Major parameters of pp interactions at $\sqrt{s} = 40 \div 200$ TeV

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1. Total and elastic cross sections
2. Multiplicity distributions
3. Charged tracks rapidity distribution
4. Radiation doses
5. Summary

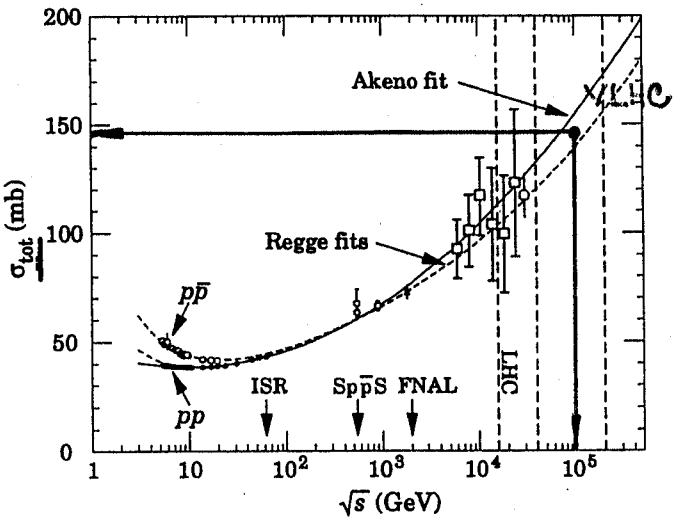
Snowmass 2001, July 9 2001

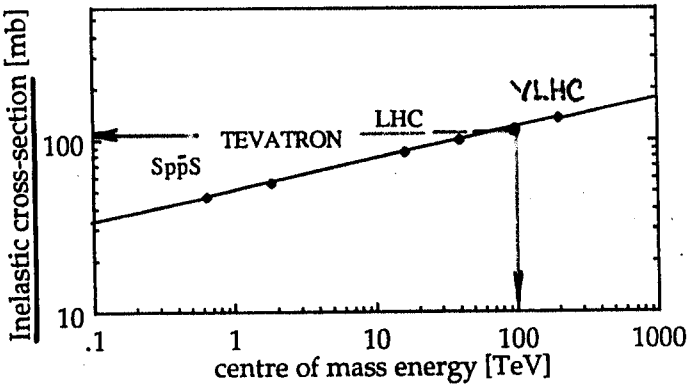
Parameters of pp Interactions

- Most results are for 100TeV and luminosity $10^{34}cm^{-2}s^{-1}$

We will start from properties of individual interactions

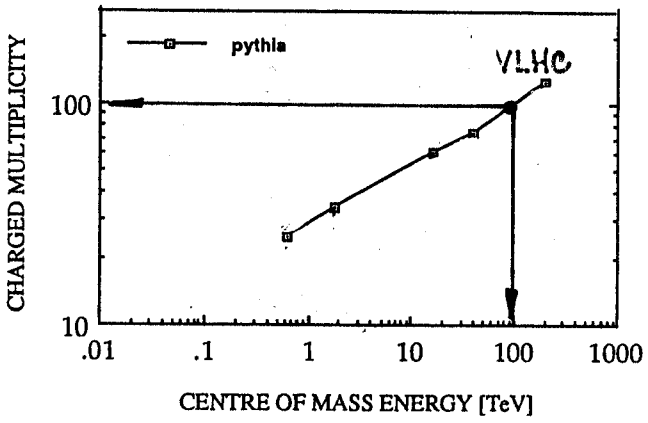
Total and inelastic cross sections



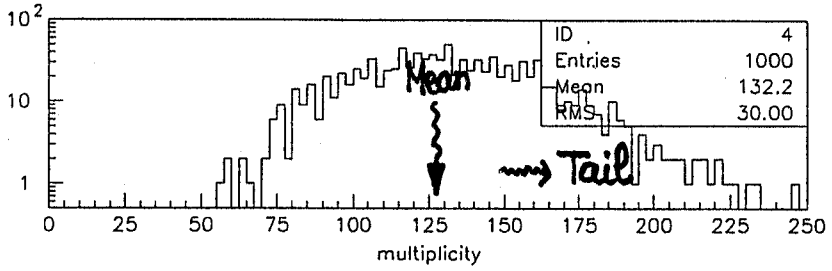


Charged Particles Multiplicity: min_bias events

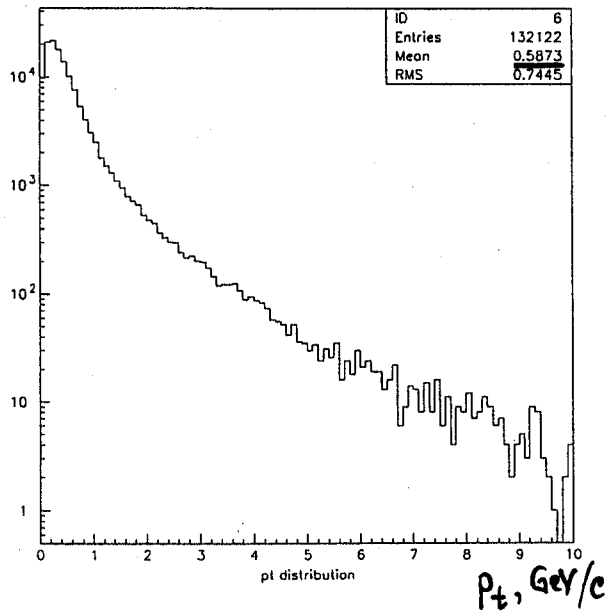
Average number of charged tracks



Multiplicity distribution



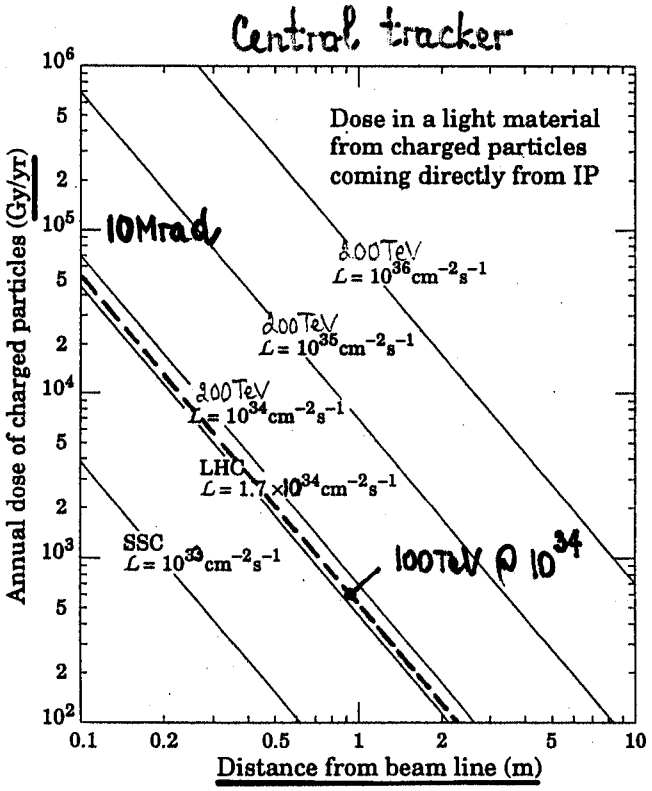
Particles p_t distribution

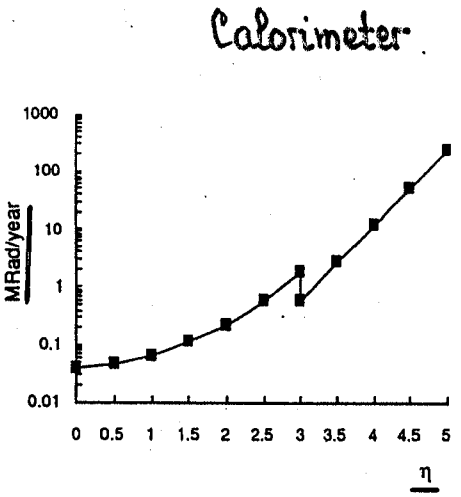


Radiation doses

- Materials change their properties under irradiation. Mostly affected areas are:
  - Central tracking detector •
  - Calorimetry in shower maximum •

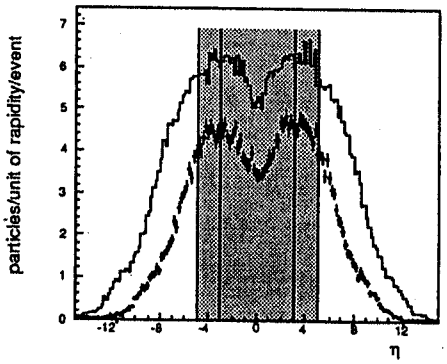
Typical dose rates for central region and calorimetry





1. Dose in central region increase slowly with energy, but linearly with luminosity
2. Beam losses is another source of irradiation
3. Radiation dose not depend upon luminosity "structure"

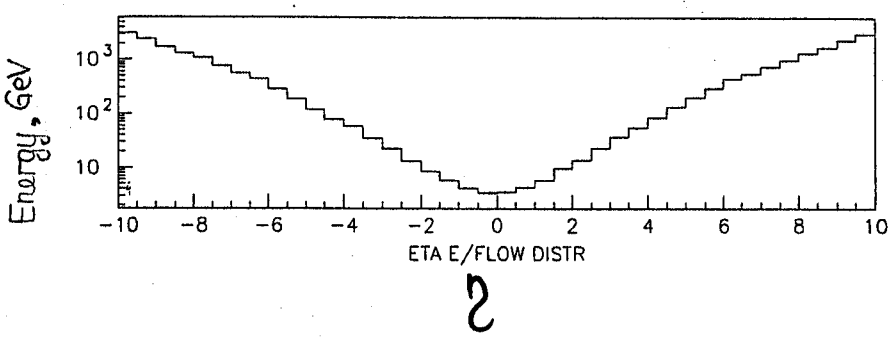
Rapidity platou



Pseudorapidity distributions for stable hadrons in minimum bias proton-proton interactions at $\sqrt{s} = 200$ TeV (solid line), and at $\sqrt{s} = 16$ TeV (points).

- Average number of particles per unit of rapidity is ~5

Energy_flow , 100 TeV, 1 event



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- Almost all energy is in the forward region

Example: # of tracker elements

For $\sqrt{s} = 200$ TeV # of tracks per event:

$$N_{tracks} = 50 \times 100 = 5 \cdot 10^3 \quad \text{tracks/event}$$

(50: # of interactions per crossing)

For reasonable reconstruction/triggering occupancy below 1% is needed:

$$N_{elem.} = 5 \cdot 10^3 \times 100 = 5 \cdot 10^5 \quad \text{elements/layer}$$

Number of layers $\gtrsim 20$ is needed:

$$N_{tot} = 5 \cdot 10^5 \times 2 \cdot 10 = 10^7 \quad \text{number of tracker "elements"}$$

Conclusions

1. Cross sections and multiplicities changing with energy increase very slowly.

2. Multiplicity distributions have long non-Gaussian tails.

3. Radiation dose in the central region is function of luminosity, "not" $\sqrt{s}$.

4. Most of charged tracks are low momentum
$\langle p_t \rangle \approx 0.6$ GeV

5. All parameters discussed are based on "extrapolation": we could see surprizes at very high energy!