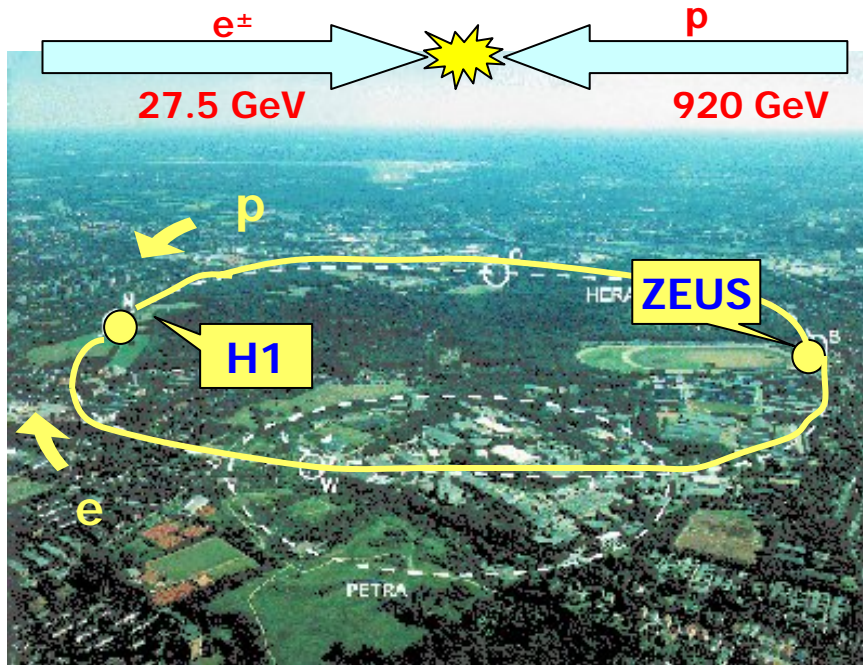


H1 MPI Project Review 2006

Bob Olivier for MPI H1 Group

- Introduction
- HERA running
- Status of MPI hardware projects
- Results of MPI physics analyses
- Future HERA running

HERA Performance



HERA-I: 1992-2000
 16 pb^{-1} e^-p , 120 pb^{-1} e^+p

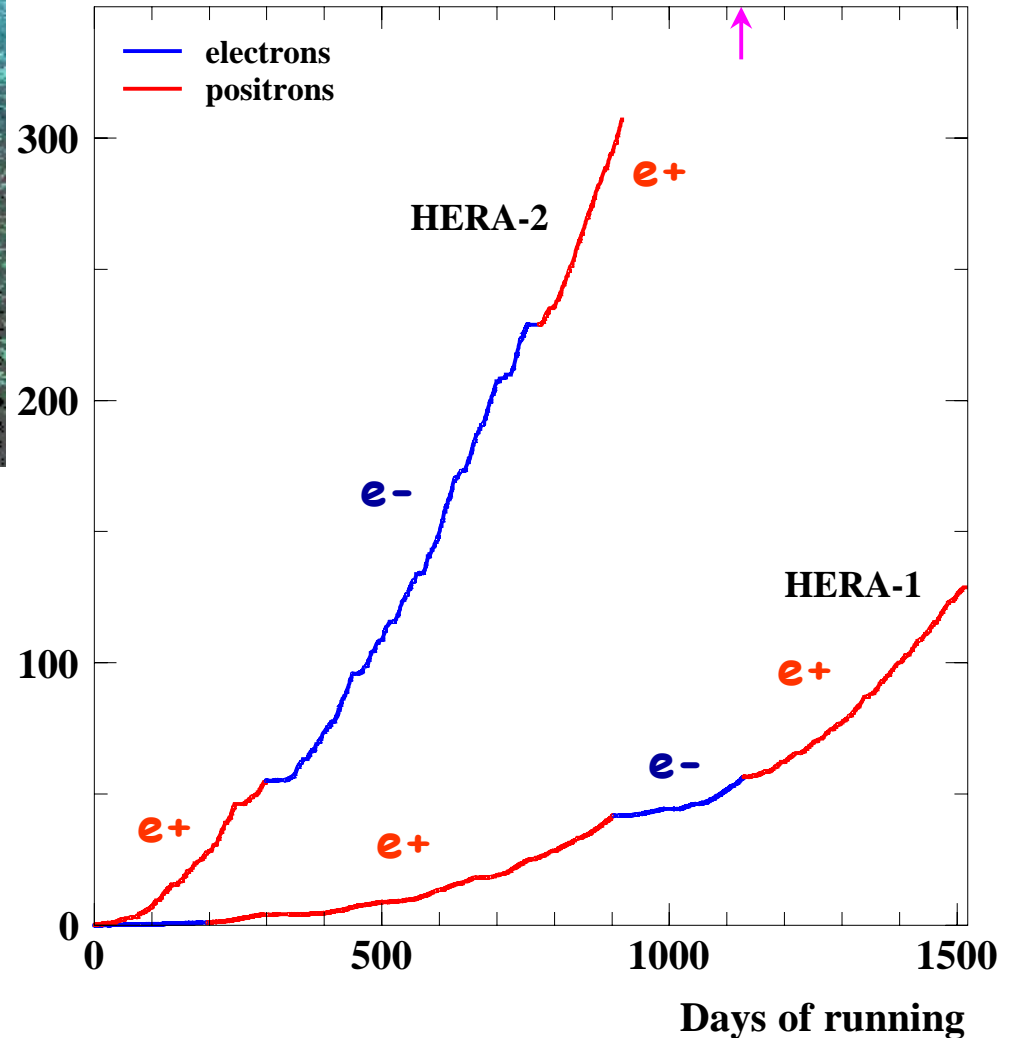
HERA-II: 2003-July 2007
 up to now
 175 pb^{-1} e^-p , 150 pb^{-1} e^+p

End running 01.07.2007

H1 integrated luminosity

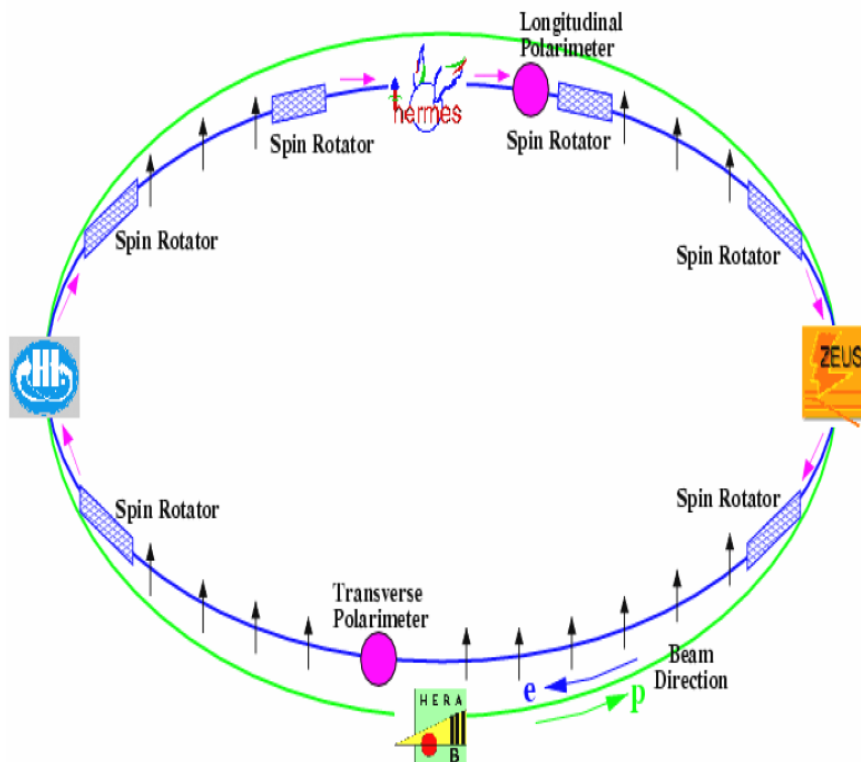
Status: 6-Dec-2006

1/07/07



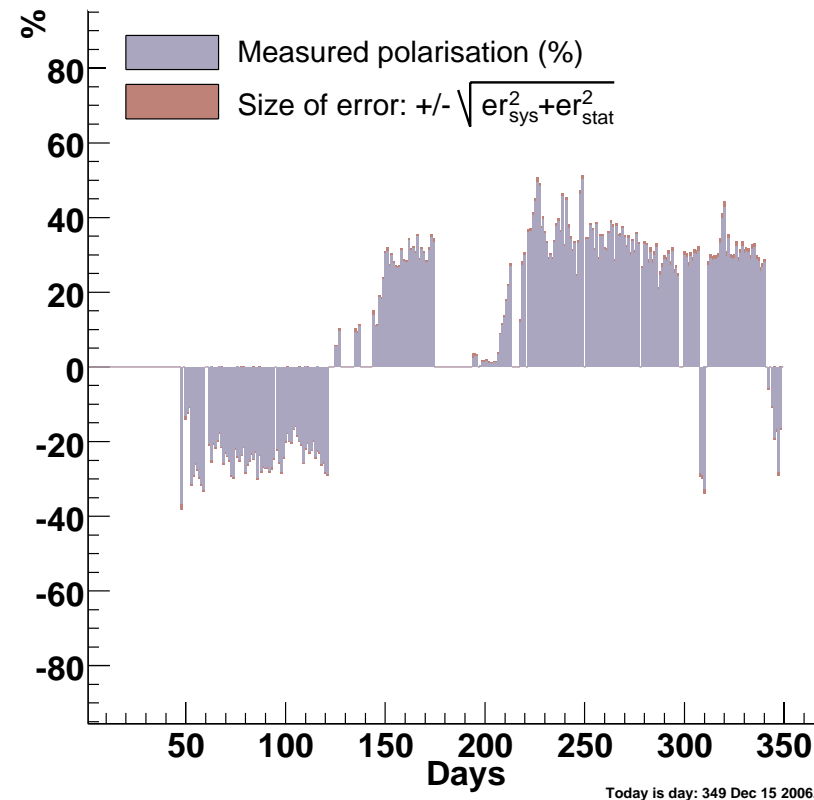
Lepton Polarization at HERA-II

- New HERA-II feature:
use spin rotators to produce longitudinal polarization in experiments
- Allow to measure polarization dependence of high- Q^2 processes:
 - limits on right-handed charged current
 - neutral current: γZ interference



Bob Olivier

Average polarisation/day 2006 Last updated@ Fri Dec 15 16:00:30 2006



Group Members

Responsible Director:

- Allen Caldwell

Staff scientists:

- Christian Kiesling (project leader)
- Vladimir Chekelian
- Guenter Grindhammer

Research Associates:

- Juraj Bracinik
- Ana Dubak
- Bob Olivier
- Alexej Raspereza (50%)

Support:

- Franziska Rudert
- Marlene Schaber

PhD students:

- Andrej Liptaj
- Andrey Nikiforov
- Ringaile Placakyte
- Biljana Antunovic
- Zusana Rurikova

Engineers:

- Markus Fras
- Werner Haberer
- Miriam Klug
- Andreas Wassatsch

Guests:

- Samvel Ghazaryan,
- Vladimir Tchoudakov

Current Activities

Hardware:

L1 LAr: J.Bracinik, C.Kiesling, A.Liptaj, A.Nikiforov + engineers

L2NN: C.Kiesling, R.Placakyte + engineers

Jet Trigger: A.Dubak, C.Kiesling, B.Olivier + engineers

Engineers: M.Fras, W.Haberer, J.Huber, M.Klug, A.Wassatsch,
S.Ghazaryan, V.Tchoudakov

Analyses:

Inclusive NC/CC measurements: V.Chekelyan, K.Kiesling, A.Nikiforov,
B.Olivier, R.Placakyte, B.Antunovic

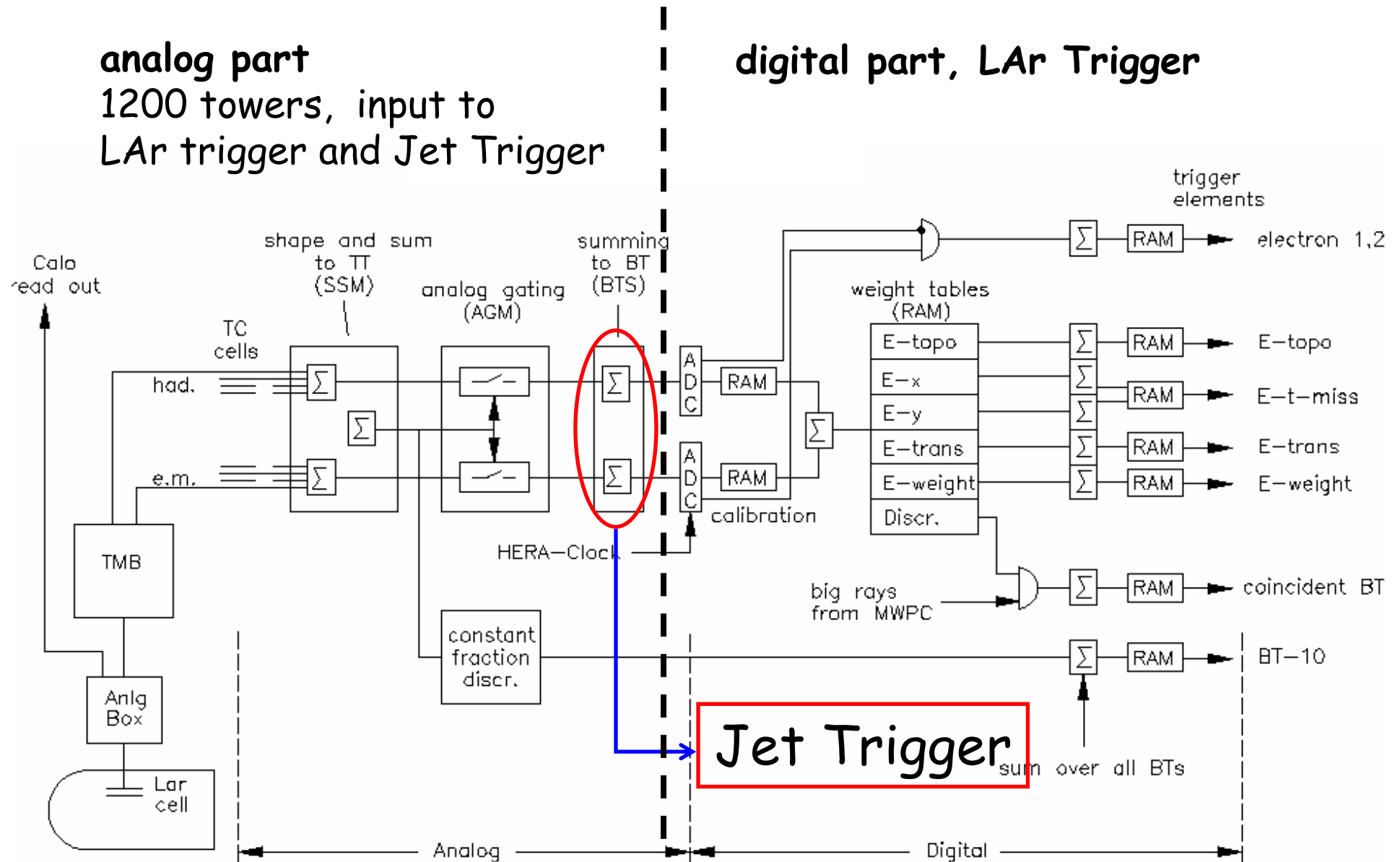
Charm physics: J.Bracinik, G.Grindhammer, A.Liptaj, Z.Rurikova

New phenomena: B.Olivier

Layout of the LAr Trigger System

analog part
1200 towers, input to
LAr trigger and Jet Trigger

digital part, LAr Trigger



H1 Liquid Argon Trigger

Stable performance, main trigger for H1 Physics, in particular high Q2 NC/CC trigger

Beginning of 2006 (shutdown):

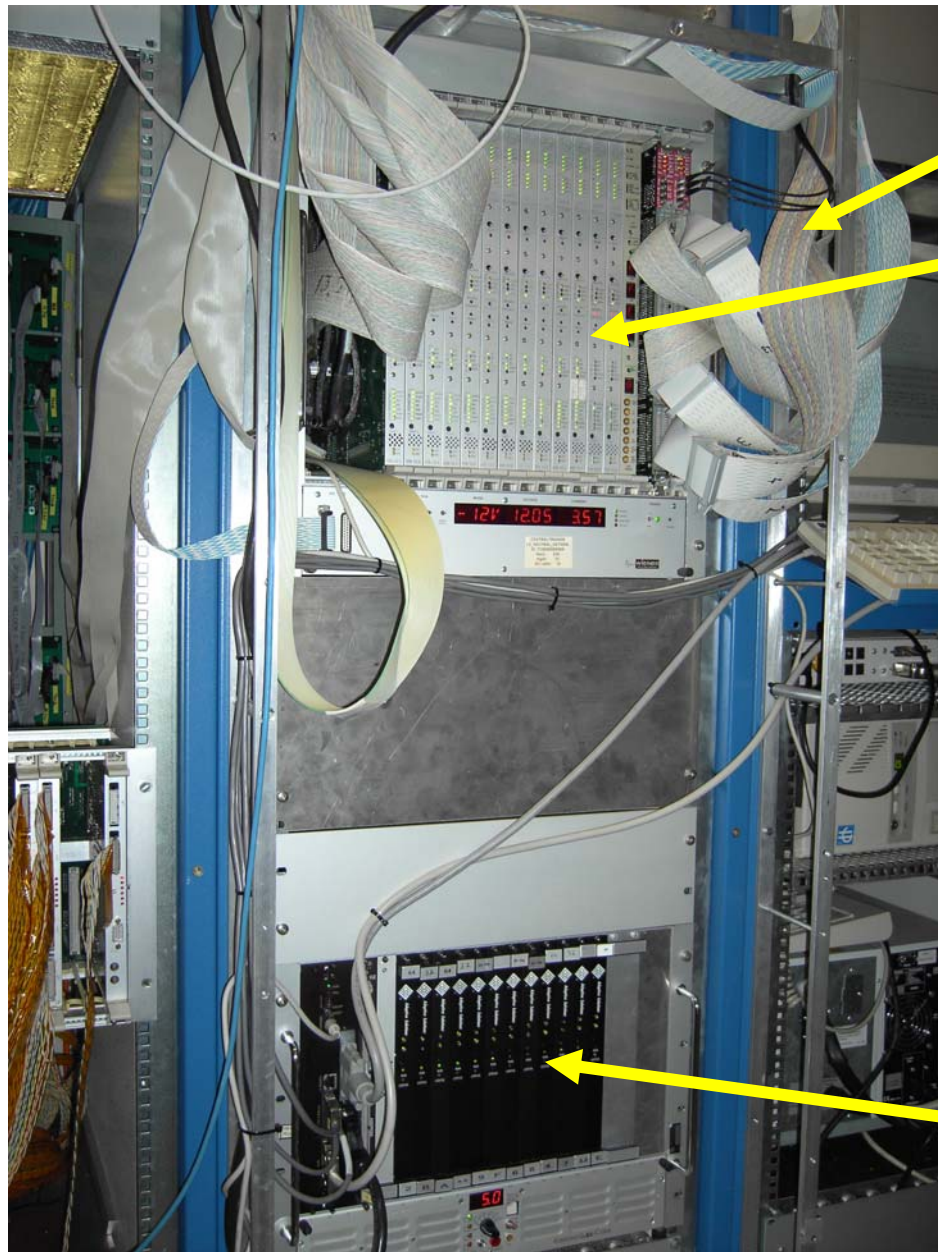
- repair of non functioning t0 modules, part of them (~1/3) recovered
- 50% noisy cells/high rates recovered

Needs a lot of attention, both analog and digital part:

- ageing components (power supplies, connectors)
- permanent fight with (mainly) external noise sources
- several problems with bad contacts in digital part of the trigger

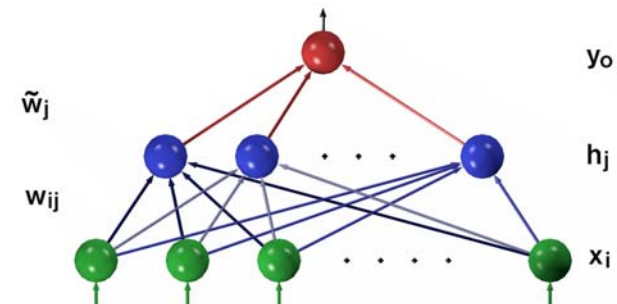
During e+ running changing beam background conditions (mainly fluctuating muon halo) lead to reoptimization of several triggers using LArT.

Neural Network Trigger @ Level 2 (L2NN)



data from the level 1 processors

selection & preprocessing of input data



12 networks for specific physics, e.g.

- untagged and tagged D^*
- DVCS
- elastic J/Ψ and Y production
- photoproduction dijets

neural network processors

L2NN Operation

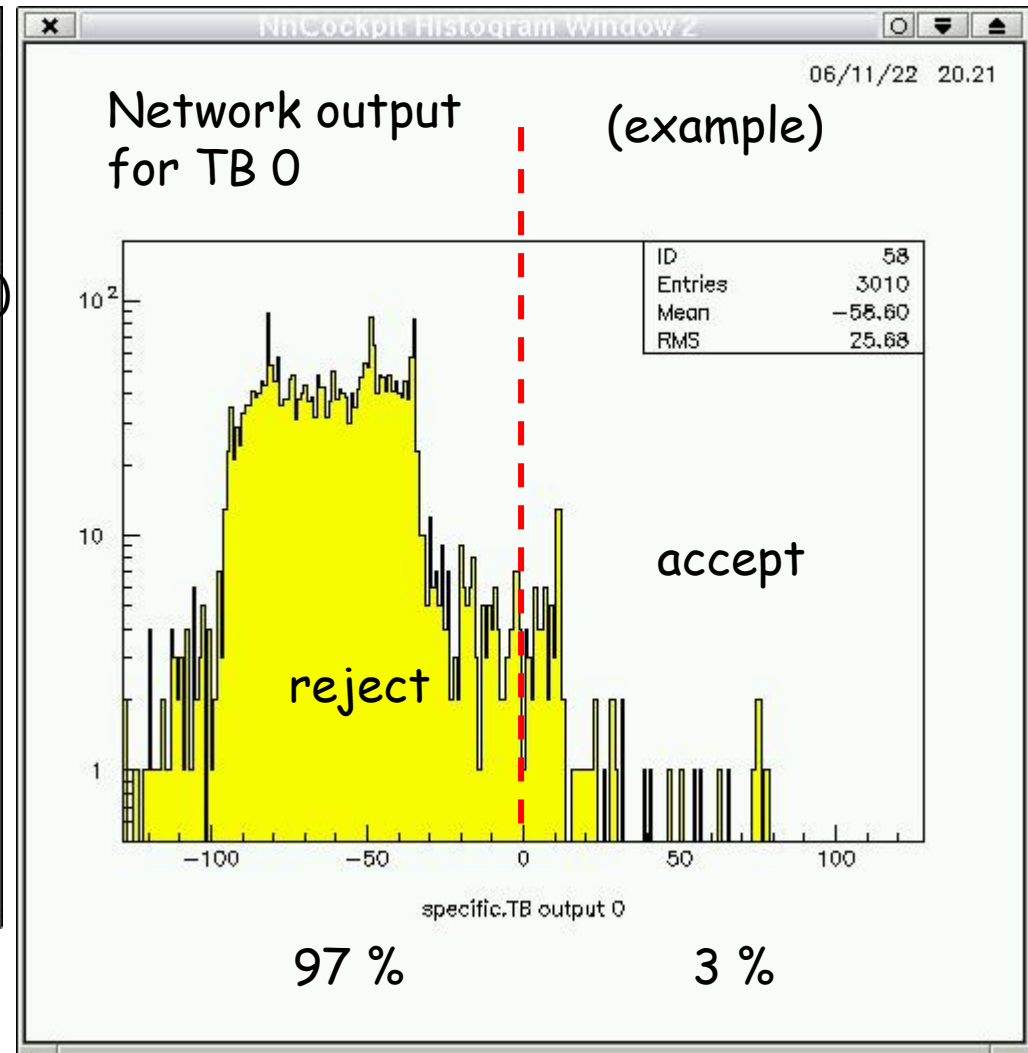
File: /h1/log/rate_file
Date: 22/11/106 Time: 20:18:55

	Sampling Phase	Sampling time/[s]	Sampling rate/[Hz]	Sampling ratio	L1 rate /[Hz]	L2 rate /[Hz]	ratio
2	120	10.35	0.02	1624.64	115.23	0.18	

L1 output rate (input to L2)

TB	in/[Hz]	out/[Hz]	BG rej[%]
0	268.85	6.03	97
1	5.53	0.50	90
2	2.51	0.50	80
3	5.53	1.51	72
4	0.00	0.00	---
5	0.00	0.00	---
6	44.72	0.50	98
7	0.00	0.00	---
8	5.53	1.51	72
9	2.51	1.51	39
10	7.54	1.51	79
11	0.00	0.00	---
12	0.00	0.00	---
13	0.00	0.00	---
14	0.00	0.00	---
15	0.00	0.00	---

L2 output rate (input to L3)



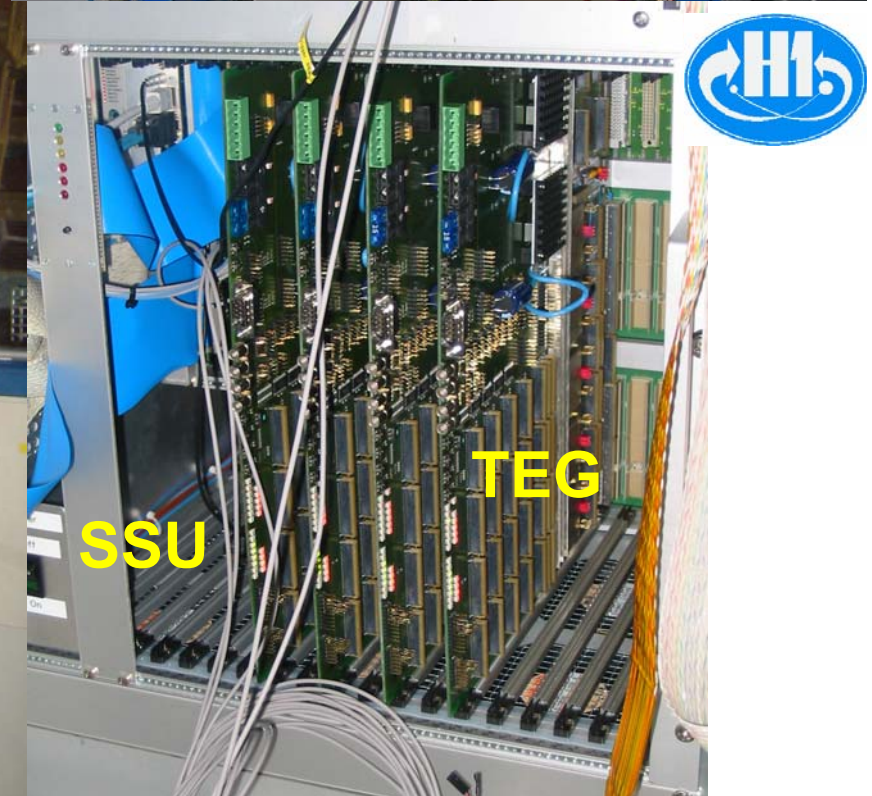
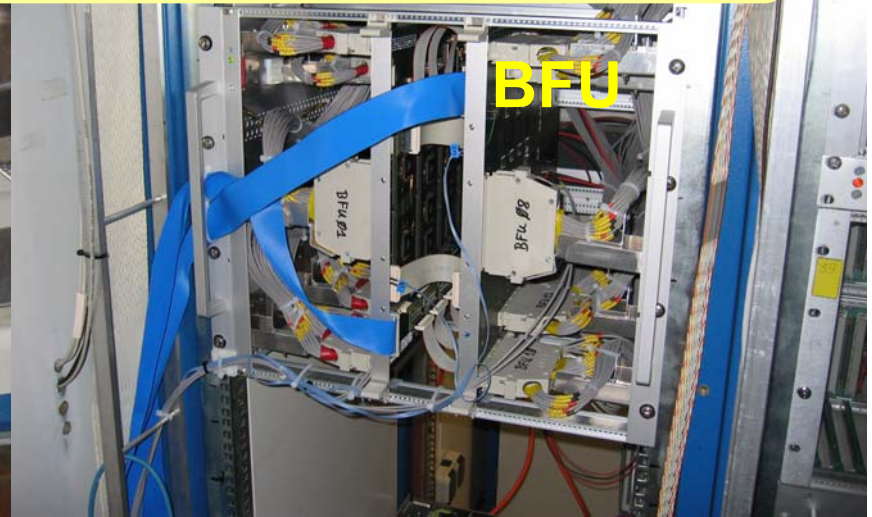
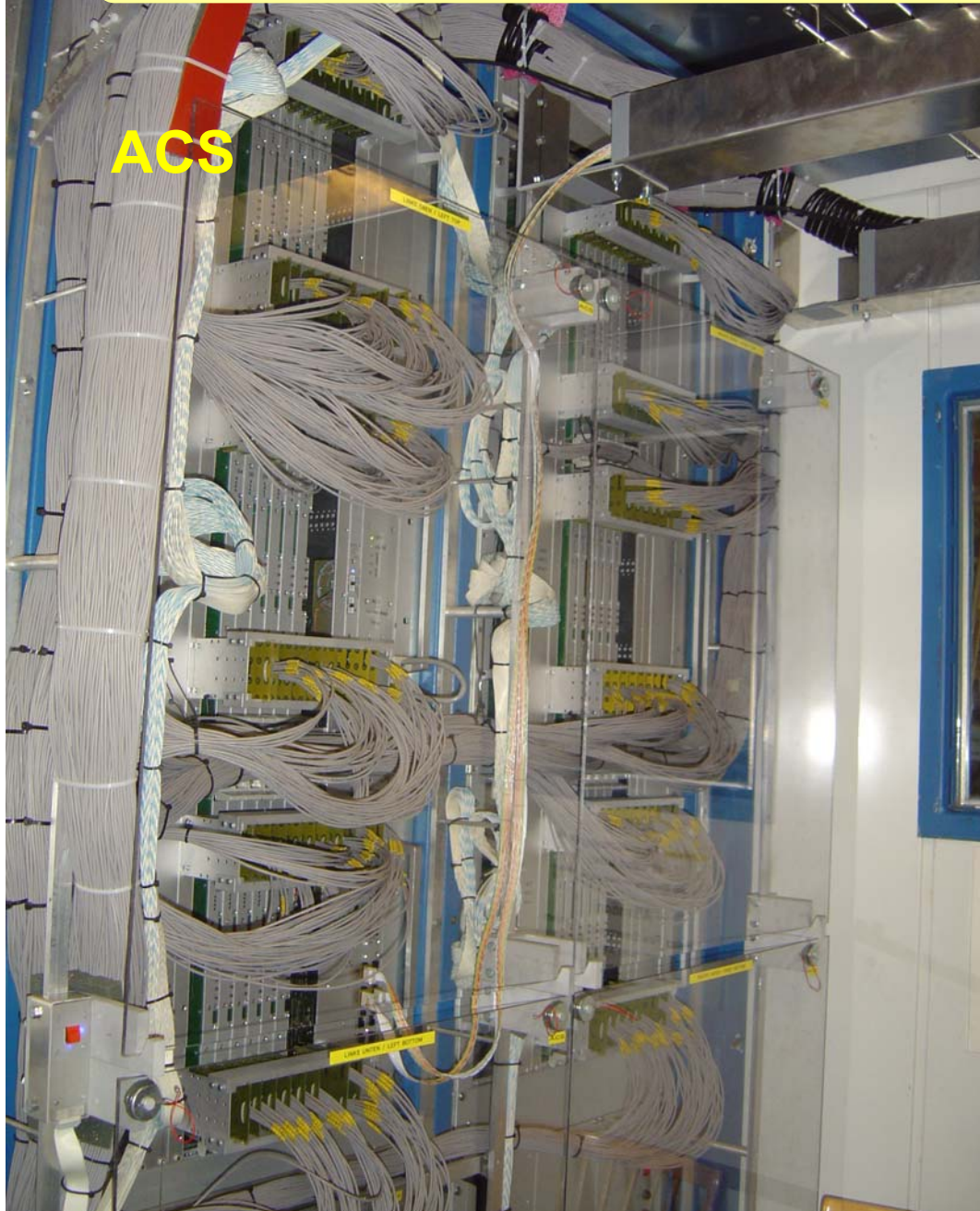
8 rejecting networks, examples:

TB 0: ST 56 (untagged D*)

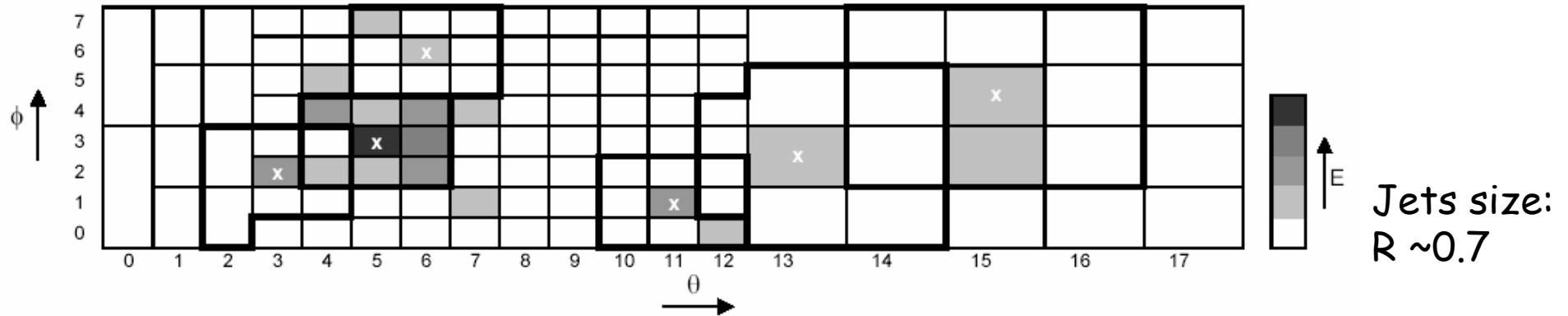
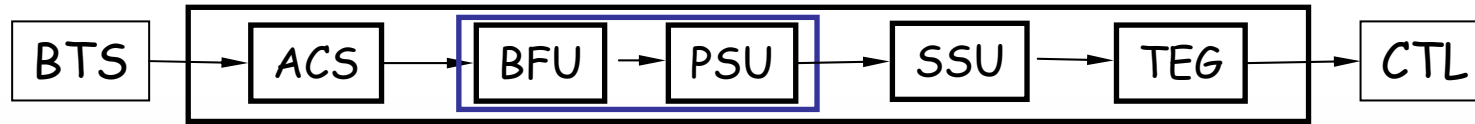
TB 6: ST 42 (J/ψ hight W, Spacal btb)

L2NN operates very reliably !
100% uptime (but: repair in Sept. 06)

Jet Trigger Hardware



Jet Trigger Hardware



- **Adc Calculation Storage:** digitise then sum towers-low coherent noise
- **Bump Finder Unit:** jet algorithm in 100ns! - less energy sharing
- **Primary Sorting Unit:** 16 energy sorted jets:
- **Secondary Sorting Unit:** leading jets physics, last jets noise
- **Trigger Element Generator:** global conditions E_{Tmiss} , E_{Ttrans}
 conditions on individual jets E_T , θ
 topological conditions on $\Delta\theta$, $\Delta\phi$

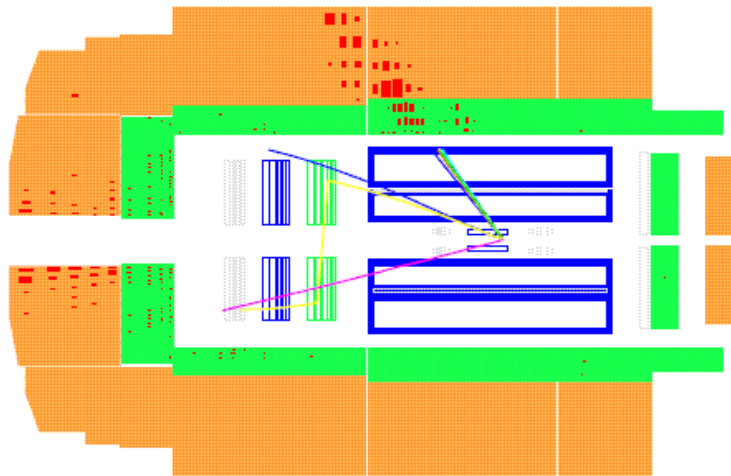
Commissioning completed

Last steps of jet trigger commissioning:

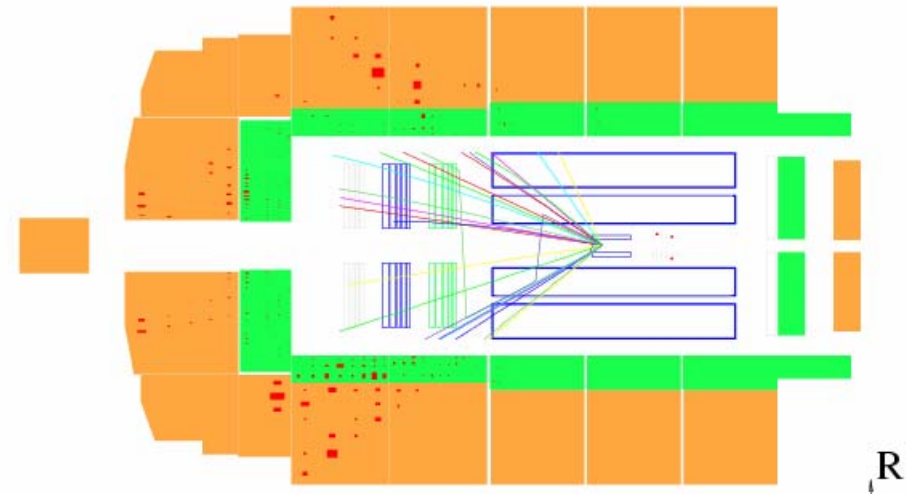
- BFU, SSU operational 2004-2005
- ACS operational $\theta < 45^\circ$ 01.06
- TEG delivers first triggers 09.04.06
- First L3 test triggers using jet Trigger june 06
- ACS installation completed, covers full θ 31.07.06
- TEG debugged 27.10.06
- Installation of first physics L1 triggers 27.10.06
- Jet triggered commissioned 02.11.06**
- Latency optimisation - on time! 800ns 06.12.06
- H1 green light - activation JETT triggers at L1/L3 13.12.06**

First Jet Trigger'ed Events 09.04.2006

Charged Current Event



Multi-jets at low E_T in photoproduction



Main use of jet trigger: *CC* and photo-production, when there is no electron to trigger on!

Physics Cases, L1/L3 Triggers

L1:

- Forward charged current (Inclusive measurements) activated 13.12.06, $\sim 3\text{pb}^{-1}$
- Inclusive jets at high p_t [$\theta < 90^\circ$] (QCD)
- Multijets in the central detector (QCD)
- Forward gluon radiation +jet in central detector (QCD)

L3:

- Electron validation at L3, b physics, $\sim 10\text{pb}^{-1}$

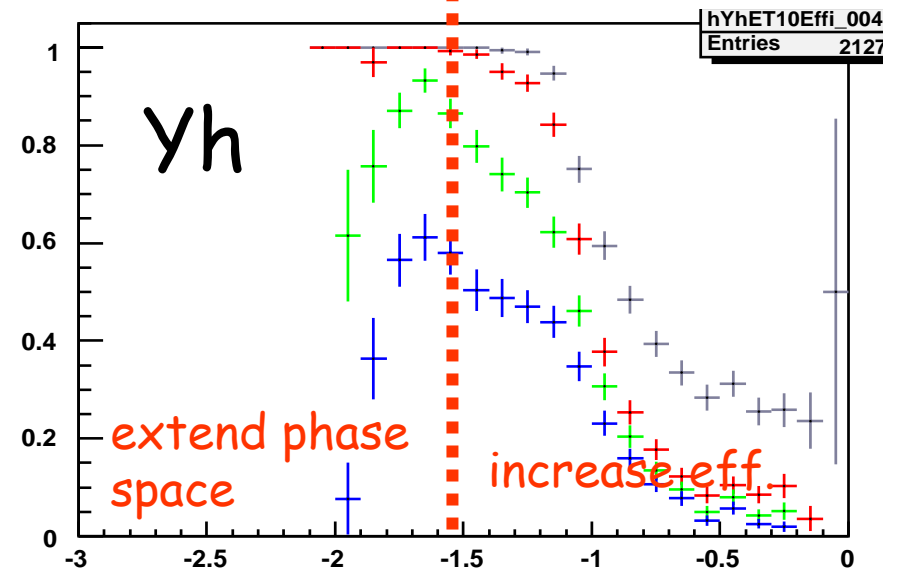
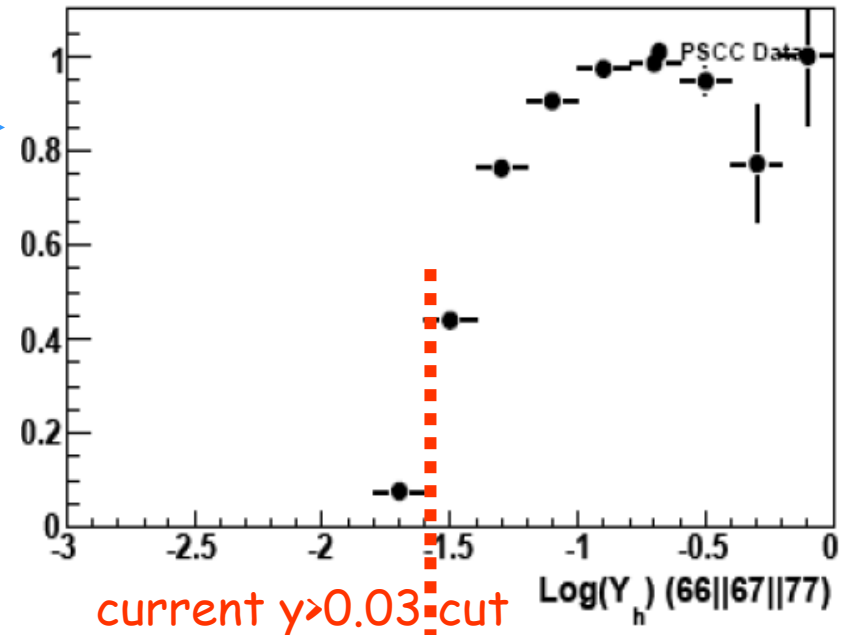
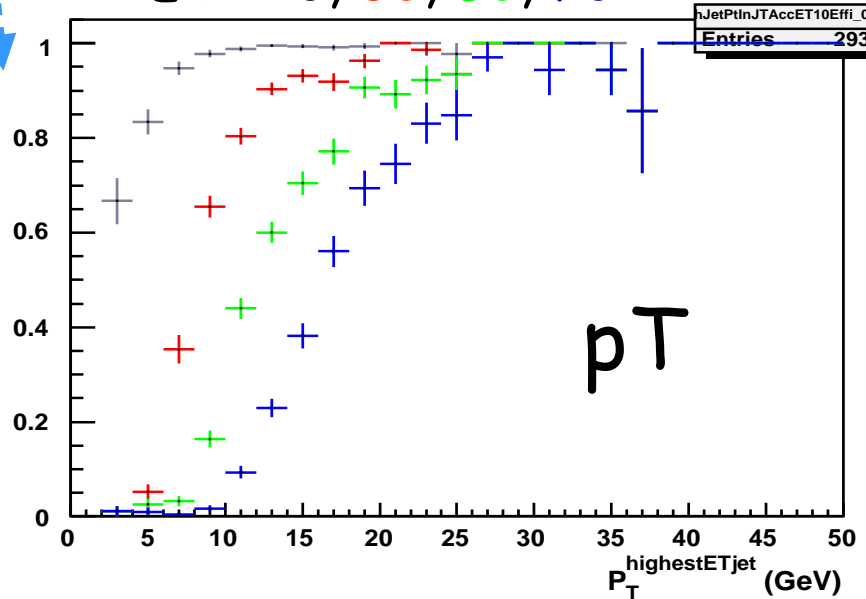
Jet Trigger & CC

• Previous CC analysis suffer from low eff. @ low p_T and low y

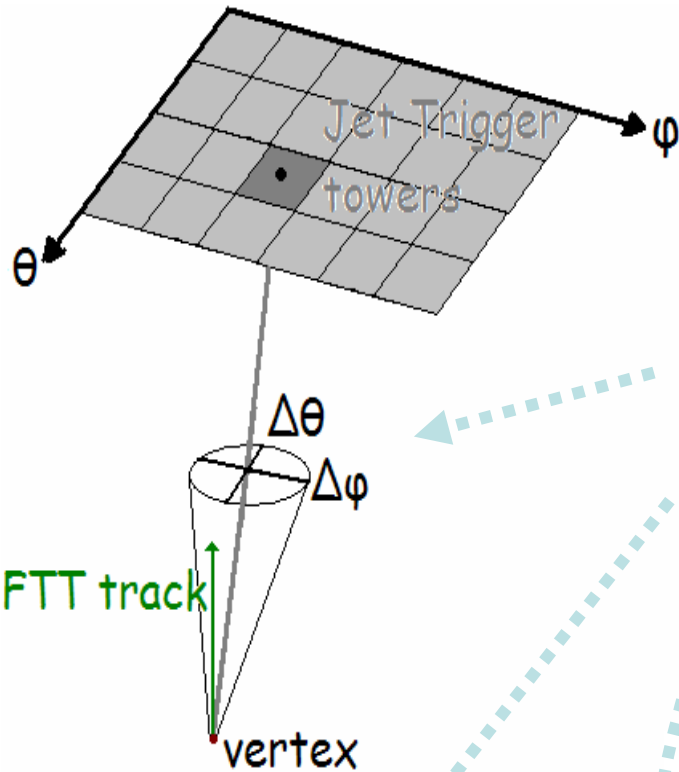
• New jet trigger:

Trigger on low angle ($<30^\circ$) HFS
 Trigger eff. & rate: ET dependent
 ET > 50 counts (~ 10 GeV):
 rate < 0.5 Hz

ET > 10, 30, 50, 70

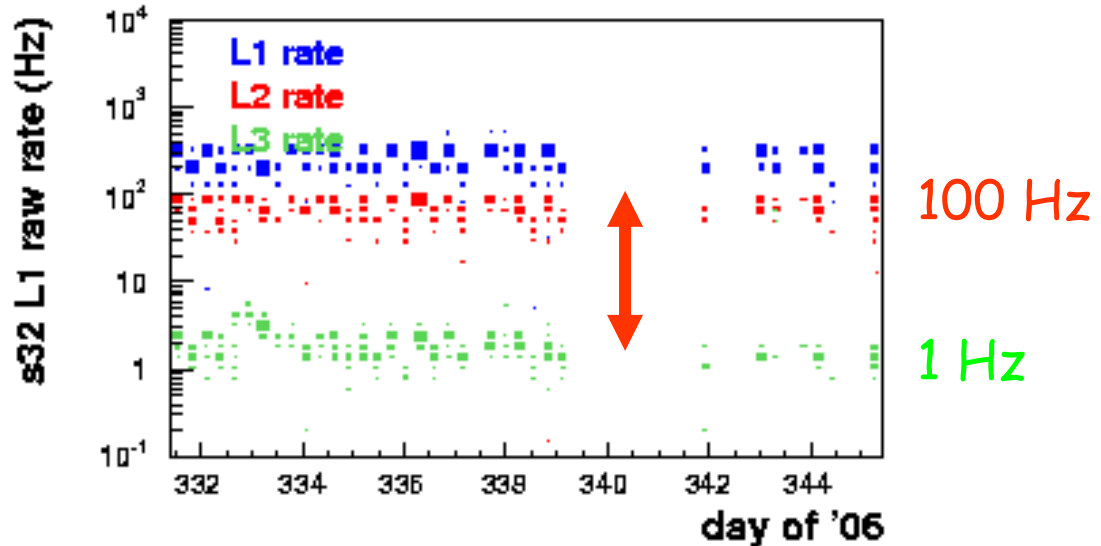
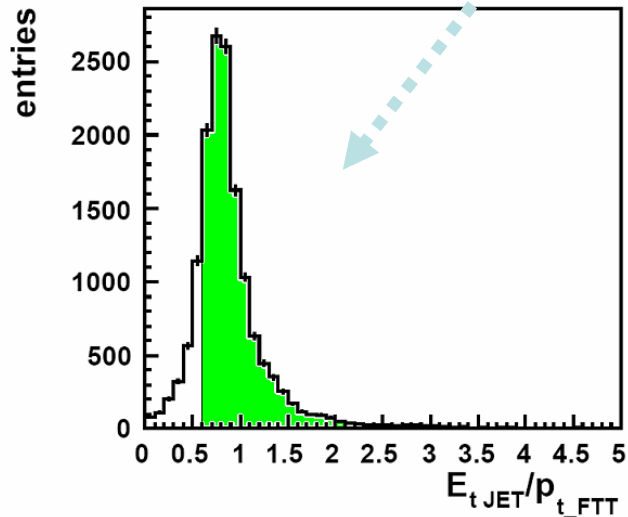


Jet trigger @ L3



L2 information from Jet Trigger and Fast Track Trigger (FTT) are combined: electron finder at low p_T

- Geometrical track - electron cluster matching, electron validation
- $E_{JT} / p_{T,FTT}$
- Measure $ep \rightarrow e bbX' \rightarrow l(l)X$, 6k events expected
- Rate reduction factor 100

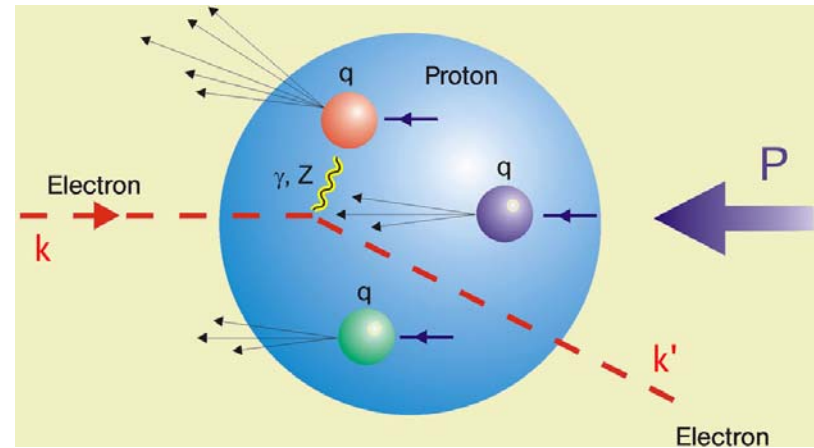


Physics Analyses

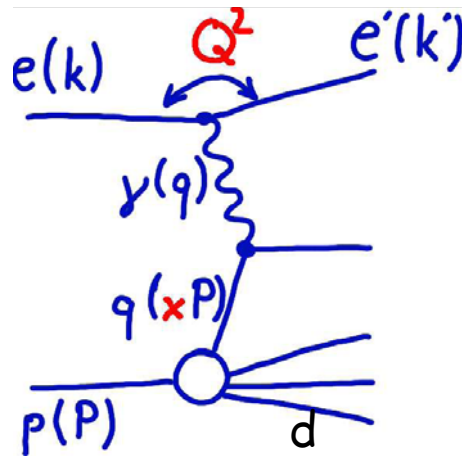
Inclusive measurements
NC/CC

Charm physics

New phenomena



Structure Functions, xF_3



$$\frac{d^2\sigma_{NC}^{e^+p}}{dx dQ^2} = \frac{2\pi\alpha^2}{xQ^4} \left[Y_+ \tilde{F}_2(x, Q^2) - y^2 \tilde{F}_L(x, Q^2) \mp Y_- x\tilde{F}_3(x, Q^2) \right]$$

$$F_3, F_L \ll F_2$$

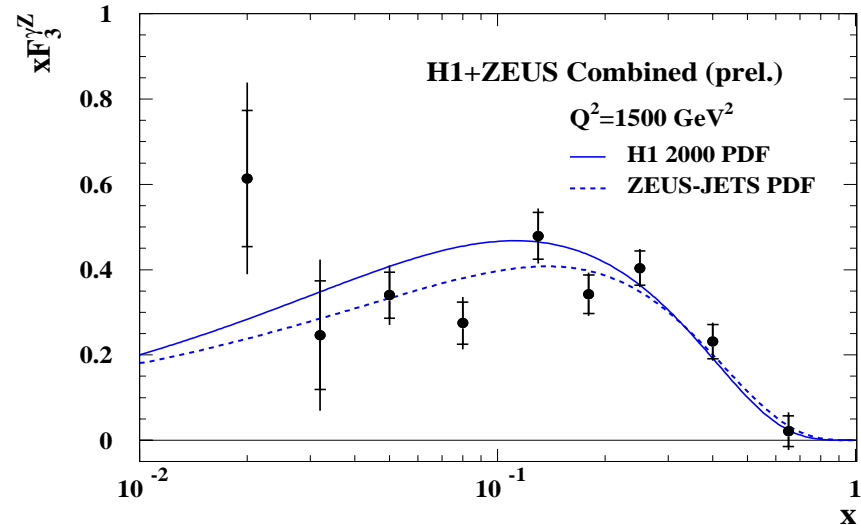
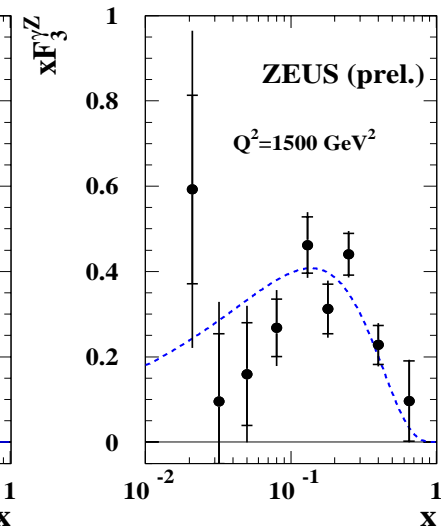
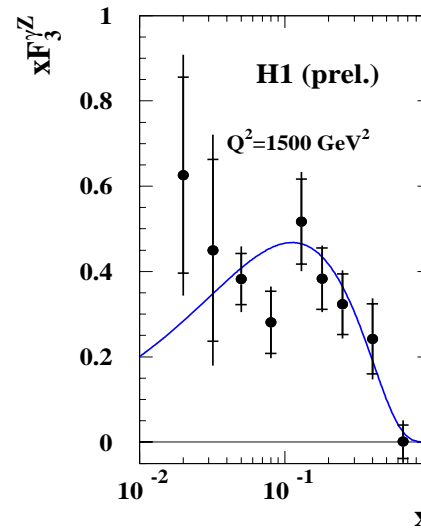
$$xF_3 \sim \sigma(e^+p) - \sigma(e^-p)$$

$$xF_3^{\gamma Z} \sim xF_3 \sim (u - \bar{u})$$

Measure u valence quark density

First combined H1/ZEUS measurement
HERA 1 + 2

→ overall 478.8 pb⁻¹

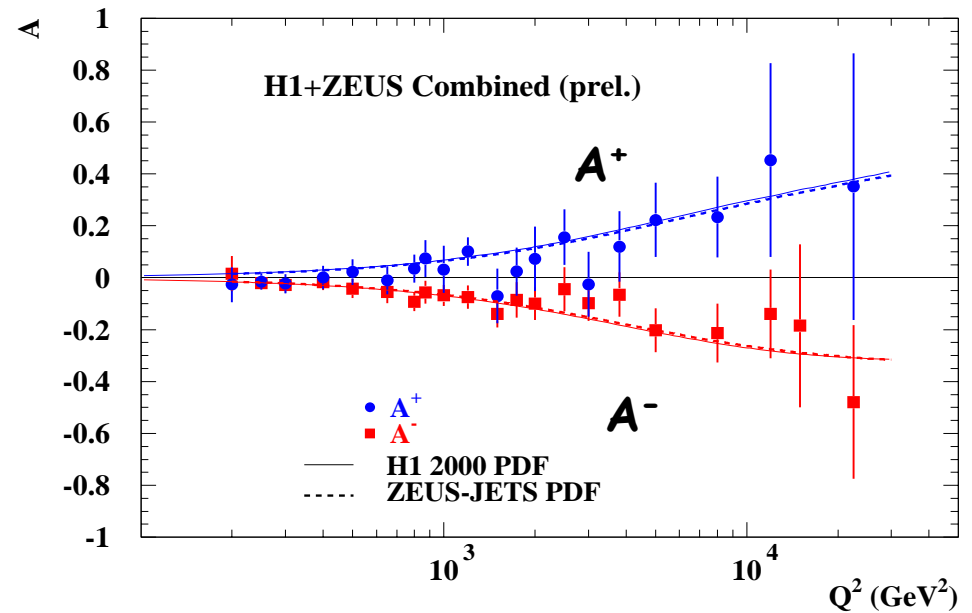
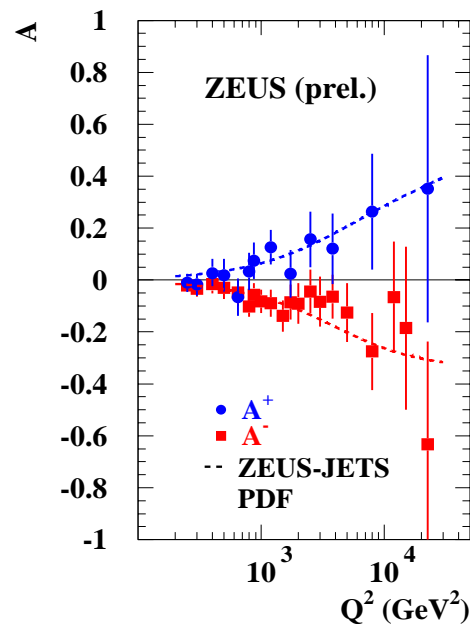
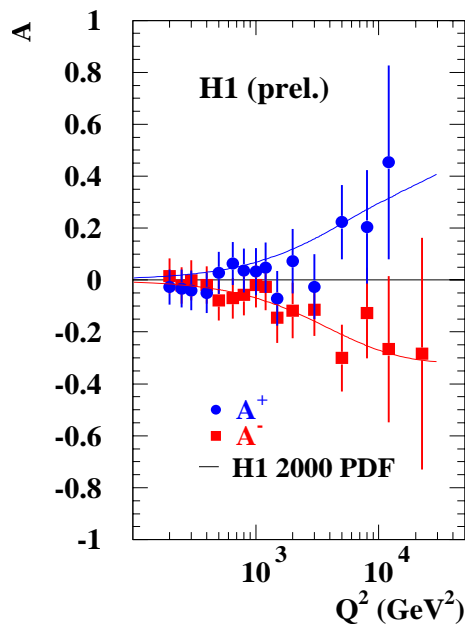


Polarised NC Measurements

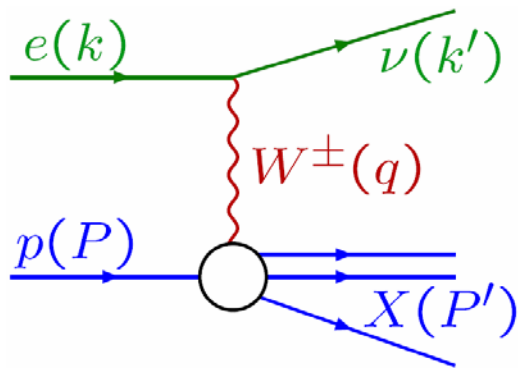
Polarisation asymmetry $A^\pm = \frac{2}{P_R - P_L} \cdot \frac{\sigma^\pm(P_R) - \sigma^\pm(P_L)}{\sigma^\pm(P_R) + \sigma^\pm(P_L)}$ $\begin{matrix} P_R > 0 \\ P_L < 0 \end{matrix}$

→ a direct measure of parity violation in NC

$$A^\pm \sim \pm \frac{1 + d_v / u_v}{4 + d_v / u_v}$$



Charged Current

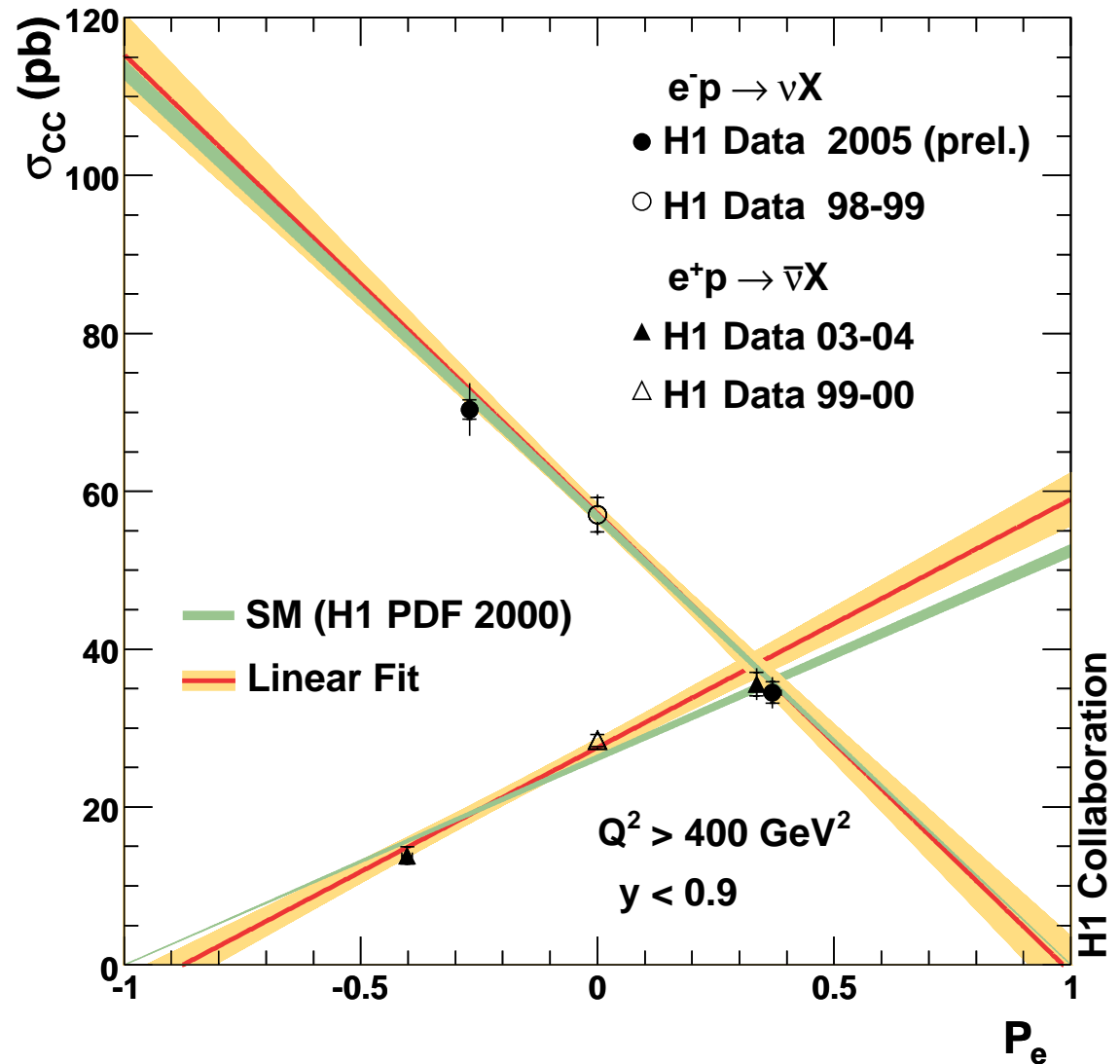


Integrated CC cross section
proportional to $(1 \pm P_e)$:

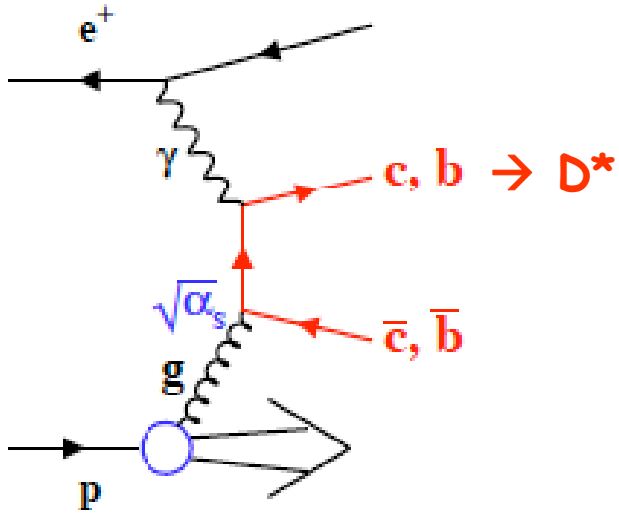
Consistent w/ linear fit,
limit on W_R 186 GeV

H1 prelim-06-041

Charged Current $e^\pm p$ Scattering



Charm D^*+jets



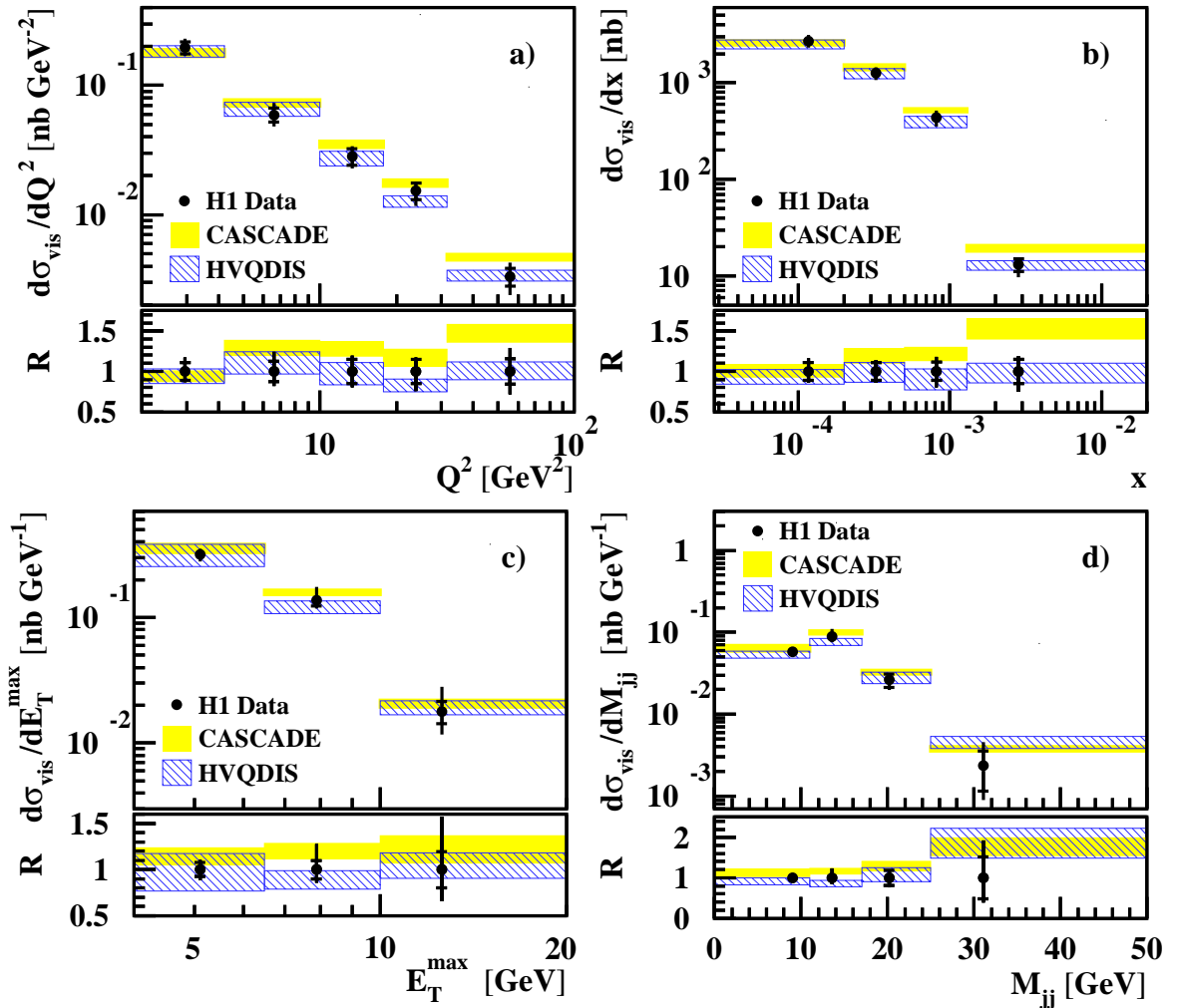
Production of D^* Mesons with dijets in DIS

Reasonable description of HO effects by NLO QCD (HVQDIS) and CCFM (CASCADE)

Measure x_g

Final reading passed

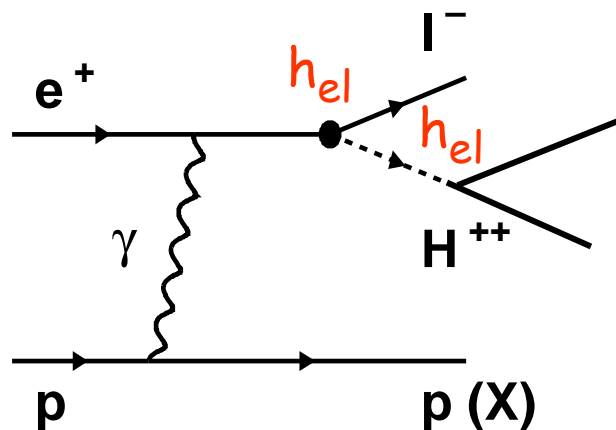
Bob Olivier



Work on charm fragmentation ongoing

MPI PR 20.12.2006

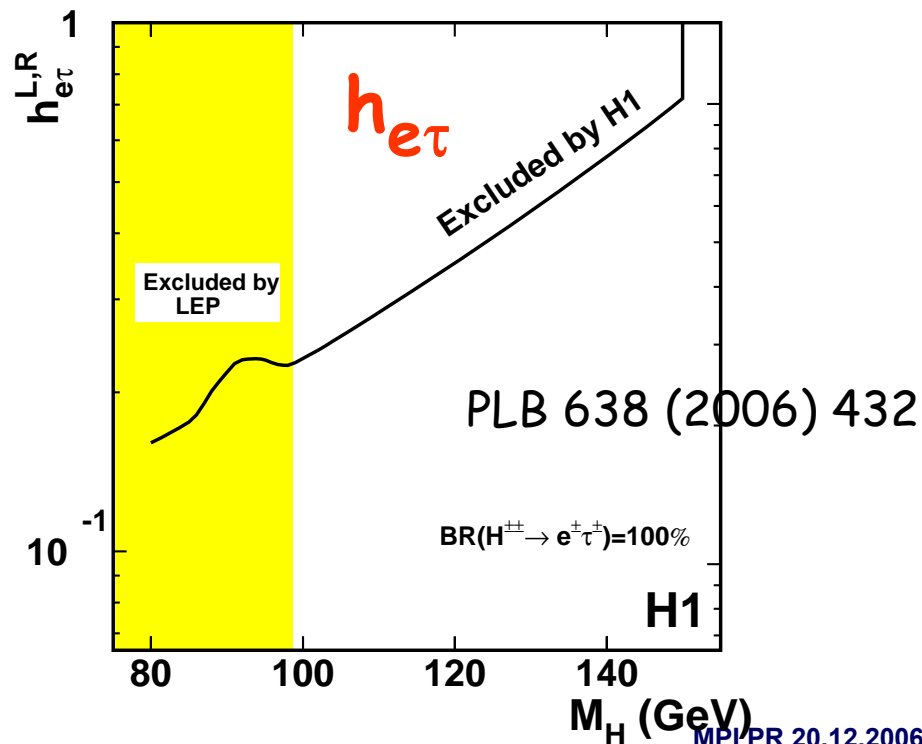
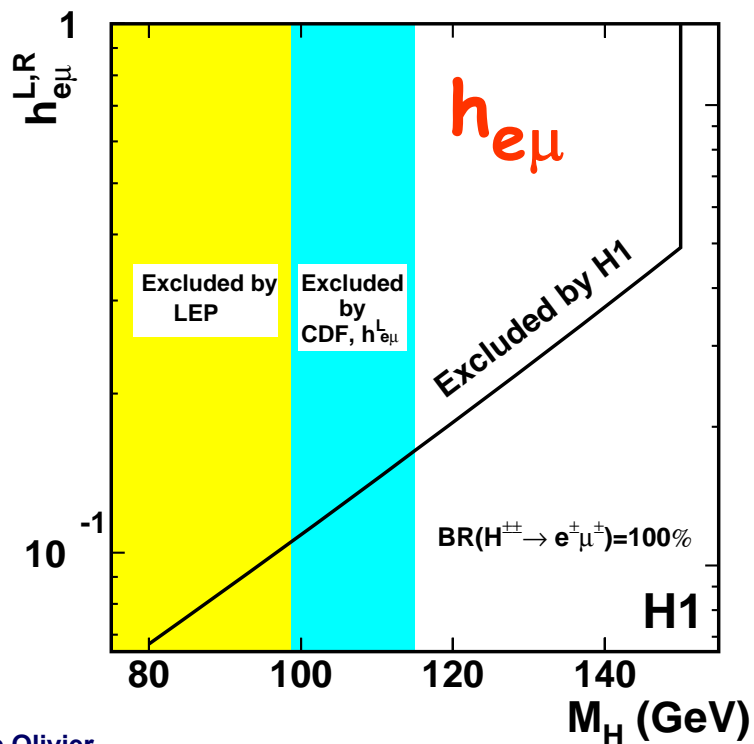
Search for Doubly Charged Higgs



Excess of multi-leptons high mass $6/1.5 \pm 0.5$
 H^{++} appear in LRS extensions of SM, $SU(2)_R$
 Coupling h_{el} not related to leptons masses

Excess kinematics/charges don't fit with model

H1 limits extend the excluded regions on $h_{e\mu}$ and $h_{e\tau}$



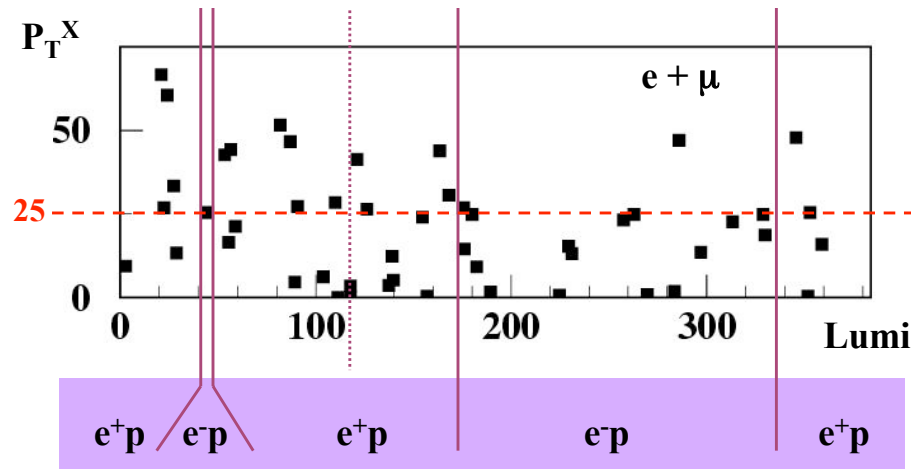
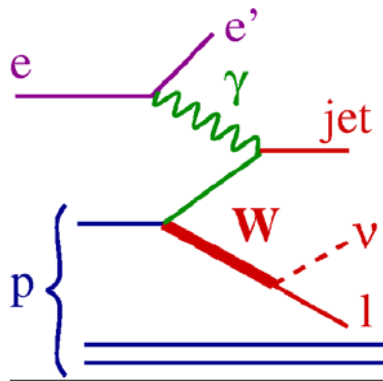
Hot issues until end of HERA

Isolated leptons

Low proton energy run,
direct F_L measurement

Isolated Leptons

Excess $P_T^X > 25 \text{ GeV}$ 17 / 6.0 ± 1.0



H1 Preliminary		Electron obs./exp. (Signal contribution)	Muon obs./exp. (Signal contribution)	Combined obs./exp. (Signal contribution)
1994-2006 e^+p	Full Sample	21 / 18.7 ± 2.6 (70%)	11 / 4.9 ± 0.8 (84%)	32 / 23.6 ± 3.3 (73%)
200 pb ⁻¹	$P_T^X > 25 \text{ GeV}$	10 / 3.1 ± 0.6 (77%)	7 / 2.9 ± 0.5 (84%)	17 / 6.0 ± 1.0 (80%)

3.3 σ

Low Ep run / F_L Measurement

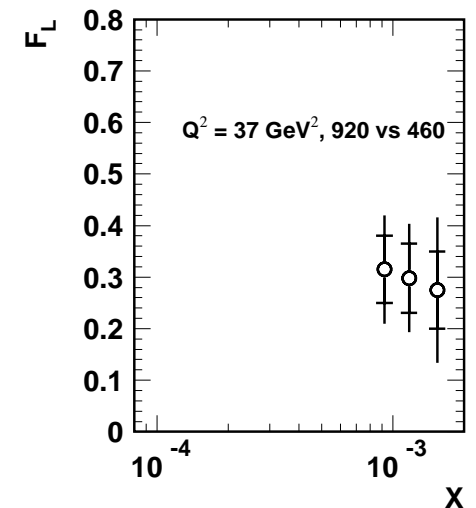
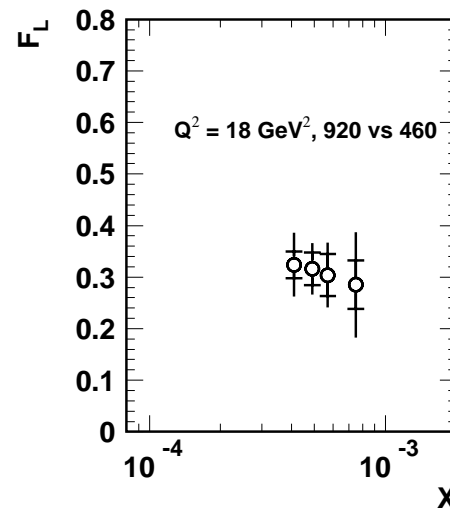
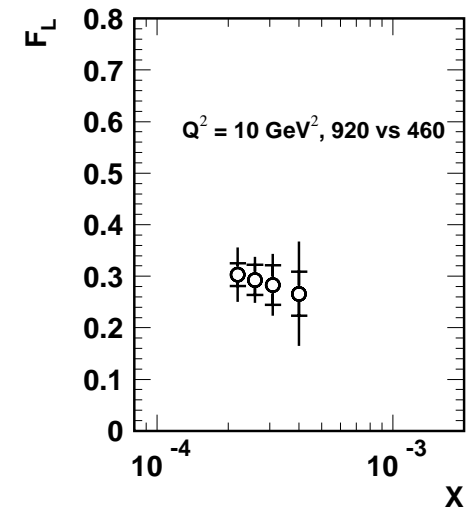
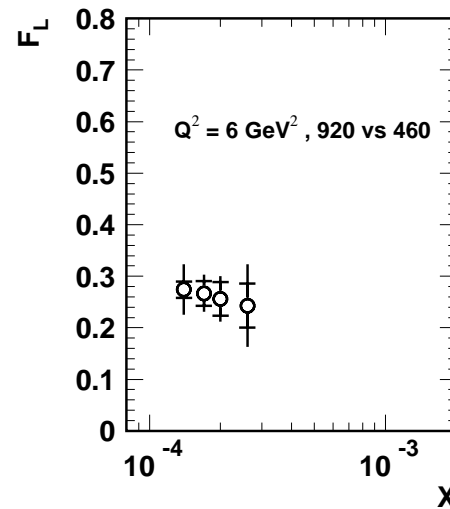
$F_L \sim (1-x)g$. At low x , $10^{-4} - 10^{-3}$, F_L measures gluon density \rightarrow Higgs production at LHC

Direct measurement of F_L needs measurements at different proton energy: low energy run

H1 ready:

- backward electron measurement
- backward silicon tracker
- new triggers

Last 3 months of data taking,
 $10-15\text{pb}^{-1}$ at $E_p=460\text{ GeV}$



H1 final decision on low energy run by february 2007 collaboration meeting

Conclusions

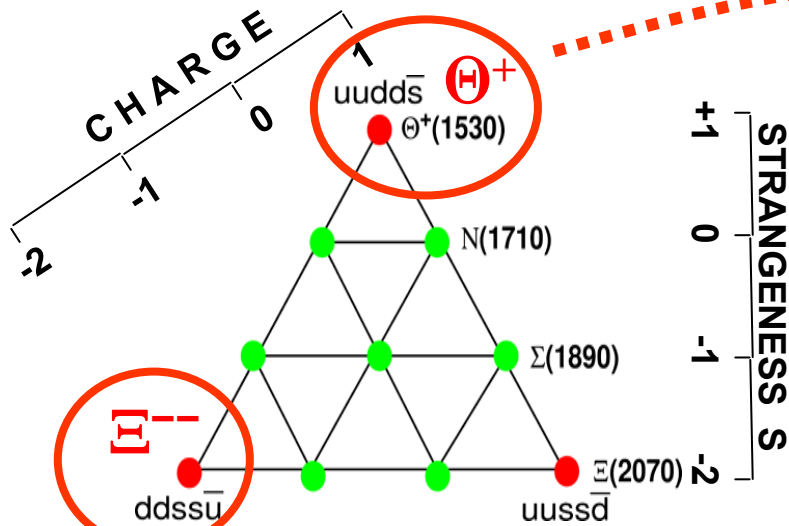
Successful hardware and analysis activities

Good support from our director

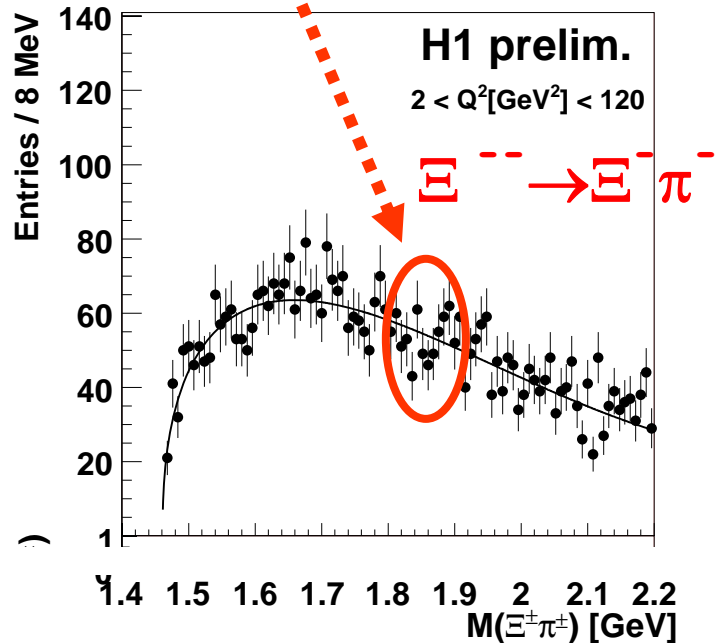
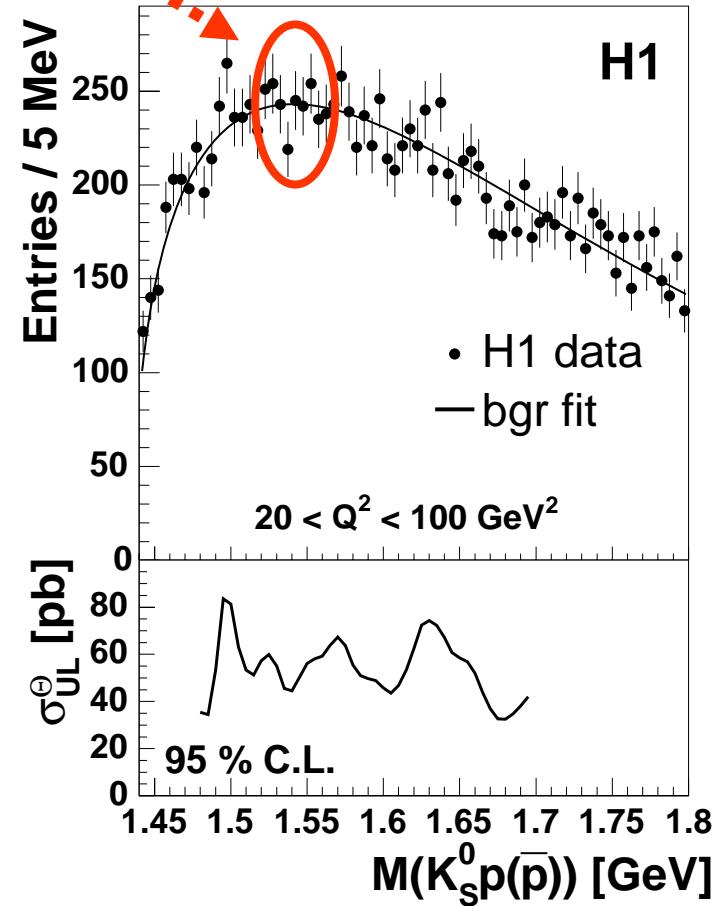
Plans

collect data until July 2007
analysis of whole HERA dataset

Strange Pentaquarks



$\Theta^+ \rightarrow p K^0s$



NOTHING