

# HERA Status

HERA Experiment Collaboration Meeting

February 24 2004

F. Willeke, MHE

## Topics

- **Schedule**
- **Luminosity production**
  - **Understanding of Luminosity data**
  - **accelerator availability**
  - **operational efficiency**
  - **expected luminosity until August 04**
- **Polarization**
- **Uncontrolled proton beam losses**
- **HERA Improvement Program**

## Issues

- **180 bunch operation and fill pattern**
- **Closing and opening the ZEUS calorimeter**
- **Shut down prolongation and luminosity production**
- **Dedicated Tuning for Polarization**
- **Switching to electrons**

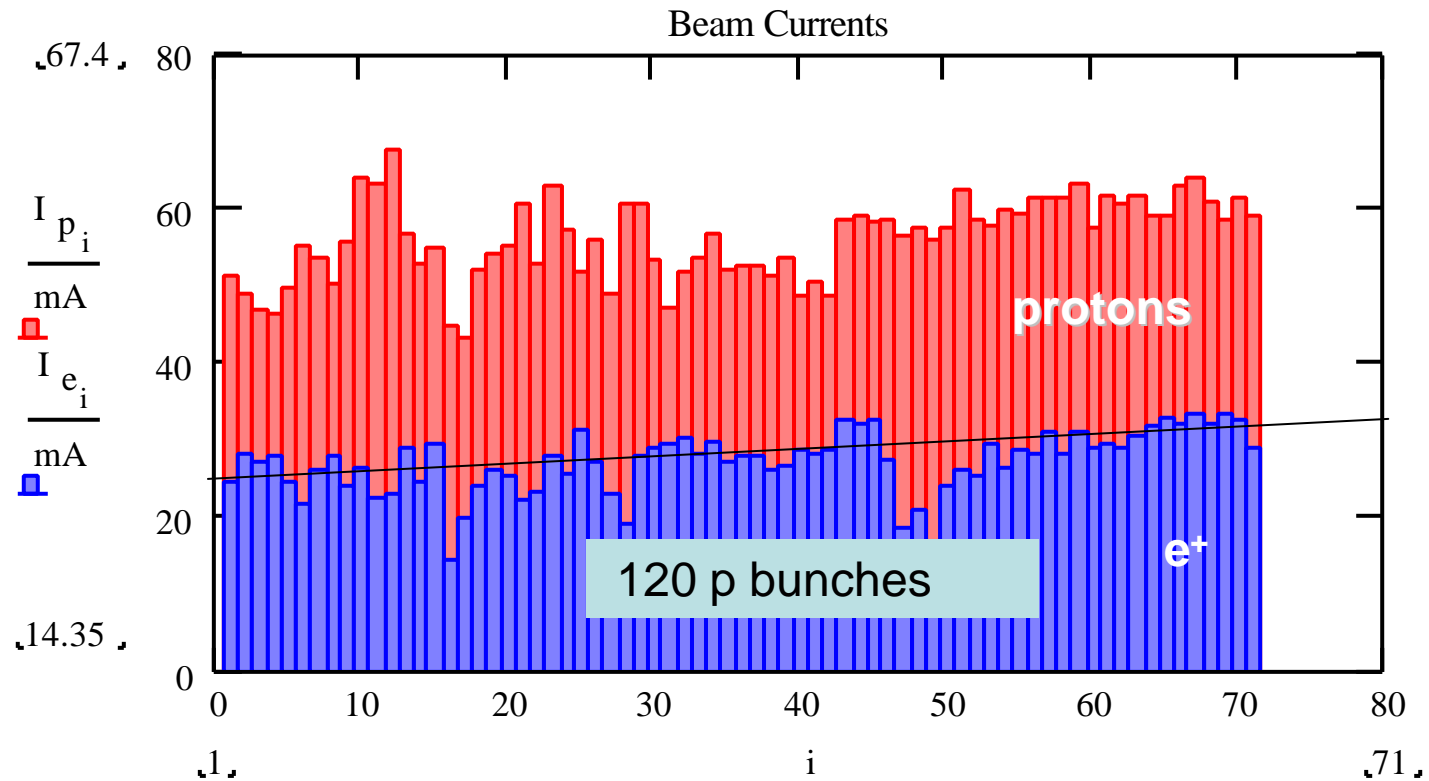
## Updated HERA Schedule 2004

	Start	Dt / 8h	End
<b>Start-up</b>	29.12.2003 07:00	4	30.12.2003 15:00
<b>Luminosity Run</b>	30.12.2003 15:00	26	08.01.2004 07:00
<i>Maintenance Day +Studies</i>	08.01.2004 07:00	5	09.01.2004 23:00
<b>Luminosity Run</b>	09.01.2004 23:00	79	05.02.2004 07:00
<i>Maintenance Day +Studies</i>	05.02.2004 07:00	8	07.02.2004 23:00
<b>Luminosity Run</b>	07.02.2004 23:00	76	04.03.2004 07:00
<i>Maintenance Day +Studies</i>	04.03.2004 07:00	13	08.03.2004 15:00
<b>Luminosity Run</b>	08.03.2004 15:00	71	01.04.2004 07:00
<i>Maintenance Day +Studies</i>	01.04.2004 07:00	5	02.04.2004 23:00
<b>Luminosity Run</b>	02.04.2004 23:00	97	05.05.2004 07:00
<i>Maintenance Day +Studies</i>	05.05.2004 07:00	5	06.05.2004 23:00
<b>Luminosity Run</b>	06.05.2004 23:00	82	03.06.2004 07:00
<i>Maintenance Day +Studies</i>	03.06.2004 07:00	5	04.06.2004 23:00
<b>Lumirun</b>	04.06.2004 23:00	79	01.07.2004 07:00
<i>Maintenance Day</i>	01.07.2004 07:00	2	01.07.2004 23:00
<b>Lumirun</b>	01.07.2004 23:00	136	16.08.2004 07:00
<i>Shutdown</i>	16.08.2004 07:00	170	11.10.2004 23:00
<b>Start-up &amp; Studies</b>	11.10.2004 23:00	37	24.10.2004 07:00
<b>Lumirun</b>	24.10.2004 07:00	33	04.11.2004 07:00
<i>Maintenance Day +Studies</i>	04.11.2004 07:00	5	05.11.2004 23:00
<b>Lumirun</b>	05.11.2004 23:00	79	02.12.2004 07:00
<i>Maintenance Day</i>	02.12.2004 07:00	2	02.12.2004 23:00
<b>Lumirun</b>	02.12.2004 23:00	46	18.12.2004 07:00
<b>Machine studies</b>	18.12.2004 07:00	17	23.12.2004 23:00

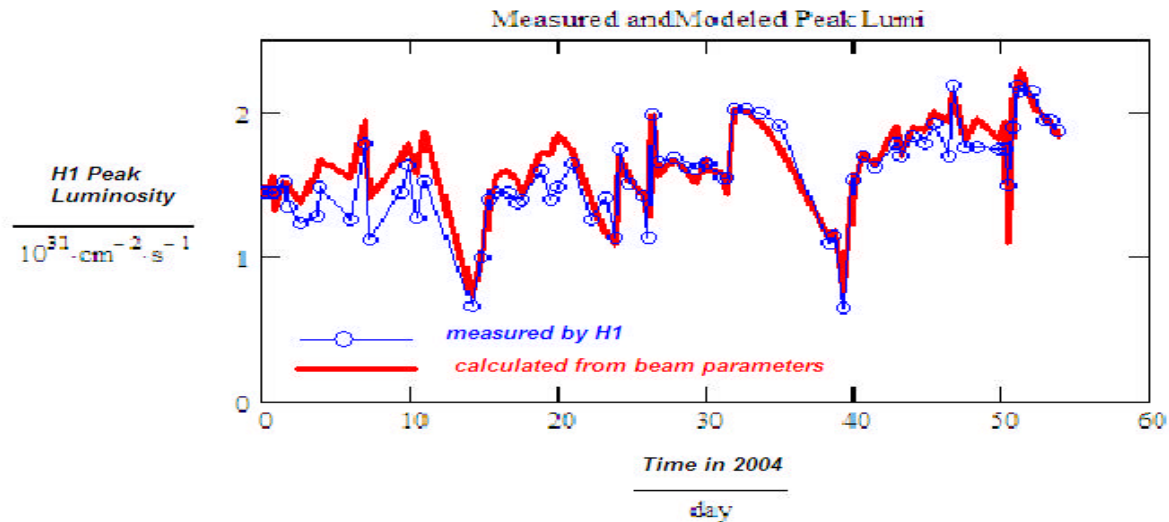
# HERA Luminosity

Slow but steady increase of beam lepton currents = 0.1 mA / day

Proton bunch currents already at Y1999 / 2000 levels



# HERA Luminosity



Measured Luminosity is well explained by the measured beam parameters. A reduction factor of 0.874 needs to be introduced to describe the effect of optical imperfections, beam ellipse tilts and errors in the emittance measurements

# HERA Luminosity

## Issues and possible improvements:

Compensation of beam-beam beta beat

→ Expect up to 10% improvement

Continue optics fine polishing

→ Expect (5-10) % improvement

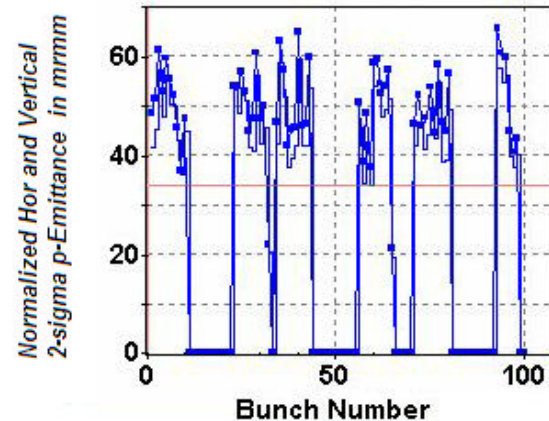
Increase number of bunches from 120 to 180

→ Expect a factor of 1.5 improvement

HERA peak luminosity

Expected to be eventually

$$L_{\text{peak}} = 3.8 \times 10^{31} \text{ cm}^{-2}\text{s}^{-1}$$



**Issue:** Occasional rapid increase of proton emittance when beams are brought into collision (10sec emittance doubling time):

- Not yet well understood,
- presumably related to unstable e-beam,
- needs some more study

# HERA Peak Luminosity

HERA Luminosity satisfactory for the time being.  
The absolute measured values can be understood by measured beam parameters and plausible reduction of 13% due to imperfections.

Expect an increase of  $L_{\text{peak}}$  of 80% from increase of number of bunches and planned improvements

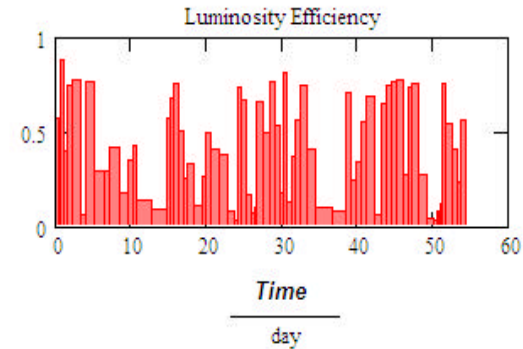
There are remaining issues which needs to be studied

# Luminosity Production

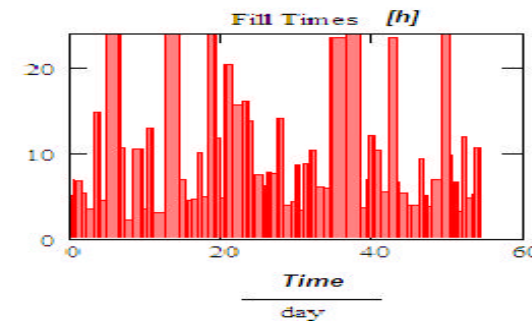
Overall efficiency still poor due to major technical problems

Time to refill still too large: need to shorten the lengthy luminosity tuning and end of luminosity procedures

Average Run length 7h too short: 2/3 of the runs ended non-intentionally (43 of 70)

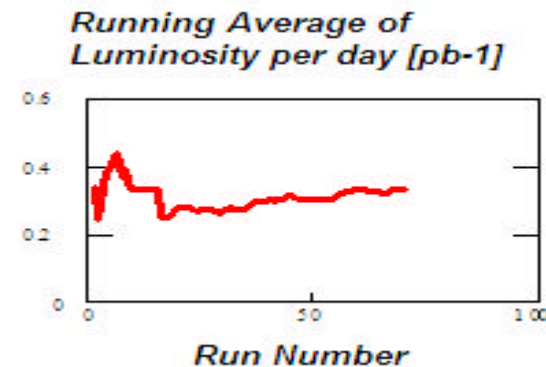


Average value  
41.6%



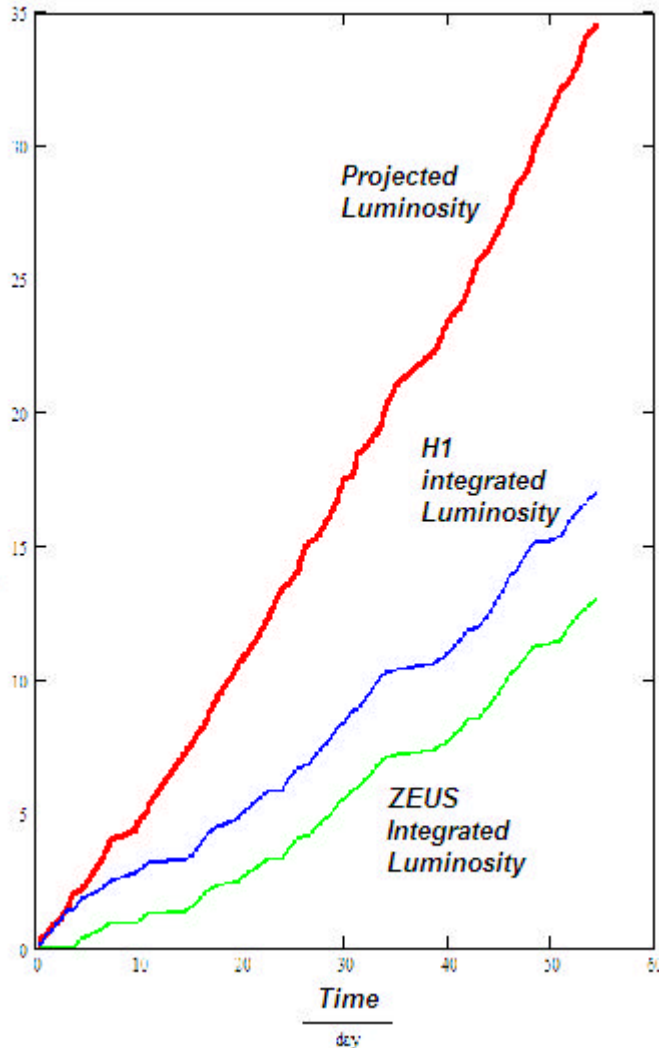
Average Time between runs  
10 h

Average Fill time  
4.5h



Average Luminosity Production per day

0.335 pb<sup>-1</sup>



## Luminosity extrapolation

→ 214 days for luminosity production left

Present luminosity production rate:

**0.335 pb<sup>-1</sup>d<sup>-1</sup>**

Expected luminosity production rate

(factor 1.8 increase in peak luminosity, factor of 1.25 increase in overall efficiency)

**0.760 pb<sup>-1</sup>d<sup>-1</sup>**

Expected luminosity production

2004

**135 pb<sup>-1</sup>**



Superconducting RF

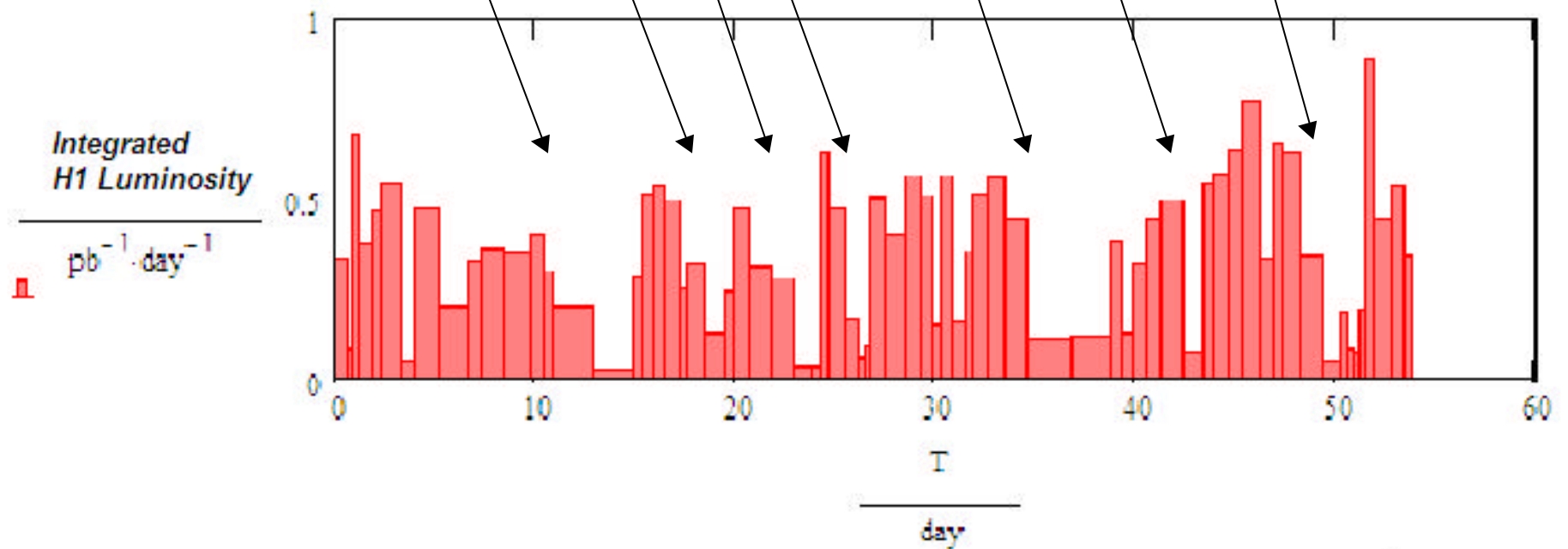
Major Technical Problems

Proton RF

ZEUS Solenoid after cooling water problems

RF section venting RF Window broken

PETRA Extraction Kicker



## **Technical Improvement Program:**

Preventive Maintenance for Power Supplies: MTBF is improving

Global preventive maintenance, technical failure management (improved logging of errors and parameters, improved error tracking) under discussion

RF Systems: work on klystron protection circuitry in progress

Protection against uncontrolled p-beam loss well underway

The measures taken so far have prevented a major uncontrolled p-beam loss

# Polarization

Polarization in collisions:

30-40%

Polarization without collisions

50%

Further improvement plans:

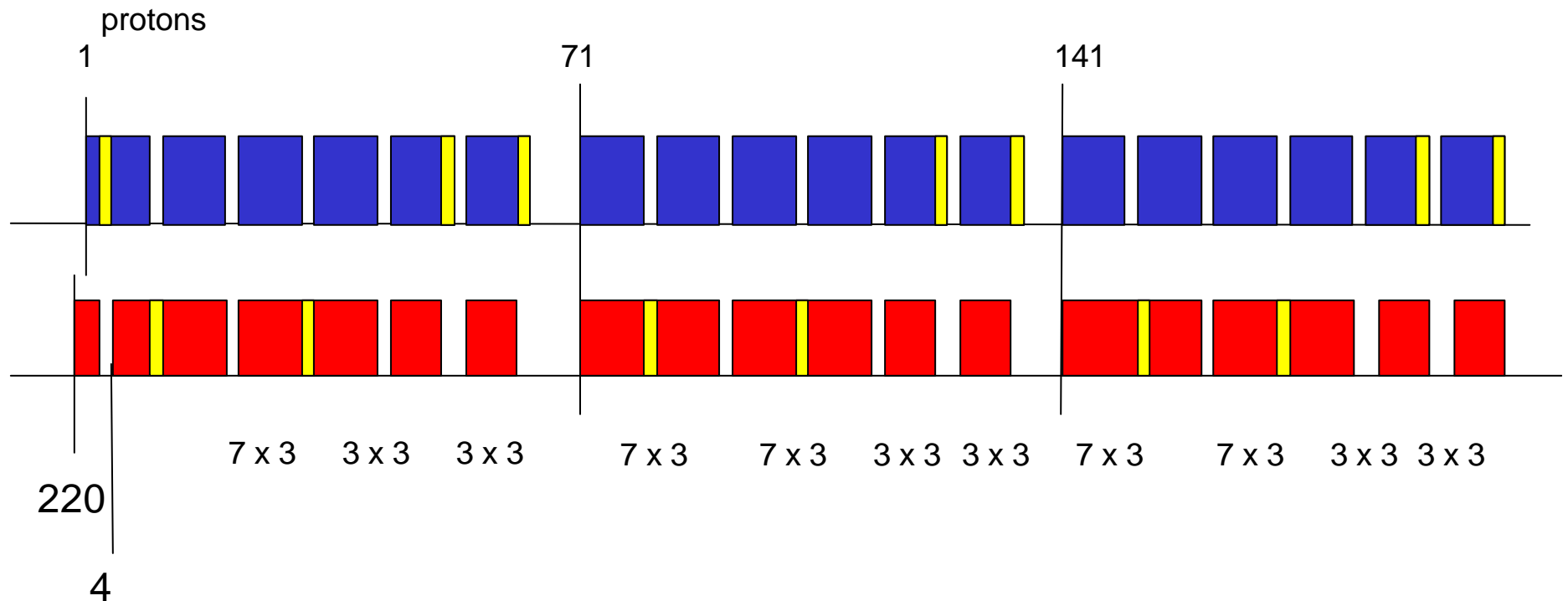
→ E. Gianfelice-Wendt

Rotator Flip: Foreseen after March Maintenance Day

# Operations

- HERA procedure works well and does (almost) not require expert support any more
- Background tuning very efficient due to recent tools (provided by ZEUS)
- High temperatures at IR South Right avoided by better steering, local cooling and protection system
- Operational procedures still improving:
  - proton orbit feedback,
  - automatized p-tune control
  - simplifying and speed up of the injection and
  - ramp procedure

# Propose to switch to 180 bunches soon: Proposed 180 Bunch fill pattern



$3 \times 6 \times 10 = 180$  proton bunches, 7 proton pilot bunches

$3 \times ( 2 \times (7 \times 3) + 2 \times ( 3 \times 3 ) ) = 180$  positron bunches, 6 positron pilot bunches

# Request to speed up operations:

Dump of p and e beam with ZEUS calorimeter closed

closing the ZEUS calorimeter at 12GeV  
(to be tested)

# Request:

All activities during shut down in the frame of  
present schedule  
(no extra installation time for detectors at NL)

# Request

Dedicated Tuning Time for Polarizations  
(2 days)



# Switching to electrons (reminder)

2 weeks (at least) required for adjusting  
The IR magnet positions

2 weeks of (additional) tuning time to steer the  
beam through IR (no surprises included)

Required before switching-over: Background  
analysis required as for positrons, support of  
experiments desirable

# Conclusions

- HERA is well under way now
- There is still room for improving luminosity and polarization
- Ready to switch to 180 bunches
- Improvement of overall availability will be crucial