

Y2 Neutrino Physics

2008-9

Dr. N.K. Watson

"Office Hours"

Monday and Tuesdays, in the hour following lectures

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Course Material

Currently on WebCT (copy of 2007-8)

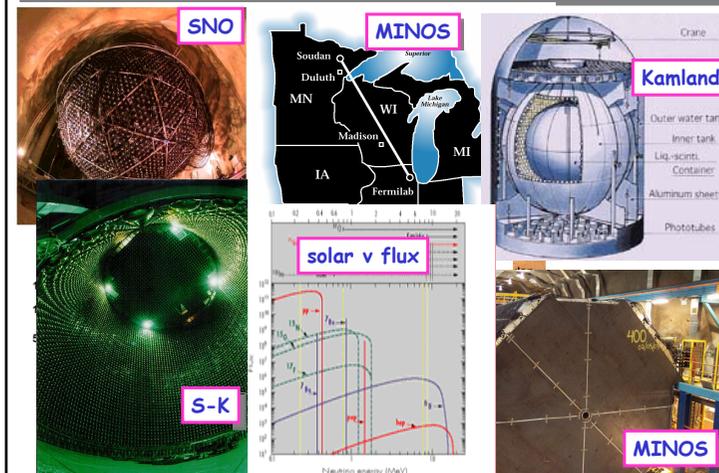
Will register you for module

Expect to migrate to PP group server and give you URL

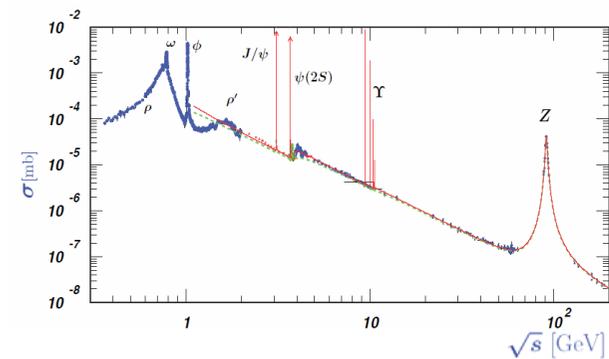
Outline

- Some changes to previous years
 - ▶ Have a better idea of your baseline from Y1 into to PP&C
 - ▶ Can get onto more interesting material if background/basics already established
 - ▶ Need your active help, please tell me
 - ⇒ If I am showing you things you already know and understand
 - ⇒ If I assume you know material you do not understand/have not seen previously
- Introduction to PP (review)
 - ▶ Refresh what you know from Y1/background information
- Neutrino properties
- Detection and observation
- Solar neutrinos
- Atmospheric neutrinos
- Neutrino oscillations and mass
 - ▶ Expand this in 2008/9 compared to previous years
 - ▶ Mass hierarchies, 3 flavour mixing
 - ▶ Matter effects
- Neutrinoless Double Beta Decay
- Future experiments and outlook
 - ▶ Much more active field since course first established
 - ▶ More running and in-build experiments
 - ▶ Still not a well-understood area of HEP

~Current neutrino experiments

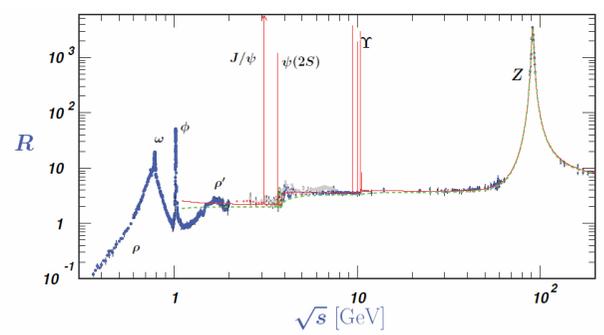


cross-section ($e^+e^- \rightarrow \text{hadrons}$)



<http://pdg.lbl.gov/2008/reviews/hadronicrpp.pdf>

cross-section $(e^+e^- \rightarrow \text{hadrons}) / (e^+e^- \rightarrow \mu^+\mu^-)$



<http://pdg.lbl.gov/2008/reviews/hadronicrpp.pdf>

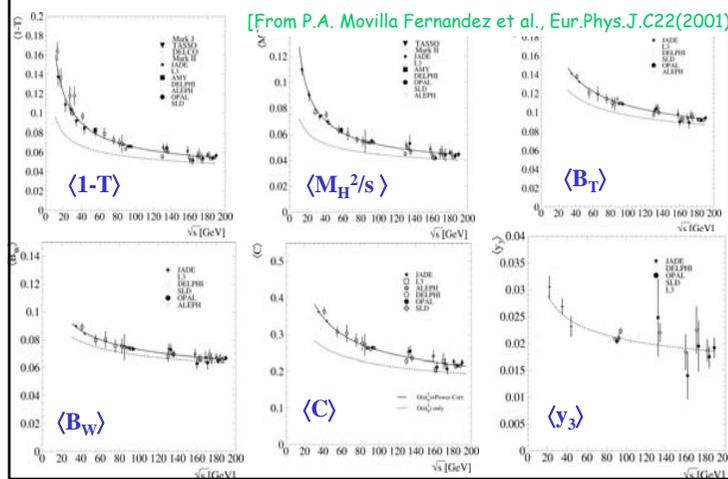
Strong Coupling "constant", α_s

- α_s the fundamental, universal QCD parameter
- Standard Model predicts "momentum scale", Q ($\sim \sqrt{s}$) evolution, but not absolute value
 - ▶ Perturbative effects, varying as $\sim 1/\ln Q$
 - ▶ Non-perturbative effects, varying as $\sim 1/Q$
- Test: measure different processes, energies
- Intuitive techniques in e^+e^-

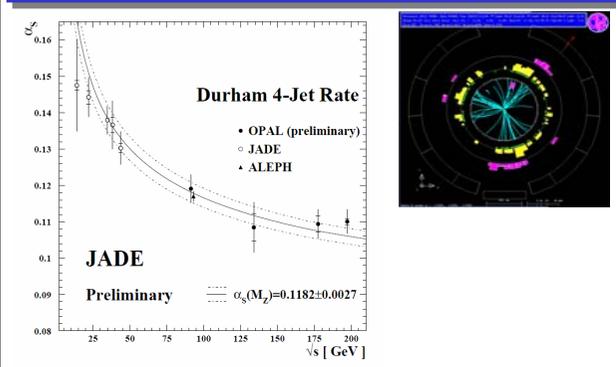


- Precision low, O(%) cf. electroweak O(10⁻⁵)

Global α_s measurements, various e^+e^- observables



Strong coupling constant



- α_s is strong force coupling constant
- Momentum scale-dependent value
 - ▶ Illustrate by measurement at different centre-of-mass energies in e^+e^- collisions