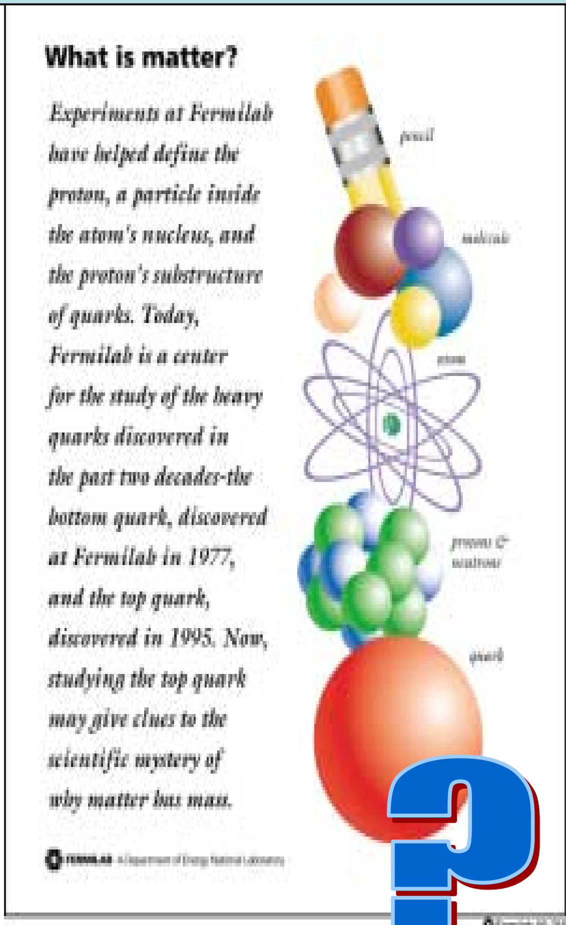
Search for Compositeness at DØ

Standard Model



Subhendu Chakrabarti

on behalf of

DO Experiment ,Fermilab

Tata Institute ,INDIA

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Phenomenology of Compositeness

- Theoretical Models based on composite fermions and their constituents "preons" with binding interaction termed "metacolor"

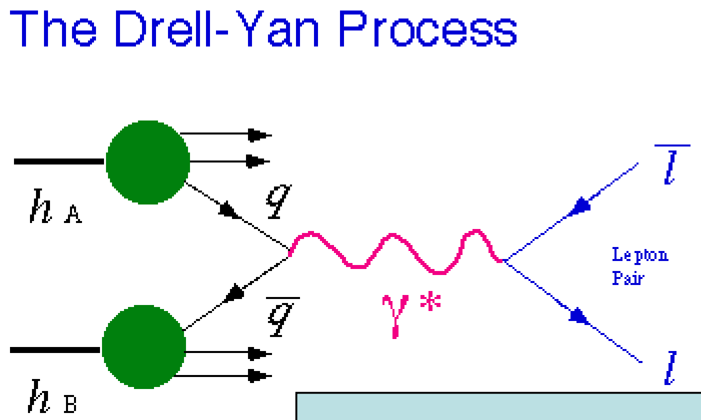
('t Hooft 1979, Dimopolous 1980)

- Four-fermion contact interaction model

with a scale of compositeness Λ

(Eichten, Lane and Peskin 1983, 1984)

Drell Yan Process



Dielectron pair production

Observable consequences presence of any contact interaction would modify Standard Model Drell Yan Cross section for electron pair production with high invariant mass

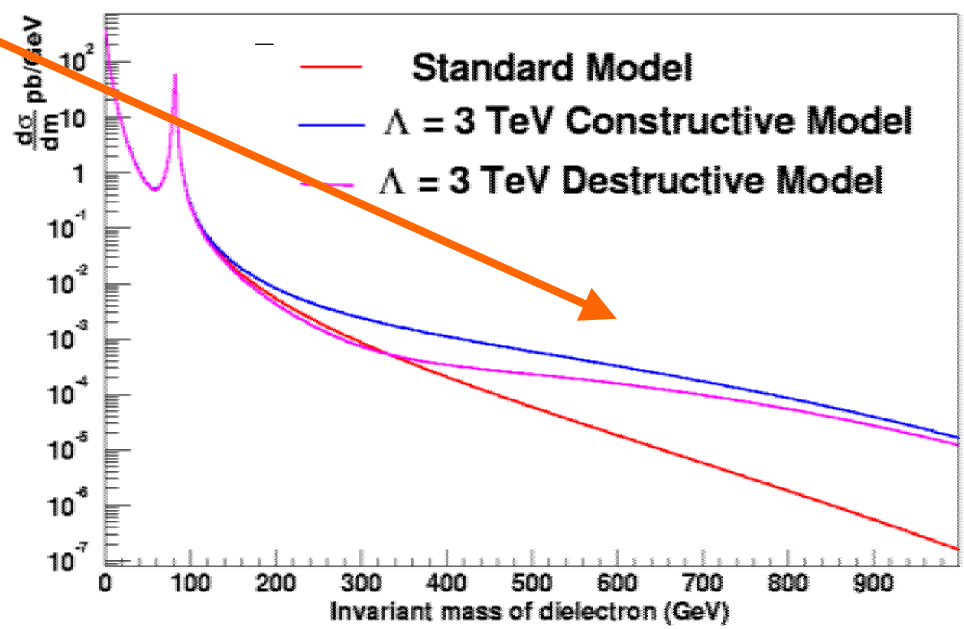
Contact Interaction

q represents u and d quarks

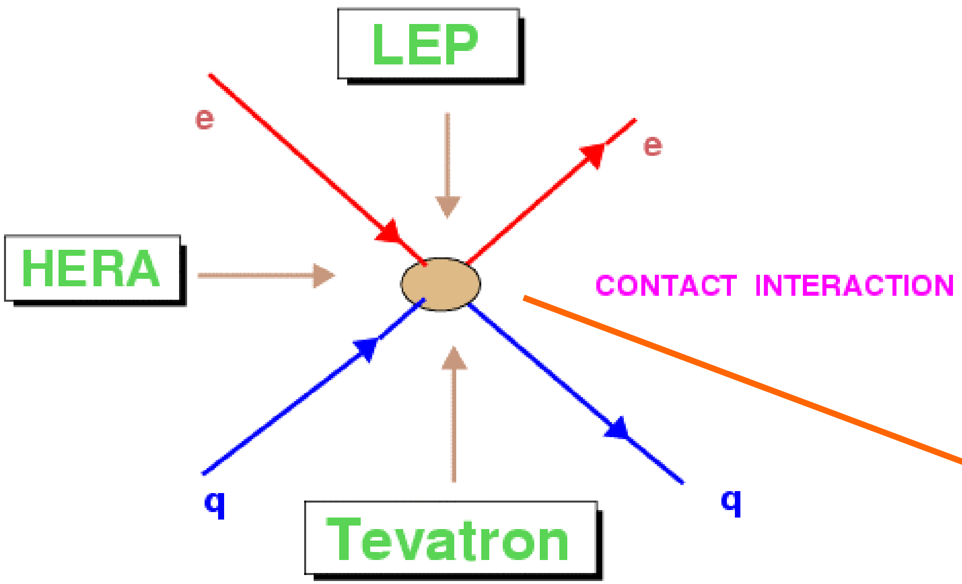
$$£ \sim \frac{4\pi\eta_{LL}}{\Lambda^2}(\overline{q_L}\gamma^{\mu}q_L)(\overline{e_L}\gamma_{\mu}e_L)$$

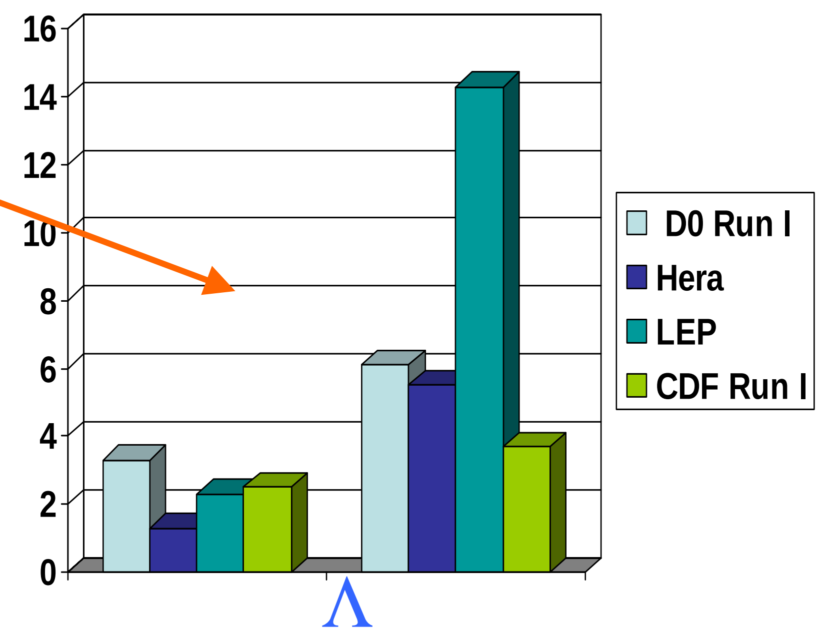
η denotes the sign of constructive (-1) or destructive (+1) interference

L denotes left-handed helicity of quark and leptons currents ,different combination of L and R helicity gives rise to parity violating models LL, RR. RL, LR and parity conserving models as well (LL+RR,LR+RL). Also vector (VV) or axial vector (AA) currents are possible



Experimental Status- Colliders





Highest and lowest values of limits of Λ from different experiments are shown

Limits of scale of compositeness Λ (TeV)

Experimental Status- APV

Atomic parity violation experiments put stringent limits on compositeness scale

Λ > 10 TeV

APV experiments are sensitive ONLY for parity- violating LL,RR,RL,LR models

phenomenological analysis even suggested a possible scale of compositeness ~ 11 TeV to accommodate certain anomalous results from atomic parity violation experiments
V. Barger et. al. 2000

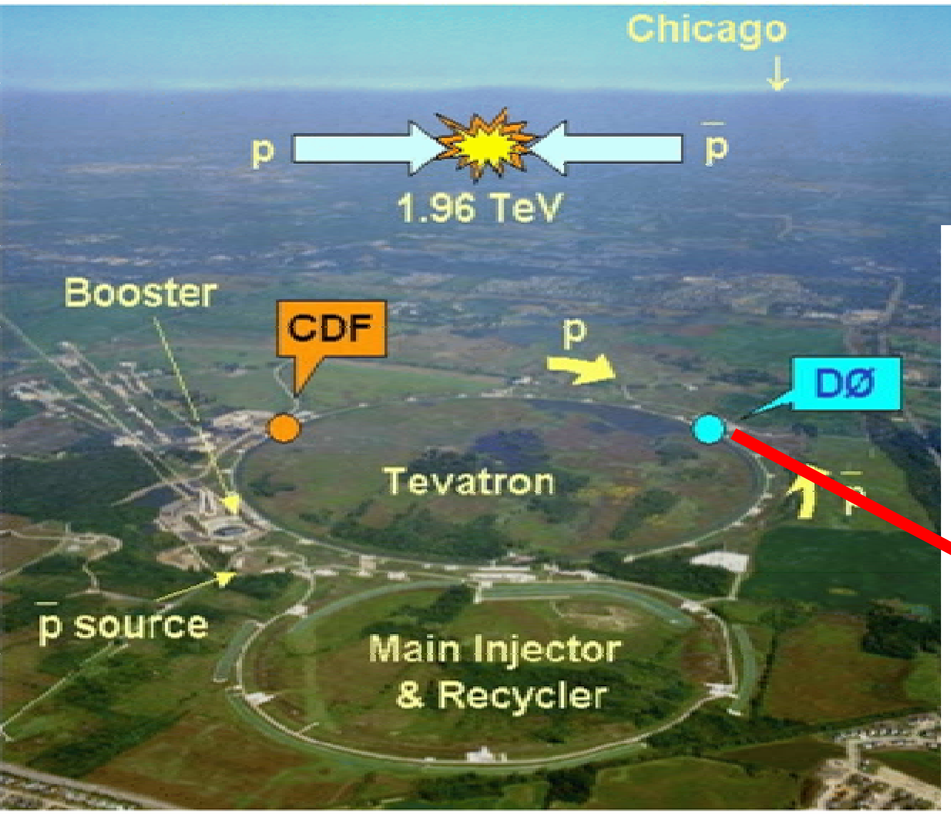
D0 Experiment

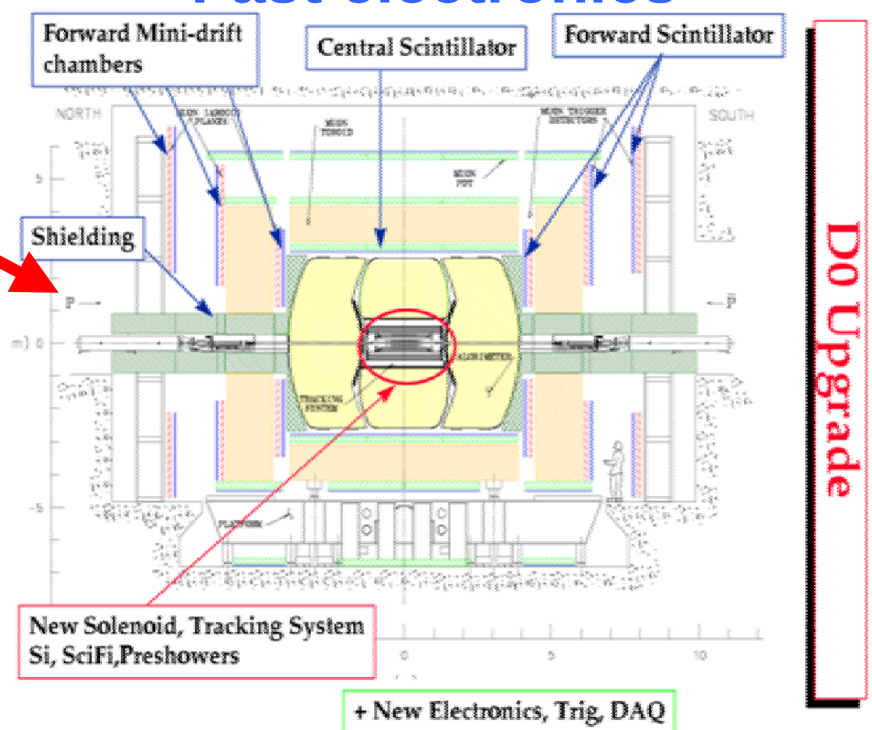
D0 Run II detector

LAr Calorimeter

Improved tracking

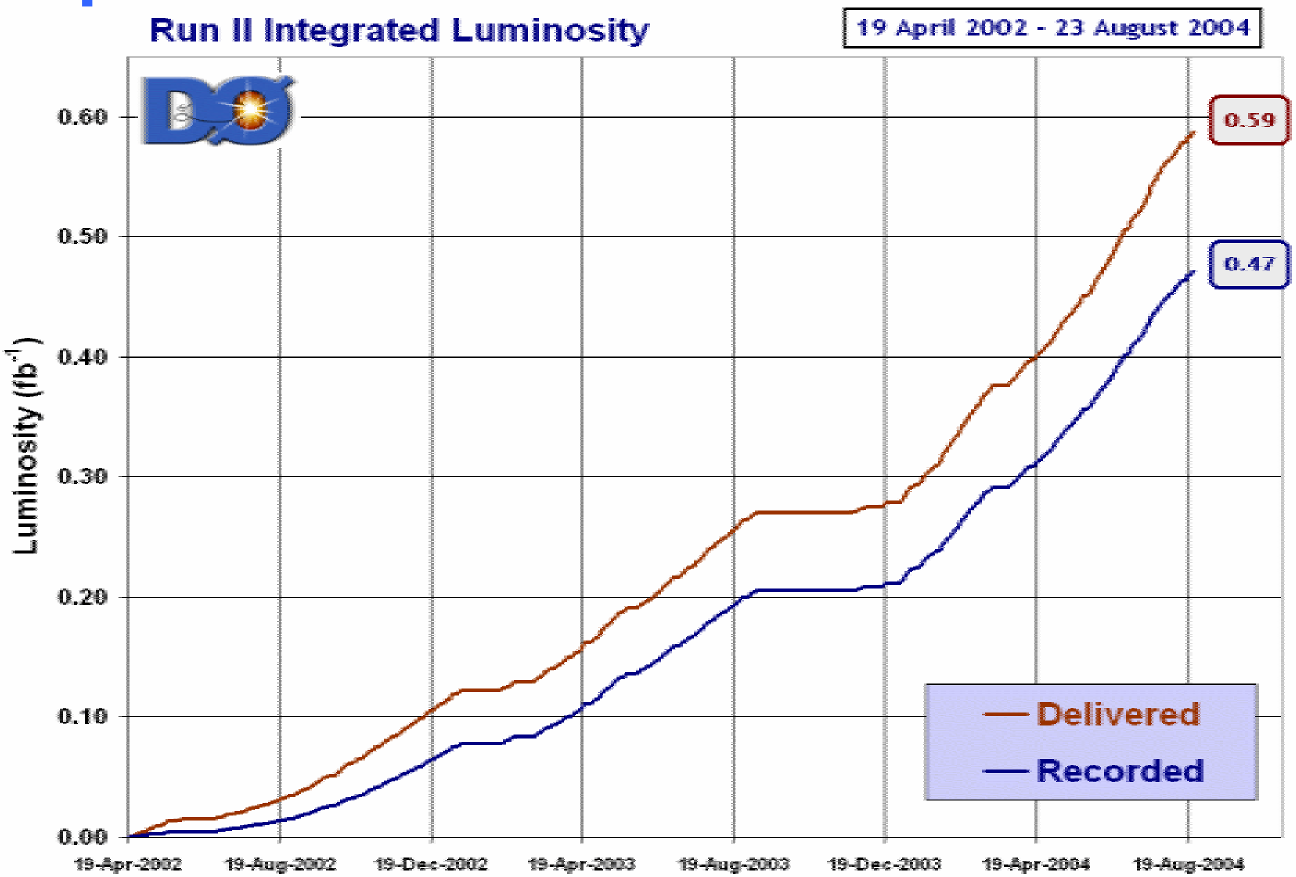
Fast electronics





DATA

Data for this analysis is collected between Sept. 2002 and March 2004



Integrated luminosity 271 pb-1

Already more than double data is on the tape !

Data Analysis

- We look for a pair of electrons having high transverse momentum (> 25 GeV) and at least one in central calorimeter ($|\eta|$ <1.1) or other in end-cap calorimeter (1.5<$|\eta|$<2.4)

- also look for at least one track match for this high-efficiency search

- invariant mass region chosen to look for new physics is (120-1000 GeV)

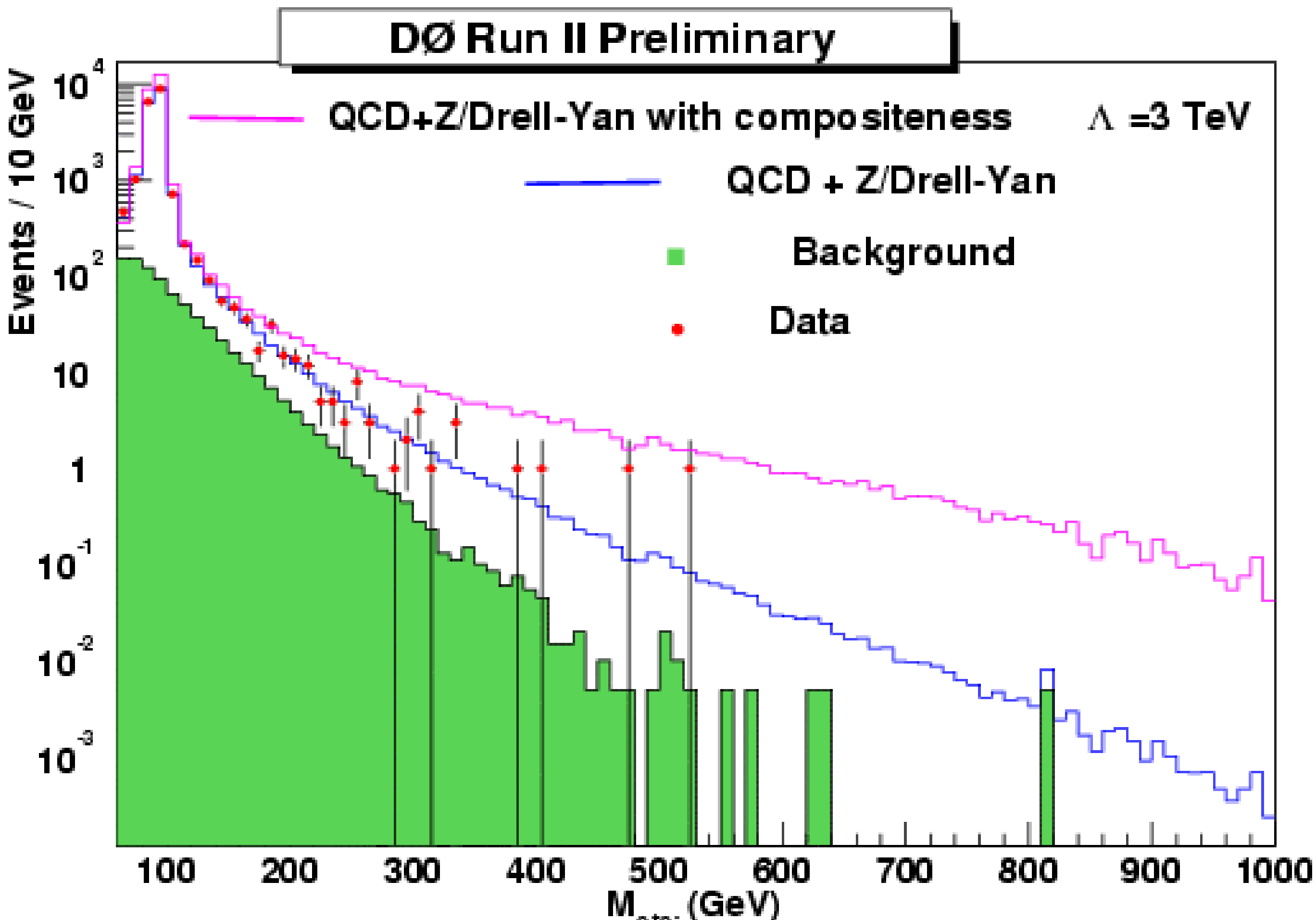
Background

The main background sources are di-jet and γ+jet ("QCD") events estimated from same data sample but with poor electron identification depending on shower shape requirements.

Background estimated from data and D0 Geant simulated MC is fitted with data

DATA ANALYSIS

Event distribution with invariant mass



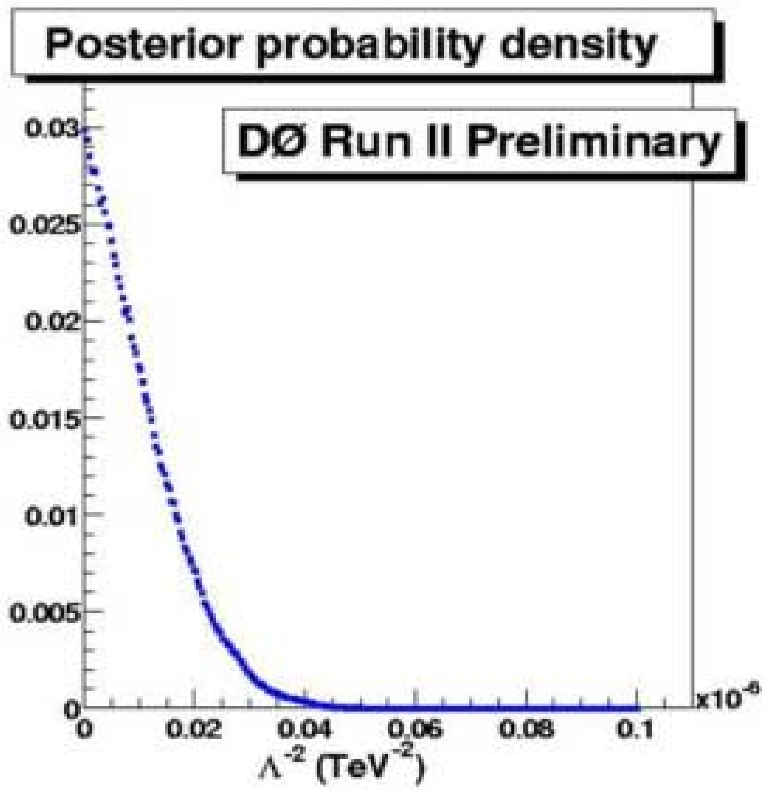
Good agreement with Standard Model

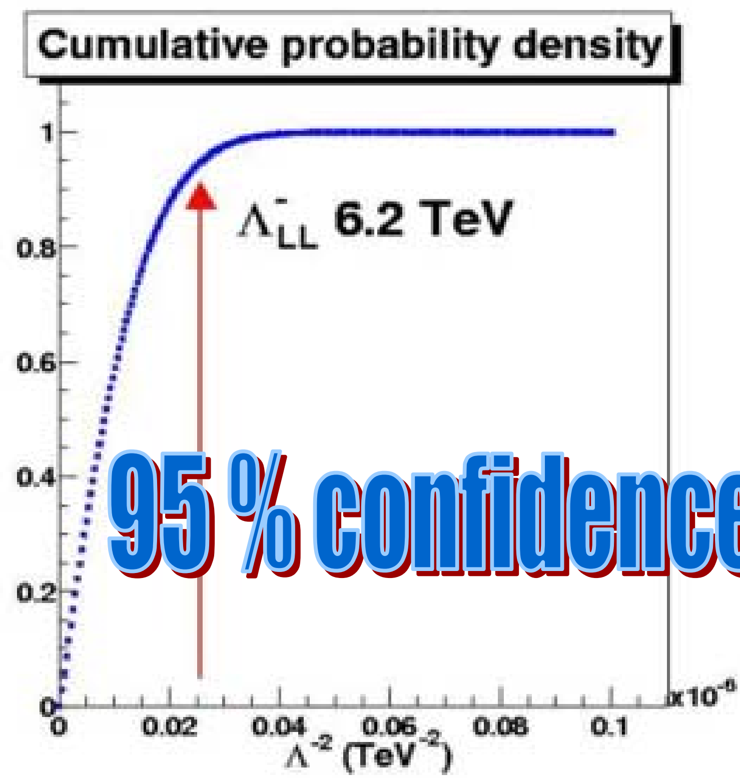
Data Vs. MC

Mass (GeV)	Observed	Expected (SM)
120-160	343	350.38±28.5
160-200	99	107±9.4
200-240	36	40.8±3.3
240-290	15	20.1±1.5
290-340	10	8.3±0.8
340-400	1	4.3±0.31
400-500	2	2.2±0.17
500-600	1	0.69±0.05
600-1000	0	0.31±0.02

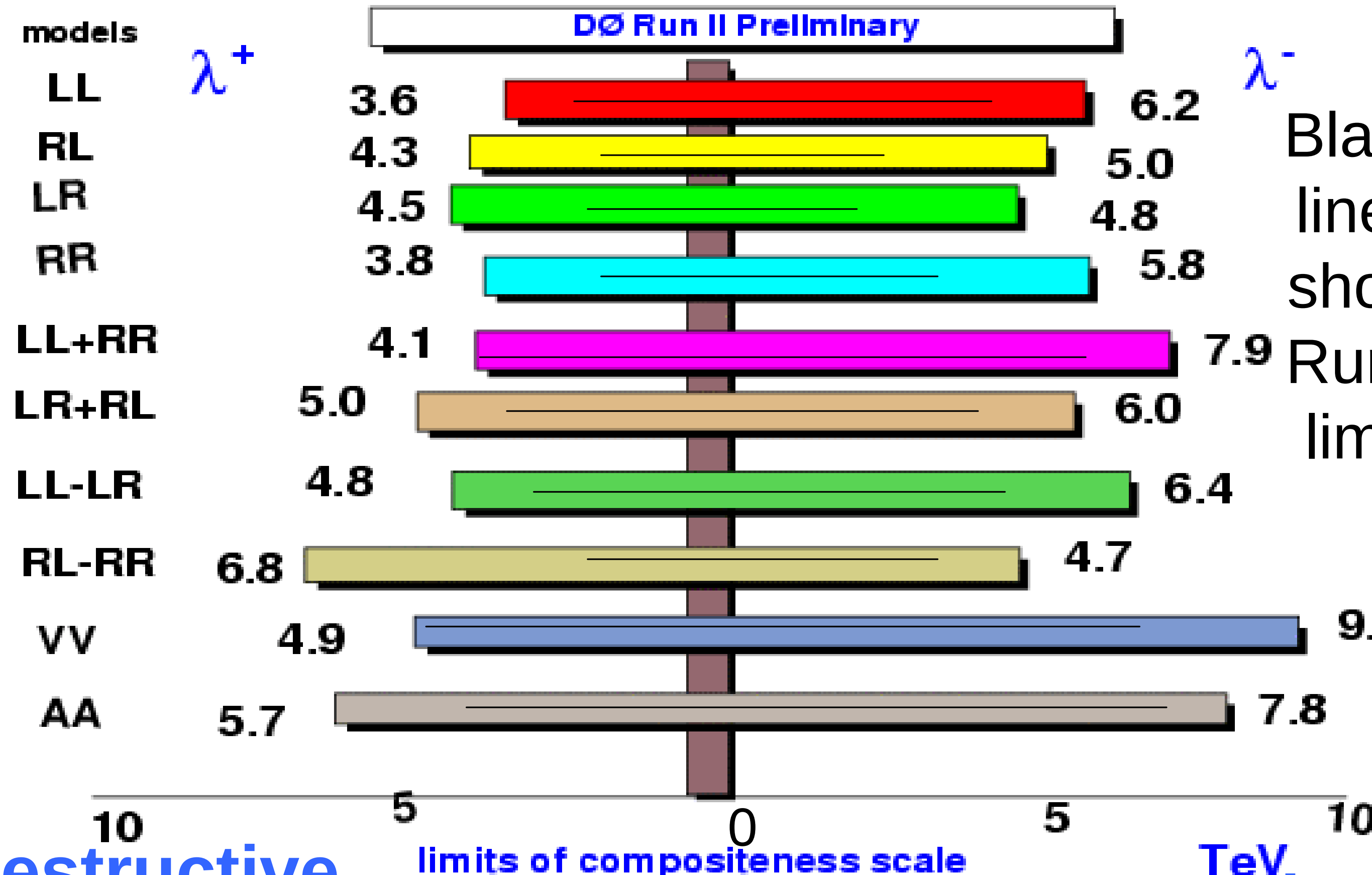
Results

Bayesian method to set a limit on Λ





Limits of Λ



Black lines show Run I limit

Destructive

constructive

Conclusions

No evidence of new physics

Stringent lower limits on Λ from 3.6 TeV to 9.1 TeV in Run II considerably improved than Run I

New lower limits of Λ not obtainable from APV experiments

Run II is ongoing , more data in coming years.