

**Tools and strategies**

**What we want to discover**

**A view of what we do at Purdue**

**All in 15 minutes including a small show**

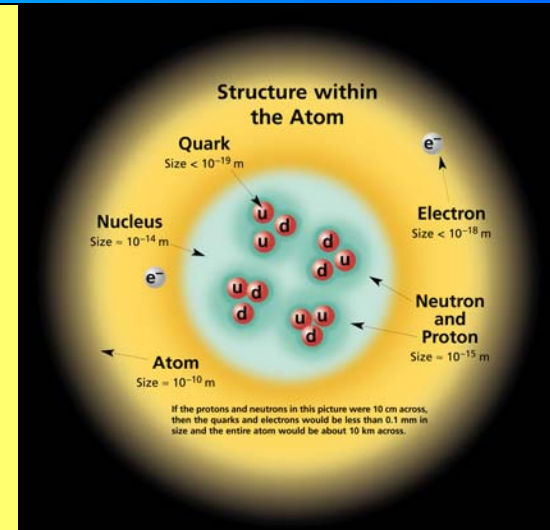
## Very piercing electronic eyes

$$\lambda = \hbar / p$$

$$p \approx E = 1\text{TeV} = 10^{12} \text{eV}$$

$$= 1,000,000,000,000 \text{eV}$$

$$\lambda \approx 10^{-19} \text{m}$$

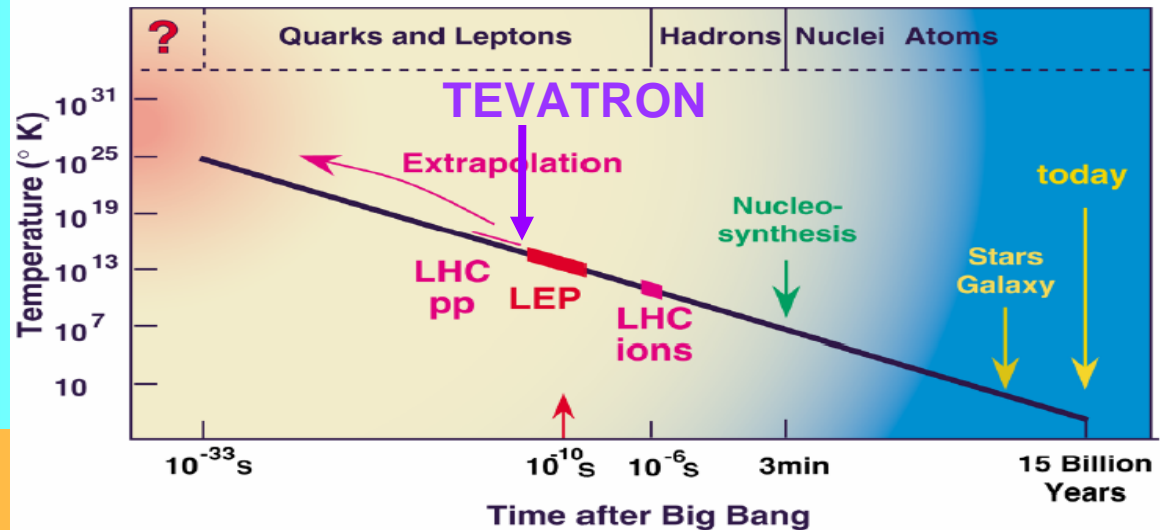


## Time machine

$$E = kT$$

$$E = 1\text{TeV}$$

$$T = 3 \times 10^{15} \text{degrees}$$



Create particles present in early universe

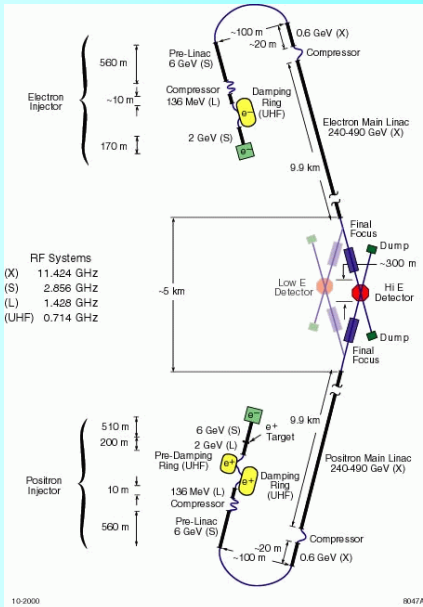
$$E = mc^2$$

# Timeline



**2 TEV**  
**Tevatron**

**14 TEV**  
**LHC**



**LHC Upgrade**

**0.5-1 TEV**  
**Linear Collider**

**50 TEV**  
**>1 TEV**

**VLHC**  
**CLIC**

**2003**

**2007**

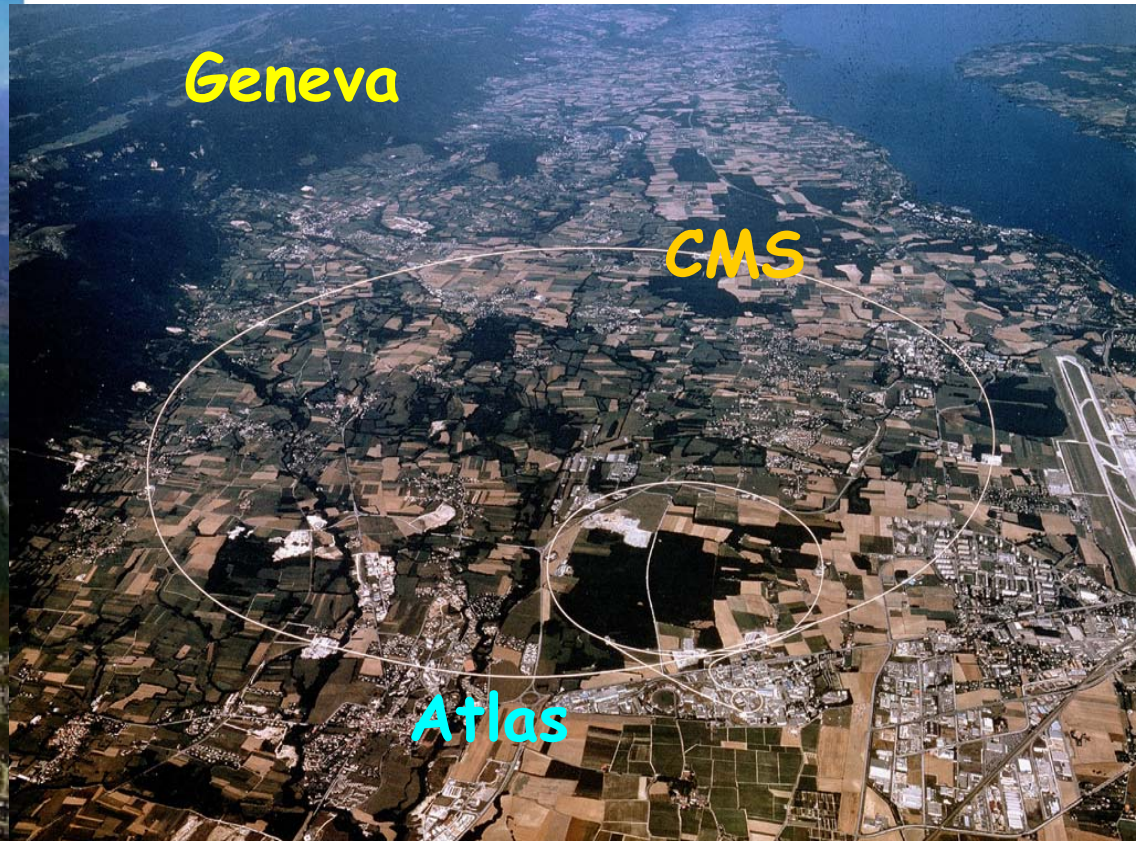
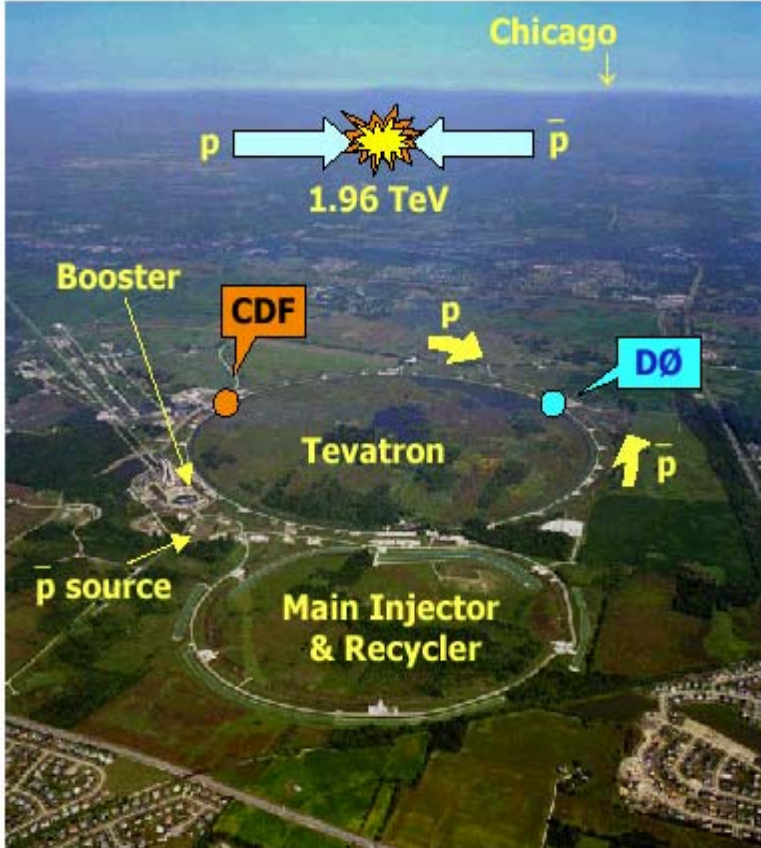
**2012**

**202x**



**14 TEV**

**???????**



**Circumference      Energy      Collisions/s**

**TEVATRON**

**6.4 Km**

**2 TeV**

**$10^6$**

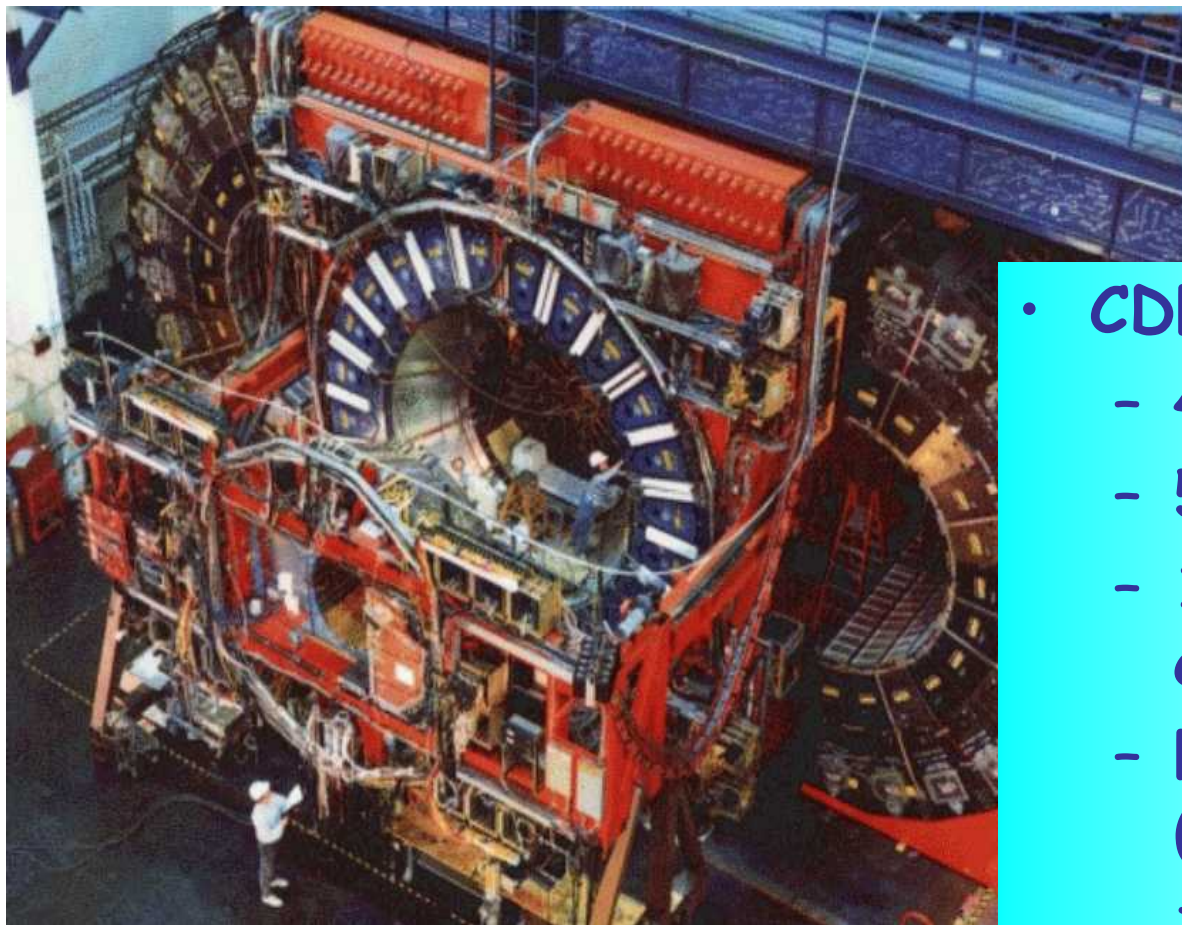
**LHC**

**27 Km**

**14 TeV**

**$10^7 - 10^9$**

# The CDF experiment

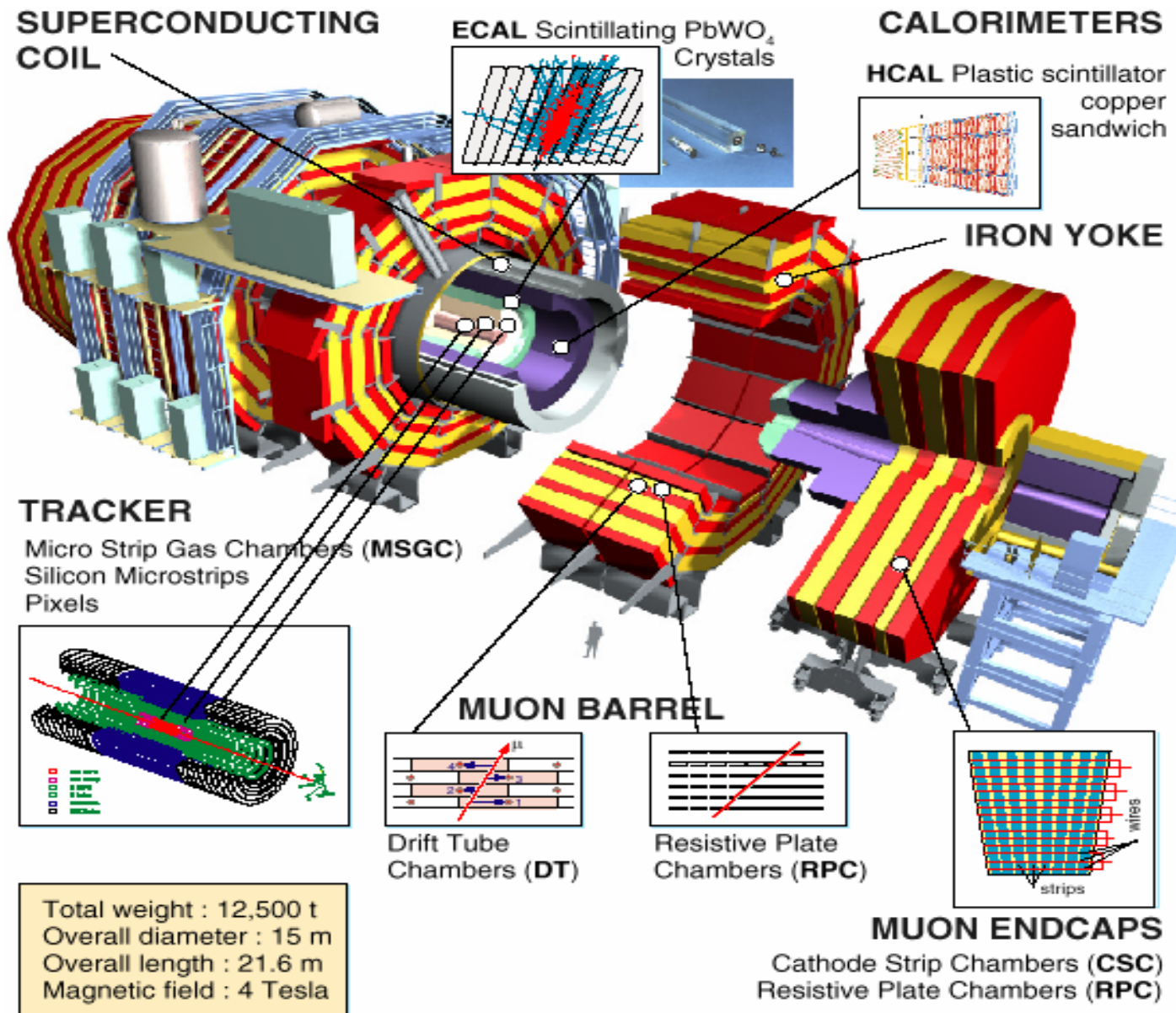


- CDF:
  - 4 stories tall
  - 5000 tons
  - 1 million electronic channels
  - Full coverage (cylindrical geometry + end caps)

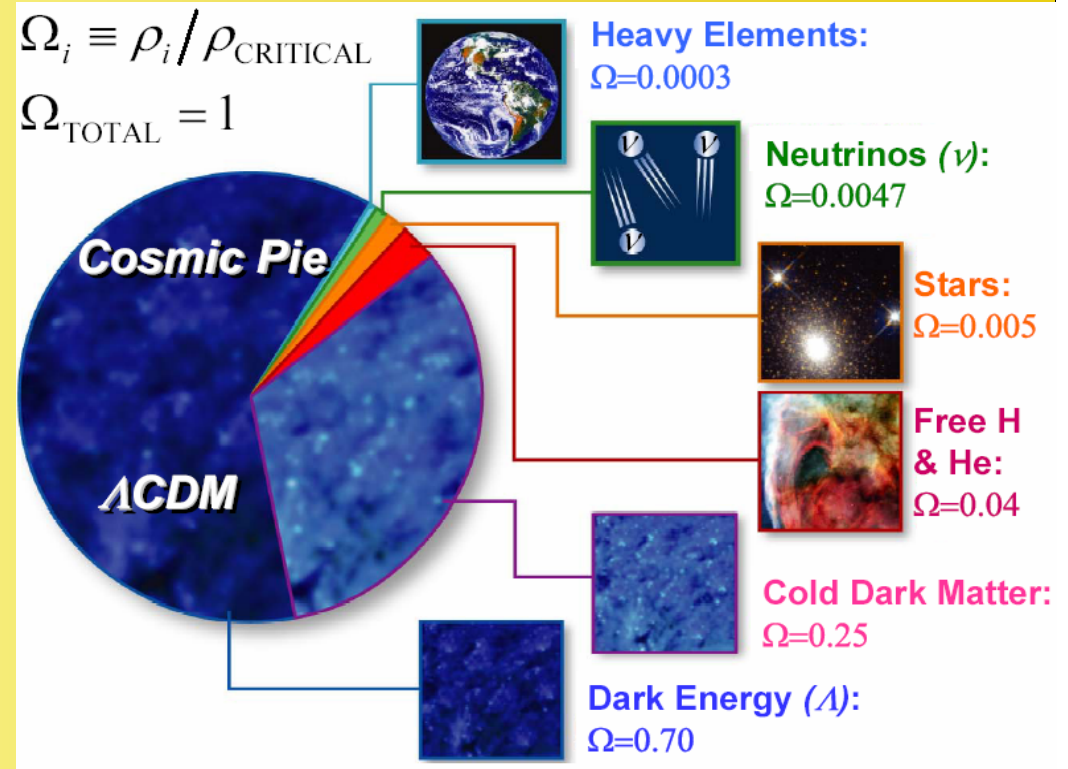
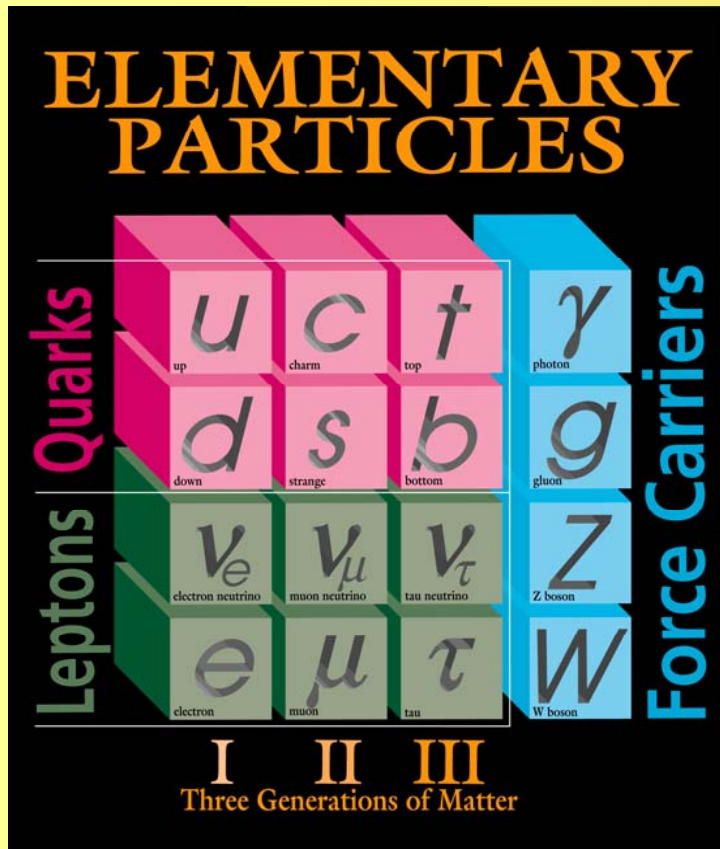
**Antz. Z (Woody Allen) feels underappreciated "as the middle child in a family of five million." When Z complains to his shrink that he's feeling insignificant, the bug-world psychologist sensibly responds, "You are insignificant."**



# The CMS experiment



- Standard Model of particle physics is very successful. It has been tested at 1% level at LEP + Tevatron



- Standard model of cosmology and WMAP data tells us that we do not know the composition of 95% of the universe



## COSMOLOGY MARCHES ON



J. Feng



To understand the Higgs mechanism, imagine that a room full of physicists quietly chattering is like space filled only with the Higgs field ...



... a well known scientist walks in, creating a disturbance as he moves across the room, and attracting a cluster of admirers with each step ...



... this increases his resistance to movement, in other words, he acquires mass, just like a particle moving through the Higgs field ...

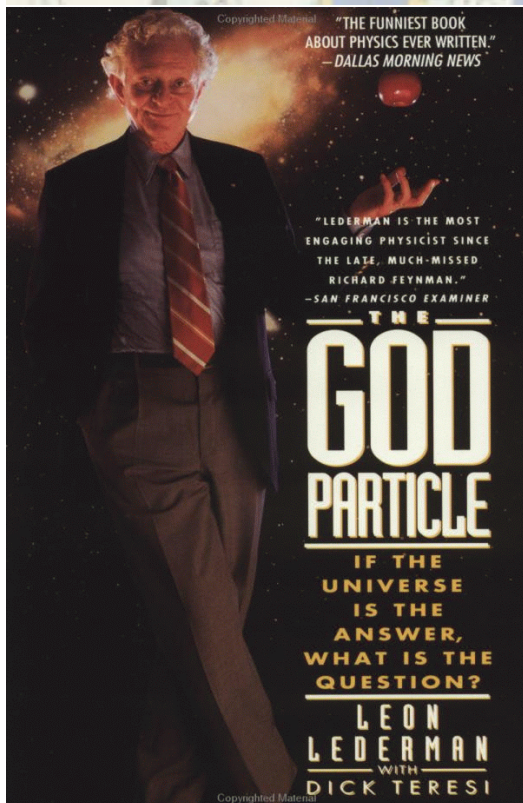


... if a rumour crosses the room ...



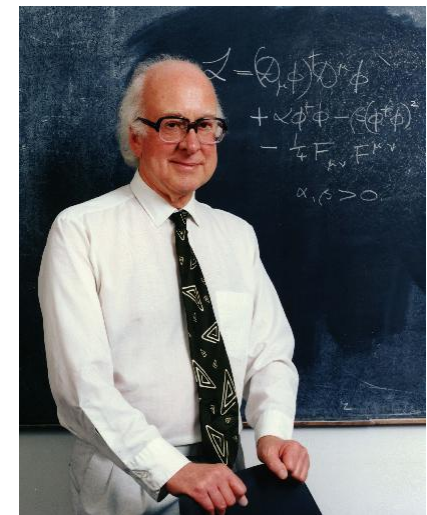
... it creates the same kind of clustering, but this time among the scientists themselves. In this analogy this cluster is a Higgs particle.

From an idea by David Miller, University College, London.

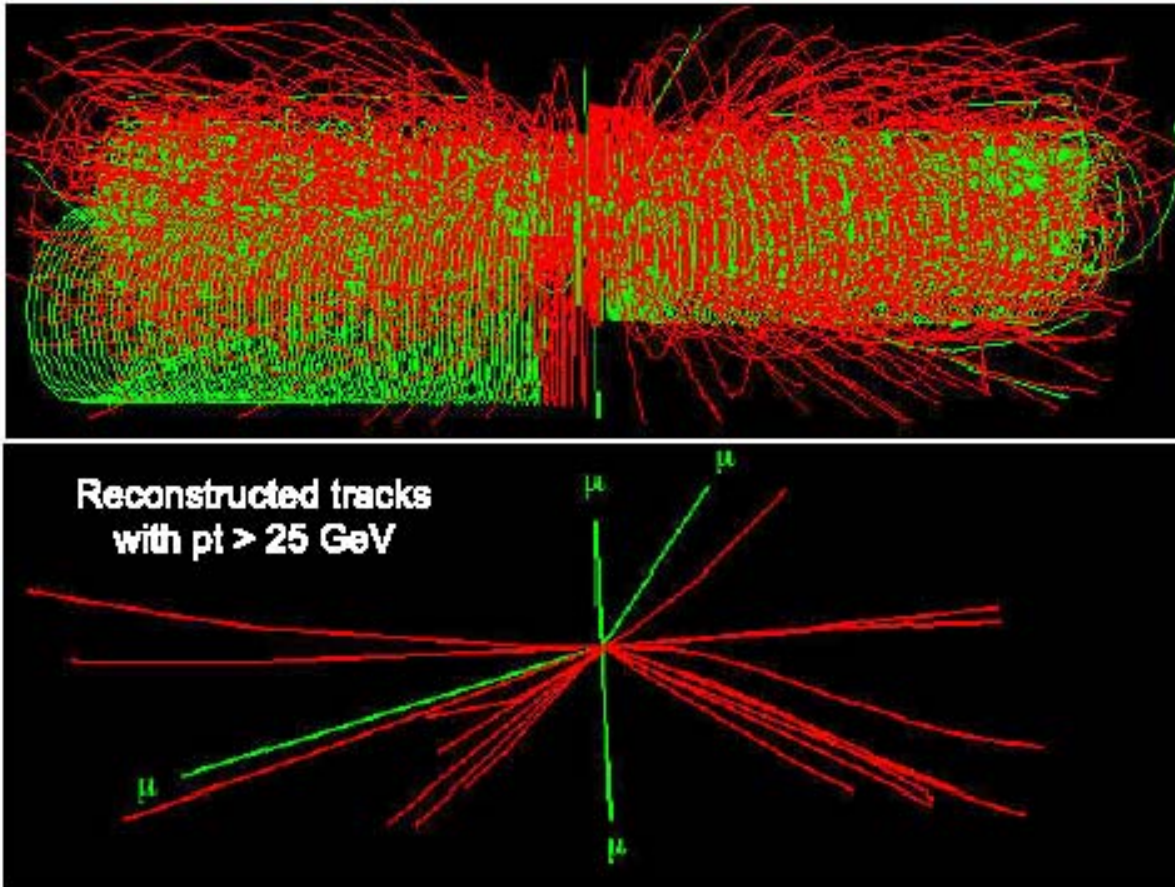


## What is mass?

- We still do not understand what mass is and why the quarks and leptons have different masses.
- Our best idea is that a "Higgs Field" fills the universe and mass measures the resistance to movement through this field



# Higgs events



**GOLDEN  
EVENT**

20 Min bias  
events overlap a  
 $H \rightarrow ZZ$  event,  
the  $Z \rightarrow \mu\mu$ . Final  
state  $H \rightarrow \mu\mu\mu\mu$

- Detectors requirements: granularity, time response, and radiation resistance, measurement of 1 TeV muons with 10% resolution

# Critical contributions

CDF: silicon microstrip detectors

LHC/CMS: silicon pixel detectors

