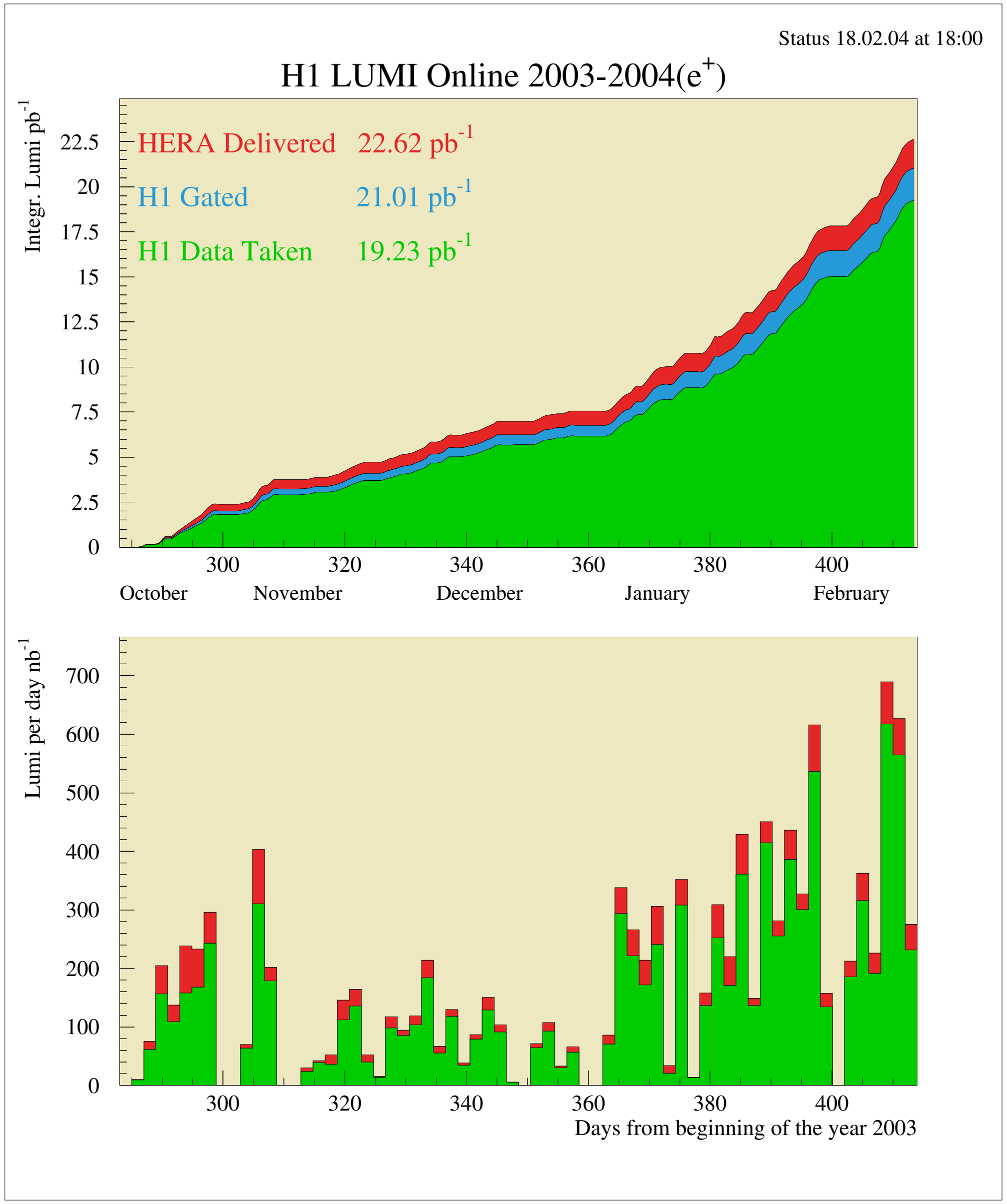
Report of the Technical Coordinator

Daniel Pitzl, DESY

H1 collaboration meeting, 25.2.2004

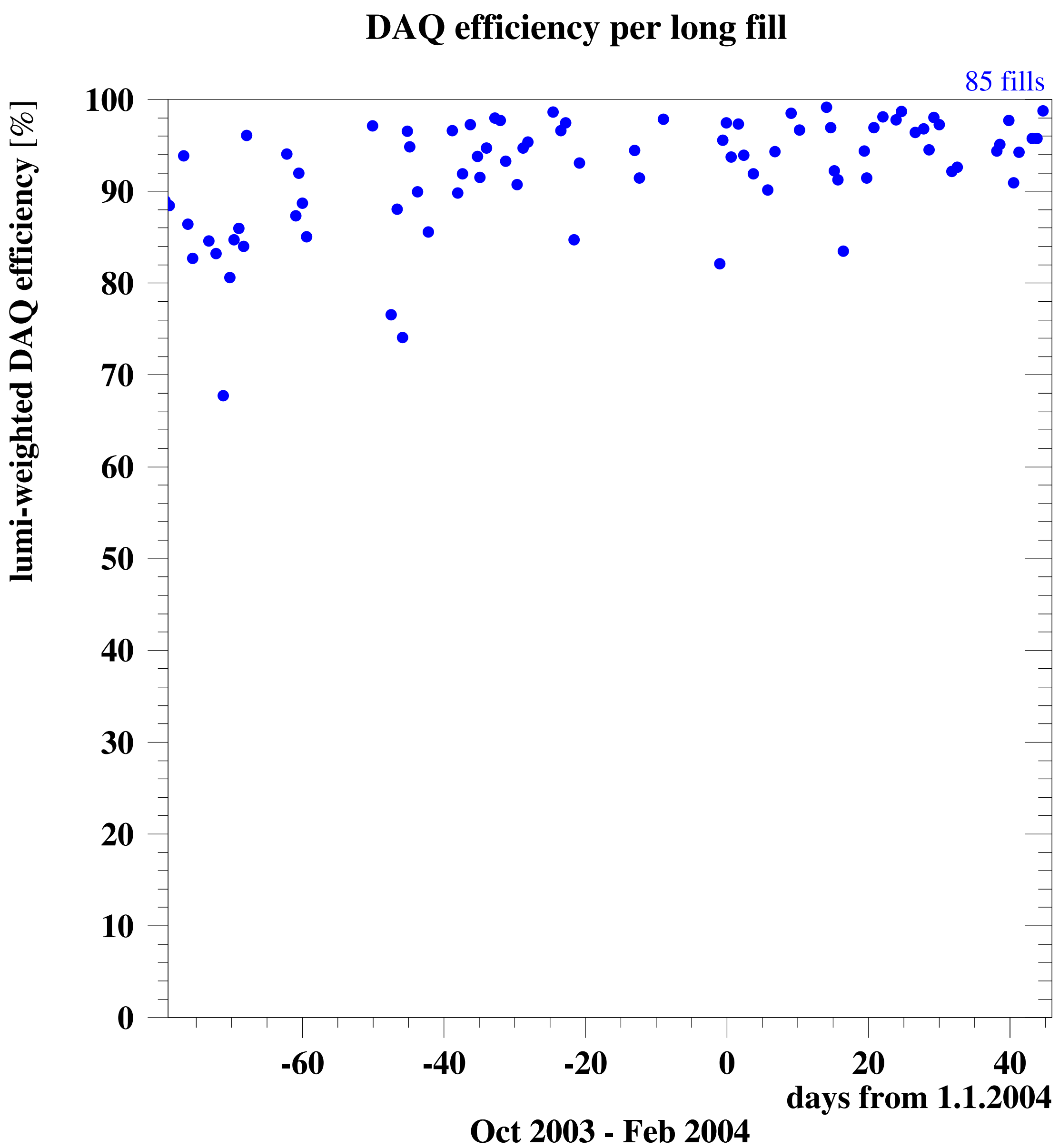
- Luminosity running and operational efficiencies
- Backgrounds
- H1 status
- Plans

4 months of luminosity running



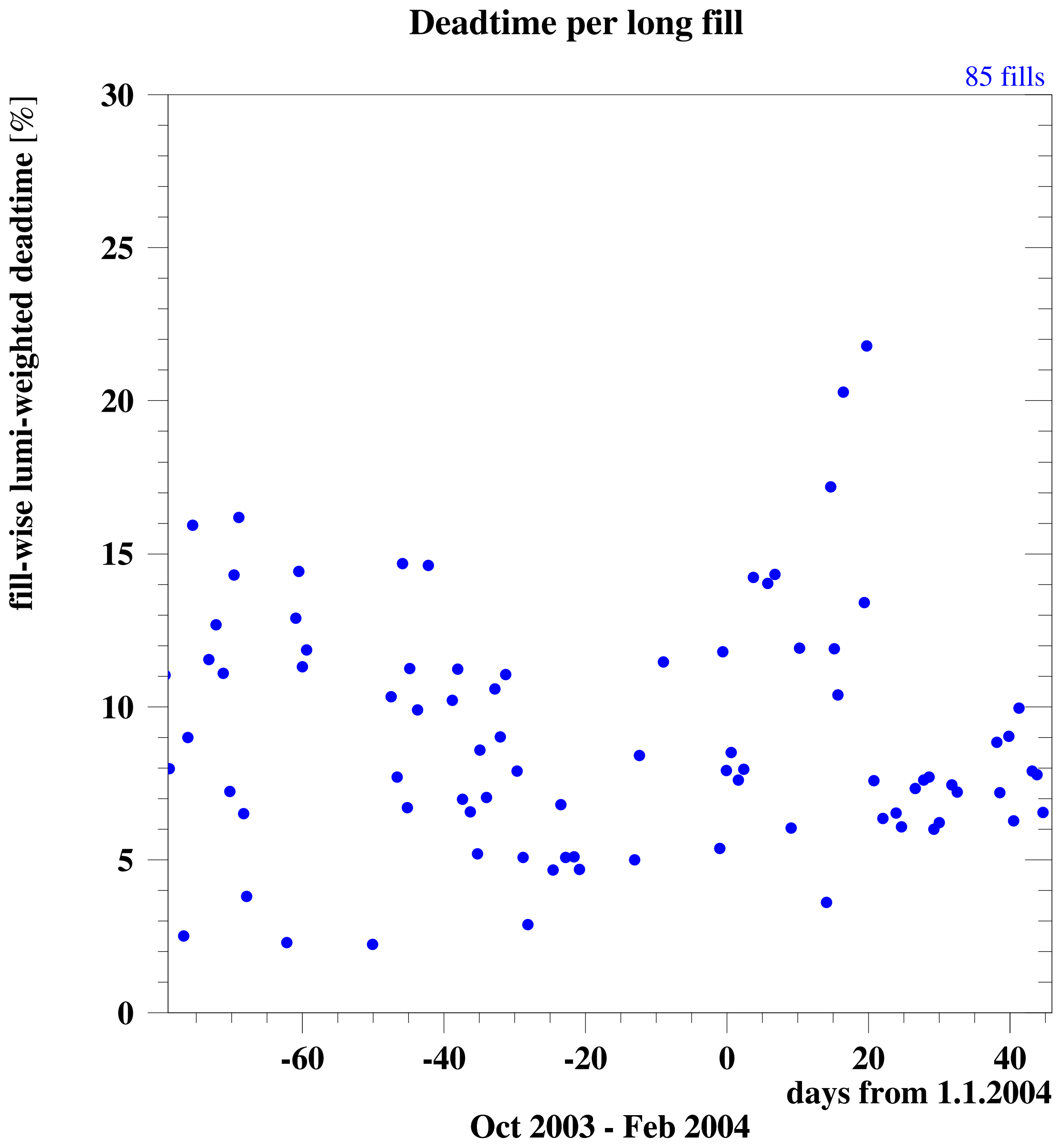
- HERA delivered: $22.6\,\text{pb}^{-1}$.
- H1 DAQ running: $21.0\,\text{pb}^{-1}$.
  93% average DAQ efficiency
- DAQ · (1 - deadtime) $19.2\,\text{pb}^{-1}$.
  8.5% average deadtime
- CJC1,2 and CIP full HV: $12.2\,\text{pb}^{-1}$.
  64% average HV efficiency
- Peak luminosity: $2.2 \cdot 10^{31}\,\text{cm}^2/\text{s}$
  best in 2000 was $1.8 \cdot 10^{31}\,\text{cm}^2/\text{s}$
- Several fills had $500\,\text{nb}^{-1}$ in 14 hours.
- Specific lumi typ.: $1.2 \cdot 10^{30}\,\text{cm}^2/\text{s}/\text{mA}^2$
  Design: $1.7 \cdot 10^{30}\,\text{cm}^2/\text{s}/\text{mA}^2$
  Outstanding machine phycis issue: optics errors and/or beam-beam emittance growth?

DAQ efficiency



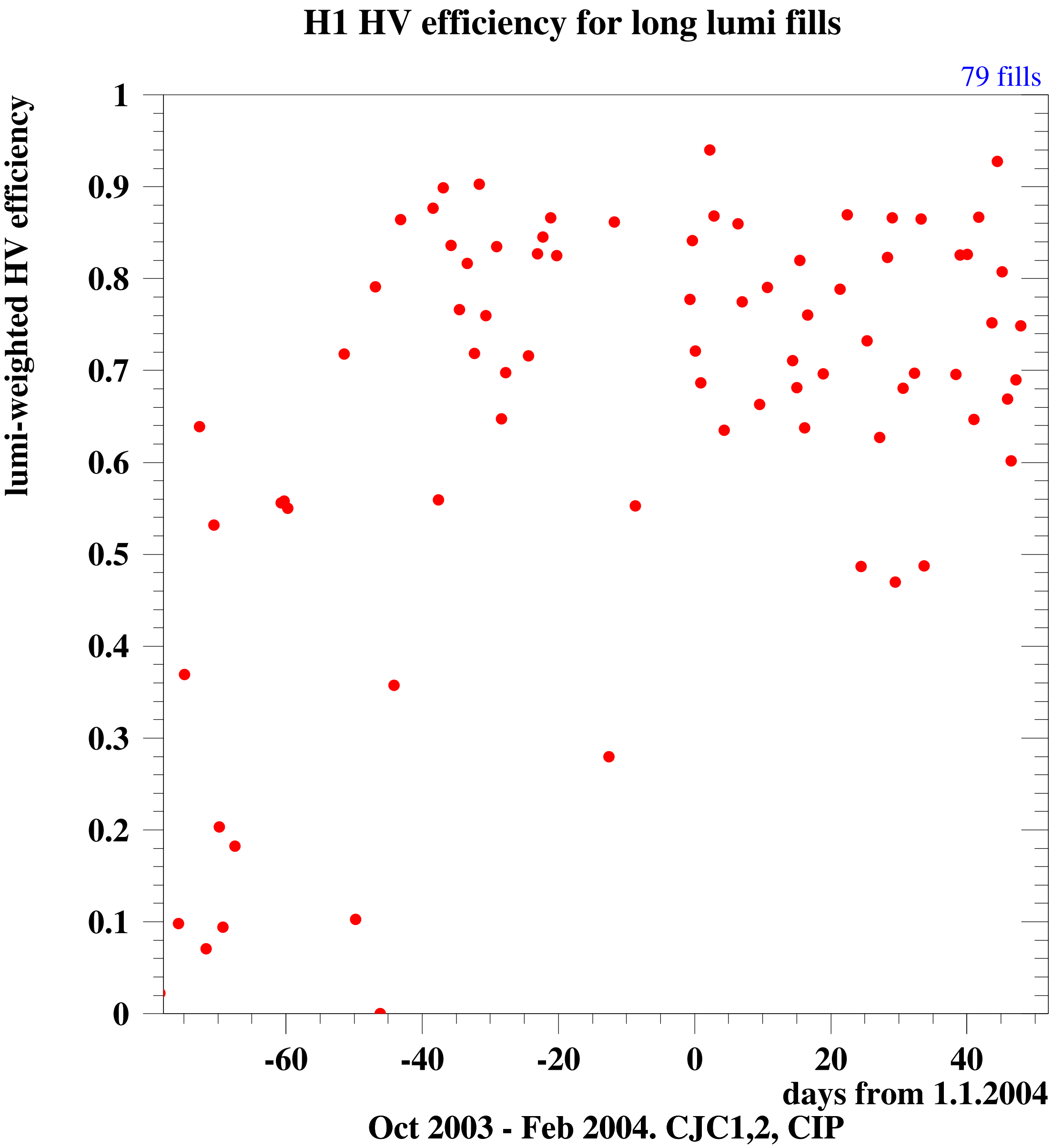
- The DAQ efficiency has improved significantly since October 2003.
- Thanks to work on Calo, Silicon, Lumi, CIP, VFPS, FTT.
- Improved monitoring (consoles) and messaging (Supervisor).
- All subsystems run stable, now.
- Aging hardware (Taxi cards, optical link) contributes to remaining problems.
- Development of an Ethernet based CDAQ has started, see G. Eckerlin's talk.

Deadtime



- The deadtime is now typically 7–8% at a readout rate of 40 Hz.
- Improvements were made in data transfer to the Farm via Fast Ethernet and in several subsystems (Silicon, FTT, VFPS).
- Deadtime is determined by tails in the frontend system response time beyond 2 ms (Silicon).
- The goal is 6% deadtime at 50 Hz.

High voltage efficiency



- Upper limit of 90% due to safe but slow sequential HV ramp-up procedure for CJC2, CJC1, CIP.
- Automatic procedure under test, see S. Karstensen's talk.
- Spread from 65 to 90% due to trips from background spikes.
- Several noisy HERA magnet power supplies were identified and cured.
- Most spikes are now caused by drifting beam parameters (e and p tunes). HERA-e has narrow working range between synchro-betatron resonances.

List of horrors and noteworthy moments

25.9.2003	Short to ground in a warm proton vertical bending dipole magnet BU NL72 (next to FPS).
	Now operated at 'virtual ground' (works only at one place at a time).
	6 BU coils NL will be replaced in Aug 2004 shutdown.
25.9.2003	Vacuum leak at SR 11 m: direct SynRad from 22 mA e^+ with large orbit displacement heating a flange.
	Temperature around this flange limited the e^+ current until Jan '04.
	Now water cooled. Orbit stabilizer always active.
	Backup absorber with Cu insert ready.
5.10.2003	Vacuum leak in an e^+ cavity OR.
	Cured by exchanging 4 plungers.
20.10.2003	H1 agrees to run over Christmas and New Year (M. Klein by SMS).
24.10.2003	Reached 62 mA protons: close to the injector limit for 120 bunches.

...continued...

25.10.2003	Failure of the He kryo control system. HERA-p warming up to 50 K.
	Required 4 days to cool down again.
4.11.2003	Vacuum leak NL 11 m: loss of a 60 mA proton beam due to trip of a GA magnet power supply.
	Now regular power supply inspection and maintenance.
	Beam loss monitor and fast dump signal active.
	Power supply monitoring electronics being installed until March 2004.
20.11.2003	D3 measured dose up to 2 mSv in Hall North for Oct/Nov 2003.
	D3 and DIR imposed 20 mA proton current limit until mid Dec 2003.
	Halls are radiation controlled areas: dosimeters and instructions mandatory.
	There was no radiation in the H1 control room (D3 mapping error).
25.11.2003	F. Willeke: 'There's a certain urgency to make some progress!'
21.12.2003	Short in cold p magnet QQ17 NL114.
	Now operated with separate power supply. Repair in Aug?
31.12.2003	Lumi run on New Year's eve. J. Olsson and N. Gogitidze on shift!

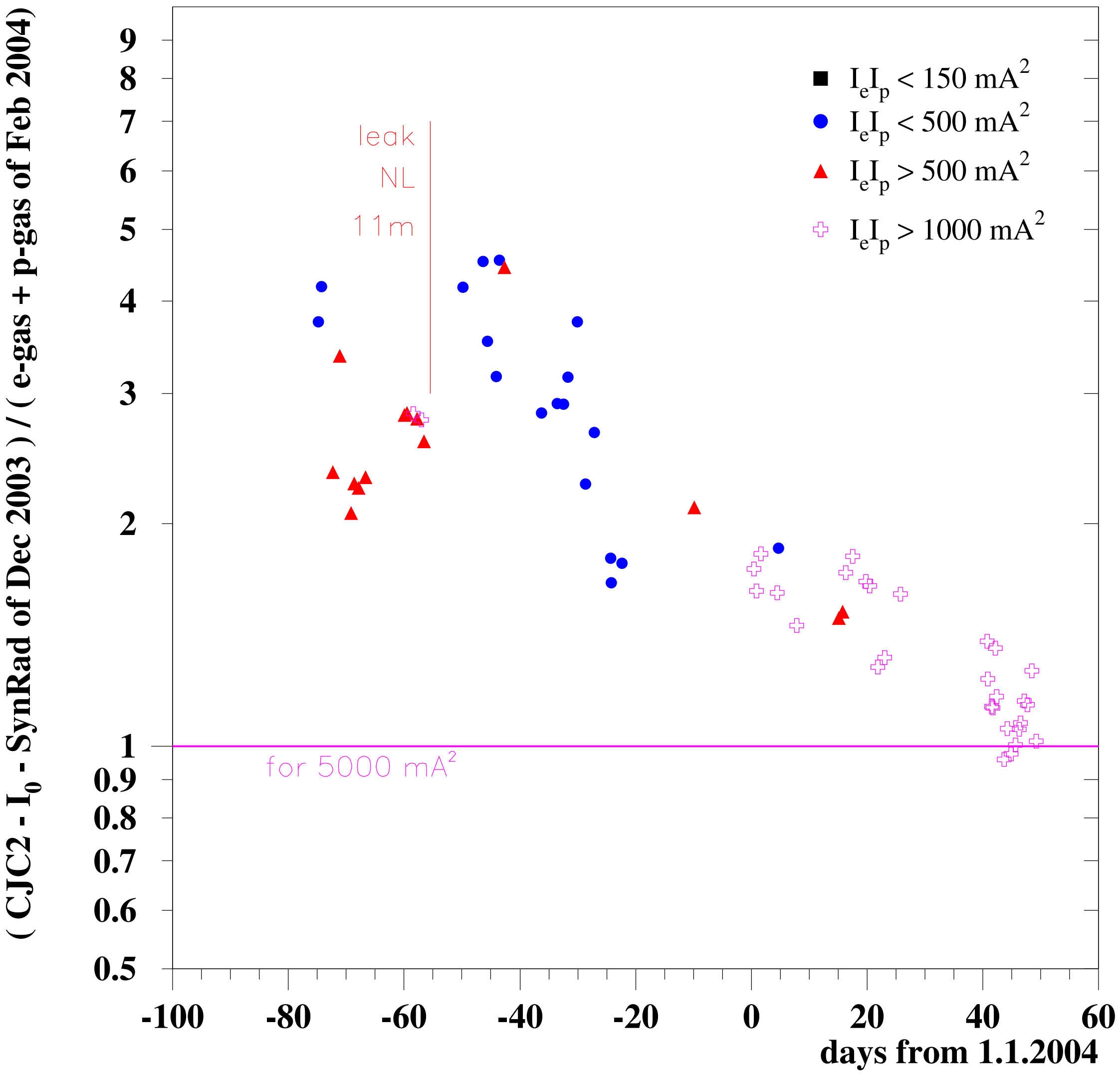
...and continued...

10.1.2004	Trailer off due to cooling water failure (TN/MKK error) during lumi run.
	Had to request beam dump: no RadMon.
12.1.2004	Vacuum leak in superconducting e RF cavity WR.
	Sealed after 2 days. 1 of 16 cavities disabled.
6.2.2004	Vacuum leak due to broken e RF cavity window NL 70 m.
	Cavity exchanged ('happens every 5 years').
	Back to 25 mA e^+ after 4 days.
18.2.2004	Vacuum leak in PETRA kicker magnet vessel.
	Exchanged. No beams for 24 h.

Reasons for beam losses

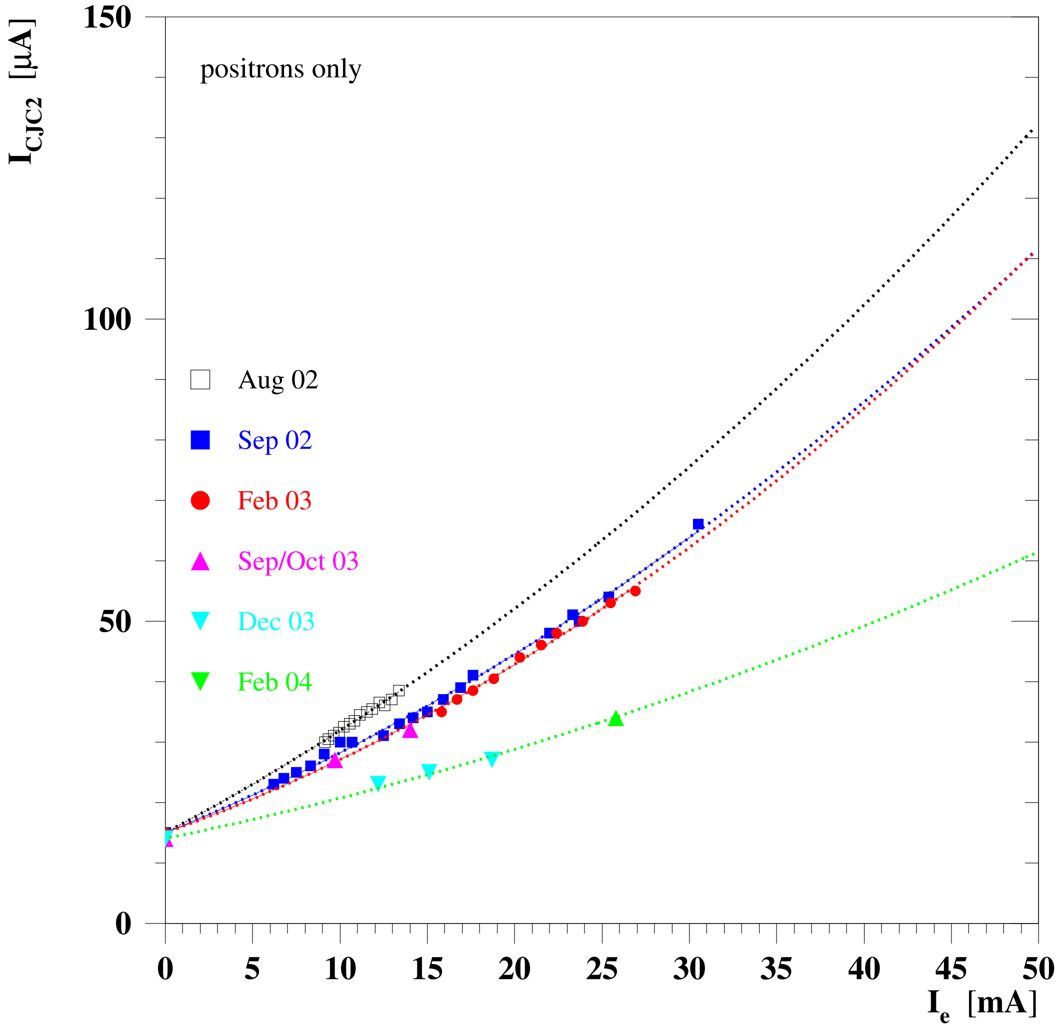
- RF trips:
  e-RF needs conditioning with increasing currents,
  p-RF needed tuning, amplifier exchanges.
- Quench protection system, mainly false alarms.
- Magnet power supply trips.
- Beam pipe temperature alarms.
- ZEUS Calo closing, Hermes target magnet ramping.
- ZEUS solenoid quenches.
- Radiation monitor alarms ZEUS, Hermes, H1.
- Strong beam-beam interaction and p emittance blow-up.

CJC current history Oct 2003 – Feb 2004



- Long-term improvement by factor ≈ 4 with $\tau \approx 70$ days after vacuum leak on 4.11.2003
- Chamber currents in Feb 2004 allow operation at design beam currents.
- HERA is no longer background limited!
- For the time being, the extra margin was used to increase the CJC gain by 17% for slightly higher hit efficiency and dE/dx resolution, see C. Kleinwort's talk.

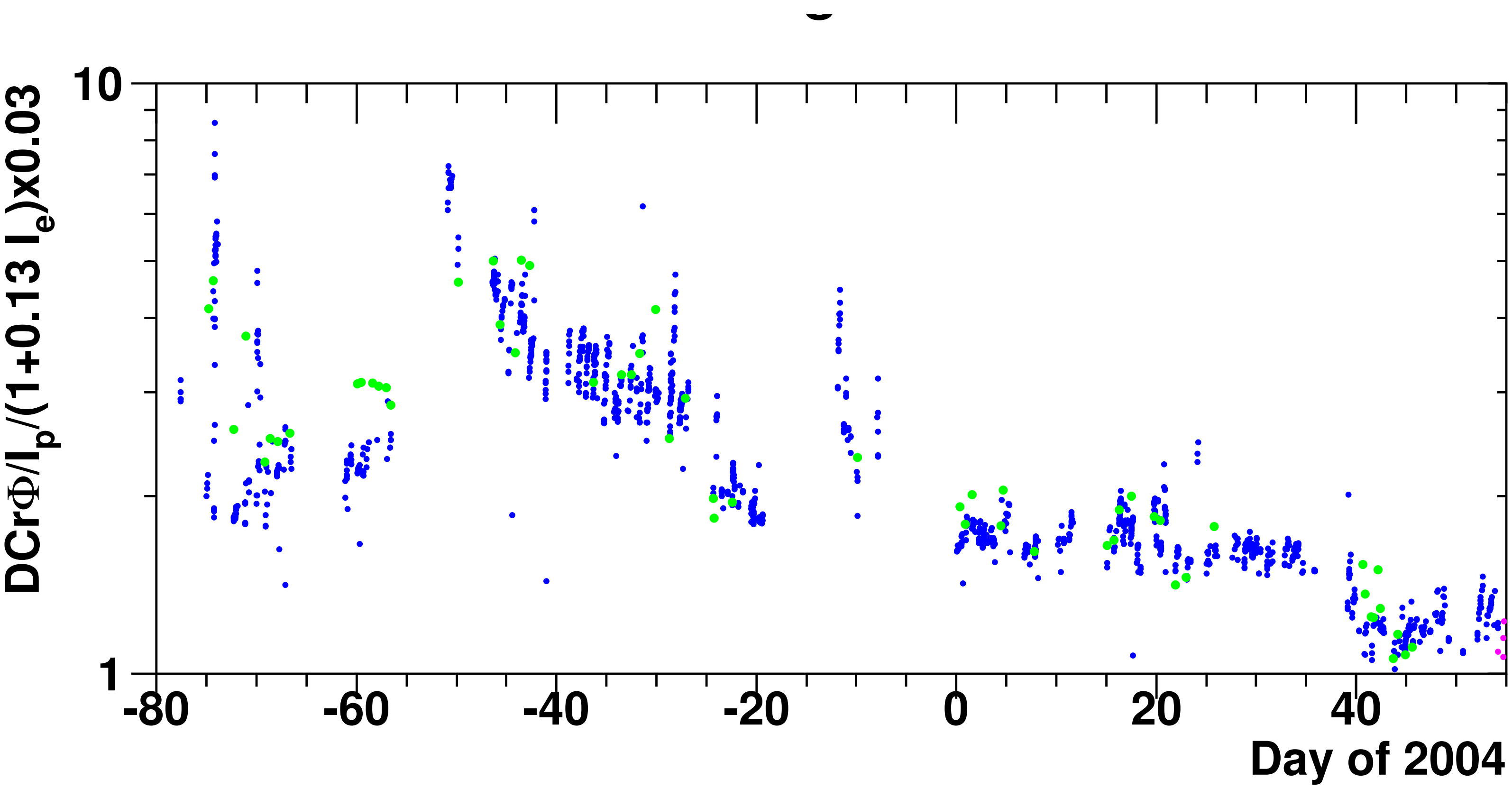
Synchrotron Radiation background reduction



- Synchrotron radiation background in the CJC is now a factor of 2 smaller than in 2002.
- Main effect due to better alignment of H1 beam pipe and better beam steering.
- Lead shielding in backward region also contributes.
- Further reduction factor 1.7 possible by installation of a coated absorber, but requires break of vacuum.

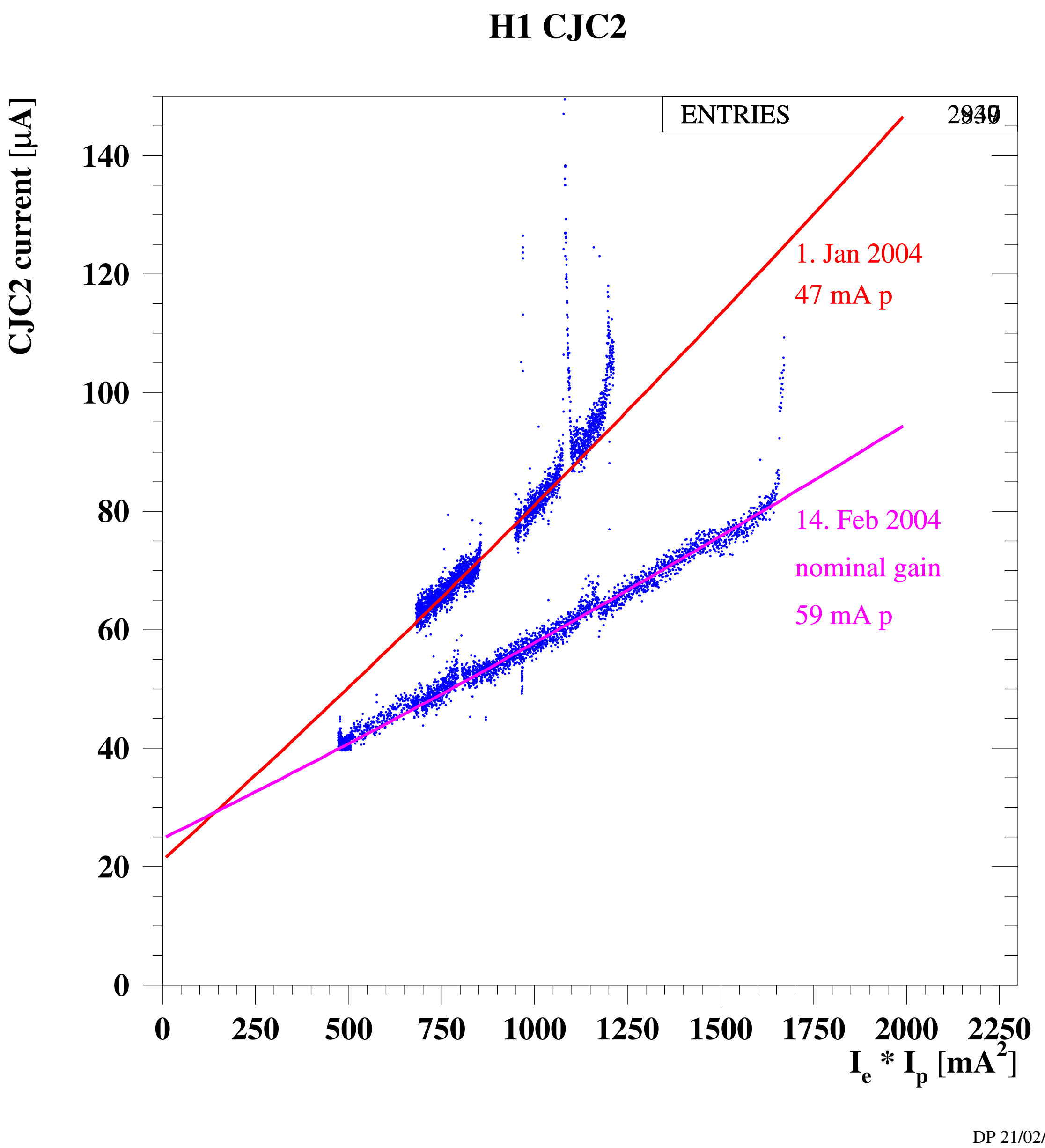
Proton background reduction in 2004

DC-Rϕ track trigger rate is dominated by p-gas background:



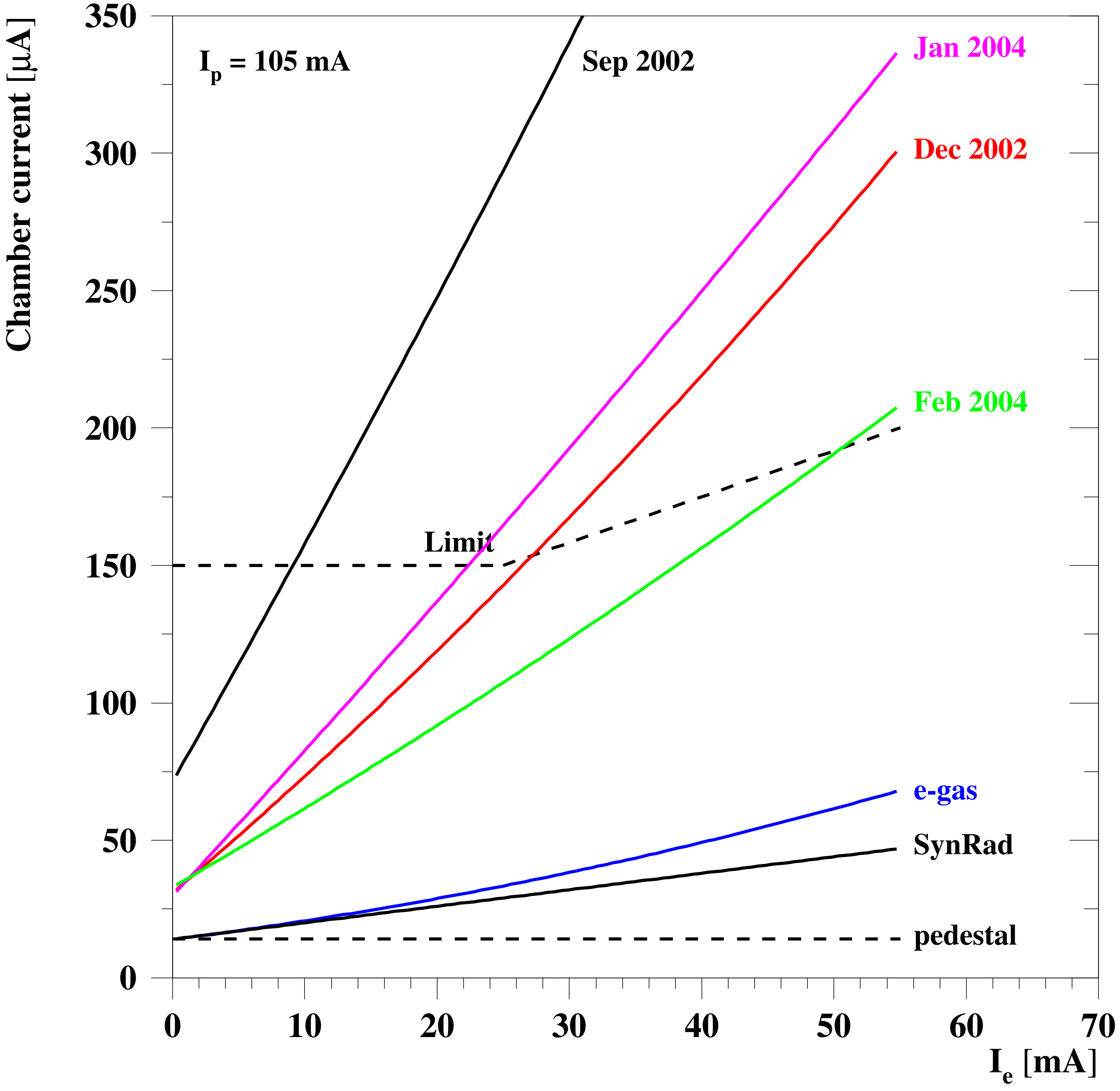
Recovery from vacuum leak on 4.11.2003 took about 1 month.
Observe slow trend in January.
Sharp step after NEG pump regeneration around H1 on 5.2.2004.
Procedure will be repeated on 3.3.2004.

Examples: lumi fills 1.1. and 14.2.2004



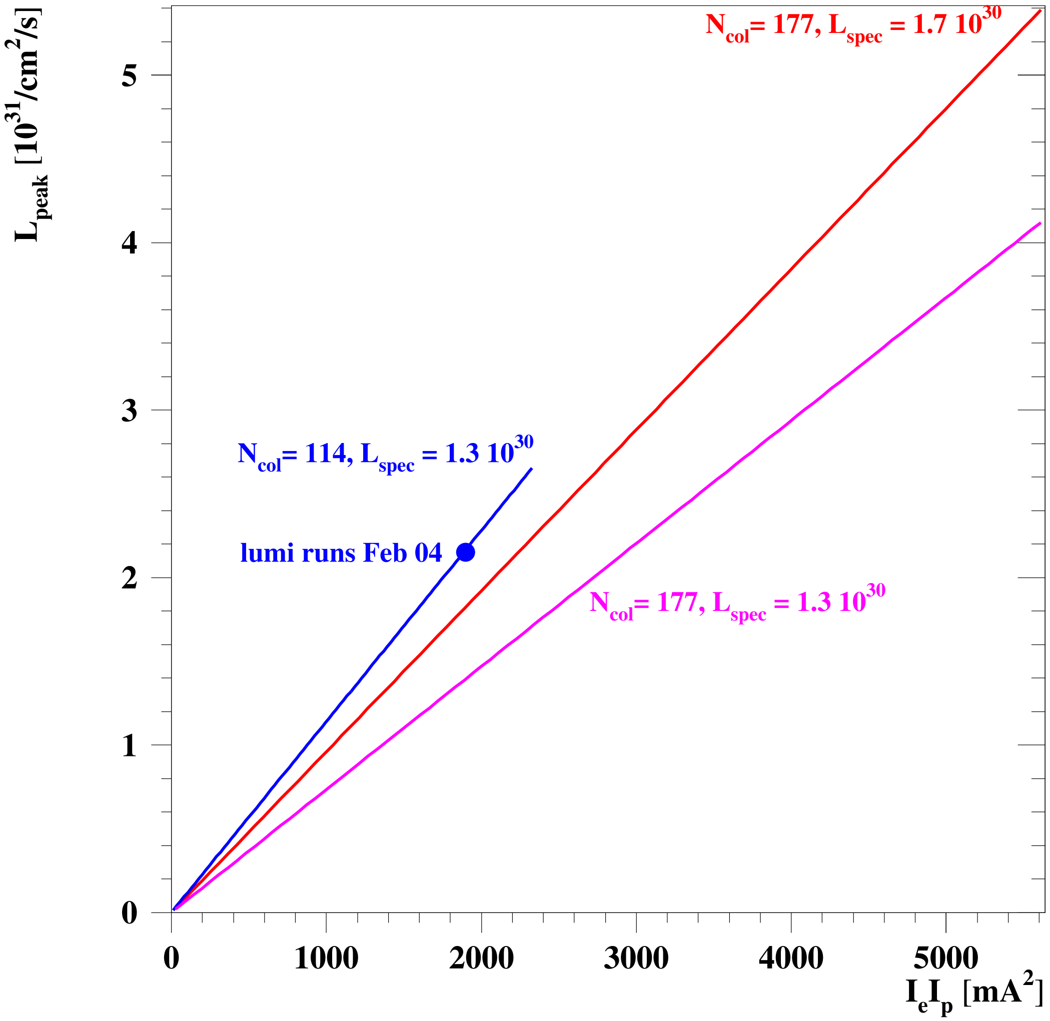
- Curves use the same e-gas and SynRad coefficients.
- p-gas contribution improved by a factor 2 in this period.
- Parameterization works well out to $I_e = 32\,\mathrm{mA}$.
- 17% CJC gain increase taken out for Feb.

Expected chamber current



- Extrapolating the present conditions by a factor of 3 takes us to 200 μA at $I_e \cdot I_p = 50 \cdot 100\,\mathrm{mA}^2$.
- We always intended to allow higher chamber currents at the highest luminosity, like in 2000.
- p-gas background dominates over SynRad and e-gas.
- Further improvement due to long-term conditioning is not excluded.

Choosing the number of bunches



- $$\mathcal{L} = \mathcal{L}_{\rm spec} \frac{I_e \cdot I_p}{N_{col}}$$
- $I_e \cdot I_p$ was limited by backgrounds.

$\Rightarrow$ We started with $N_{col} = 114$.

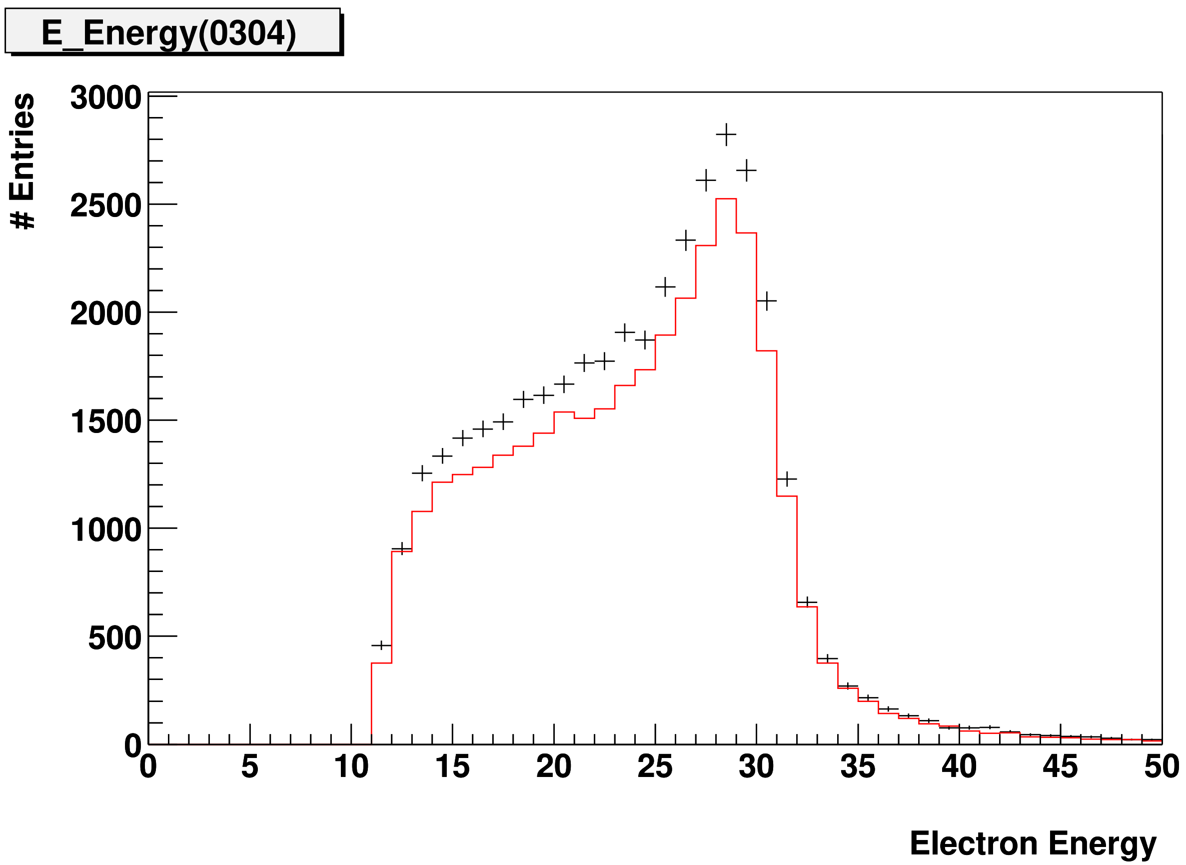
- We have reached the bunch current limits:
  - $I^e_{\rm bunch} \lesssim 0.30\,$mA (strong beam-beam interaction).
  - $I^p_{\rm bunch} \lesssim 0.6\,$mA (space charge limit at injection).

$\Rightarrow$ Go to 177 bunches, with $I_p = 90\,$mA.

- Minimize pilot bunches.

Luminosity measurement

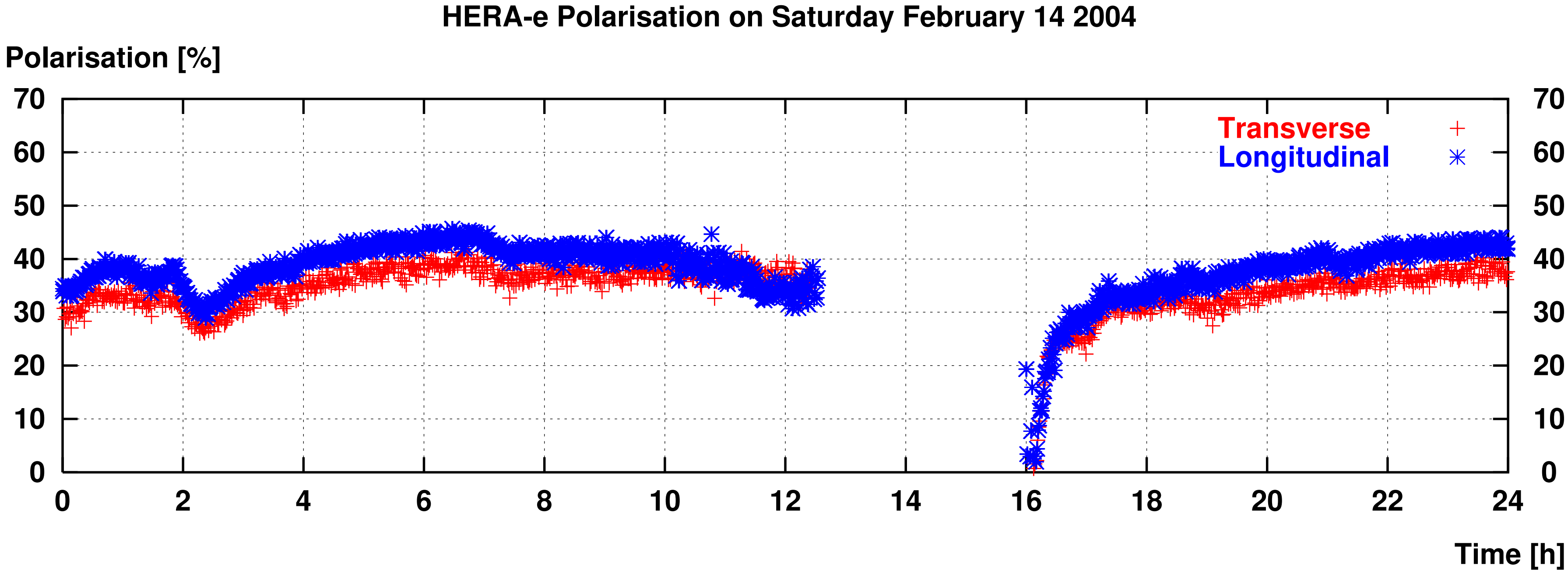
$Q^2 > 100\,\mathrm{GeV}^2$, Nov 2003 – Feb 2004, $11.5\,\mathrm{pb}^{-1}$



Histogram = MC, normalized by luminosity.

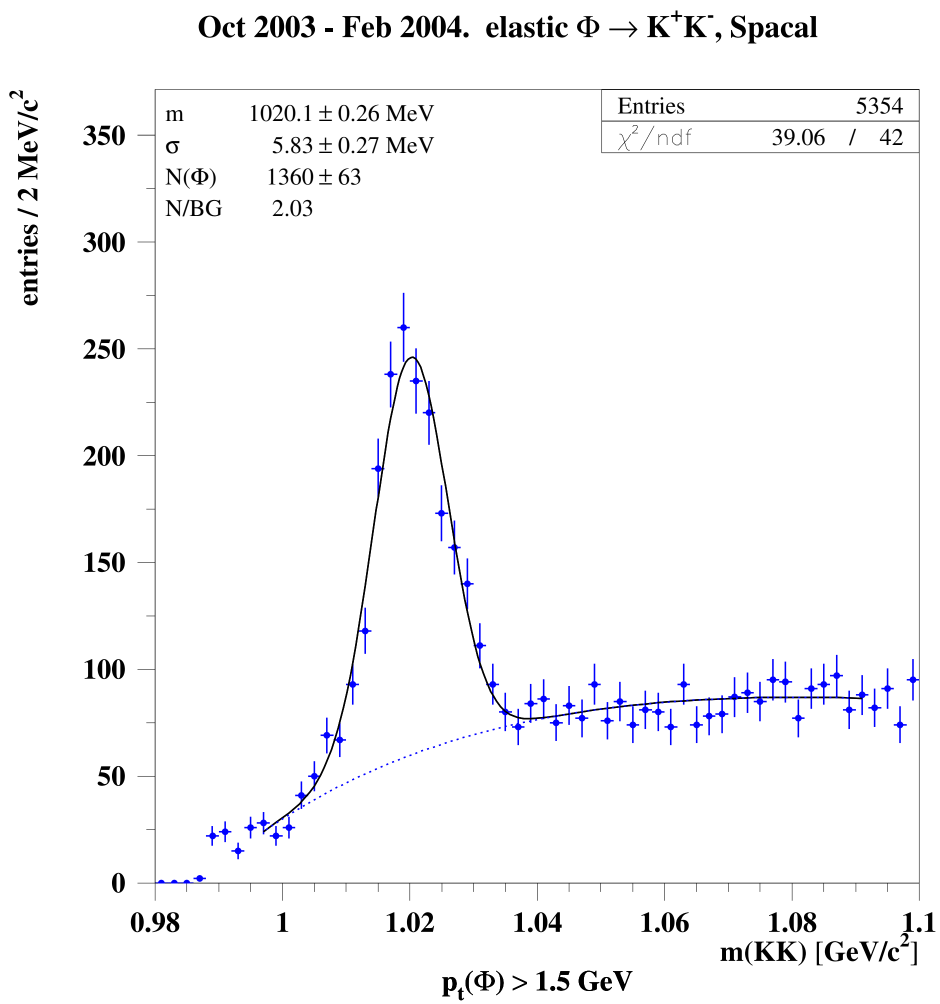
- Check online lumi with DIS:
- High Q^2 (LAr):
  12% more events in data than in HERA-2 MC.
- Low Q^2 (Spacal):
  13–16% higher yield in Jan 2004 than in the 1999 minimum bias run. Variation with E_e in Spacal and vertex requirement.
- Lumi energy calibration?
  Photon acceptance low?
  Pile-up?
- Offline lumi analysis in progress, talk this afternoon.

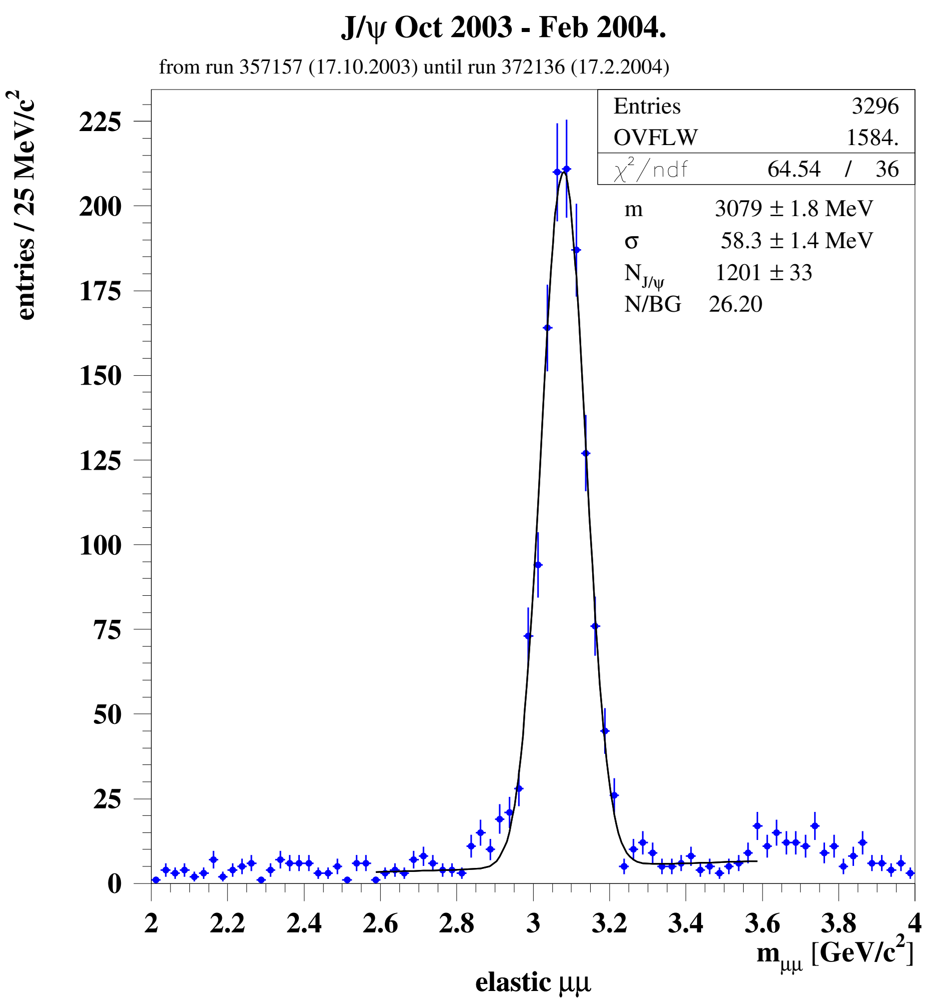
Polarization measurement



- LPol / TPol $\approx$ 1.12
- Old Hermes LPol measures energy asymmetry for laser left vs. laser right. Calo response must be linear.
- TPol measures up-down asymmetry in a split calorimeter. Non-linear transformation from energy asymmetry to spatial asymmetry.
- TPol needs risetime calibration in dedicated beam studies. Under preparation. Might take a week. Needs support from all experiments.

DQ: ϕ and J/ψ

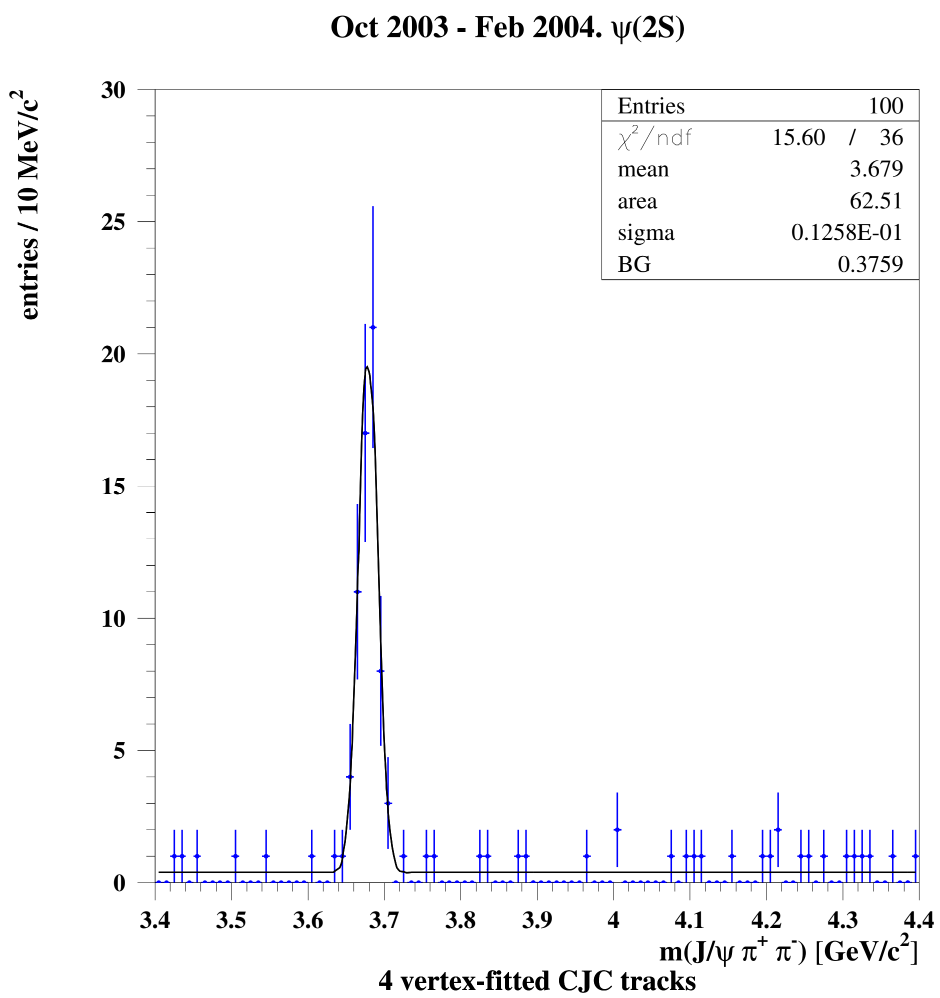


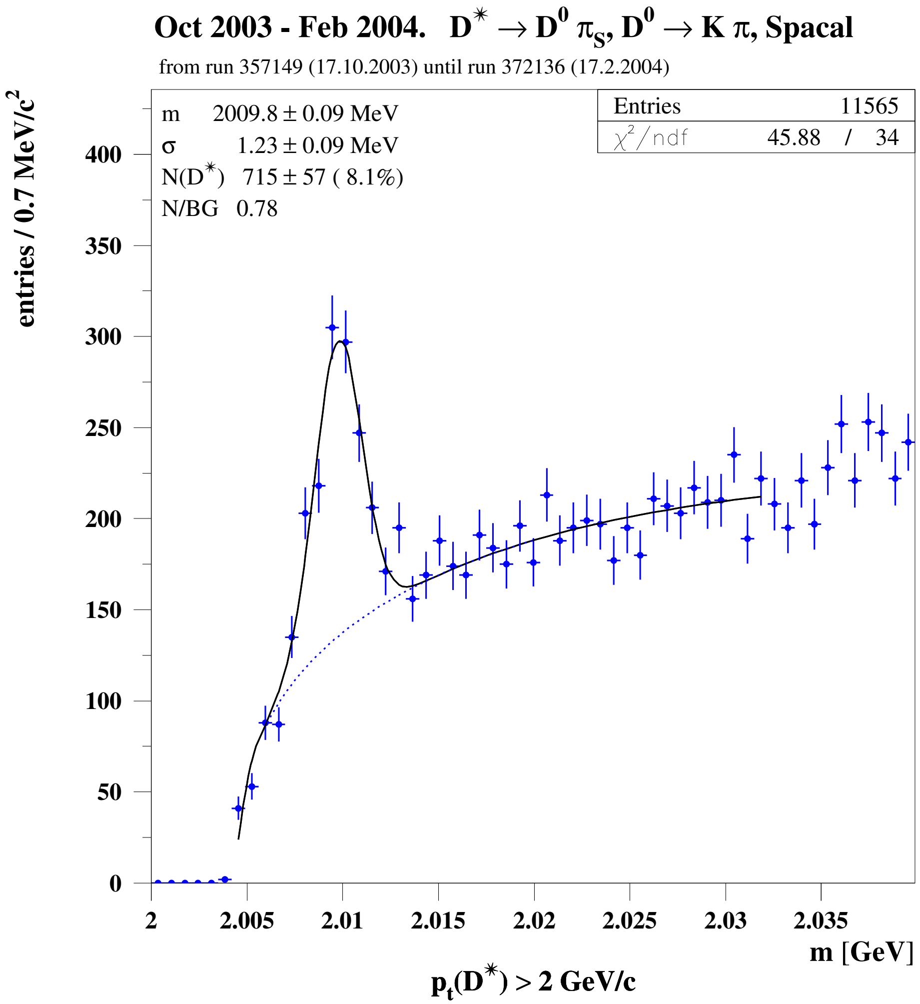


Mass and width as expected.

Waiting for FTT!

DQ: $\psi(2S)$ and $D^\star$





$D^\star$ is a little fat.

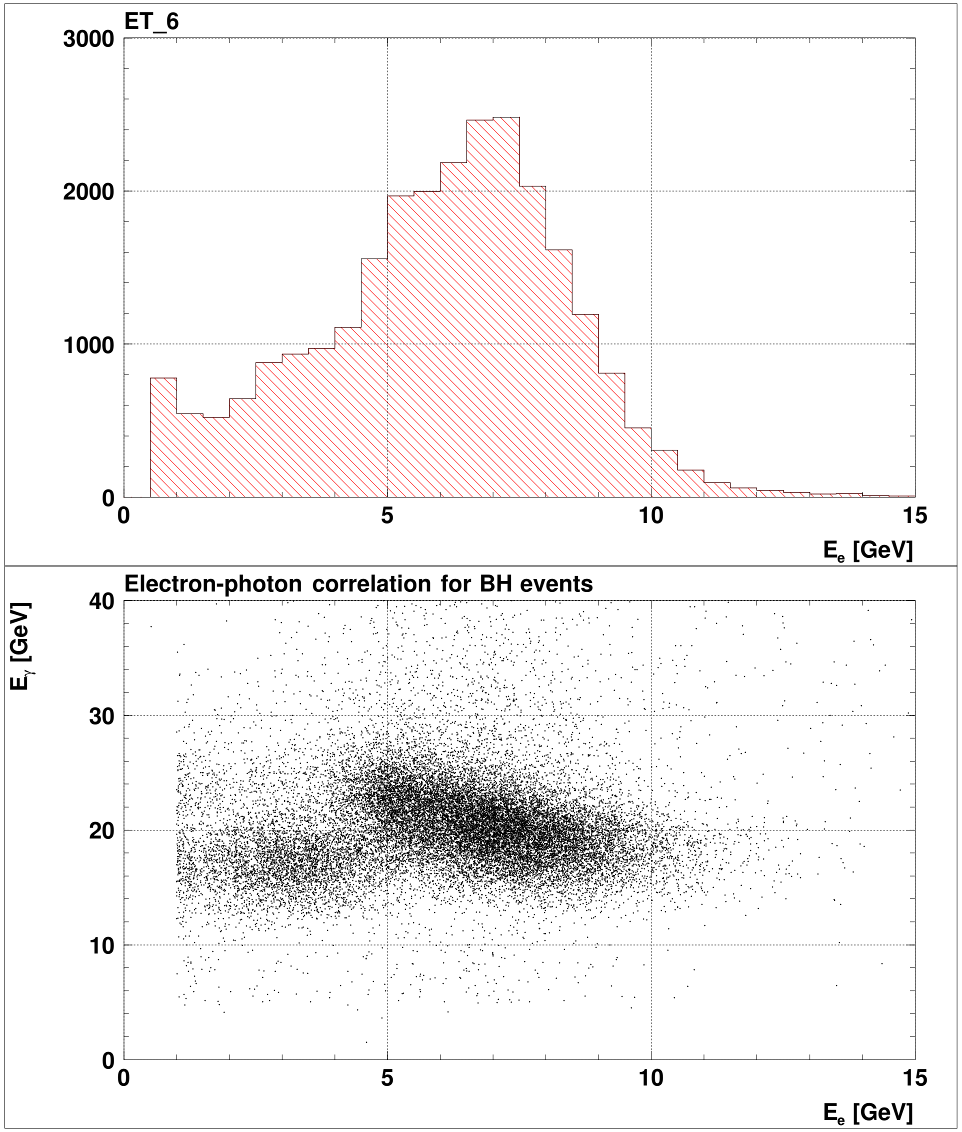
Commissioning of new components

CIP	Stable. Essential at L1: t_0, z-vertex significance.
	Background rejection by z-vertex and multiplicity.
BPC	Stable since gas change from Ar-CO_2 to Ar-ethane-freon in Dec 2003.
	Efficiency w.r.t. Spacal clusters is up to 95%.
	Some efficiency drift under study.
FTD	HV and readout are stable. Old P: 9% dead, new Q: 31% dead channels.
	FTREC takes 0.3 s on average. Acceptable.
	FTD SM0 segment linking efficiency w.r.t. CJC is only 35%.
	Calibration and alignment work ongoing.
FST	Excellent hardware quality. S/N $=$ 32. Alignment done, $8\,\mu$m resolution.
	Readout error (missing and multiple events) cured last week.
	Cooling water flow is decreasing, frontend reaches 47^{o}C.
	Maintenance next week.
BST	Should now reach same quality as FST.
BST Pad	Radiation monitor is stable. Trigger being commissioned.

Commissioning of tunnel systems

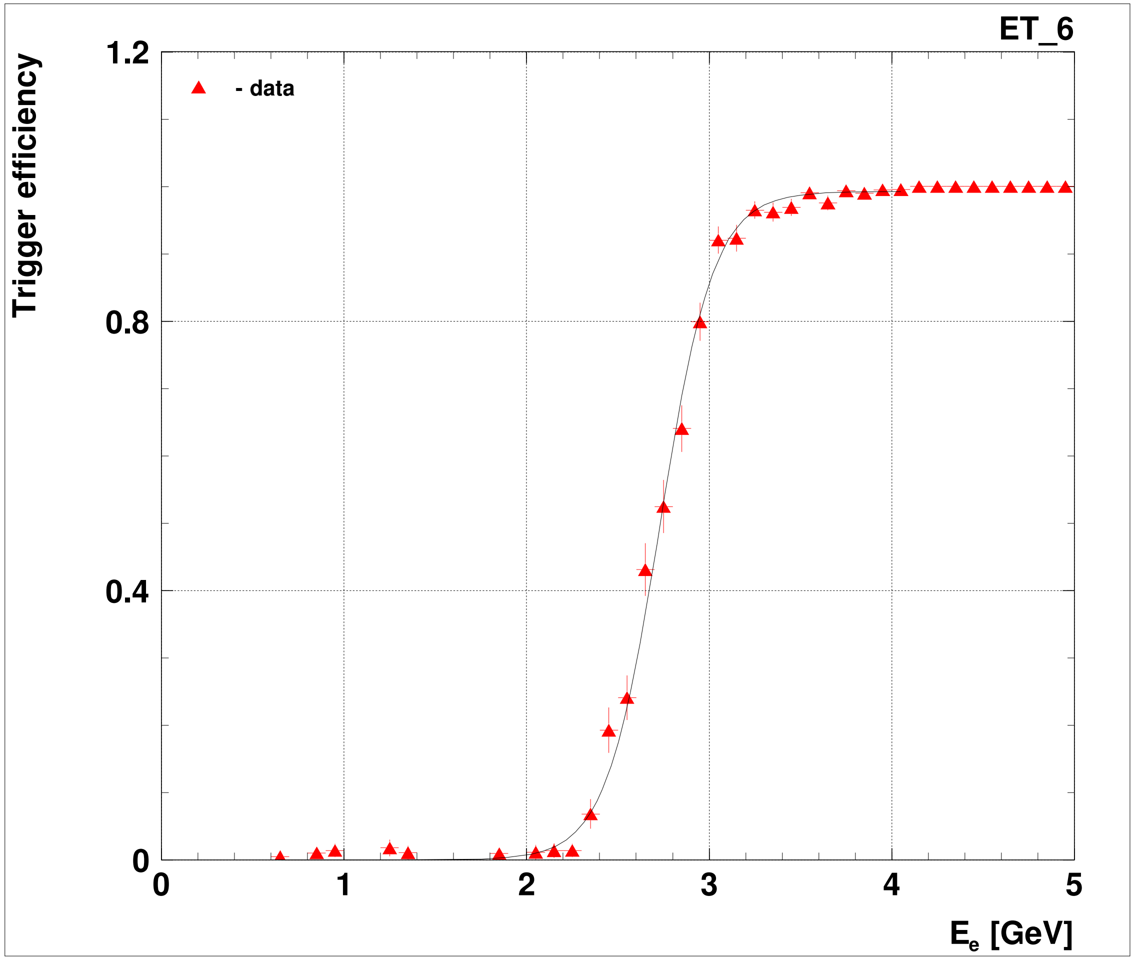
FNC	Ready since 2002. Tunnel temperature causes PMT aging. HV increased.
	Acceptance sensitive to beam tilt at IP. Need feedback to HERA.
	Background increases $\times 100$ when FPS pots are inserted.
VFPS	Commissioning in progress. First beam signals seen.
	Noise pickup from step motors cured. Pipeline timing adjusted.
	Broken optical fibers for trigger signals will be exchanged next week.
Etag 6	In operation, timed-in, calibrated, ready for physics.
Etag 40	Removed after severe radiation damage to crystals in 2002/03.
	Movable platform installed. Still 8 kGy/pb^{-1} in park position in Dec 2003
	140 kGy/pb^{-1} in beam position. Lifetime would be 1 pb^{-1}.
	More shielding and/or SynRad filter needed.
Lumi	Operation mostly stable. Timing monitored by shift, stable.
	Pedestal drifted out of ADC range in Jan, cured by AC decoupling.
	Discrepancy of online lumi with DIS rate must be understood.

ETAG 6 m



- Tag photoproduction at high y with a small tungsten-fiber calorimeter at -6 m.
- Uses GG dipole and GI2 as spectrometer magnets.
- Beam-energy calibration done with tagged Bethe-Heitler events in lumi photon detector.
- Ready for physics!

ETAG 6 m



- 90% efficient at 3 GeV.
- Subtrigger 83: etag6$\times$DCRϕ gets high prescale in present scheme.
- Low priority physics for Heavy Quarks, Jets, Diffraction?
- Etag-6 will benefit from coincidence with FTT.

Infrastructure and Maintenance

- File server (2 TB) for local data logging installed in Hall North.
- Motors for Solenoid He pumps stabilized.
- Liquid N_2 Krogenerator repaired by Philips.
- Backup dry air compressor for cooling of LAr analog boxes is ordered.
- Exchange of crate and rack cooling fans continues.
- Upgrade of the tracker gas systems and control electronics is being prepared by a new group from Sofia.
- We can re-use some components from HERA-B.
- We want to increase the gas flow in the CJCs by factor of two.
- Aim for Aug/Sep shutdown.

HERA and H1 planning

- Increase number of bunches from 120 to 180.
- Increase I_p from 60+ to 90+ mA immediately.
- Increase I_e from 35 to 50 mA in small steps.
- Switch to negative e^+ helicity postponed to 1.4.2004.
- Stable running until mid Aug 2004, collect 100 pb^{-1}.
- Further helicity flips possible.
- 10 weeks shutdown Mid Aug until end Oct 2004:
  - Upgrade FPS pots and moving system.
  - Repair a few EM Spacal cells in situ.
  - The CST (1/4 dead) will not be repaired, as it requires a break of the vacuum.
- First discussions on running in 2004/2005: H1 prefers to continue high luminosity running with e^+, aiming for another 250 pb^{-1} before switching to e^- after the 2005 summer shutdown.

Summary

- The background limitations have finally been overcome.
- The H1 detector is in good shape in most areas
- A few stragglers still have to complete commissioning of their components.
- Serious HERA II physics data taking has started.
- It's time to focus all attention on efficient data taking and analysis of the first new data!