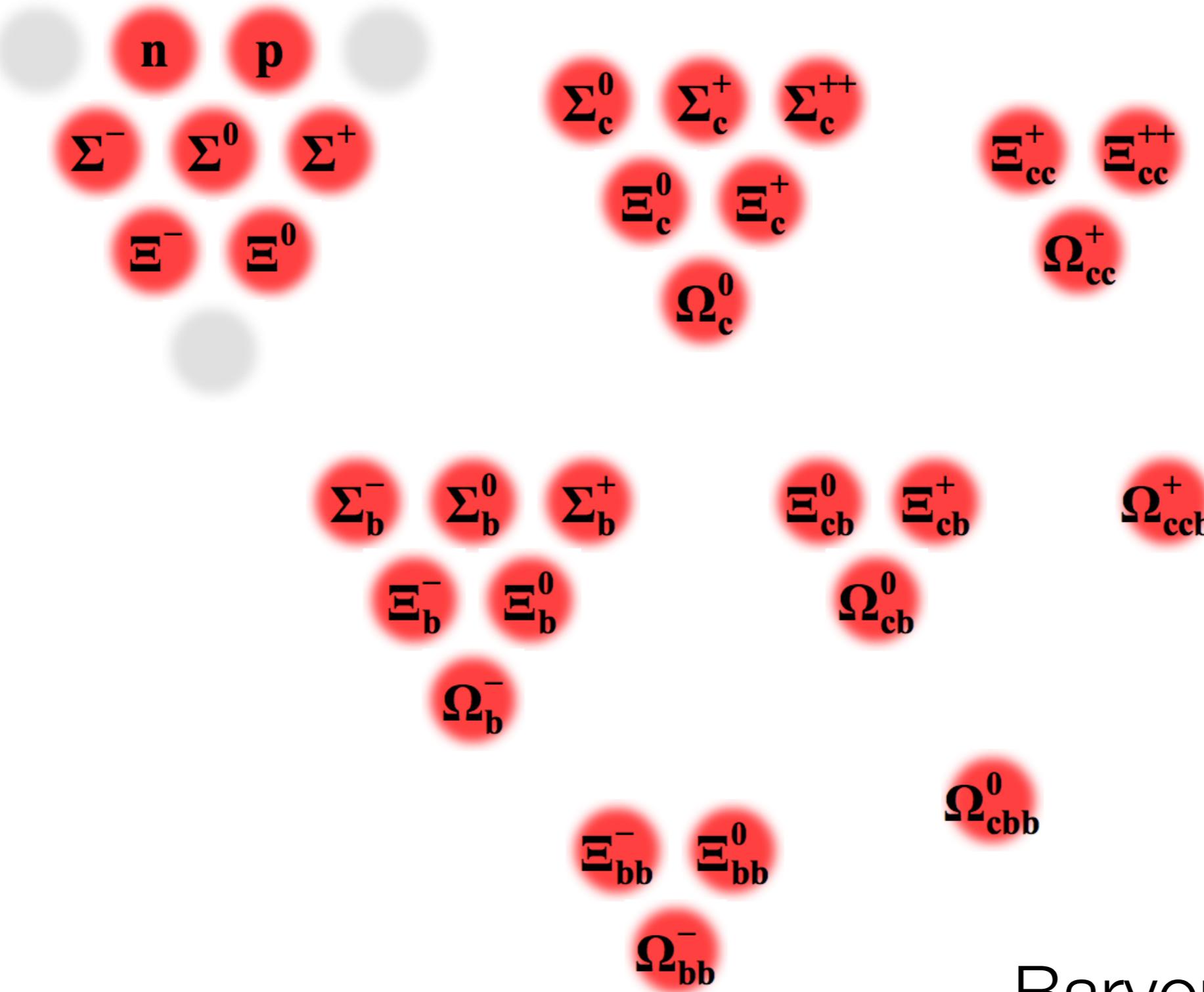
quarks
in
baryons

spin- $\frac{1}{2}$
anti-
baryons

more
spin- $\frac{1}{2}$
anti-
baryons

spin- $\frac{3}{2}$
anti-
baryons

anti-
quarks
in anti-
baryons



Baryons

<http://www.thingsmadethinkable.com/item/baryons.php>

spin- $\frac{1}{2}$
baryons

more
spin- $\frac{1}{2}$
baryons

spin- $\frac{3}{2}$
baryons

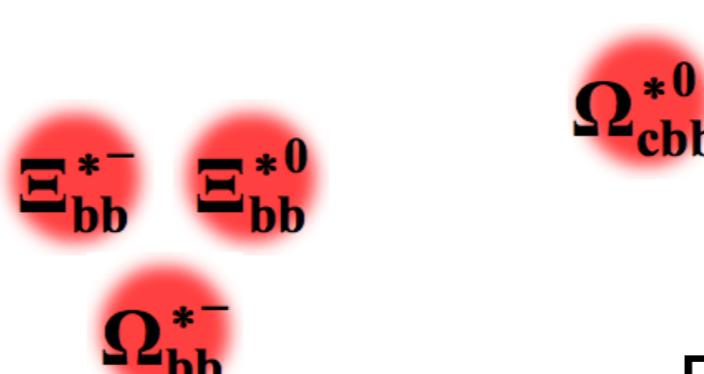
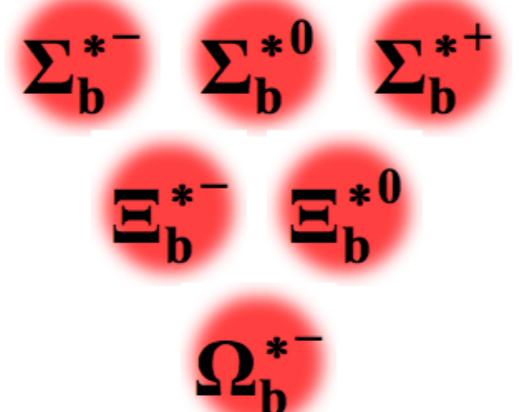
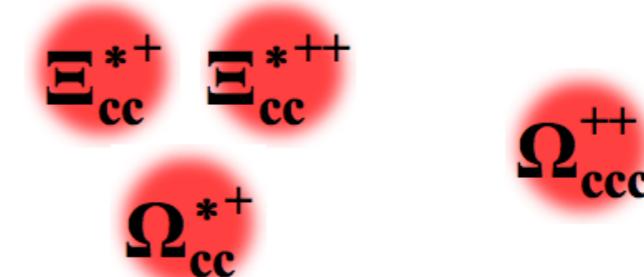
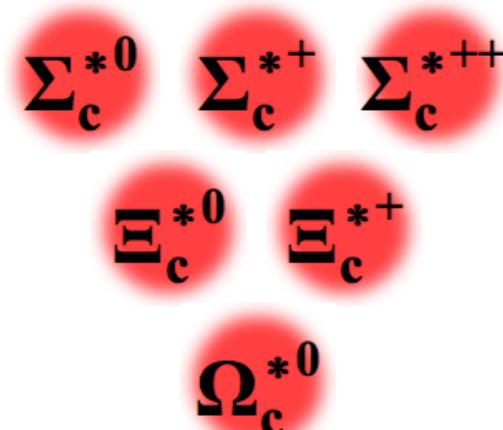
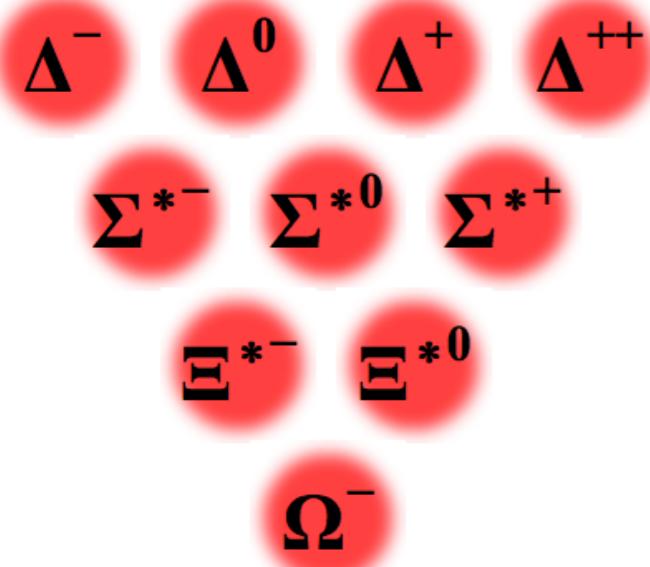
quarks
in
baryons

spin- $\frac{1}{2}$
anti-
baryons

more
spin- $\frac{1}{2}$
anti-
baryons

spin- $\frac{3}{2}$
anti-
baryons

anti-
quarks
in anti-
baryons



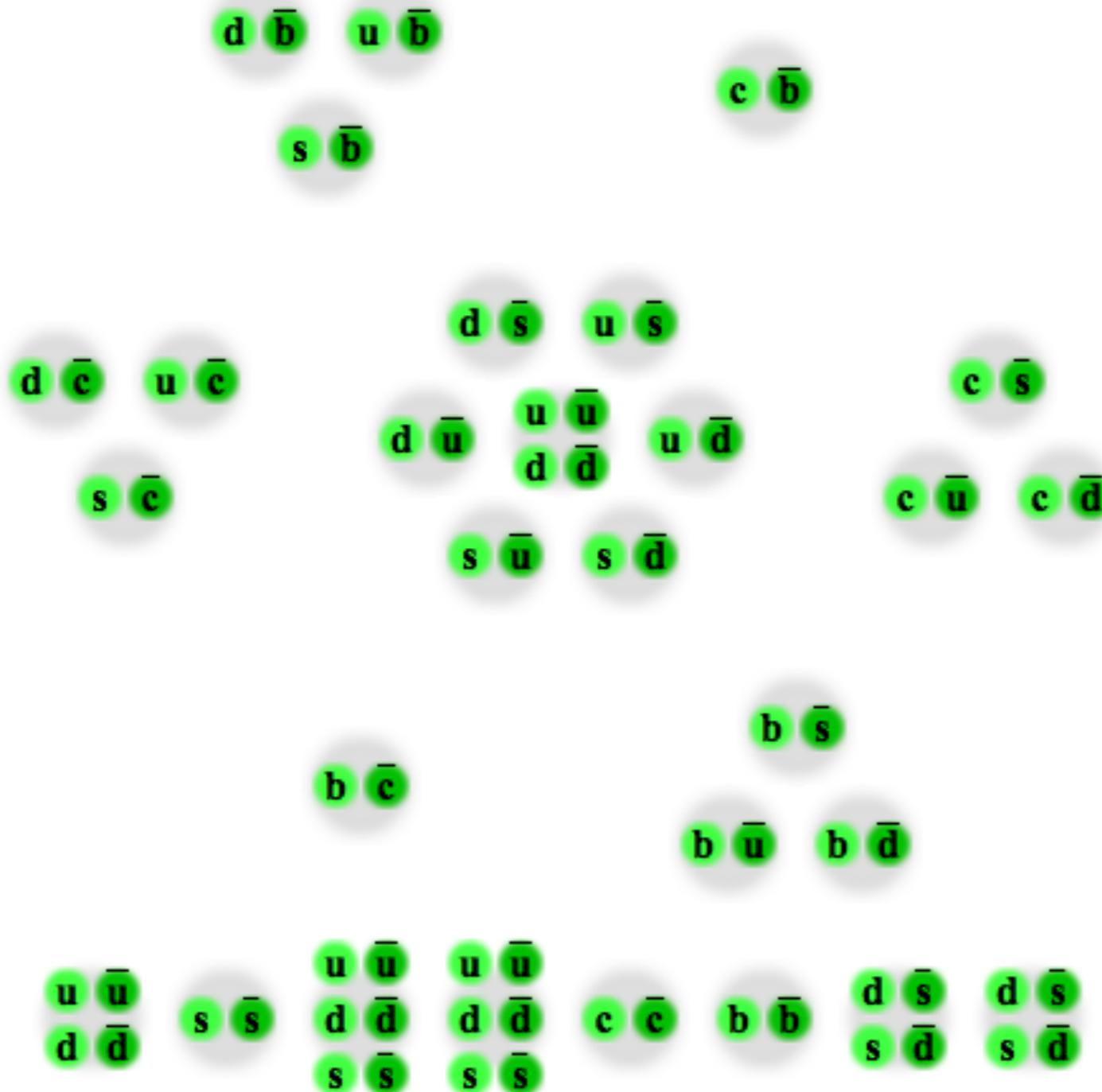
Baryons

<http://www.thingsmadethinkable.com/item/baryons.php>

pseudo-scalar
(spin-0)
mesons

vector
(spin-1)
mesons

(anti)
quarks
in
mesons



Mesons

<http://www.thingsmadethinkable.com/item/mesons.php>

pseudo-scalar
(spin-0)
mesons

vector
(spin-1)
mesons

(anti) quarks
in
mesons

B^0 B^+

B_s^0

B_c^+

D^- \bar{D}^0

D_s^-

K^0 K^+

π^- π^0 π^+

K^- \bar{K}^0

D_s^+

D^0 D^+

B_c^-

\bar{B}_s^0

B^- \bar{B}^0



η

η'

η_c

η_b

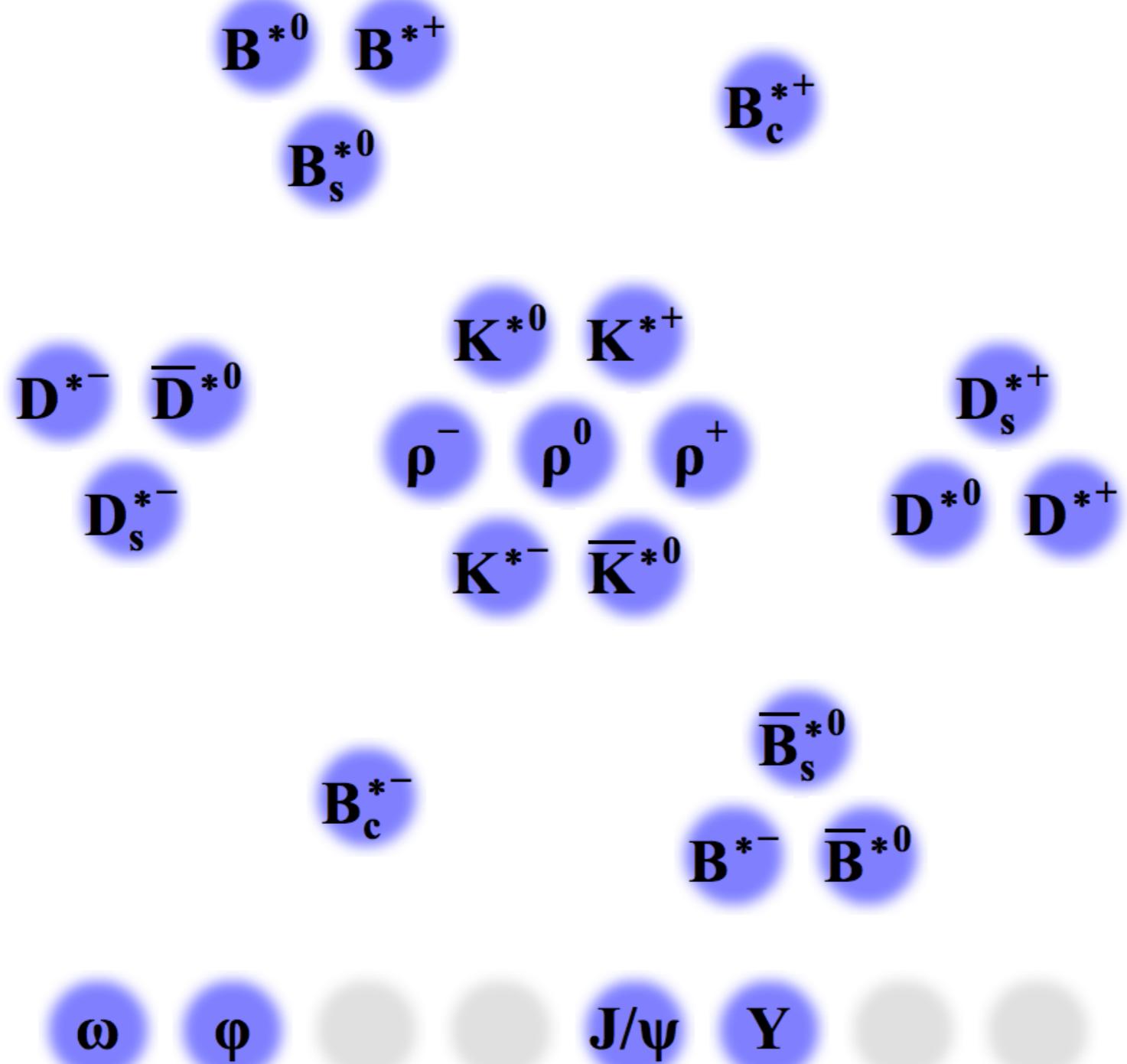
K_S^0 K_L^0

Mesons

pseudo-scalar
(spin-0)
mesons

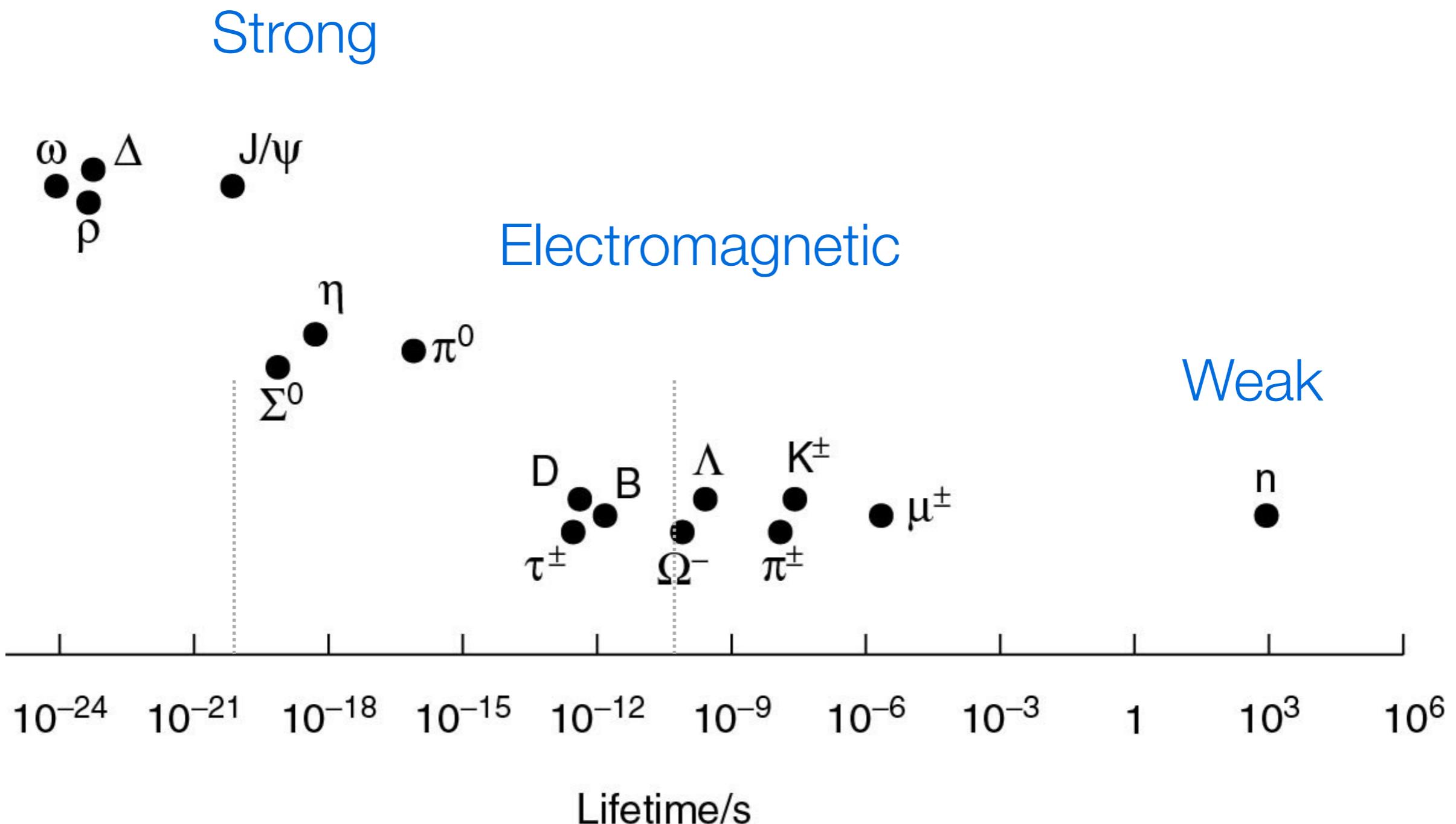
vector
(spin-1)
mesons

(anti) quarks
in
mesons

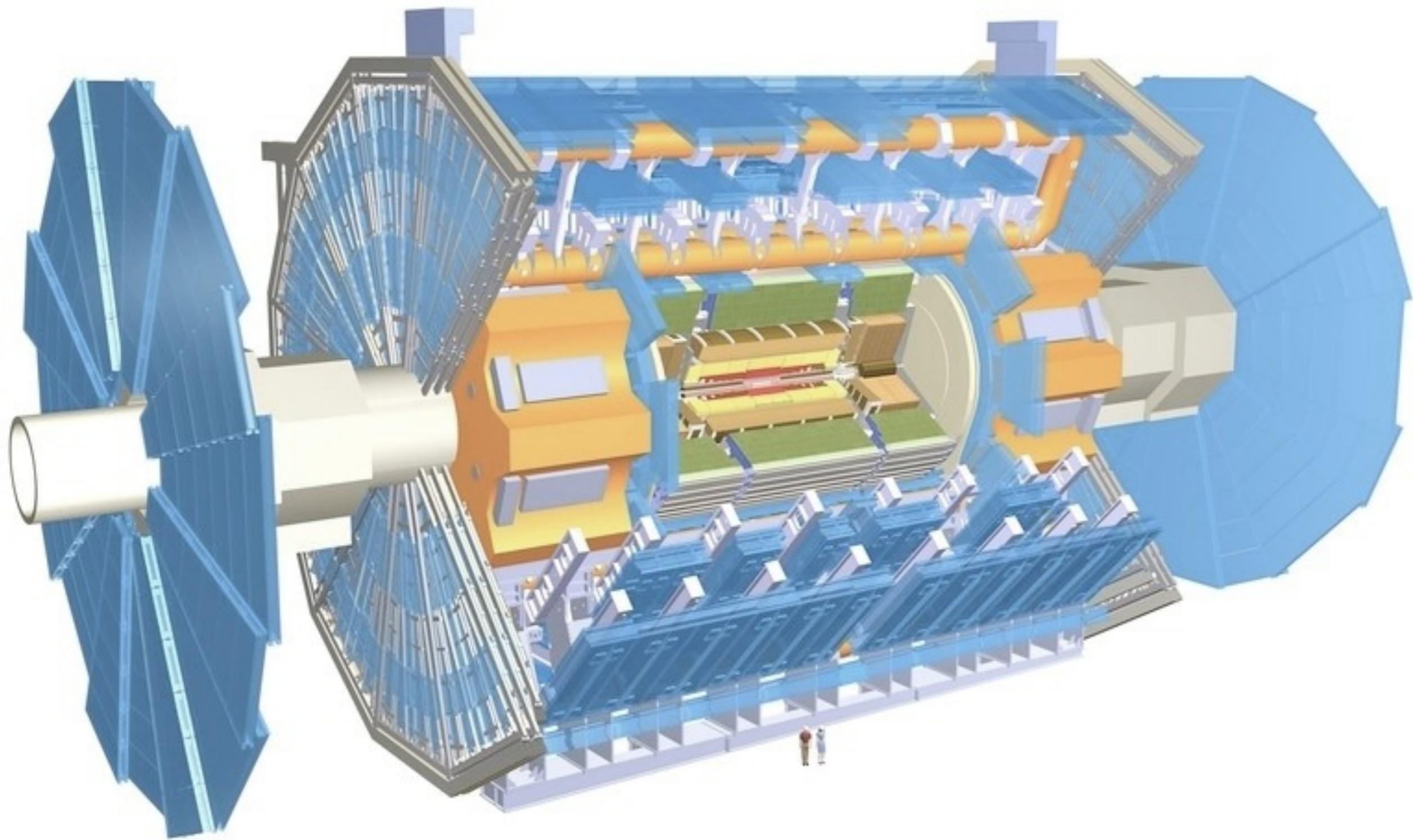


Mesons

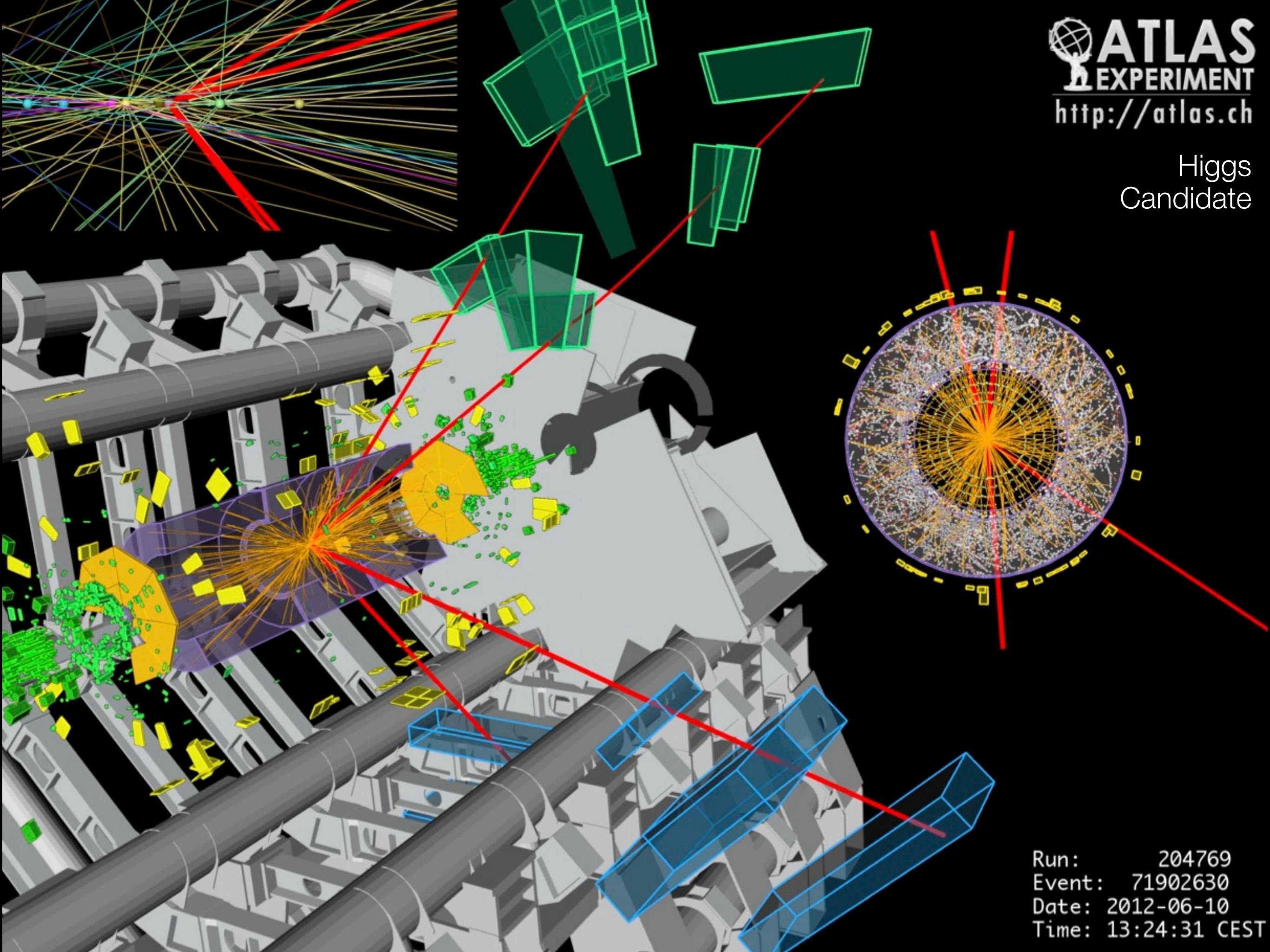
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The ATLAS Detector

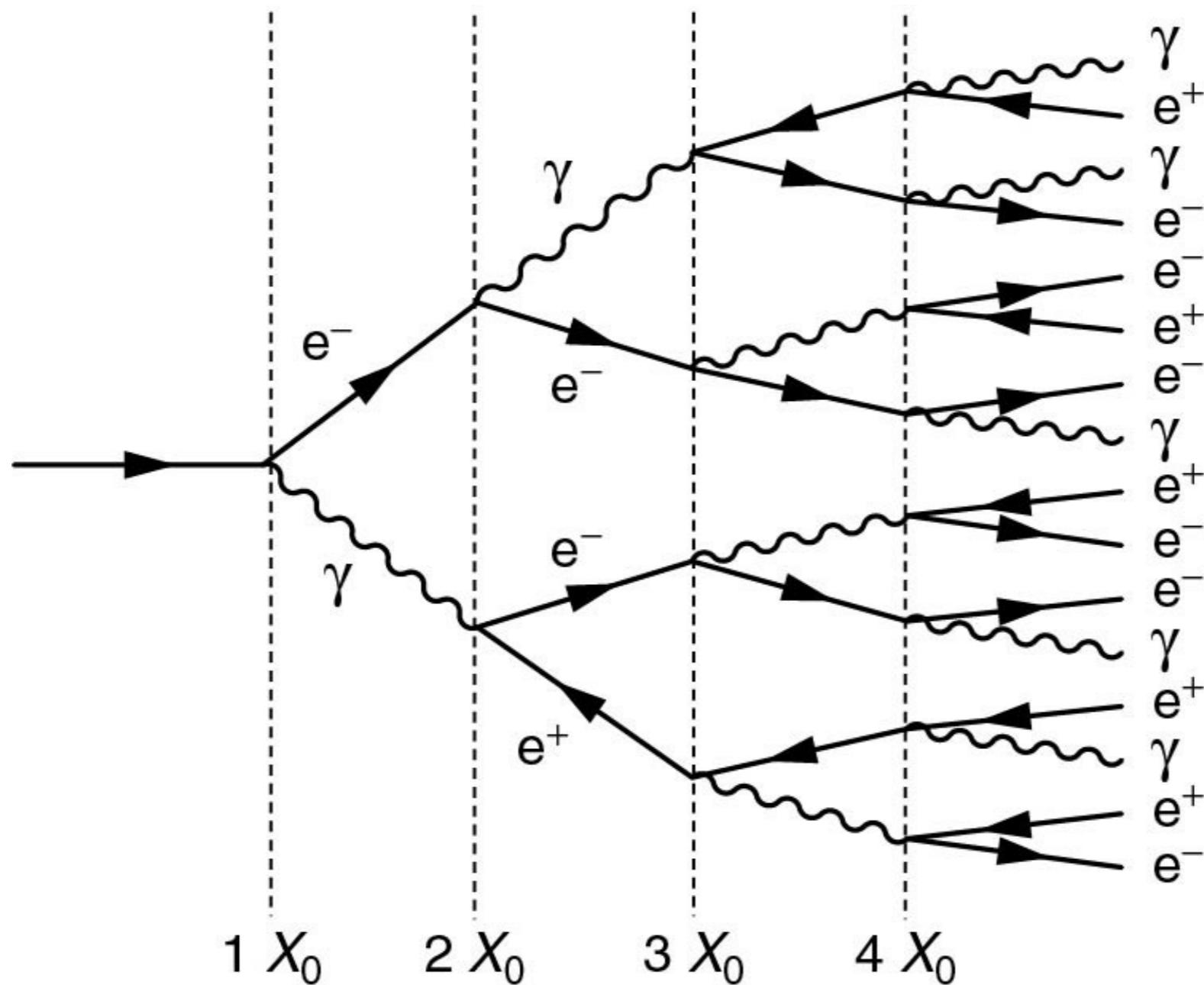


Higgs
Candidate



Run: 204769
Event: 71902630
Date: 2012-06-10
Time: 13:24:31 CEST

Electromagnetic Shower



Hadronic Shower

