1994 Status Report

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1. Online System Status
2. Methods of Lumi Measurement
   - γ−rate vs $e\gamma$−rate
   - "Brinkmann's scan"
3. Monitoring and Calibration
4. Off-line LUMI tools
5. Final Luminosities for 1992–1994
6. Review of the Shut-down Plans

H1 Collaboration meeting
DESY, Hamburg, 13. Oct. 1994

Lumi System

LUMI System Tasks

1) Permanent $\mathcal{L}$ measurements without dead time
   $\Rightarrow$ LRTL, LUMM (once per 10 sec)

2) Tagging of γp events (trigger, e' measurement)
   $\Rightarrow$ LREE, LRPE (detector responce)

3) Online detector calibration (rate dependent)
   $\Rightarrow$ LREP, LRPP (once per 10 sec)

4) Distribution of H1 Lumi data to various users
   (TV-screens, MAC's, HCR, H1CR, ZEUSCR)

5) Veto Wall scintillator bits readout
   $\Rightarrow$ VETE (event data)

6) Neutron counter trigger and readout
   $\Rightarrow$ LRNA (event data)

$\Rightarrow$ Many important and demanding tasks.
The system upgrade is necessary!

Lumi System

HERA Running Conditions

Parameter	1992	1993	1994_{e^-}	1994_{e^+}
$< I_e >$ [mA]	1.33	7.7	10.5	16.7
$< I_p >$ [mA]	0.94	10.8	28.6	40.6
$e * p$ bunches	10*10	94*90	168*170	168*170
$< L_{sp} >$ $[10^{29}\mathrm{cm}^{-2}\mathrm{s}^{-1}\mathrm{mA}^{-2}]$	2.7	3.2	3.8	3.6
$< L >$ $[10^{30}\mathrm{cm}^{-2}\mathrm{s}^{-1}]$	0.028	0.27	0.61	1.23
L_{peak}^{max} $[10^{30}\mathrm{cm}^{-2}\mathrm{s}^{-1}]$	0.22	1.30	2.60	4.30
LUMI rates [kHz]				
ET	2	30	50	100
PD	3	40	75	150
VC	5	50	120	200

Online Operation Summary

Improvements w.r.t. 1993:

- LUMI DAQ sped up by s/w optimisation
- standard shift operation simplified
- ZEUS lumi monitor installed in H1CR and H1 lumi monitor – in ZEUS CR

Main problem in 1994:

the overall reliability of the system

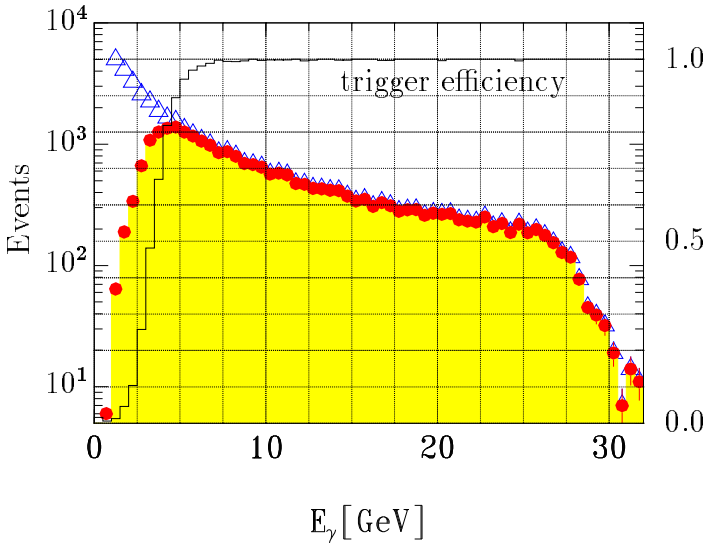
several small, but annoying errors –
only partly fixed during 1994 lumi running

Hardware status:

- several accidents with $e^{\pm}$ beams lead to very high rates and spoiled the detector resolution
- at least one channel (PM?) in the Photon detector needs replacement

Lumi System

$\gamma-$ rate vs $e\gamma-$ rate



1) Insensitive to small variations in the beam optics

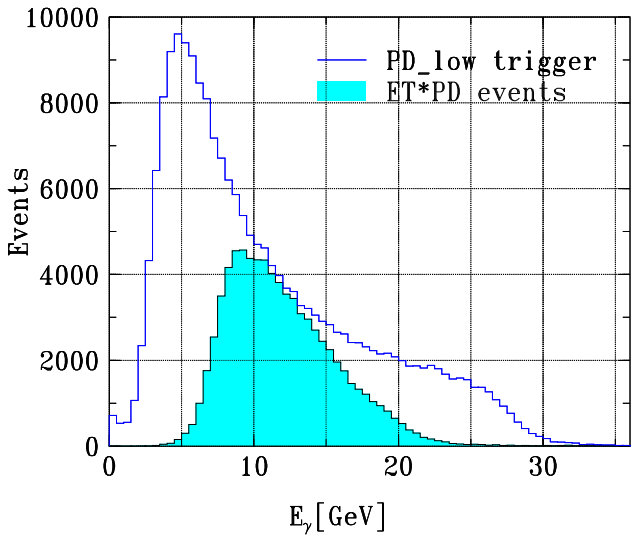
2) Needs stable trigger threshold and understanding of absolute E-scale to high precision

⇒ Good as a final offline method

1) Sensitive to the changes in beam optics (due to ET-acceptance)

2) Stable against the variations of the trigger thresholds

⇒ So far the best online method in H1



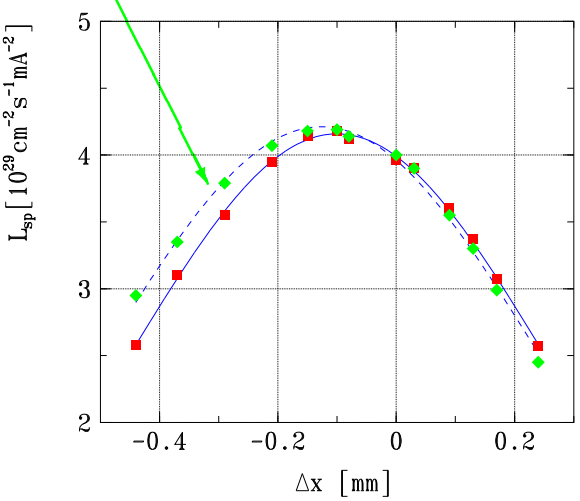
Lumi System

"Brinkmann's scan"

Why? A long standing problem of the difference in the online $\mathcal{L}$ in H1 and ZEUS IP (-8.8% in 1993, -15% in June-July 1994)

How? Moving *e*-beam w.r.t. *p*-beam in a transverse plane, and measuring Lumi-rates. This gives an effective beam sizes σ_x^*, σ_y^* and thus L_{sp} and L

Result: See R.Brinkmann, DESY-HERA Note 94-03. For the correct interpretation a change in the e-tagger acceptance during the scan must be taken into account!



Conclusions:

1) A useful exercise
2) Better working point was found for H1
3) The difference between HERA, H1 and ZEUS $\mathcal{L}$ measurements is not yet fully understood

Lumi System

LUMI System Monitoring

3 levels:

1) online expert system

2) L4/L5 control plots

3) detailed offline monitoring

Data-94:

Important! An automatic selection at SGI logging:

118 files `HERA03.H01.LUMIMON.C94*` created so far

LUMI reconstruction is done at L4

Selection: any lumi trigger OR energy deposit above noise

Bank set: header + lumi + trigger = 1.5 kb/event

Use:

s86 (eTAG)	– etag background monitoring
s91 (PD_low)	– offline $\mathcal{L}$ from γ-rate method,
	– ET-acceptance determination
s92 (PD&!VC)	– "clean" γ's for various purposes
s93 (VC)	– VC-efficiency, cross check for s91
s94 (ET&PD&!VC)	– KRS calibration (ET, PD)
s95 (ET&PD&VC)	– VC calibration

Lumi System

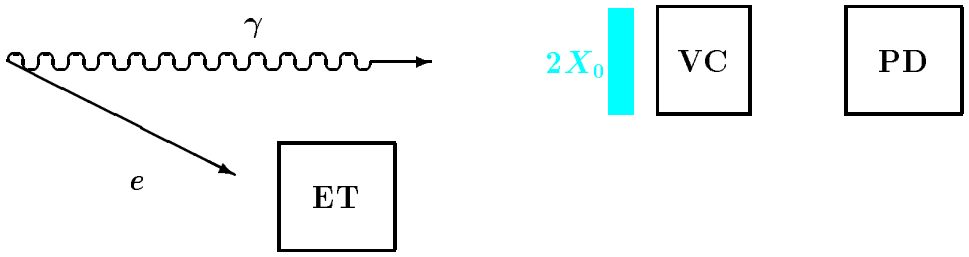
Calibration Procedure

Use the same process (B-H) as for lumi measurements:

$$ep \rightarrow e\gamma p$$

requiring for all channels i in ET, PD:

$$\sum_i \{E(e) + E(\gamma) - E_0\} = min$$



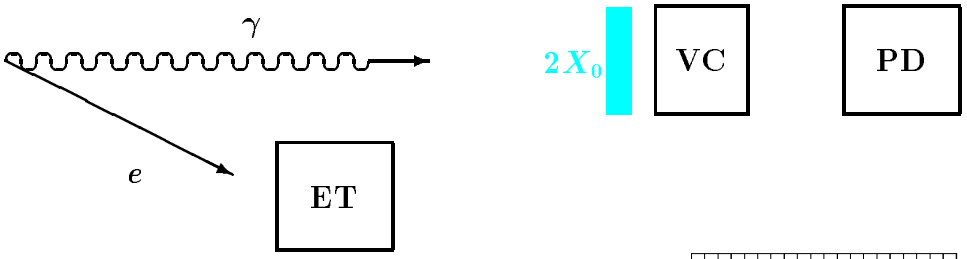
Several steps:

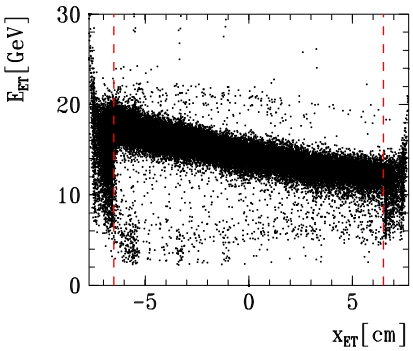
1) Permanent automatic online calibration of the lumi branch ⇒ LREP, LRPP (event stream)
2) Define RC between lumi and γp branches using LUMIMON events ⇒ LFRC (into DB)
3) Define possible global E-shift between e and γ arms by fitting E_γ spectrum ⇒ LESC (into DB)

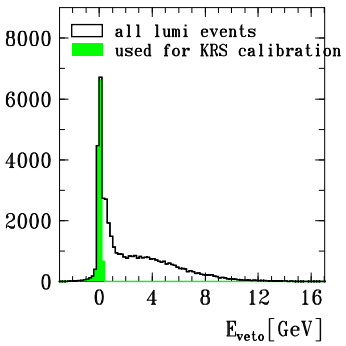
Steps 2) and 3) are performed off-line and still require manual actions ⇒ to be improved in 1995

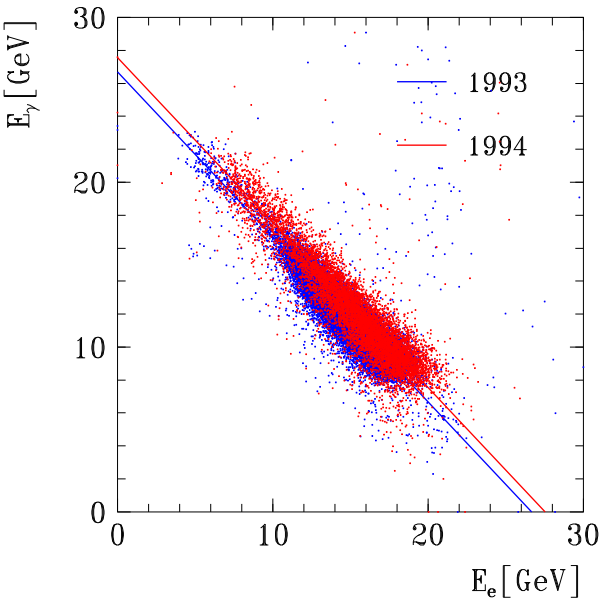
Lumi System

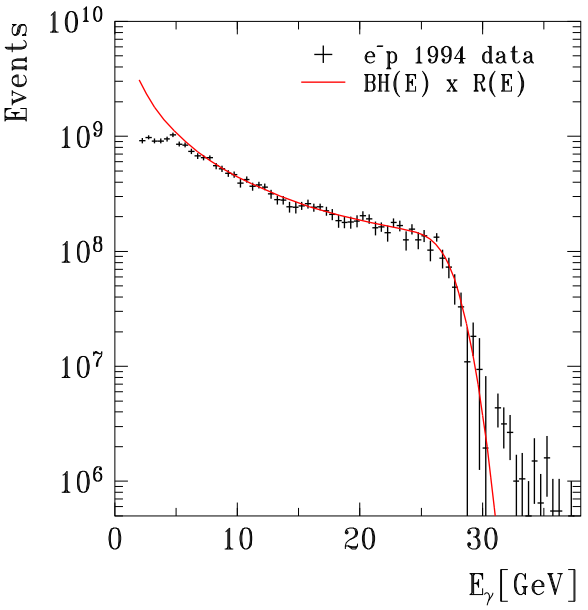
Calibration Procedure





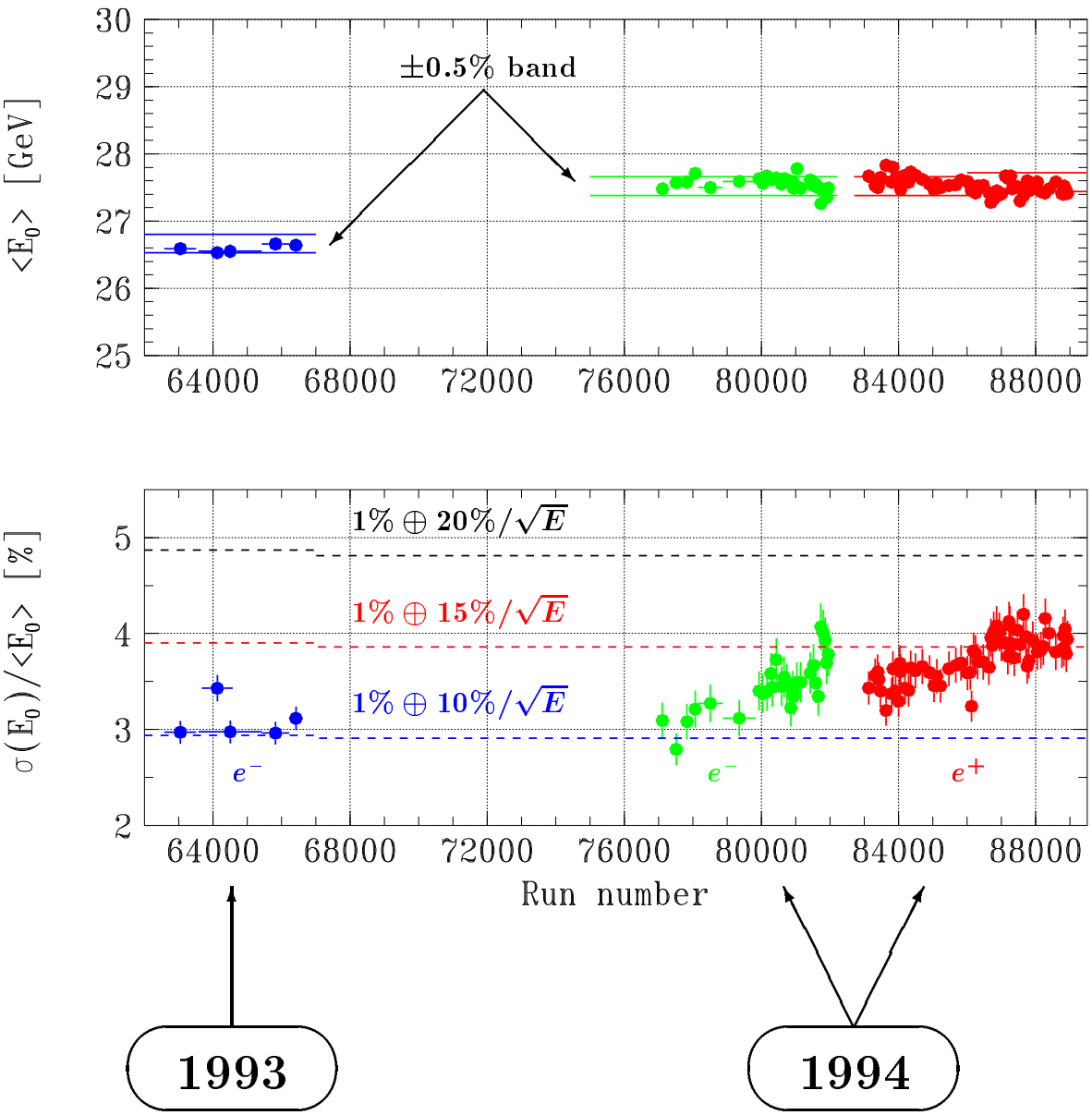






Lumi System

KRS Resolution History



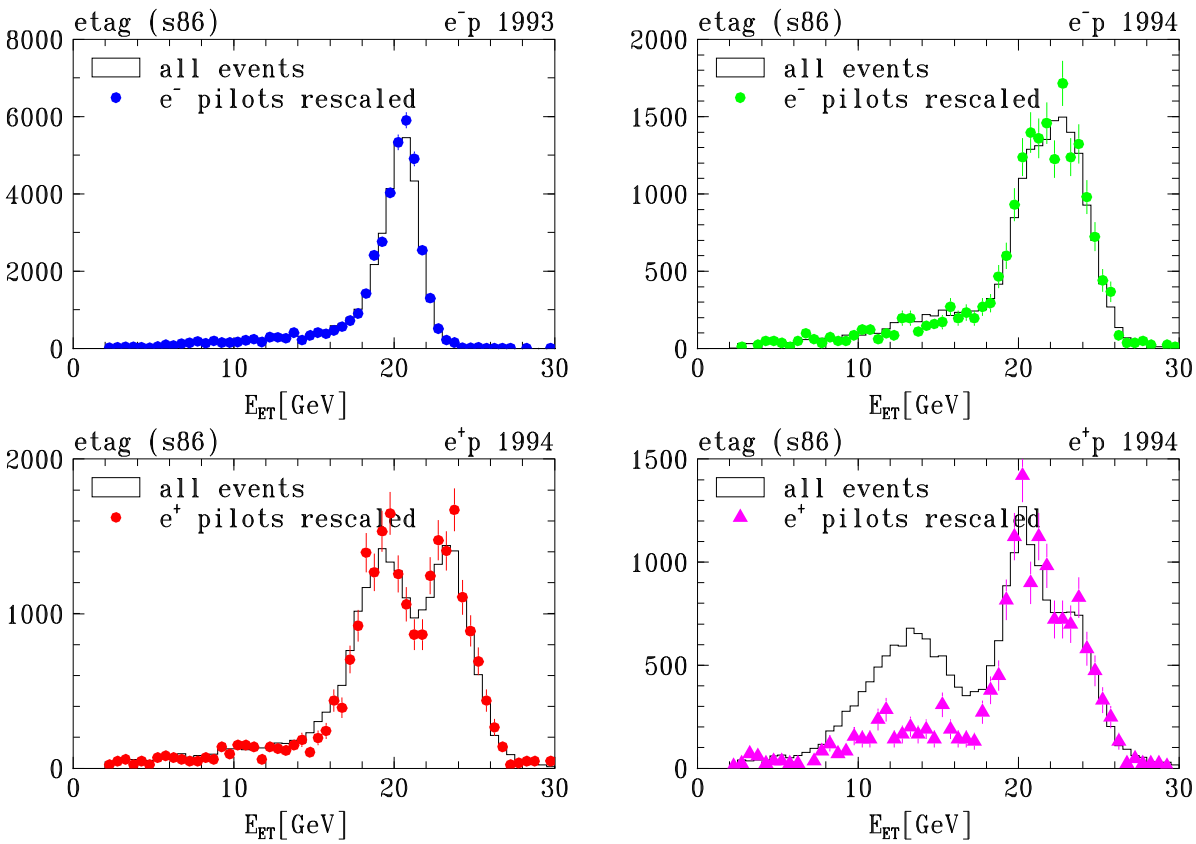
Lumi System

etag background monitoring

e^+p vs e^-p

1) different (more complicated) shape
2) sometimes different for *colliding* and *pilot* bunches

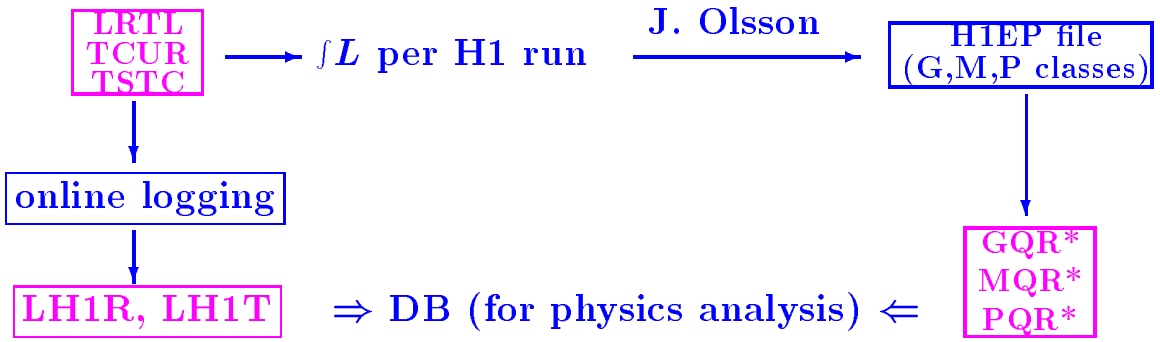
⇒ impact for physics analysis:
(statistical background subtraction)



Lumi System

LUMI Data and Tools

Lumi Data Flow



Access to the Data

H1UTIL

```
IQ = IQRH1 (IRUN)
JB = JBUNCH (IRUN, IBUNCH)
CALL GETH1L (IRUN, TOTL, H1L, RTIME, REFF, IRET)
CALL EPBEAM (IRUN, PTC, PPC, ETC, EPC, IBT, IRET)
```

Further Batch Tools

- **HV corrections** – M. Fleischer, H1 note in preparation
- **Satellite bunch correction** – still to be developped !

Lumi System

SHOWLUMI

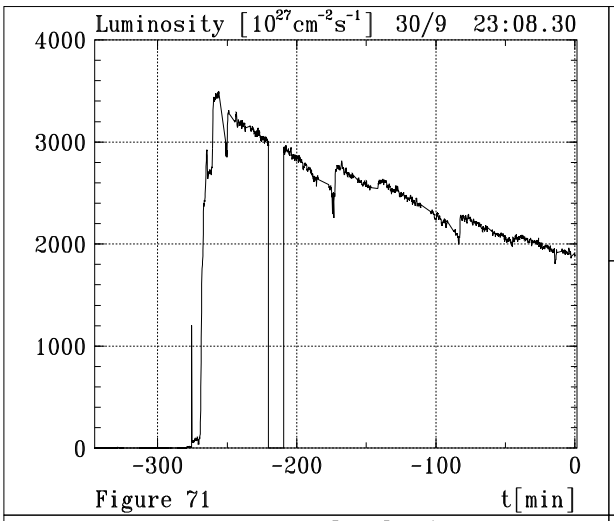


Figure 71

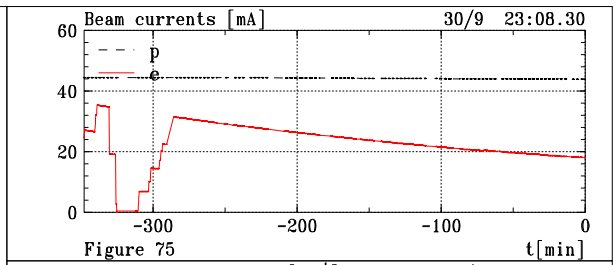


Figure 75

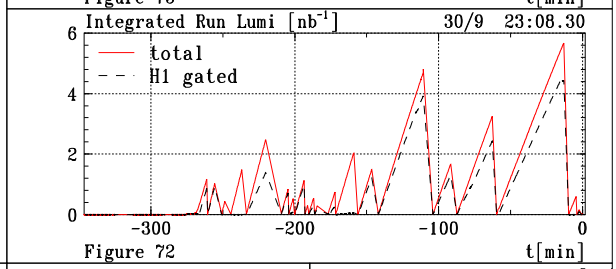


Figure 72

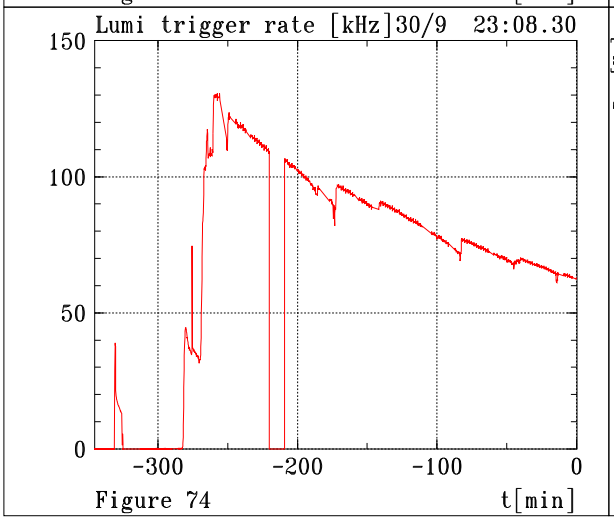


Figure 74

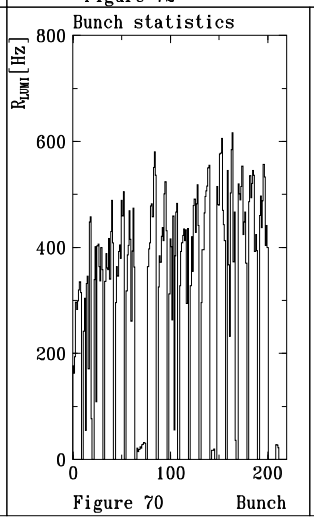


Figure 70

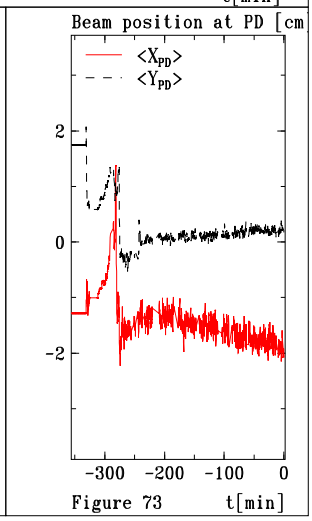


Figure 73

Available in: **LOOK, H1ED**

Similar information – on **dice2**

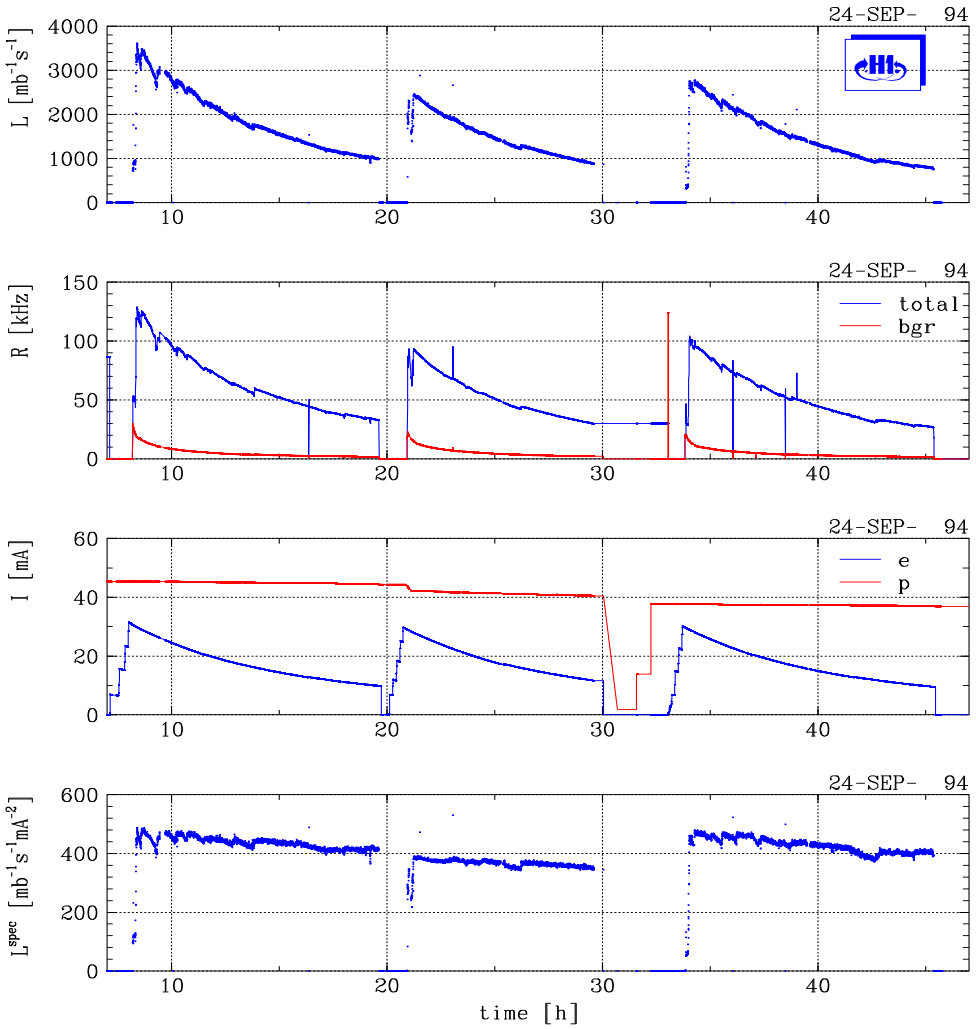
Lumi System

LRATES

Input: HERA03.H1TCL.* (LRTL, LUMM, TCUR banks)

Output: LUMI history plots (see example on this page)
optionally – files for comparison with ZEUS lumi

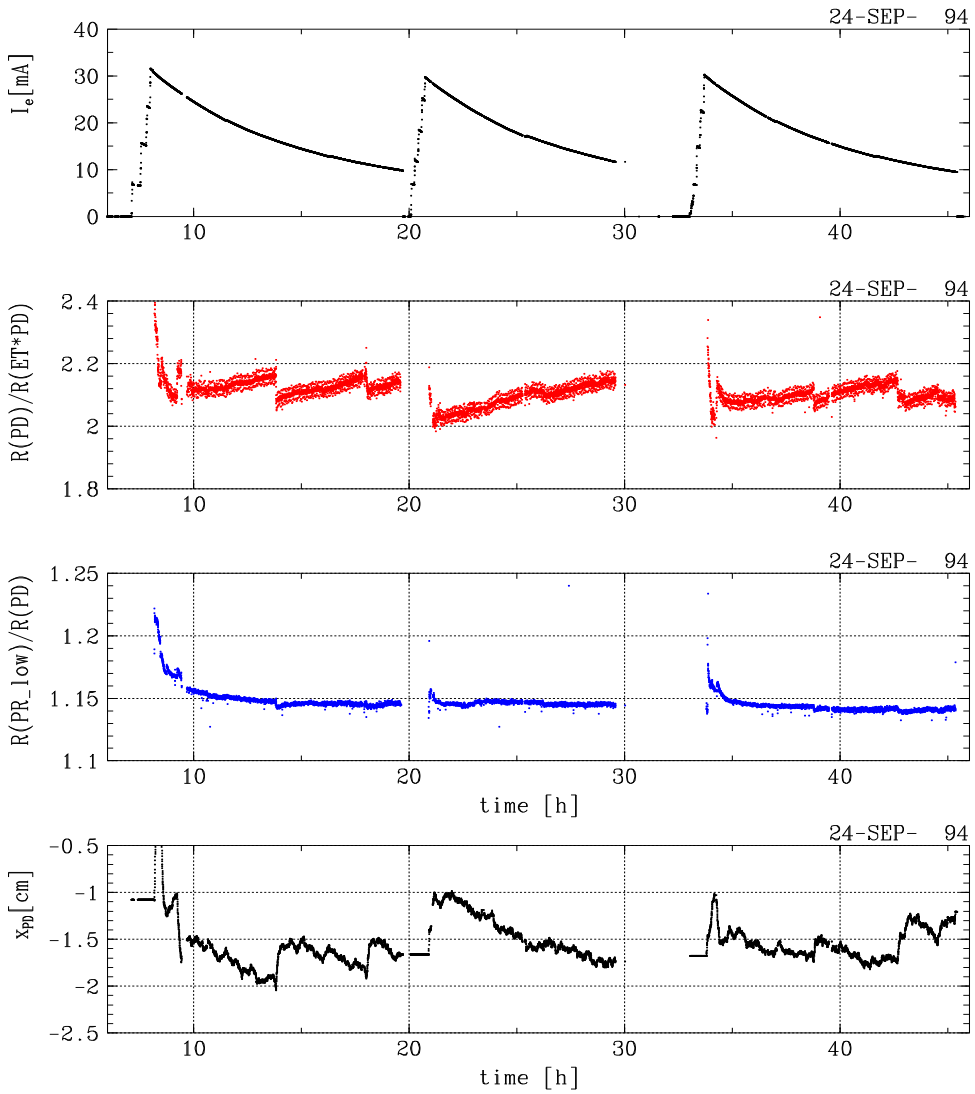
24-26 Sept 1994



Lumi System

LRATES

Different LUMI scalers behaviour as a function of various beam conditions: **current, tilt, offset(?)**



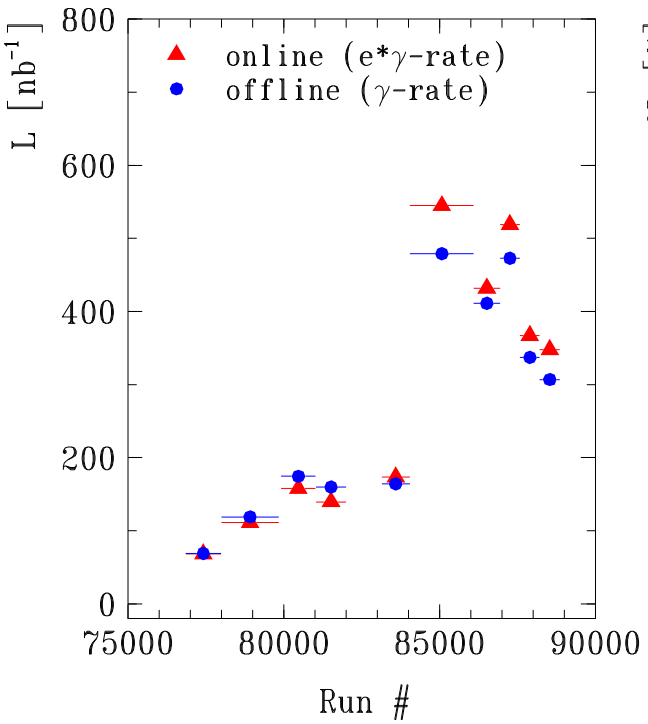
Lumi System

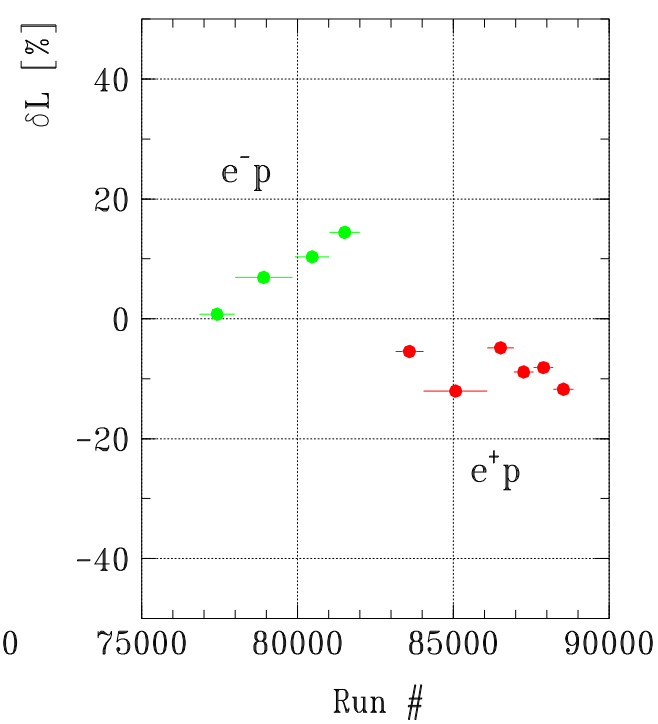
LUMI-94. Preliminary !

Data sample	Online $\mathcal{L}[\mathrm{nb}^{-1}]$	Offline $\mathcal{L}[\mathrm{nb}^{-1}]$	$\delta\mathcal{L}/\mathcal{L}$
$e^-p-1994$	478	518	8.4%
$e^+p-1994$	2384	2171	−8.9%

satellite bunch corrections are not included yet

statistical errors only are shown





Lumi System

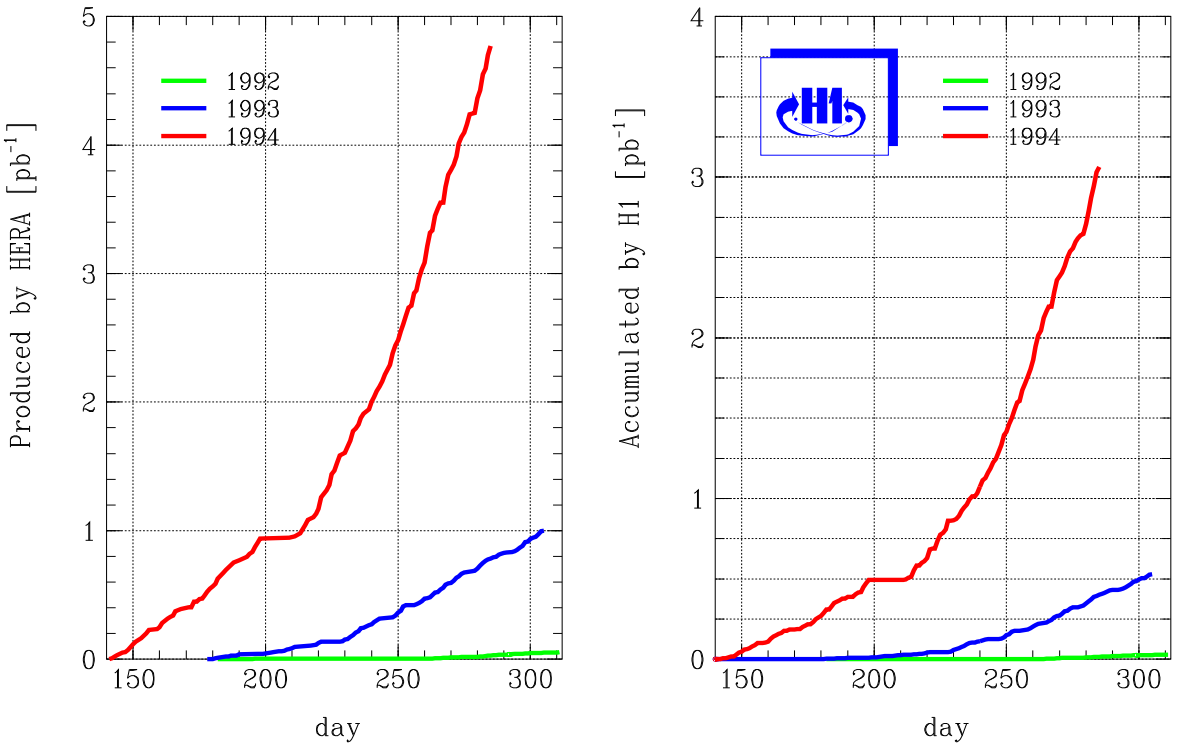
LUMI 1992-1994

Status: 12-Oct-94 at 24:00

Online measurements are shown!

H1 efficiency:
1992 = 55%
1993 = 60%
1994 = 58% $\Leftarrow e^- p$
= 72% $\Leftarrow e^+ p$

INTEGRATED LUMINOSITY



Lumi System

Work during Shut down

1) Online system upgrade:

- further LUMI DAQ speed up by factor of ~ 2 (new FIC, 2 processors, GPTP→ATPM)
- major software modifications
- implementation of several lumi methods (scalers)

2) Improvements in the standard system operation:

- main Lumi control → room 301
- upgrade Lumi information display

3) Replace few problematic PM's in ET, PD, VC

4) Improve overall system reliability (mainly s/w)

5) Realize permanent measurements of the luminosity fraction from possible e-satellites

6) Add more off-line tools in order to reduce the amount of manual actions in calibration and monitoring

... and more