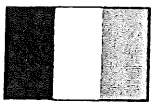
Das H1-Experiment bei HERA

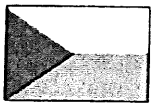
Am H1-Experiment beteiligte Institute:

(Stand September 1992)



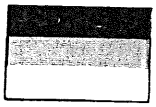
Belgien

Vrije Universiteit Brussel
Université Libre de Bruxells



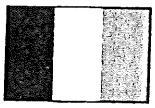
CSFR

Inst. of Exp. Phys., Slovak Acad. of Sc. Kosice
Inst. of Phys., Czechoslovak Acad. of Sc., Prag
Nuclear Center, Charles Univ., Prag



Deutschland

I. Physikalisches Institut der RWTH Aachen
III. Physikalisches Institut der RWTH Aachen
DESY, Hamburg
Institut für Physik, Universität Dortmund
I. Inst. für Experimentalphysik, Univ. Hamburg
II. Inst. für Experimentalphysik, Univ. Hamburg
Inst. für Hochenergiephysik, Univ. Heidelberg
Physikalisches Institut, Univ. Heidelberg
Institut für reine und ang. Kernphysik, Univ. Kiel
Max-Planck-Institut für Physik, München
Fachbereich Physik, Bergische Univ., Wuppertal
DESY - Inst. für Hochenergiephysik, Zeuthen



Frankreich

Centre d´Etudes de Saclay, Gif-sur-Yvette
LAL, Univ. de Paris-Sud, Orsay
Ecole Polytechnique, LPNHE, Palaiseau
Université Paris VI et VII, LPNHE, Paris

Großbritannien

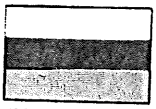
School of Physics, University of Birmingham
Rutherford Appleton Lab., Chilton
Physics Department, University of Glasgow
School of Physics, Univerity of Lancaster
Dep. of Physics, Univerity of Liverpool
Queen Mary and Westfield College, London
Physics Dep., University of Manchester

Italien

Dipt. di Fisica, Univ. e INFN, Roma

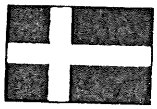
Polen

Institute of Nuclear Physics, Cracow



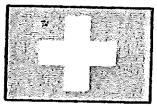
Rußland

ITEP Institute for Th. and Exp. Physics, Moscow
P. N. Lebedev Phys. Inst., Acad. of Sc., Moscow



Schweden

Physics Dep., Lund University



Schweiz

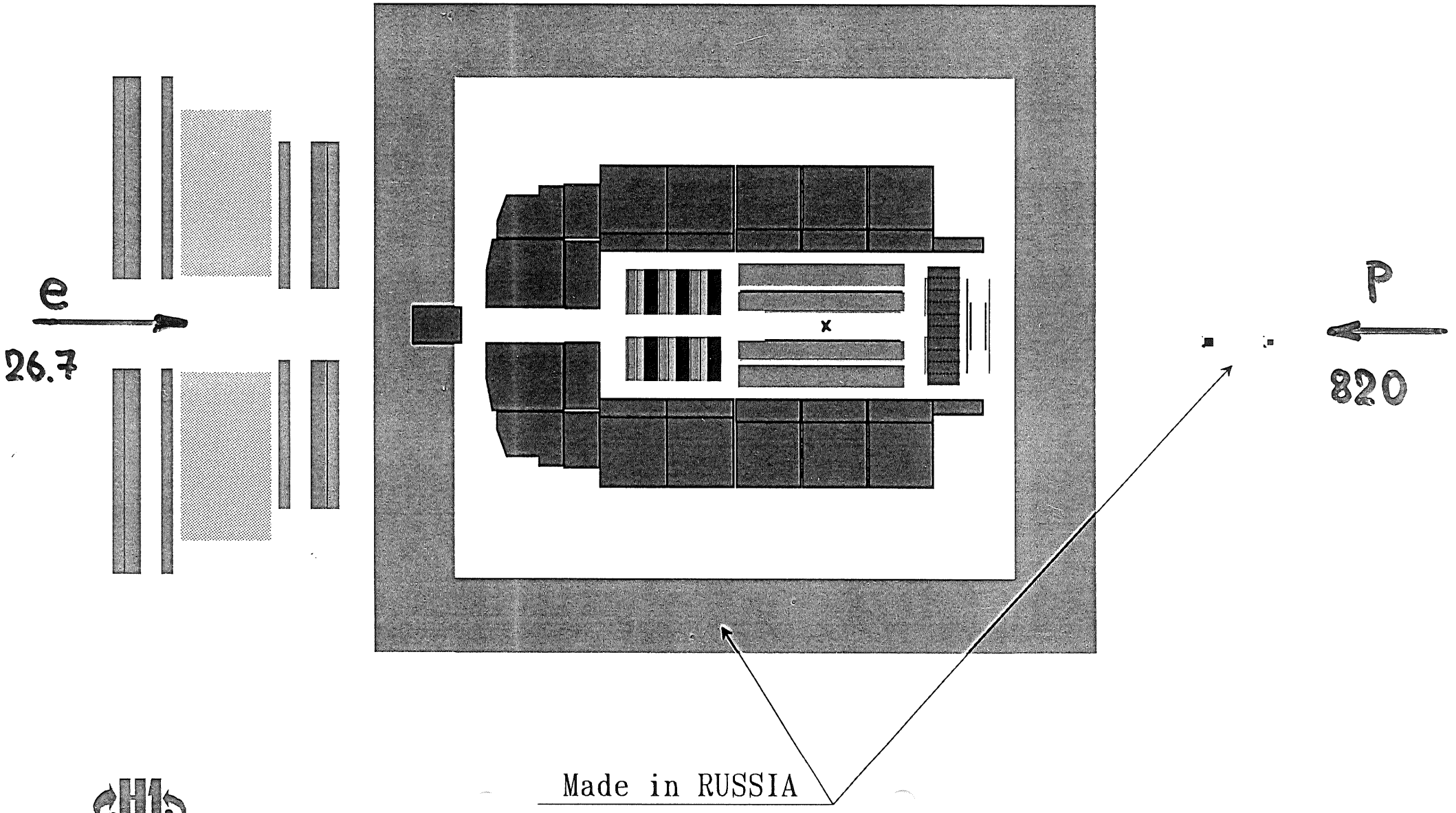
Physik Institut, Universität Zürich
Inst. für Mittelenergiephysik, ETH Zürich, Villigen

USA

Dep. of Physics, Davis, Univ. of California

H1 ist eine Kollaboration von etwa 350 Wissenschaftlern aus 11 Ländern, die in der Halle Nord von HERA eine große Meßapparatur aufgebaut hat. Kollisionen hochenergetischer Elektronen mit Protonen (Wasserstoffatomkerne) werden untersucht. Der innere Aufbau der Protonen wird mit einer besseren Auflösung als je zuvor erforscht. Es wird gleichzeitig nach Teilchen gesucht, die bis jetzt noch nie beobachtet wurden. Das Verständnis der Urkräfte der Natur wird bei diesem einzigartigen Experiment auch verbessert werden.

SCHEMATIC VIEW OF THE H1 DETECTOR



— Luminosity —

$$\sigma\,[cm^{+2}] = L\,[cm^{-2}s^{-1}]^{-1} \cdot R\,[Hz]$$

What we want to know — What we actually measur

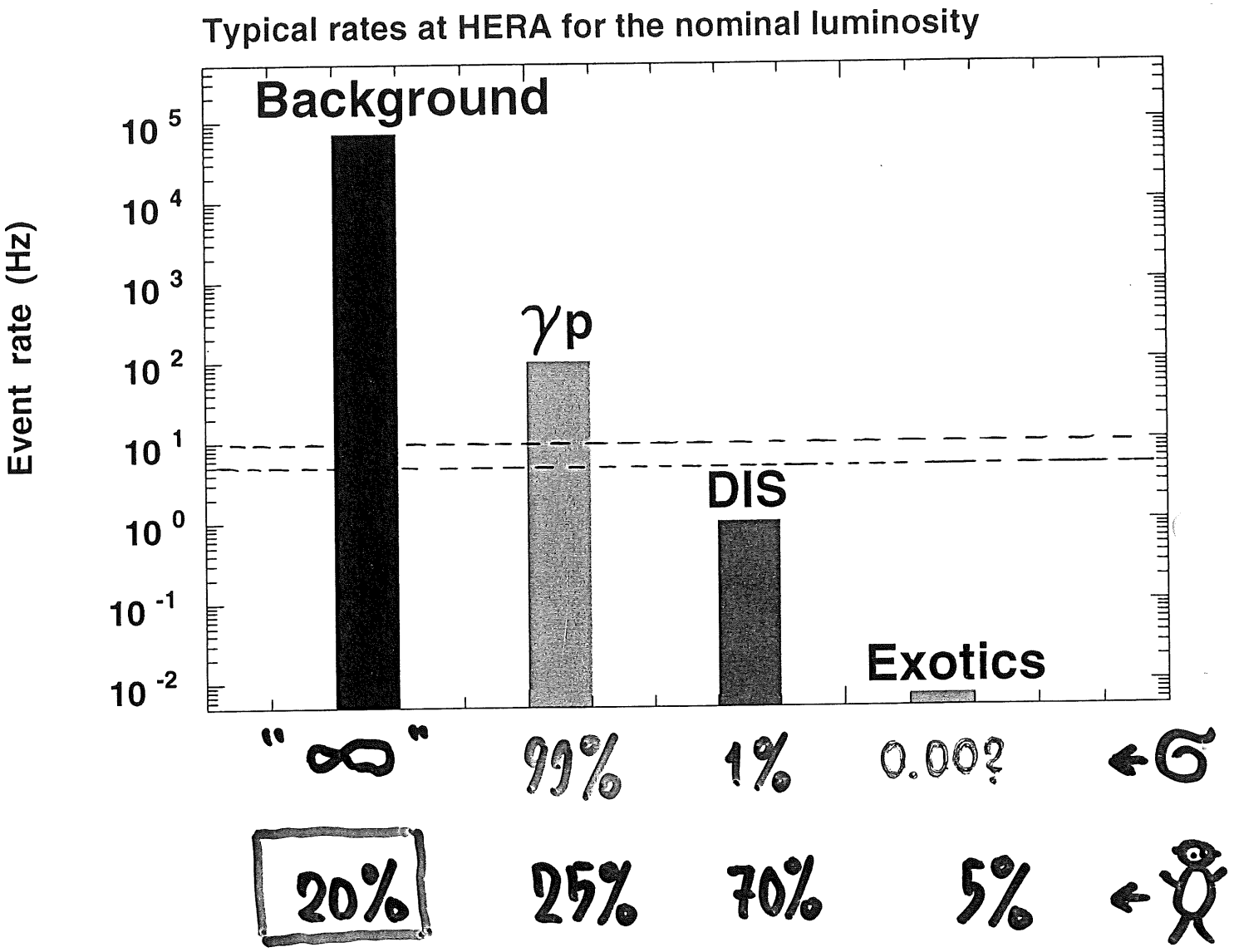
- We need **high** L to study rare processes in a reasonable time ($L_{HERA} = 1.5 \cdot 10^{31}$)
- We need **accurate** L measurements in order to estimate σ precisely
- We need **FAST** luminoty monitor to achieve collisions quickly **(SAVE $)**

How do we do this?

Measure rates for the events having **well known** and **high** cross sections:

$$ep \to ep\gamma$$

$$L = \frac{R(ep \to ep\gamma)}{\sigma(ep \to ep\gamma)}$$



July '92: $\int \mathcal{L} \approx 2\ nb^{-1}$

~ 5000 γp

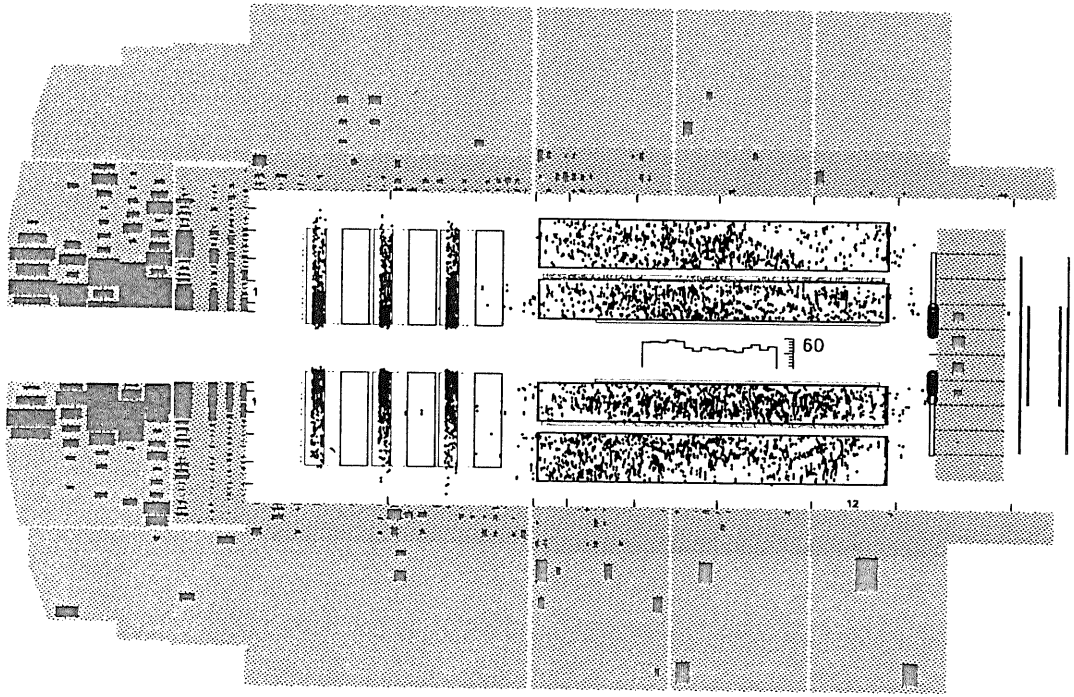
~ 200 DIS

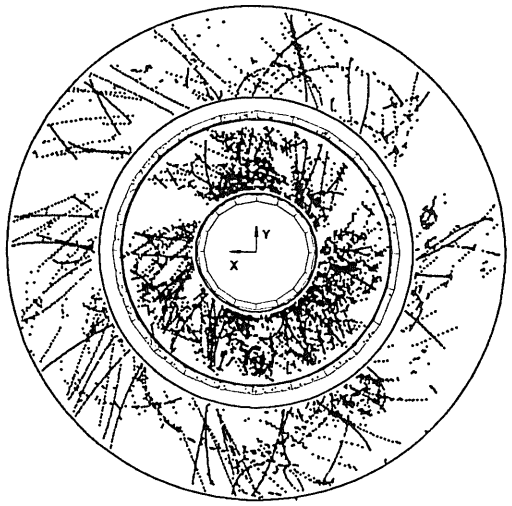
$\frac{0}{1}$? Exotics

Run 21180 Event 6251 Class 1 13 18 20 21

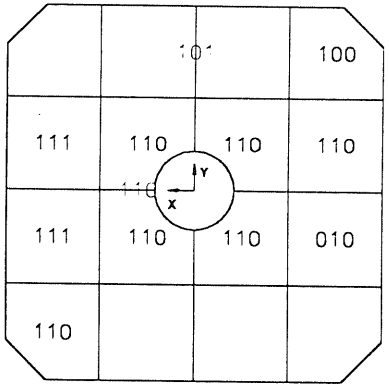
Date 26/09/1992

Trigger information
AST bits = 51
RST bits = 39 44 45 46 51
L4: rejected by ZVTX TOF





TOF



Typical background event

H1 DAQ CHAIN

H1 DETECTOR ≈ 270,000 ELECTRONIC CHANNELS
≈ 3 MBYTES RAW DIGITISED INFORMATION

FRONT-END DIGITISATION (VMEbus)

≈ 150 VME crates
≈ 200 μprocessors
≈ 65 DSPs

Qt-analysis in drift chambers

Subdetector Master Crates (12 Branches)

12 - 50 MBytes/s max.
≈ 1.5 MB/s typically

CENTRAL DAQ

SYSTEM-MANAGEMENT

EVENT BUILDING

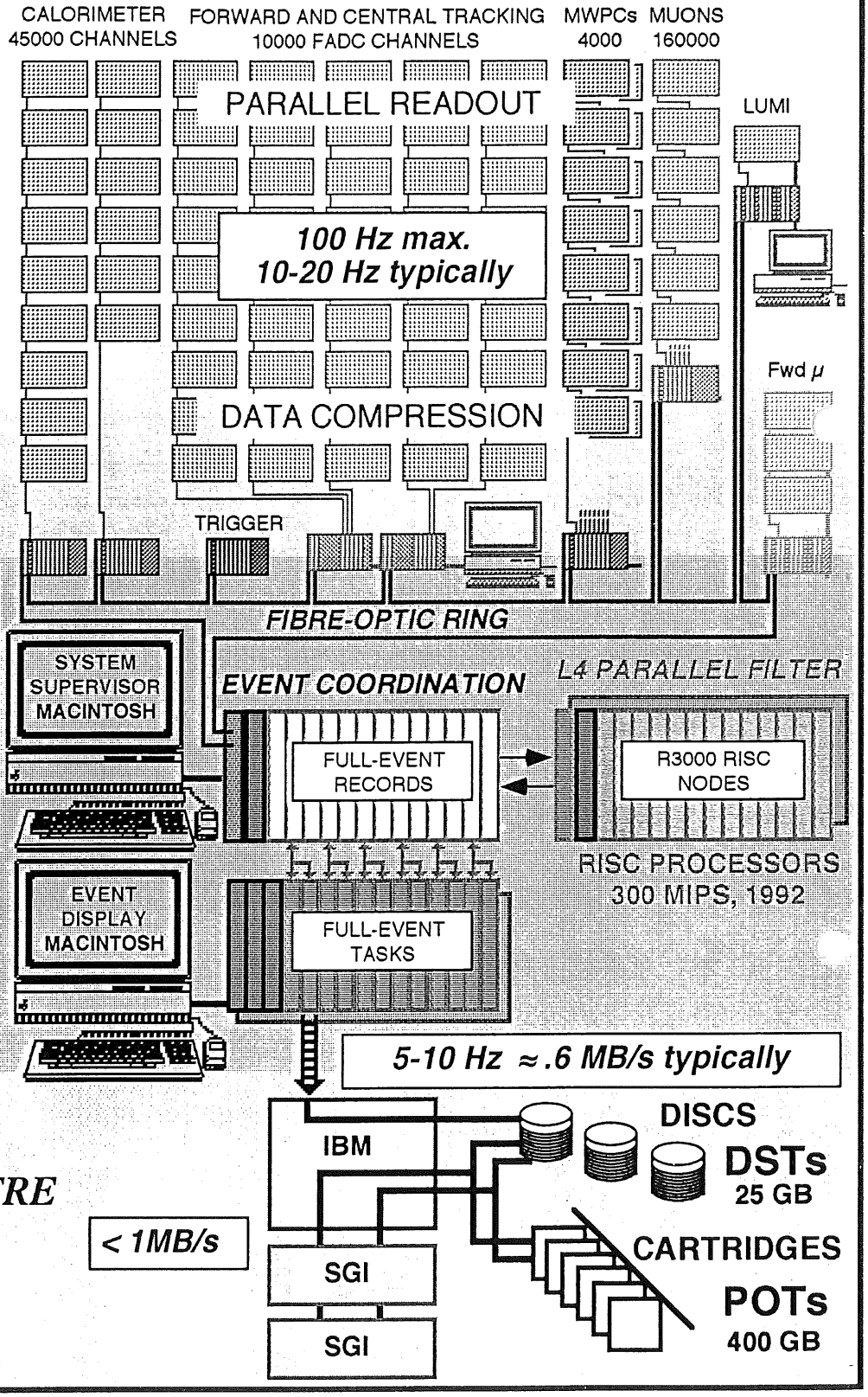
L4 FILTER RECONSTRUCTION

DATA MONITORING

DATA LOGGING

COMPUTER CENTRE

EVENT CLASSIFICATION
DATA REDUCTION



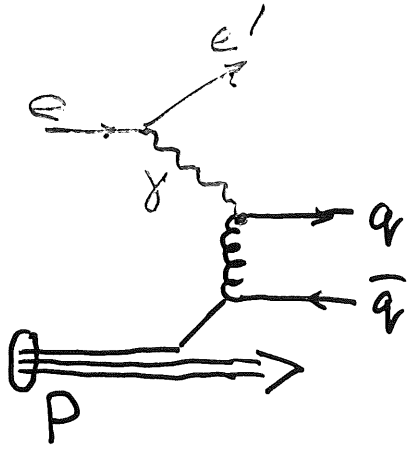
H1 ZEUS

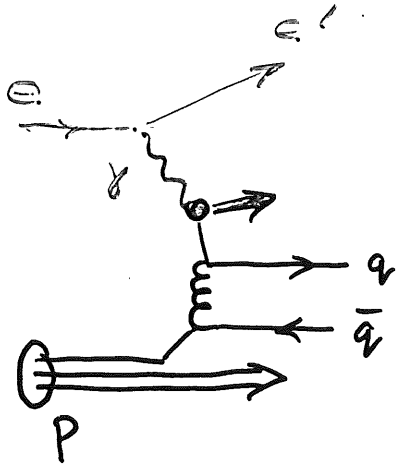
First results in γp physics

Q1: Is there a basic difference between γp and hadron-hadron interactions?

Q2: Is there any evidence of **hard** γp-scattering (do we see jets)?

Q3: Does photon have a **structure**, or it is pure point like particle?

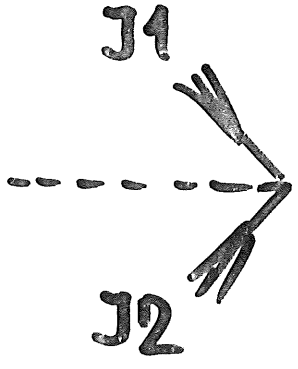


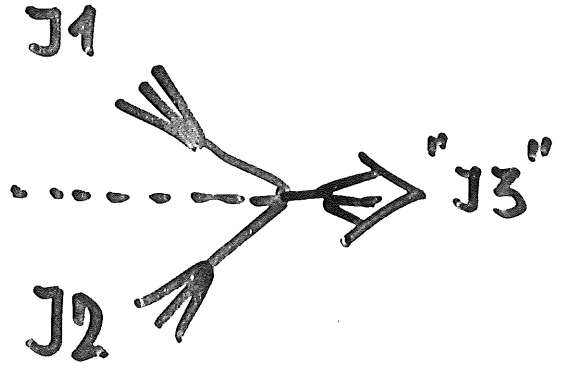


THEORY

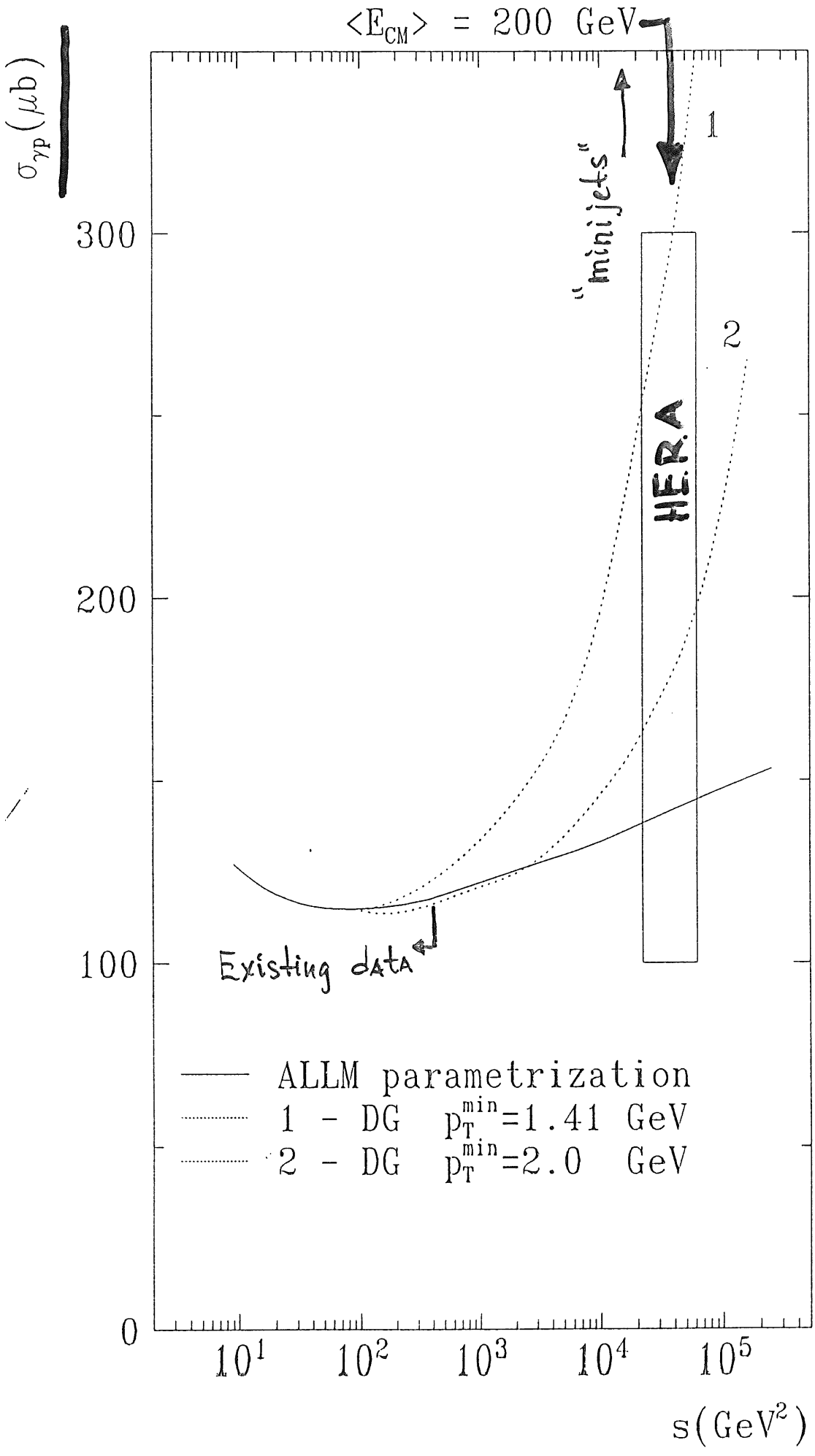
Point like

Hadron like

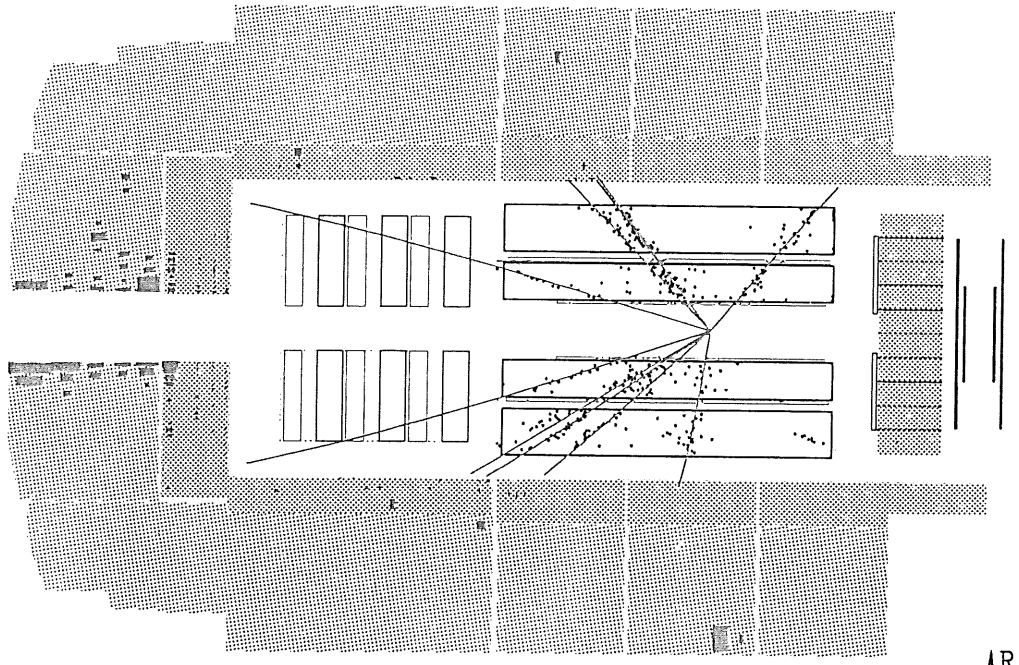


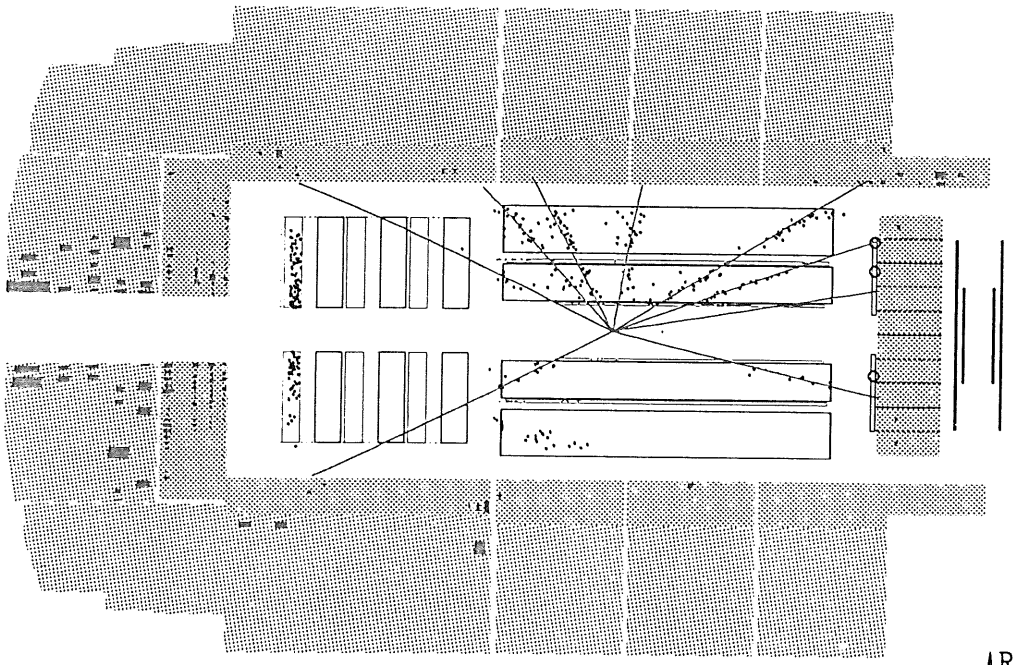


EXP.


$\langle E_{CM} \rangle$ = 200 GeV
$\sigma_{\gamma p}(\mu b)$
"minijets"
1
2
HERA
300
200
100
0
Existing data
ALLM parametrization
1 - DG p_T^{min}=1.41 GeV
2 - DG p_T^{min}=2.0 GeV
10^1
10^2
10^3
10^4
10^5
s(GeV^2)

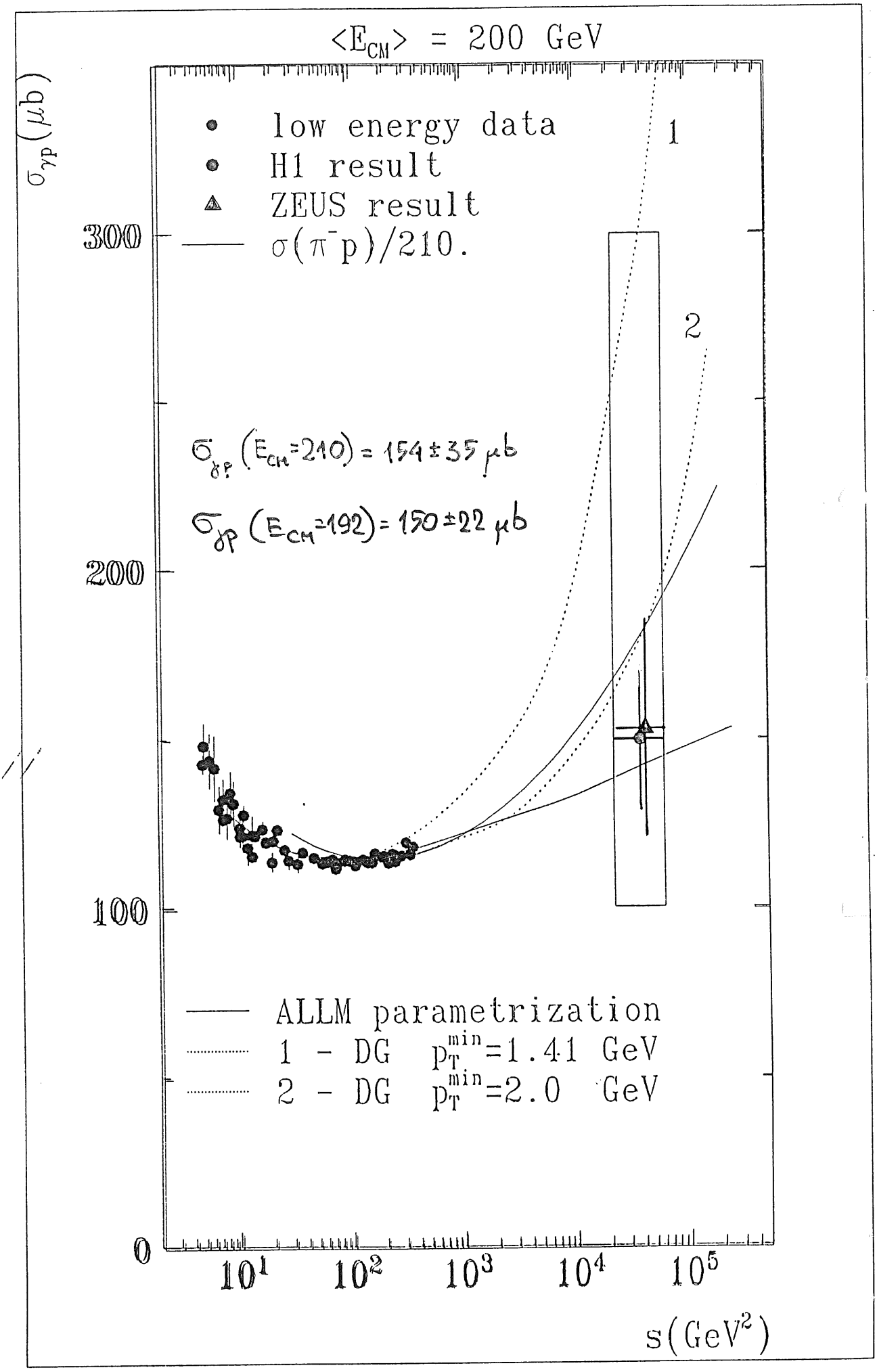
10 DM for the right answer...

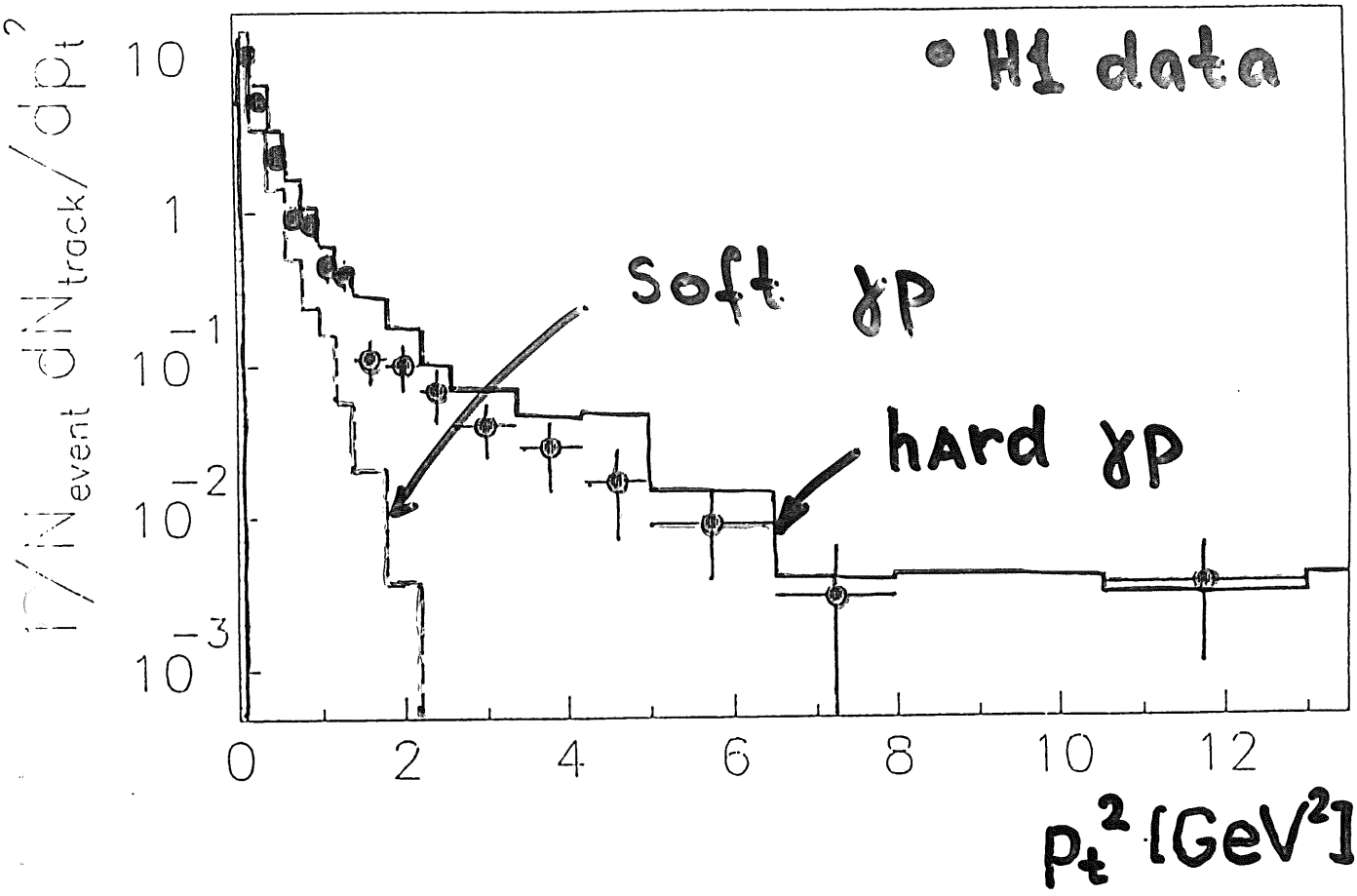




Photoproduction vs p-gas

Answer for Q1:





Q2': Do we see hard γp processes?

A: Yes!

Q2": OK, do we see jets then?

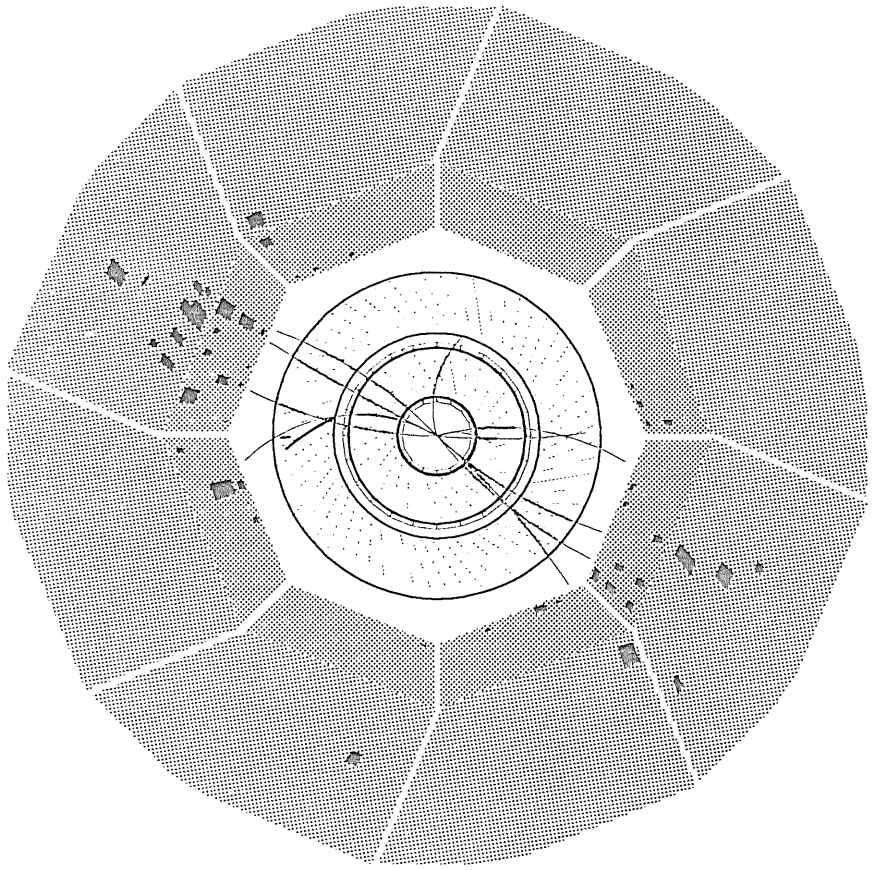
A: Yes!

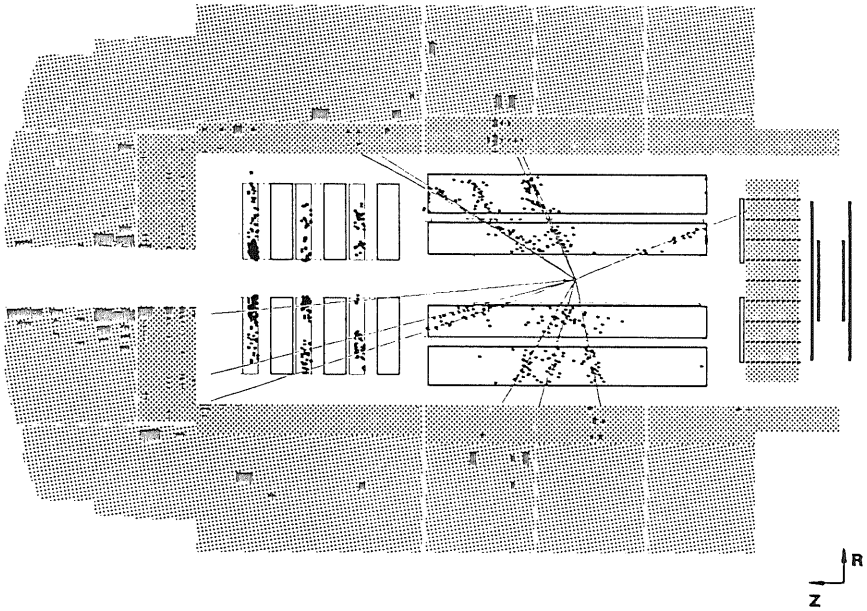
→ see next transparency

H1 **Run 24649 Event 7435 Class: 4 9 15 16 17 25** **Date 10/07/1992**

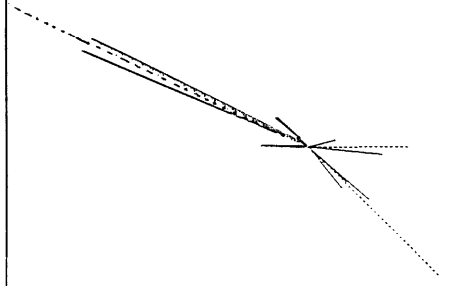
Trigger information
AST bits = 14
RST bits = 14 37 39 48 49

E= −26.7 x 819.9 CeV B=11.3 kC
Run date 92/06/29 18:49

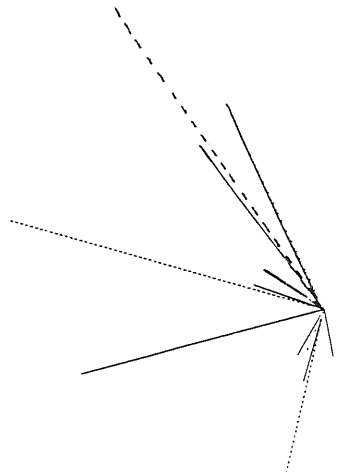




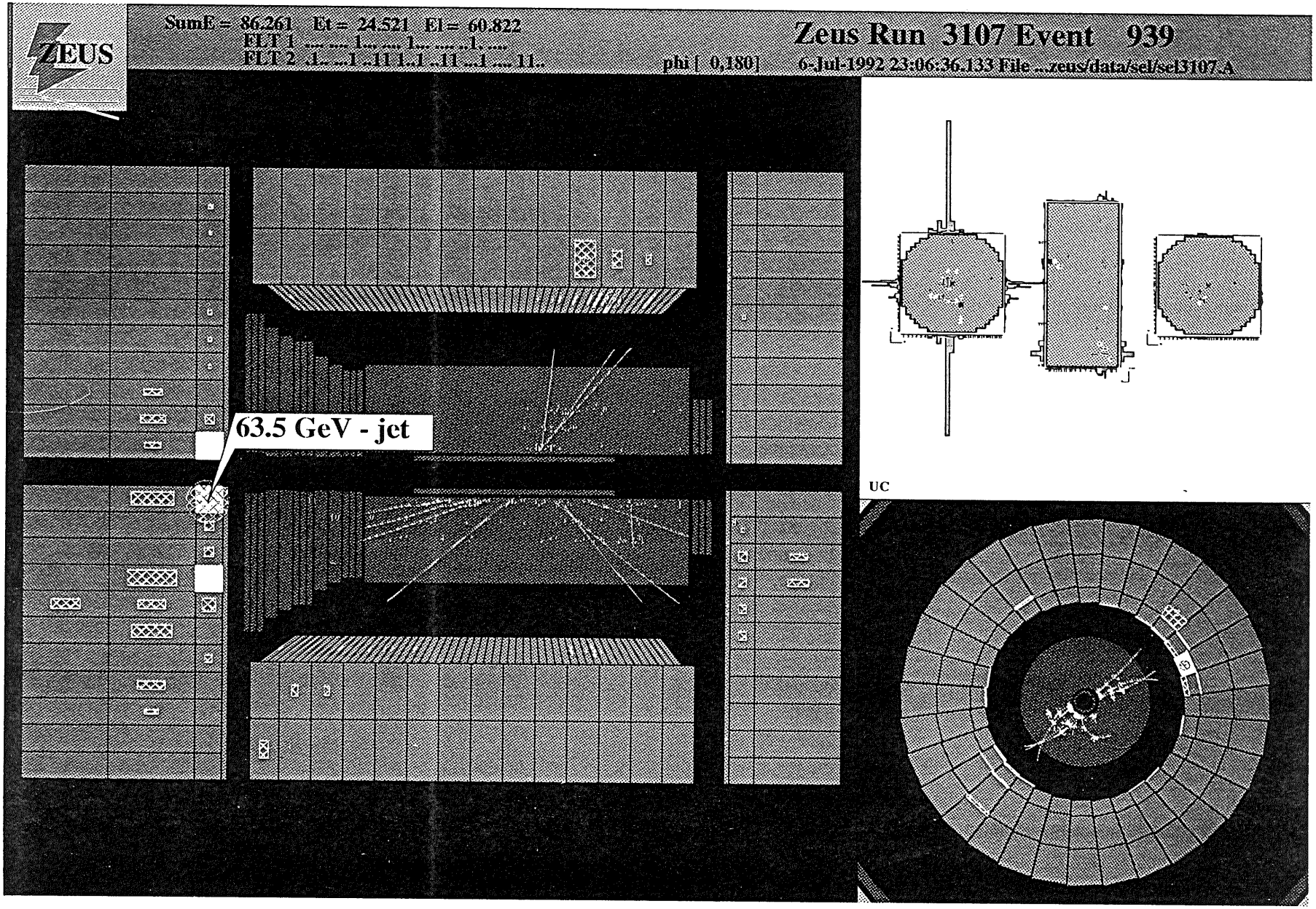
Reconstructed jets



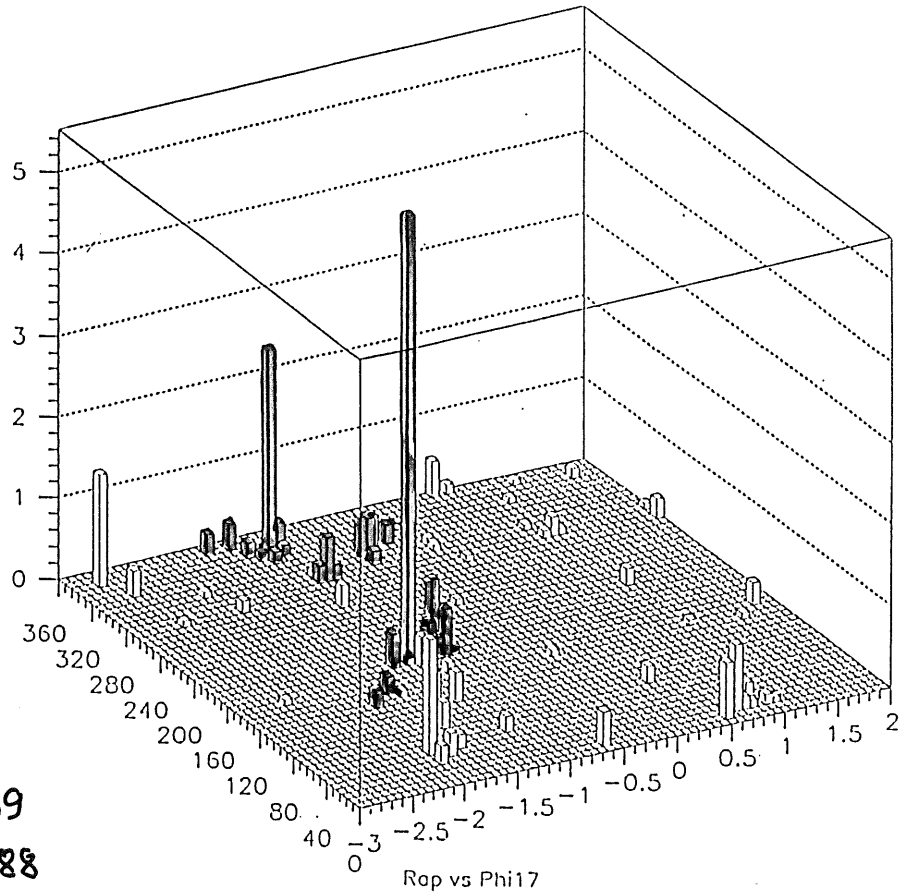
XY view



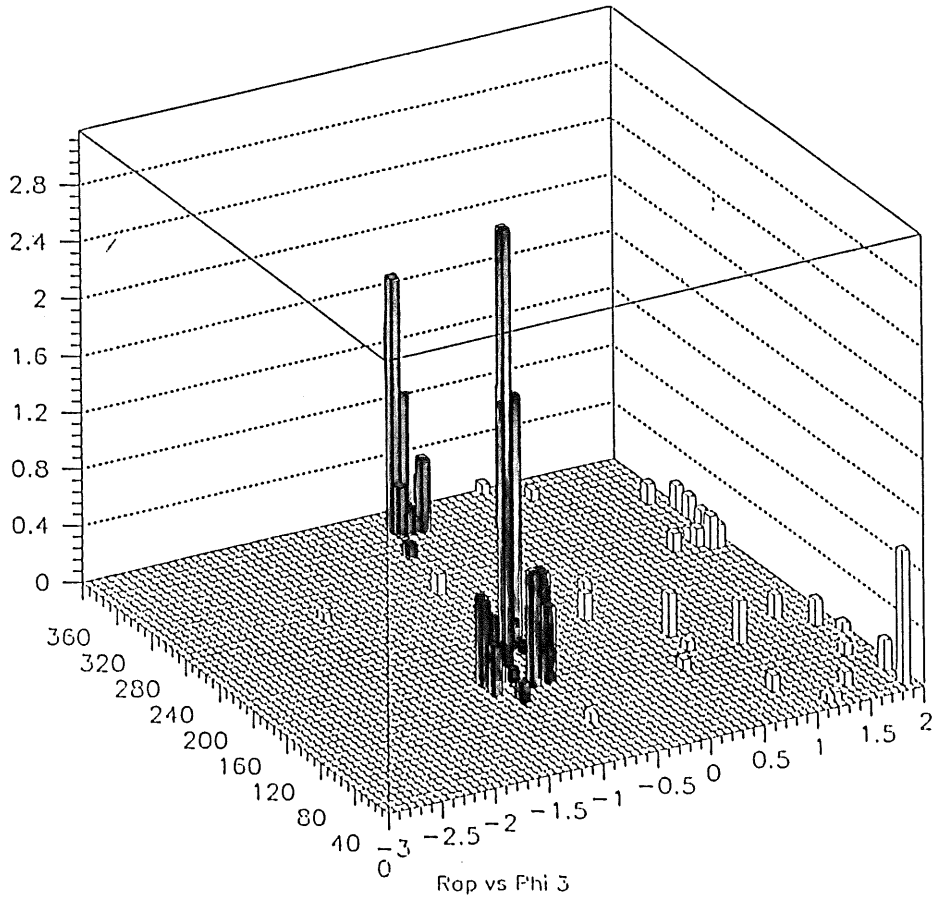
ZR view


ZEUS
SumE = 86.261 Et = 24.521 El = 60.822
ELT 1 ... ... 1... ... 1... ... ..1. ....
ELT 2 .1.. ..1 .11 1 .1 .11 ..1 ... 11..
Zeus Run 3107 Event 939
phi [0,180]
6-Jul-1992 23:06:36.133 File ...zeus/data/sel/sel3107.A
63.5 GeV - jet
UC

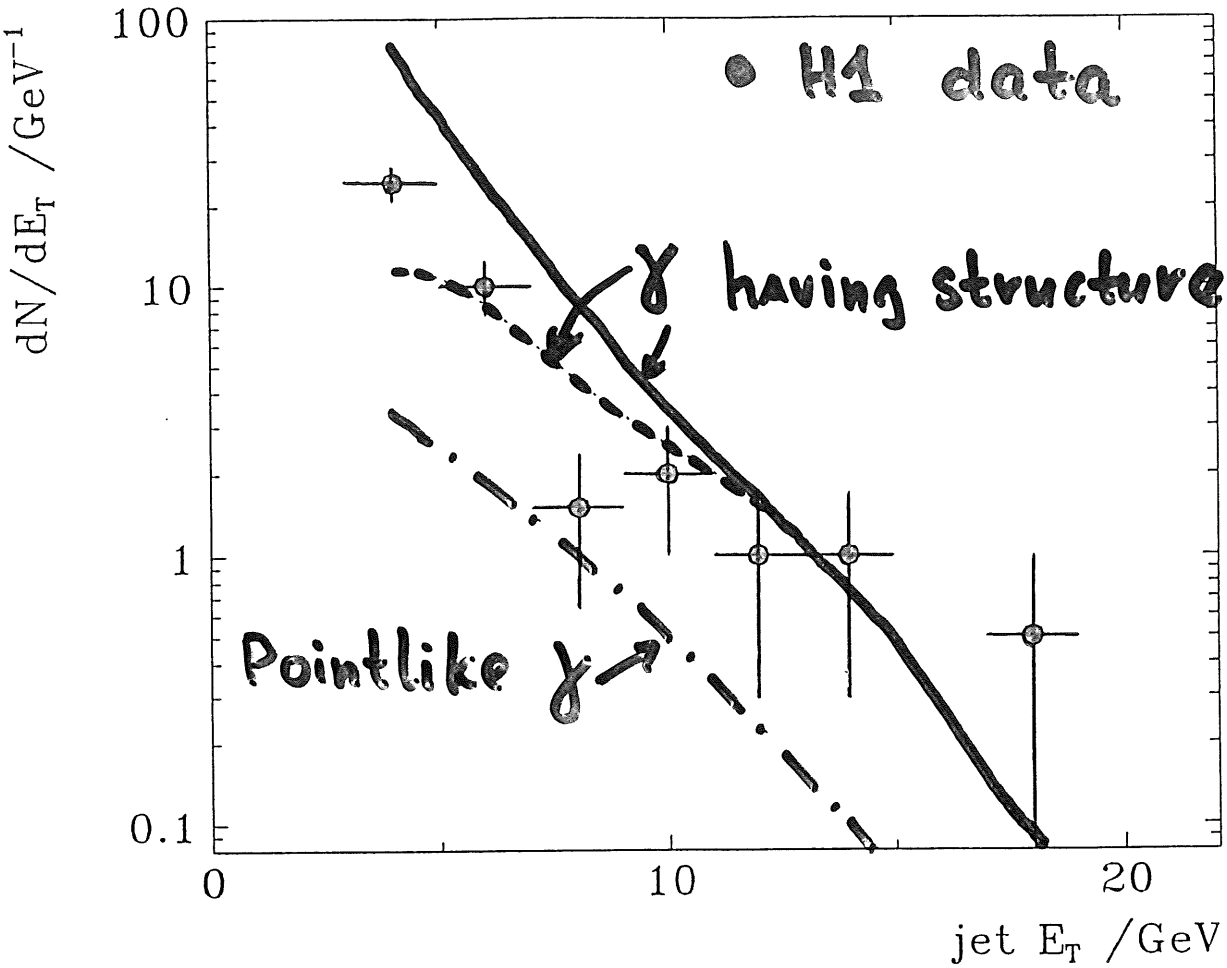
ZEUS



Run 3489
Event 16188



Run 3068
Event 21360



Q3: Is there any evidence that photon has "a structure" ?

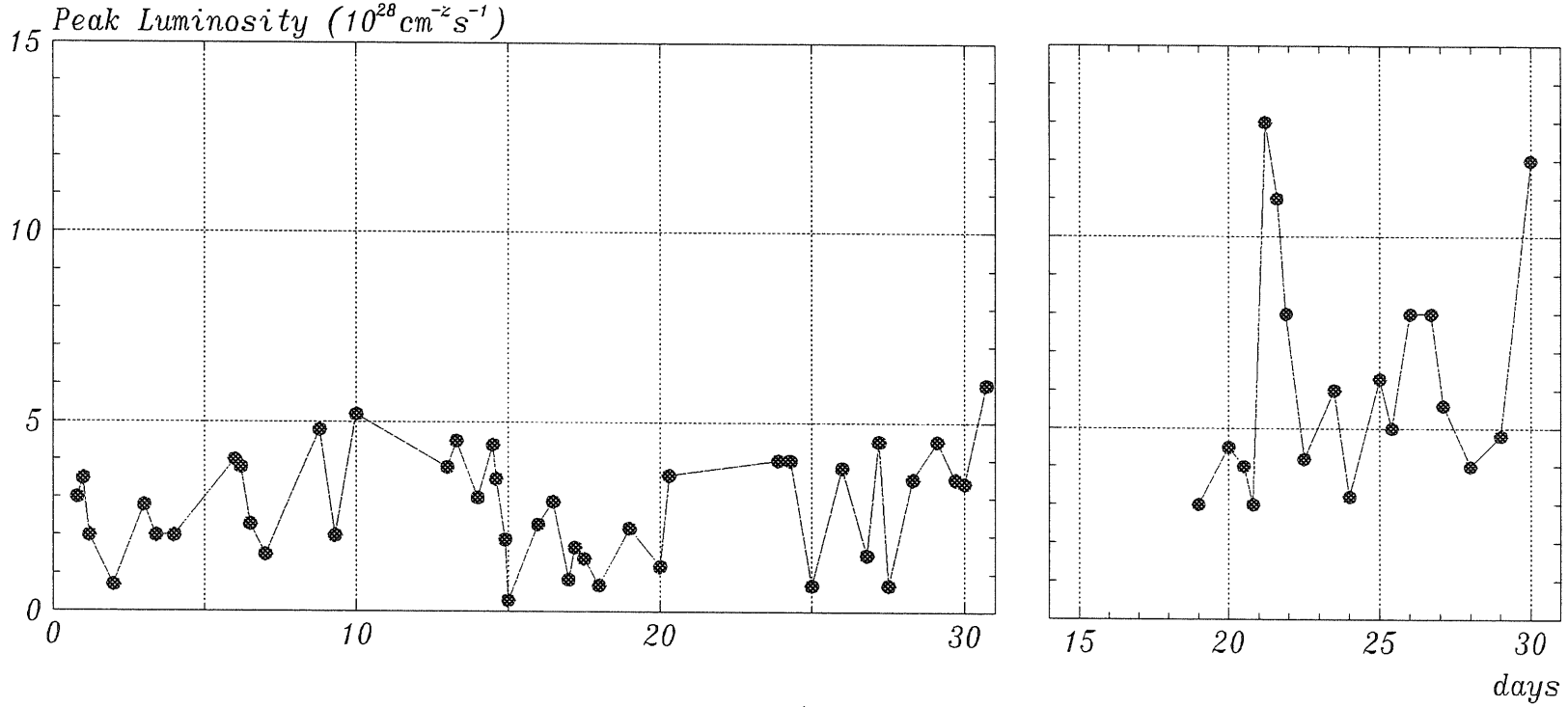
A: Again, yes !!!

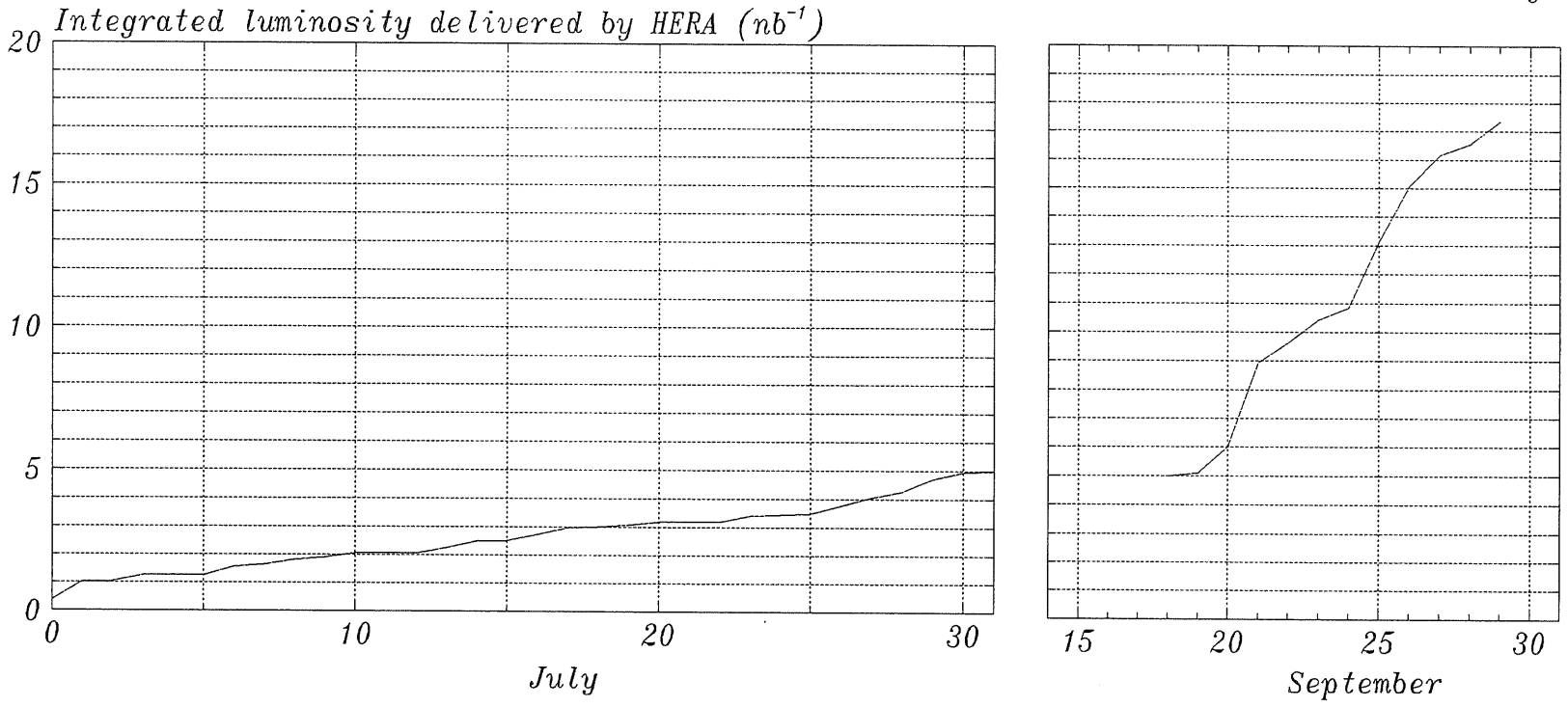
Conclusions

- Already at the level of few permille luminosity HERA was able to answer very basic questions:
  - $\sigma_{\gamma p}^{tot}(s) \sim \sigma_{hh}^{tot}(s)$
  - first experimental evidence of jets in γp (2 and 3 j er.)
  - pointlike γp-interactions at HERA energies cannot explain data

- To make more precise and detailed comparisons with theoretical models we will need much higher statistics $\Rightarrow$ higher luminosity

- Both experiments (H1 and ZEUS) as well as HERA machine are ready to approach this new regime $\rightarrow$


Peak Luminosity ($10^{28} cm^{-2} s^{-1}$)
15
10
5
0
0
10
20
30
15
20
25
30
days


Integrated luminosity delivered by HERA (nb^{-1})
20
15
10
5
0
0
10
20
30
July
15
20
25
30
September