

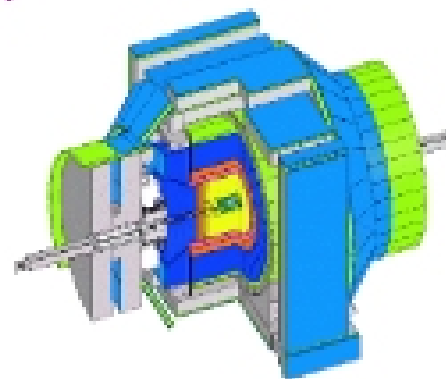
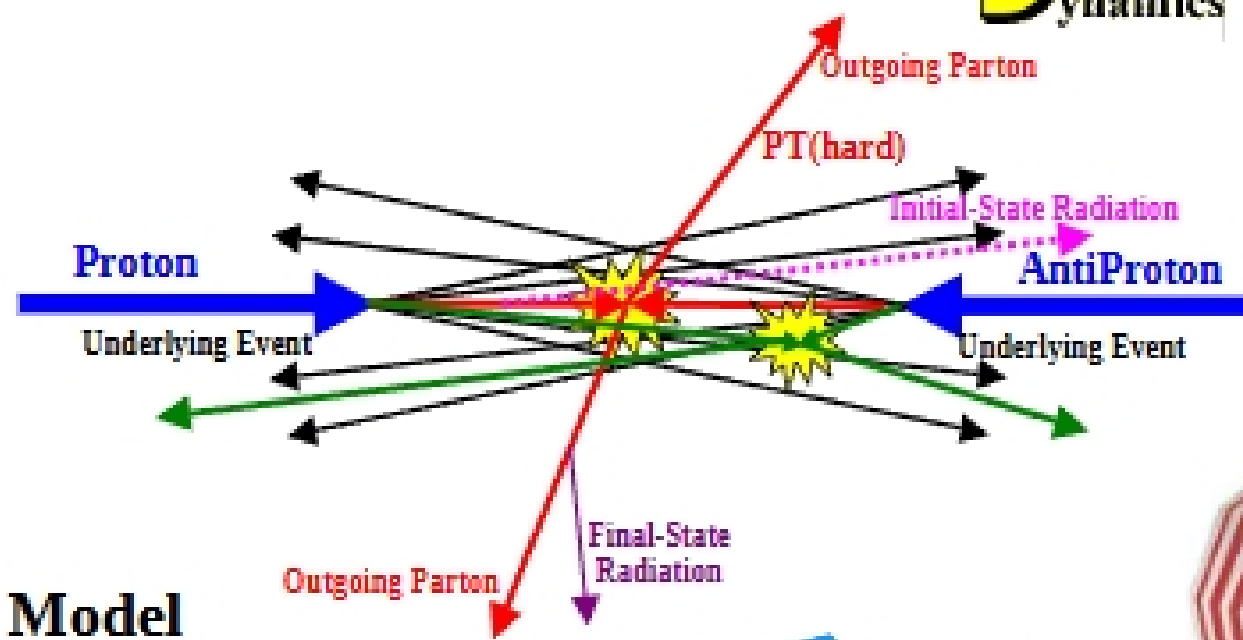
Modern Physics



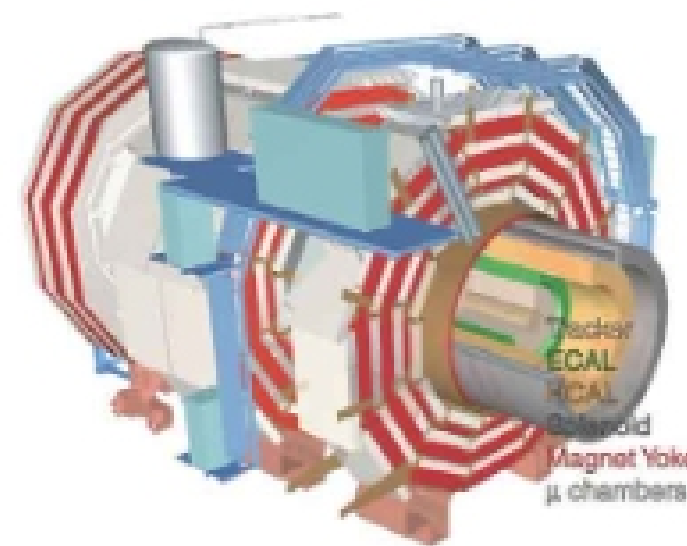
The Standard Model & Beyond

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Quantum
Chromo-
Dynamics



CDF Run 2



CMS at the LHC

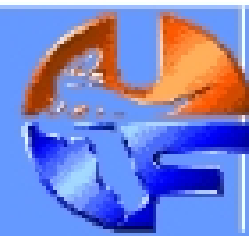
Outline of Talk

- The Standard Model
- Beyond the Standard Model
- CDF at the Tevatron
- CMS at the LHC

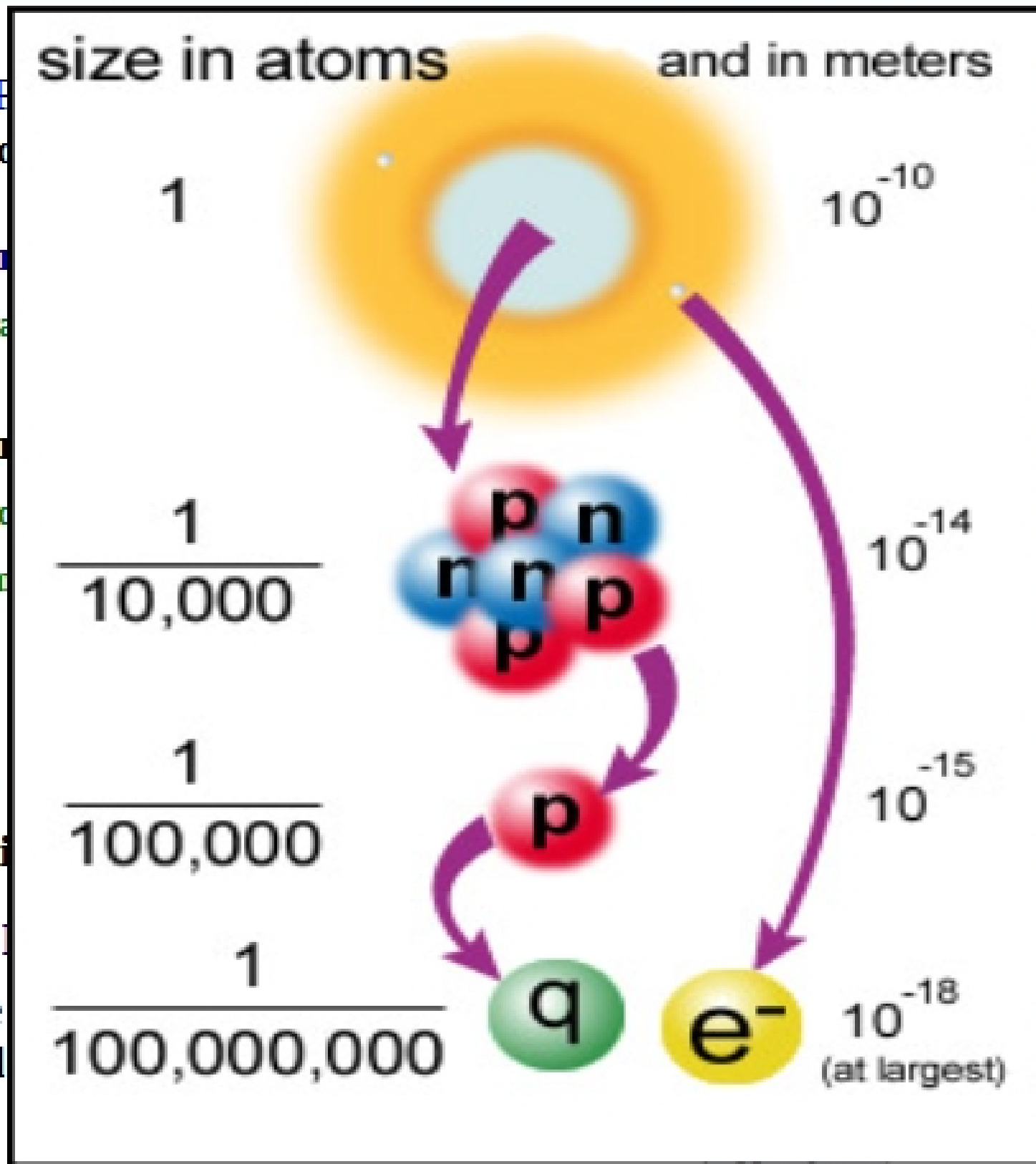


University of Florida
 November 10, 2010

The Simple Structure of Our Universe



- Elementary particles have internal structure
- Four Known Forces: Gravity (Solar Holes), Electromagnetic, Weak (Neutrinos), Strong (Atomic Nuclei)
- Two Classes of Particles: Leptons: Do not have internal structure; Quarks: Do have internal structure
- Quarks and Leptons: Quarks have internal structure, particles called quarks; Leptons exist as free particles.

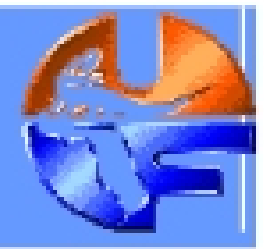


Mass and charge are distributed inside sphere with radius zero!

LEPTONS		Quarks spin = 1/2		
Spin	Electric charge	Flavor	Approx. Mass GeV/c ²	Electric charge
1/2	0	U up	0.005	2/3
1/2	-1	d down	0.01	-1/3
1/2	0	C charm	1.5	2/3
1/2	-1	S strange	0.2	-1/3
1/2	0	t top (initial evidence)	170	2/3
1/2	-1	b bottom	4.7	-1/3

Leptons (weak, EM and gravity).
Quarks (strong, weak, EM and gravity).

Leptons exist as free particles. Quarks are constituents of composite particles (hadrons).



- Elementary particles and hadrons are labeled by their quantum numbers. These labels characterize the properties of the particles.
- Not all particles carry every label. The particles are only labeled by the quantum numbers that are conserved for that particle
- Particles with integral spin J ($J = 0, 1, 2, \dots$) are called **bosons**.
- Particles with half-integral spin J ($J = \frac{1}{2}, \frac{3}{2}, \dots$) are called **fermions**.
- Particles with spin-parity $J^P = 0^-$ are referred to as scalars, 0^- are pseudo-scalars, 1^- are vectors, 1^- are pseudo-vectors, 2^+ are tensors, etc.

Symbol	Name	Additive
M	Mass	
J	Spin Angular Momentum	
C	Charge Conjugation	
P	Parity	
G	G-Parity	
B	Baryon Number	Yes
Q_{em}	Electric Charge $Q = Y/2 + I_z$ $Q = Q_{weak} + Q_{U1}$	Yes
Q_{U1}	U1 Charge	Yes
Q_{weak}	Weak Charge	Yes
Q_{color}	Strong Charge	
Y	Hypercharge $Y = B + S + C_h + B_o + T_o$	Yes
S	Strangness	Yes
C_h	Charmness	Yes
B_o	Bottomness	Yes
T_o	Topness	Yes
I	Isospin	Yes
I_z	3 rd component of Isospin	Yes
L_e	Electron Lepton Number	Yes
L_μ	Muon Lepton Number	Yes
L_τ	Tau Lepton Number	Yes
L	Overall Lepton Number $L = L_e + L_\mu + L_\tau$	Yes