

"Hands on Particle Physics" International Masterclasses

Slides on U.S. Masterclass 2009-2010

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U.S. Masterclass

Interesting findings from 2009 survey



Most students:

- Indicated increased interest in physics
- Learned particle physics content
- Preferred MC Exercise (48%) or Videoconference (24%)



Further:

- Students seemed to get more benefit in Institutes with smaller numbers
- Modifications to Videocon may be working
- Better, more focused preparation for Masterclass may be in order

U.S. Masterclass

New or Revised for 2010



- Orientation for all U.S. Institutes
- Ning networking
 - Blog/forum
 - Chat
 - RSS
 - Interactive between Institutes
- Require 3+ hours of preparation at schools
- Large Institutes (>30 students) encouraged to have onsite MC
 - Students in teams of 10-20
 - Onsite conference (no video link)

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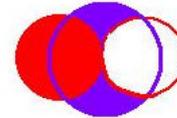
- Cloud Chamber Demo in beginning of MC
- Lunch with physicists
- Further streamlining of videoconference
- All LEP but present LHC events in videocon with discussion
- Visual aids:
 - Posters
 - Cards
 - Cheat sheets
 - Standard model charts

More information and results in Spring 2010

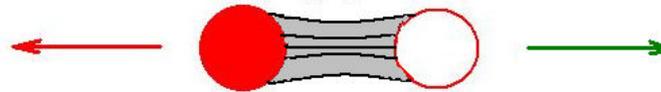
New alpha-s slides!

2-jet, 3-jet, yellow jet, blue jet *So what? (Advanced topic!)*

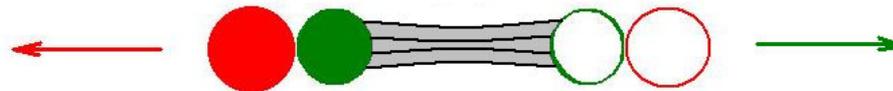
A **Z**-boson decays into an energetic pair of **quarks**



As the quarks separate, strong potential energy builds between them



That potential energy is converted to quarks...



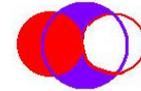
...and more quarks...and other particles...forming *hadronic jets*



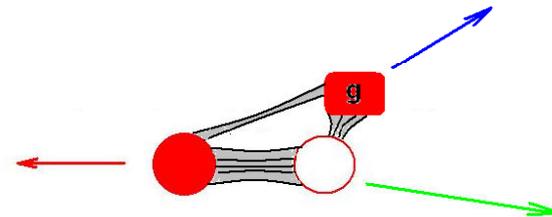
Well, look at how hadronic jets are formed from quarks and the energy of the strong nuclear force.

Sometimes, though, one quark emits a gluon. (What's that?)

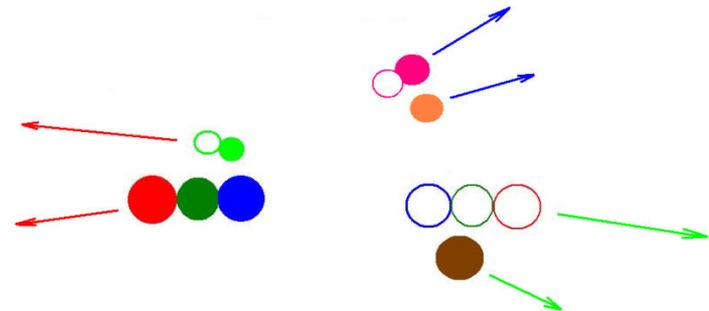
The Z-decay starts as before.



This time, one of the quarks emits a gluon. (Why?) All three particles have strong potential energy between them...

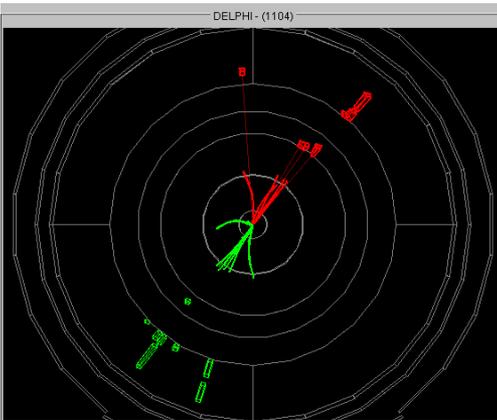
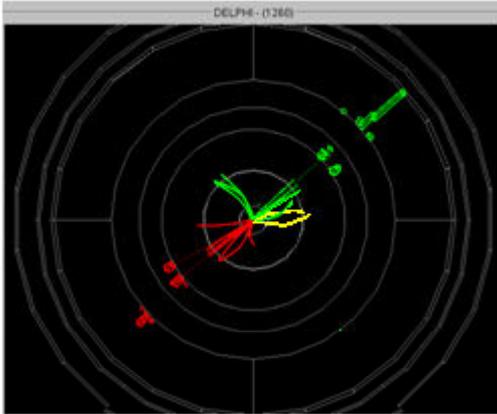


...which hadronizes into 3 jets.



Making gluons makes the strong force

So the *strong coupling constant*, a measure of the strength of the strong force, depends on the probability of quarks emitting gluons.



This can be determined for Z-bosons as the ratio of the number of

3-jet

to

2-jet

events

$$\alpha_S = 0.2 \cdot \frac{N_{3\text{Jets}}}{N_{2\text{Jets}}}$$

calibration factor

strong coupling constant

We'll check this in LEP data to help calibrate our results for LHC!