H1: Status and Prospects

Benno List

Institute for Particle Physics, ETH Zürich

- New Physics Results
- Operation: Progress and Problems
- Status of Upgrade Projects
- Plans

ETH IPP
Institute for Particle Physics

Physics Results for the Summer

Successful conference season:

Amsterdam:

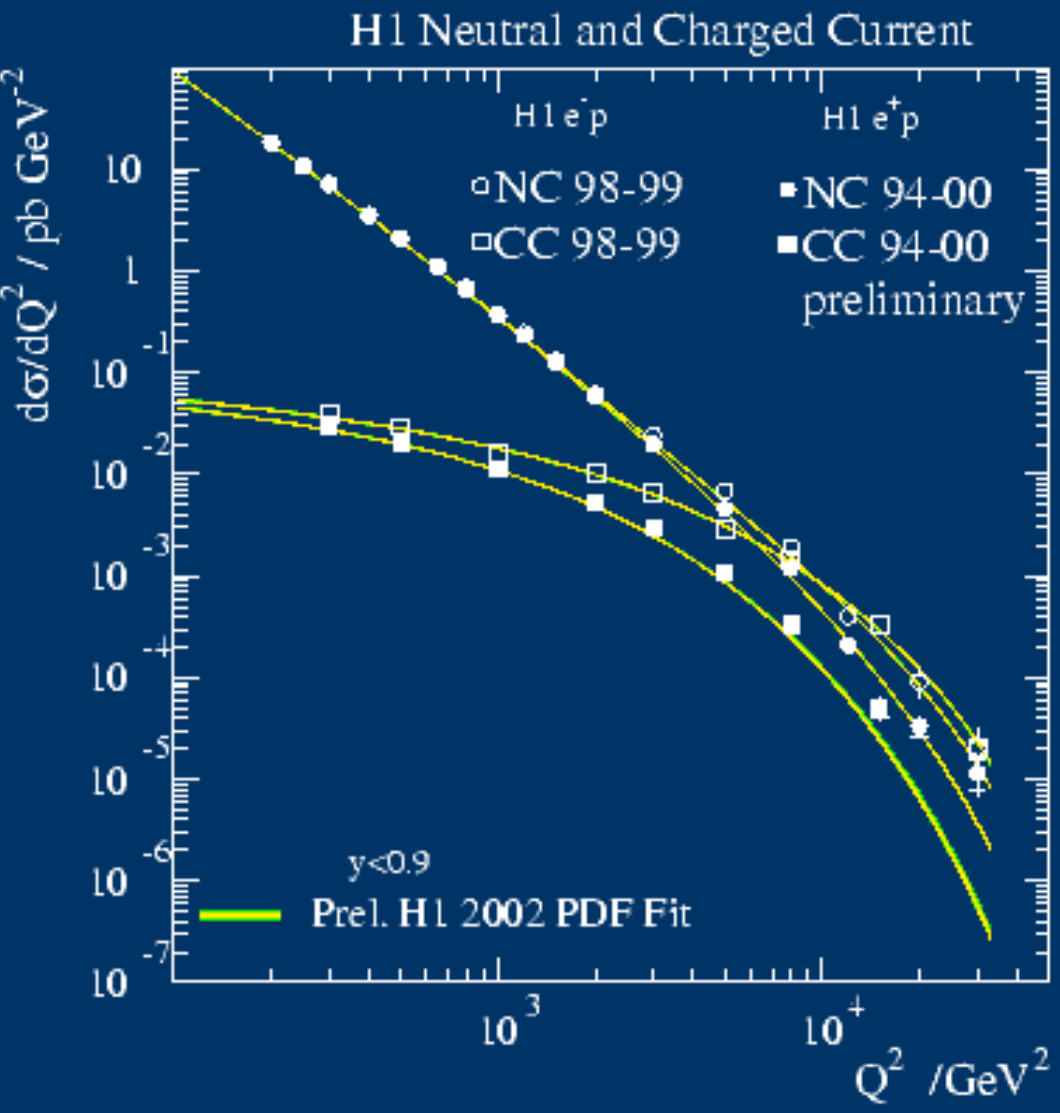
- 46 contributed papers
- 9 Talks

New Preliminary Results:

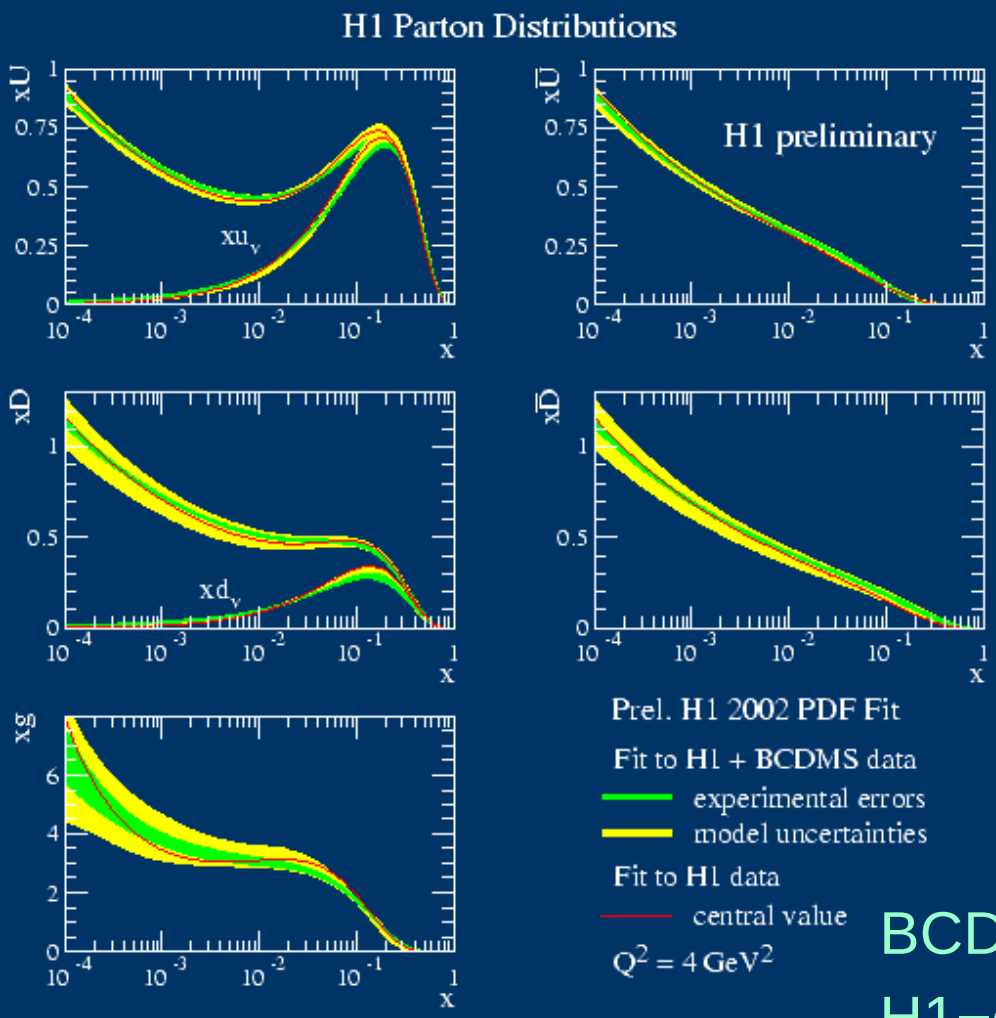
- High Q^2 NC/CC data from full HERA−I dataset, with QCD fits
- F_2^D at low Q^2
- Diffractive dijet photoproduction
- Forward jet production
- Prompt photon production
- W production with hadronic decays
- Search for doubly charged Higgs

Final High−Q^2 Cross Sections

- Full HERA−I data set has been analyzed
- Q^2 = 100 − 30000 GeV^2, X=0.0013 − 0.65
- Cross section shows nicely the unification of electromagnetic and weak interactions.



Parton Distribution Fits



Fit what is experimentally accessible:

$U=u+c$ $\quad \bar{U}=\bar{u}+\bar{c}$

$D=d+s$ $\quad \bar{D}=\bar{d}+\bar{s}$

$$F_2 \sim \frac{4}{9}(U+\bar{U}) + \frac{1}{9}(D+\bar{D})$$

$$xF_3 \sim 2(U-\bar{U}) + (D-\bar{D})$$

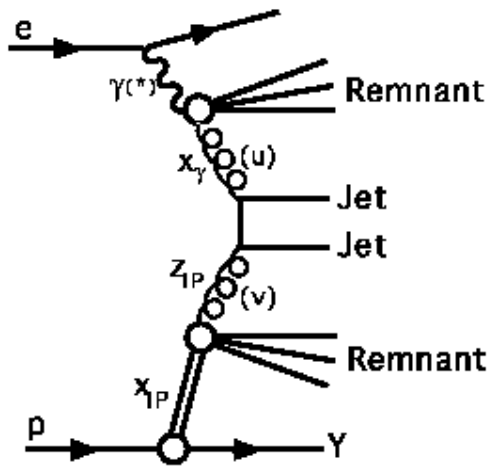
$$\Phi_{CC}^{+} \sim \bar{U} + (1-y)^2 D$$

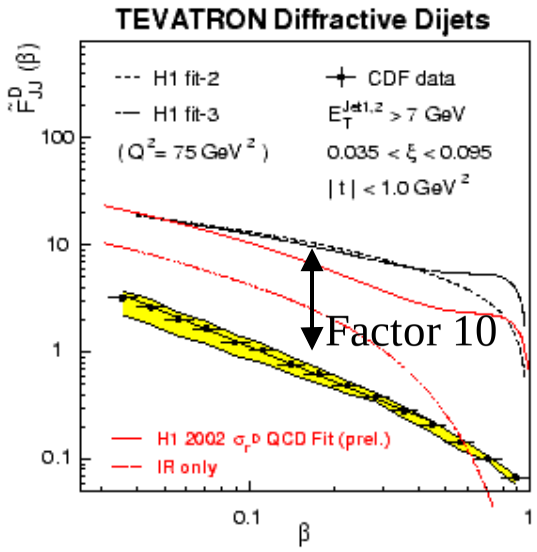
$$\Phi_{CC}^{-} \sim U + (1-y)^2 \bar{D}$$

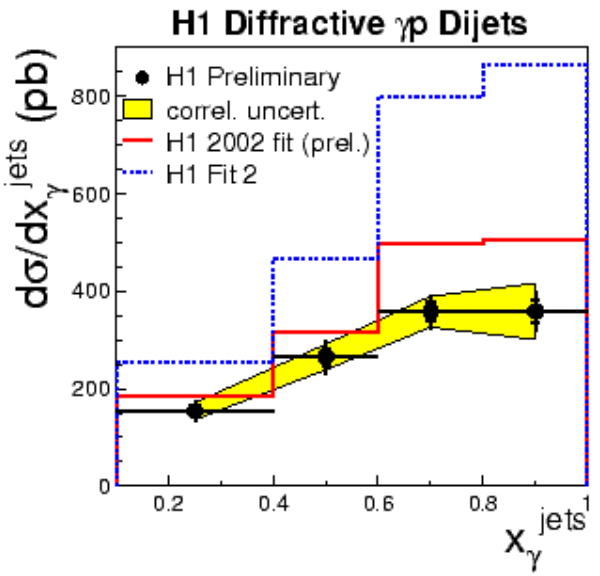
BCDMS p and d large x data important

H1−only fit in remarkable agreement

Diffractive Dijets: DIS vs. γp



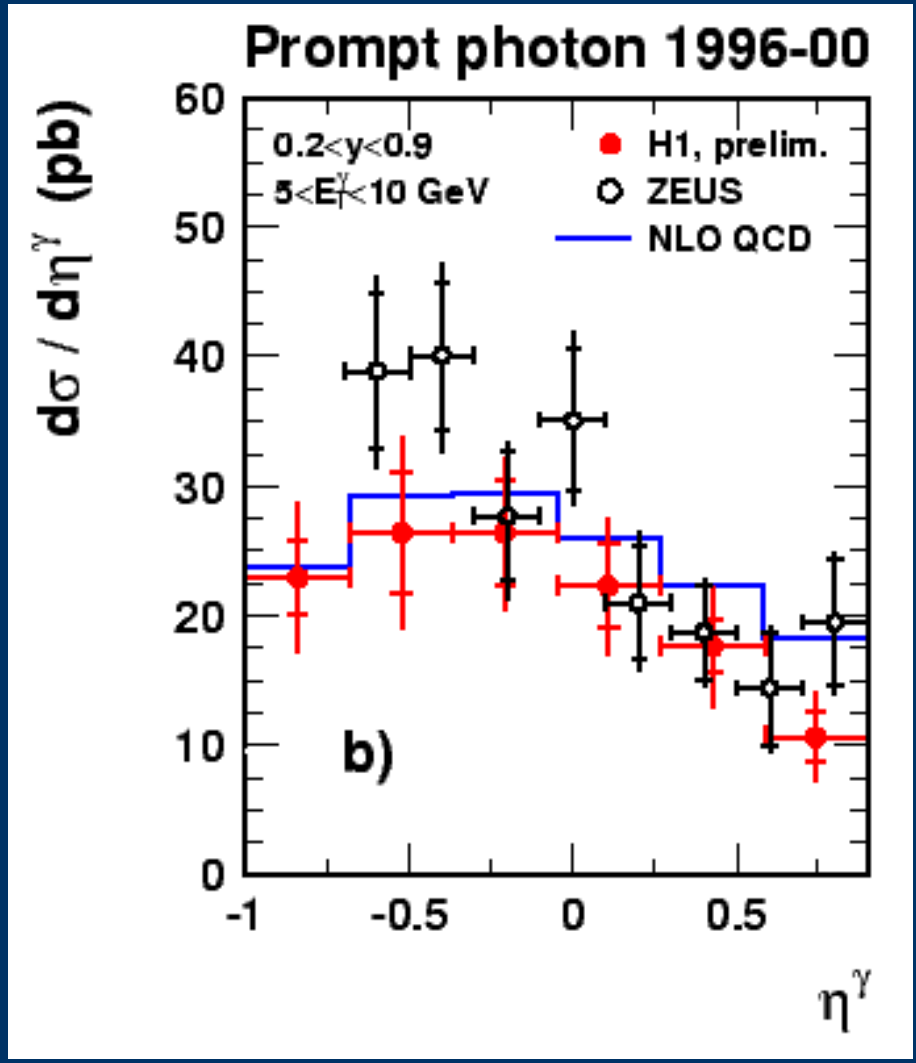




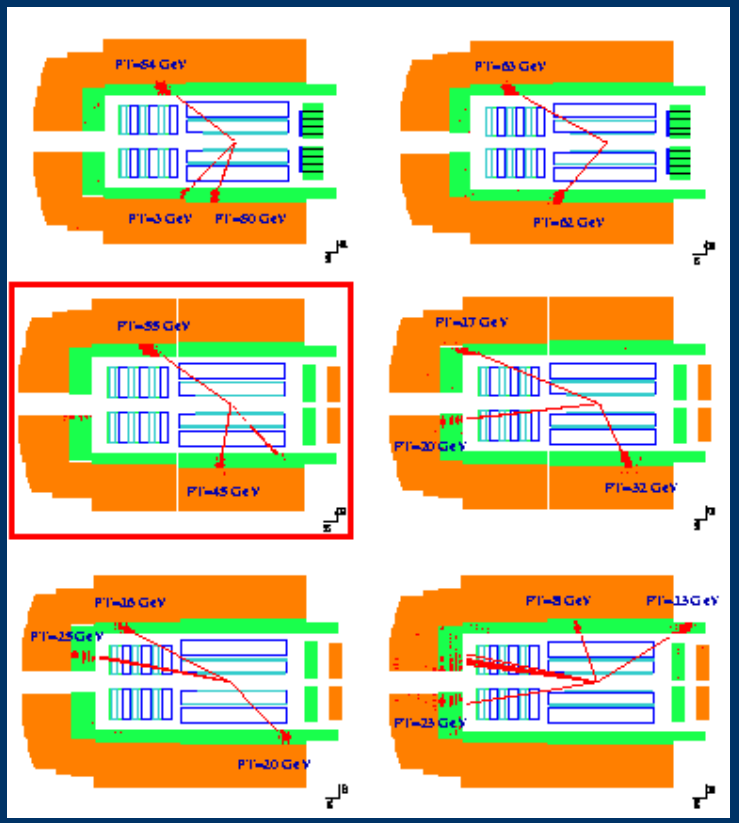
- H1 diffractive parton densities predict dijet rate
- At Tevatron: suppression by factor ~10: Gap destruction by spectator interactions
- In photoproduction at H1: Expect behaviour similar to hadron–hadron scattering, but: Far less gap destruction!

Prompt Photons in Photoproduction

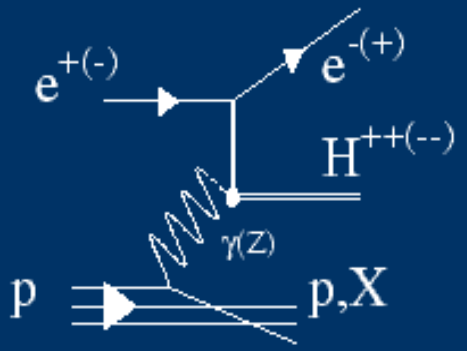
- Photon radiation off quarks in γp interactions: Nice QCD test
- Challenge: Separate γs from π^0s!
- Leading order MC (Pythia, not shown) is low, NLO fits.
- Hint of discrepancy with NLO from ZEUS data at low η is not confirmed.



Doubly Charged Higgs?

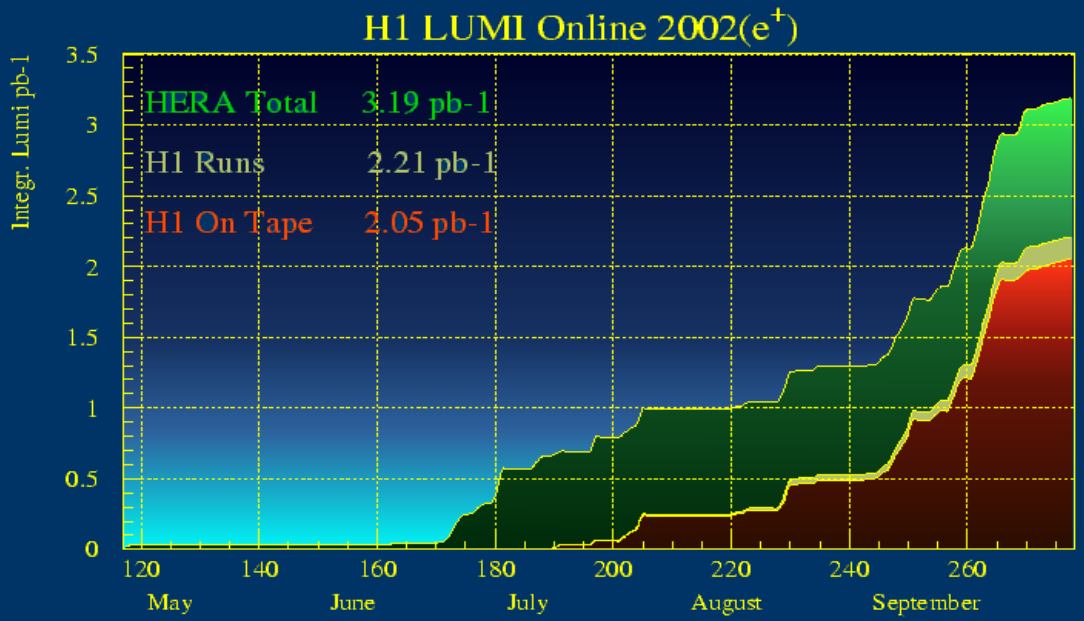


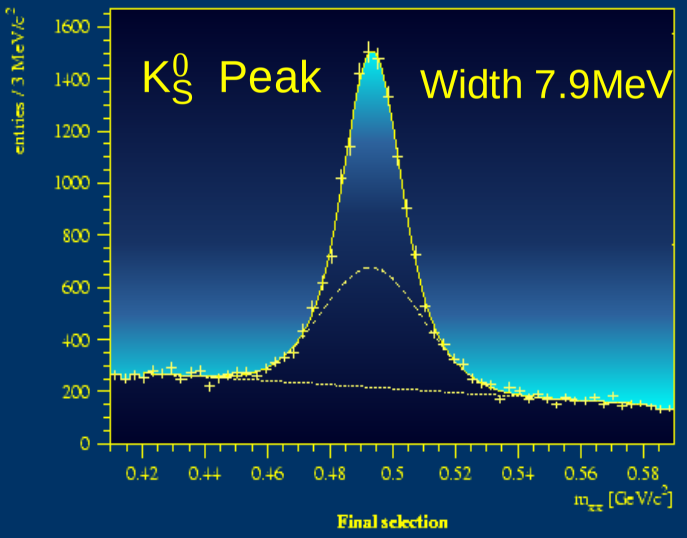
The 6 events from the di− and trilepton analysis. Only one event survives the H++ analysis cuts.

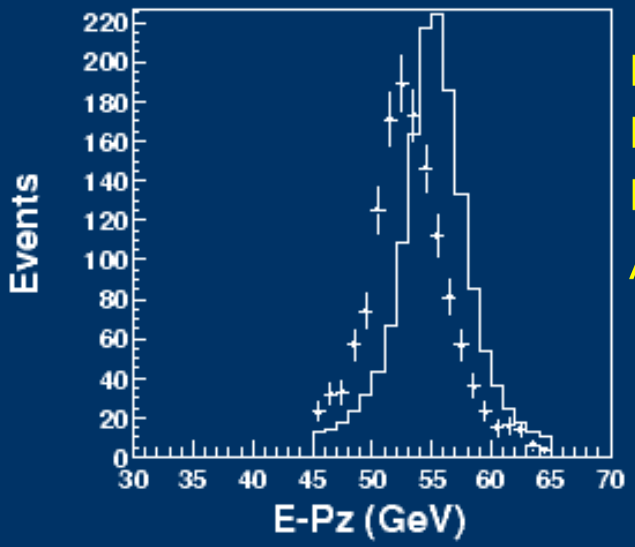


- H^{++}: Possible explanation for anomaly in di− and trilepton analyses
- Dedicated analysis: Events observed in H1 are not compatible with H^{++} production (only 1 event survives)
- First search for single production of doubly charged Higgs bosons, triggered new analyses of LEP2 data

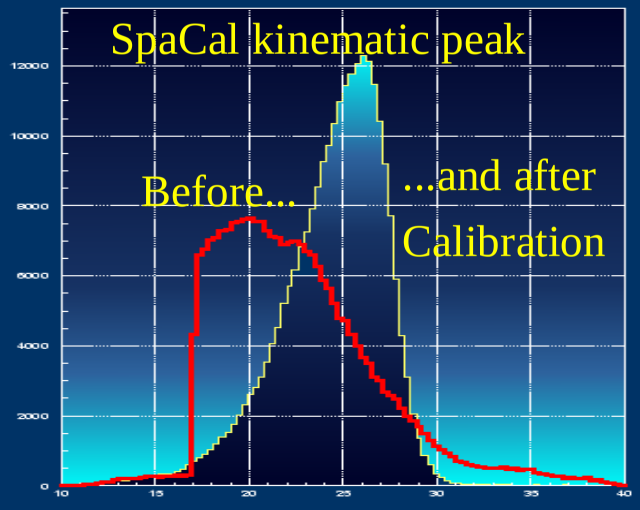
A Taste of Luminosity







High−Q^2 event selection:
E−pz peak, data vs. MC
L_{int}=0.68pb^{-1}
Analysis in OO framework



Background Situation

ep collider: ''worst of both worlds'' (read: ''most challenging''):

- Beampipe heating by synchrotron radiation from positrons
  => Bad vacuum
- High pp cross section (40mbarn)
  => high p induced background

Design currents for HERA−II are not substantially higher than at HERA−I, detector limits are the same, nevertheless:

Background does currently not allow data taking at design beam currents due to excessive chamber currents and radiation dose for silicon detectors.

Current Limit in CJC (Drift Chamber)

Drift chamber operation limits currents to

$I_e\, I_p < 1000 mA^2$

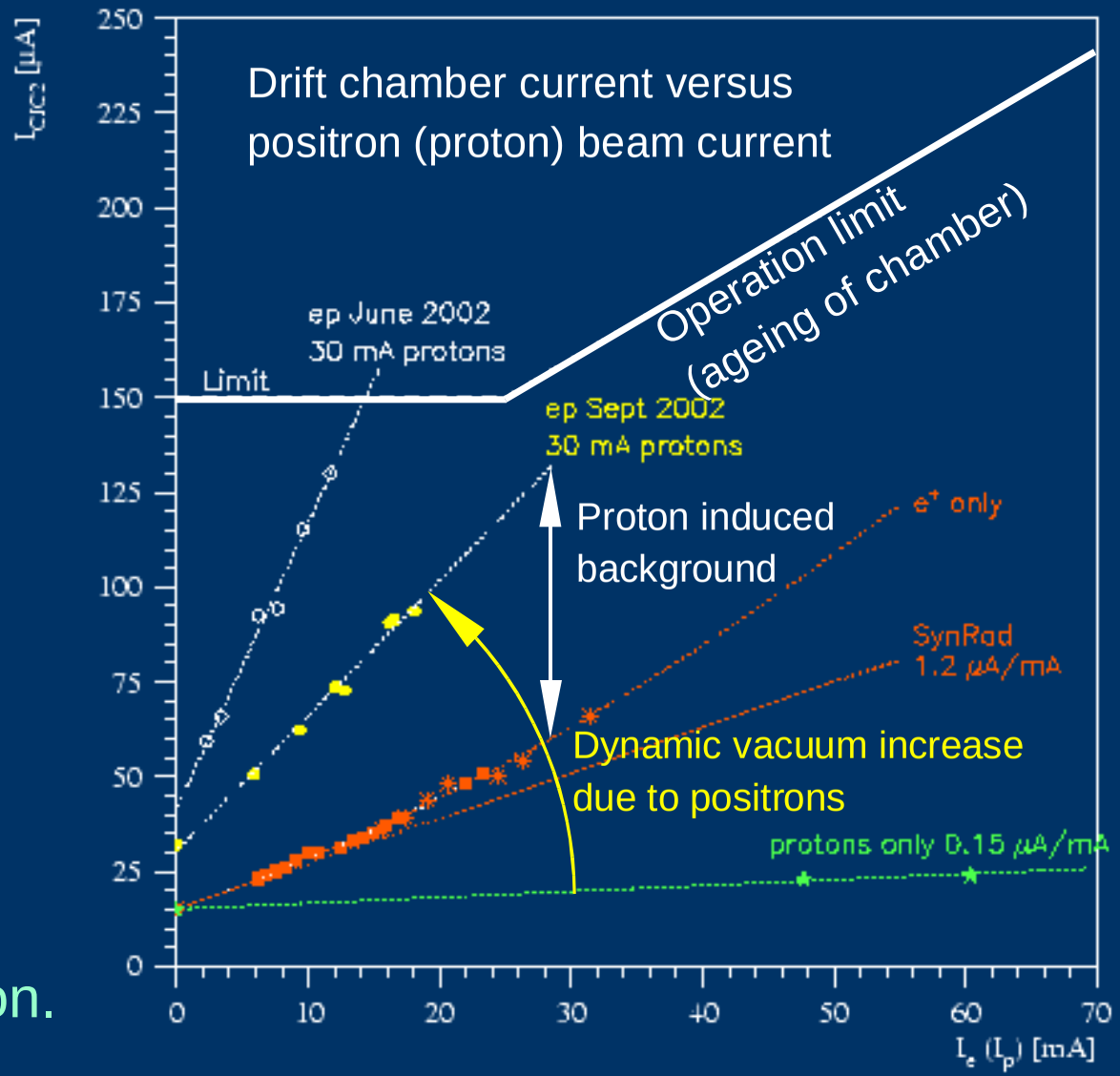
Target:

$I_e = 55mA$, $I_p = 135mA$

$I_e\, I_p = 7425 mA^2$

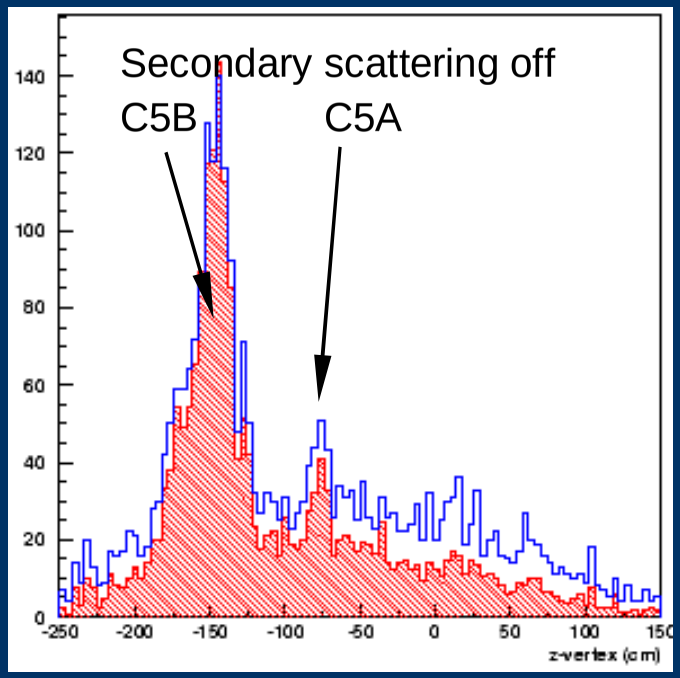
=> We need a **huge** improvement over current situation.

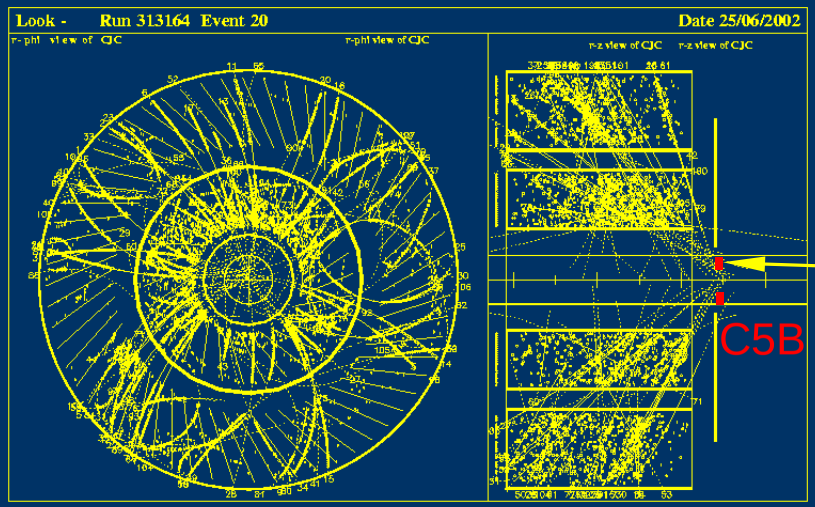
N.B.: Similar limits from radiation dose for silicon.



Proton Induced Background

Beam proton scatter off residual gas nuclei. Particles hit H1 directly or after secondary scattering.





Vertex distribution of random triggered events in a proton−only run

Secondary Particle

Primary interaction with gas nucleus

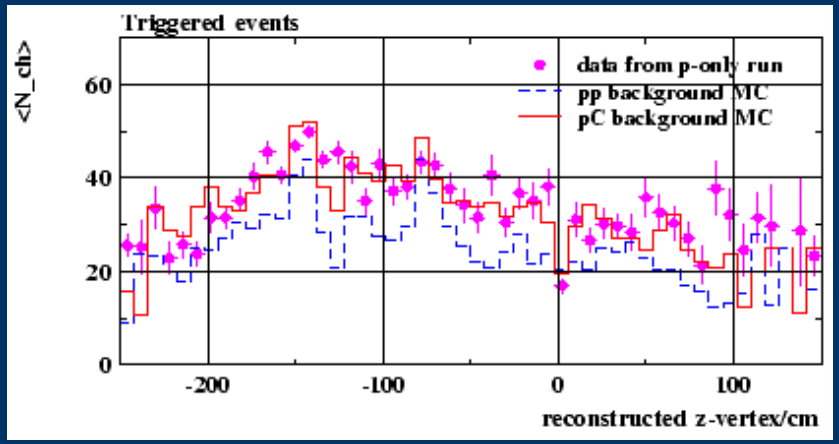
Beam Proton

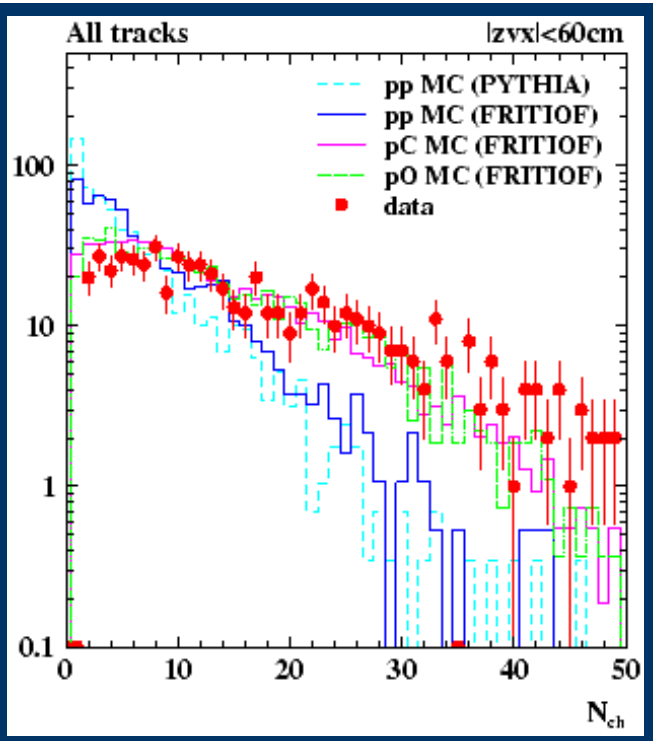
Proton Induced Background, cont'd

MC studies show: The collimators are not the problem.

What has changed compared to 2000? Pressure? Gas composition?

- Indications for presence of medium−heavy nuclei (C, O) in addition to H (CH_4?)
- Source of vacuum problem unclear. Must be identified before shutdown.

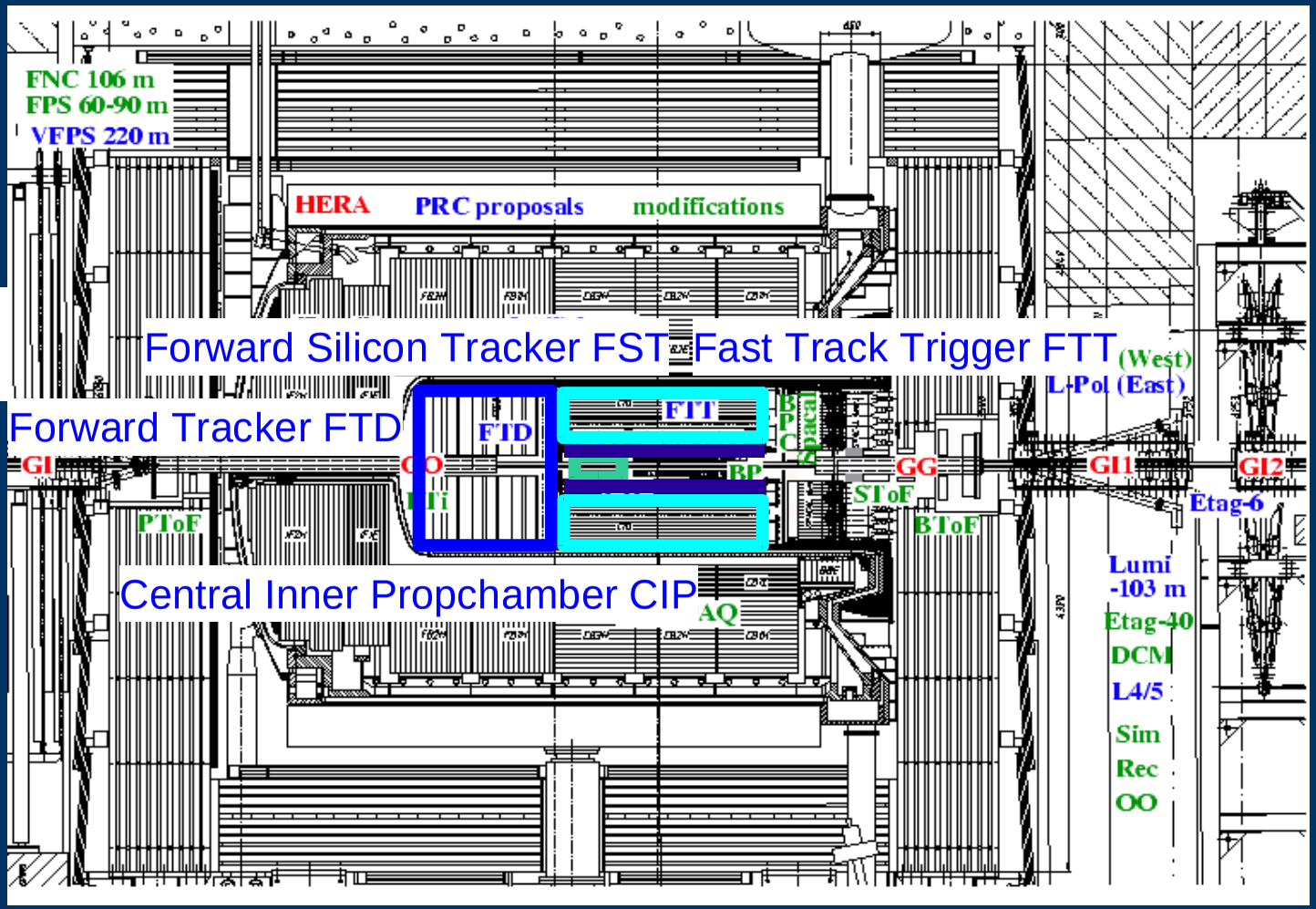




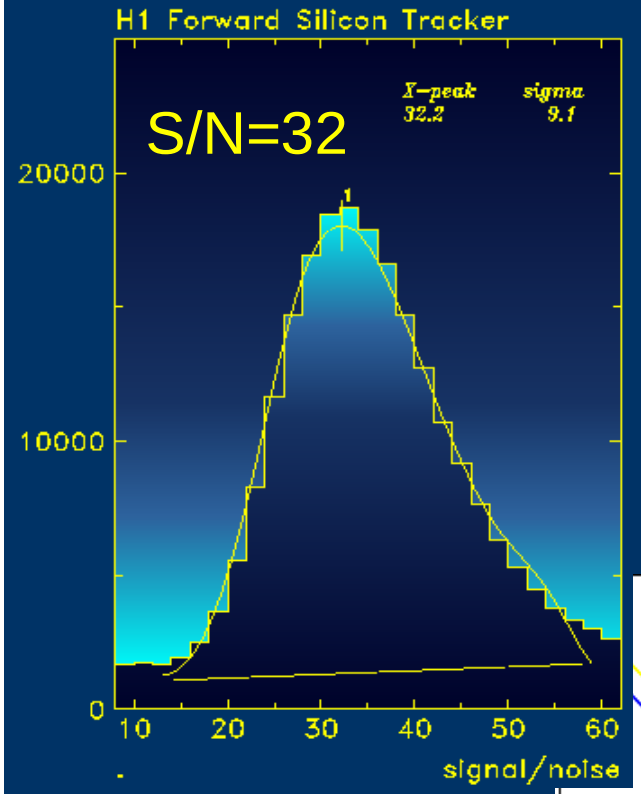
Status of Upgrade Projects

Very Forward Proton Spectrometer VFPS

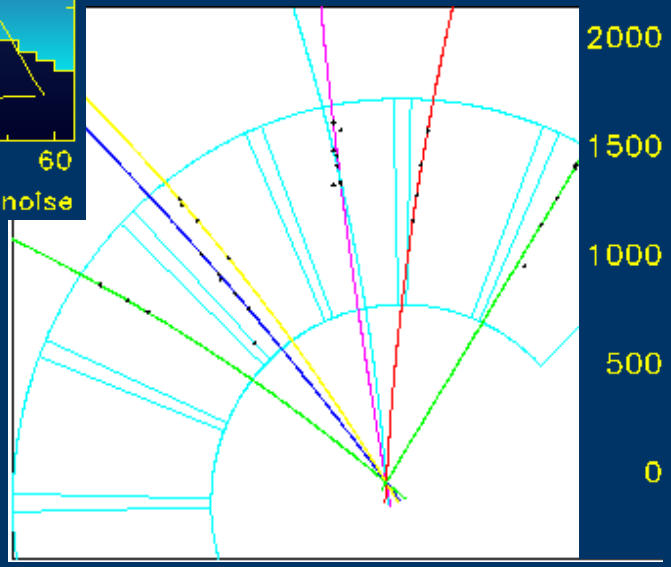
200m in the tunnel



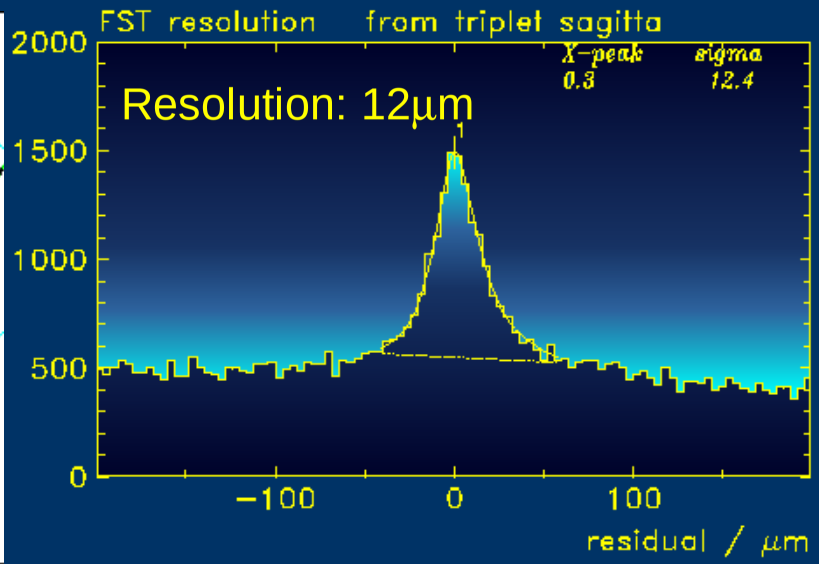
Forward Silicon Tracker FST



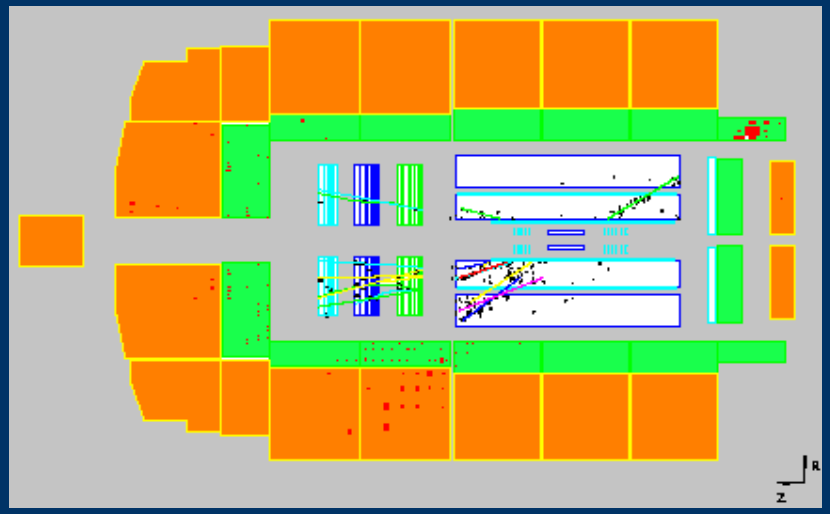
- All sensors operational
- Very good Signal/Noise = 32
- Simulation&Reconstruction work
- Alignment in Progress



FST Event with 7 fitted tracks

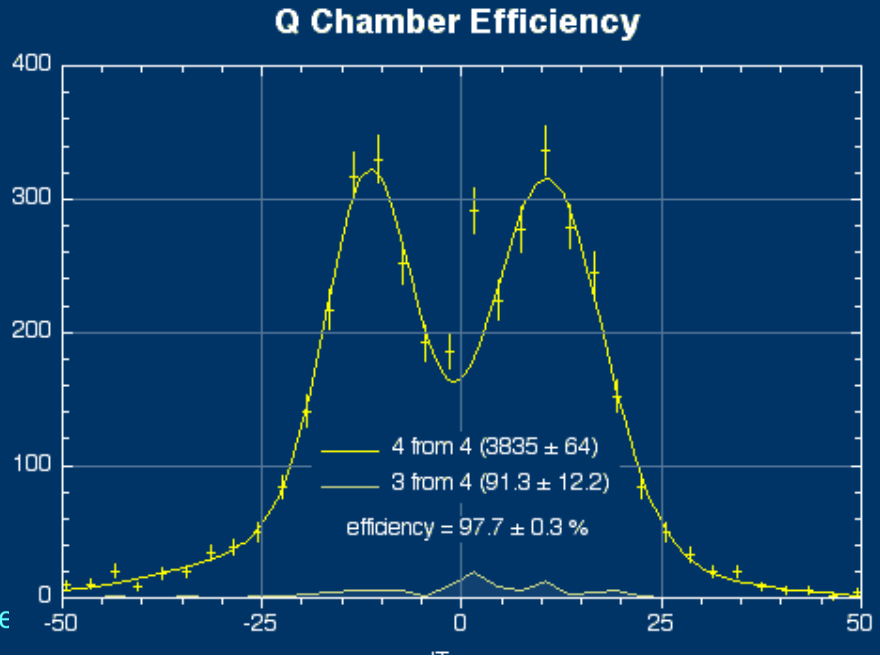


Forward Tracker

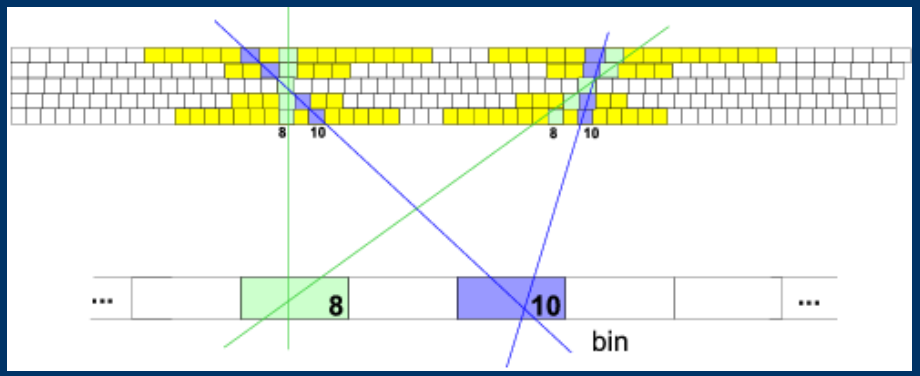


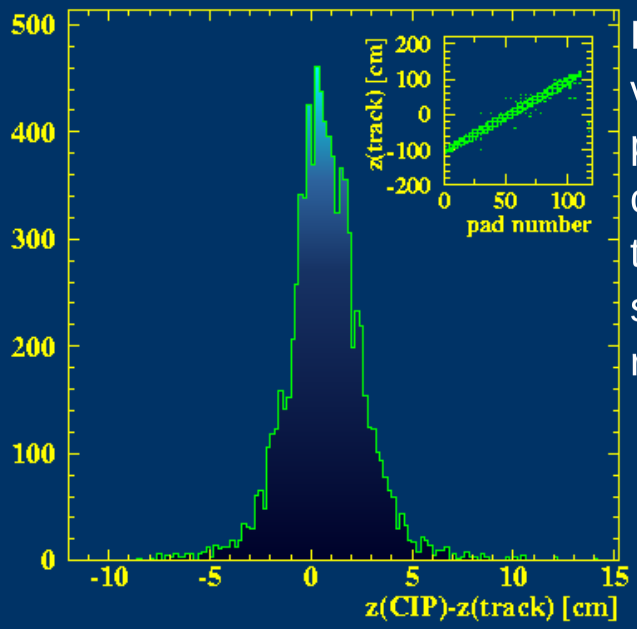
A high−Q2 event with reconstructed tracks in the upgraded forward tracker

- 5 new chambers installed additional to 9 existing ones => increased redundancy
- About 85% of channels are operational
- Hit efficiency ~98%



Central Inner Propchamber CIP





Reconstructed vs. expected hit position of cosmics tracks through CIP show expected z resolution.

5 Layer proportional chamber

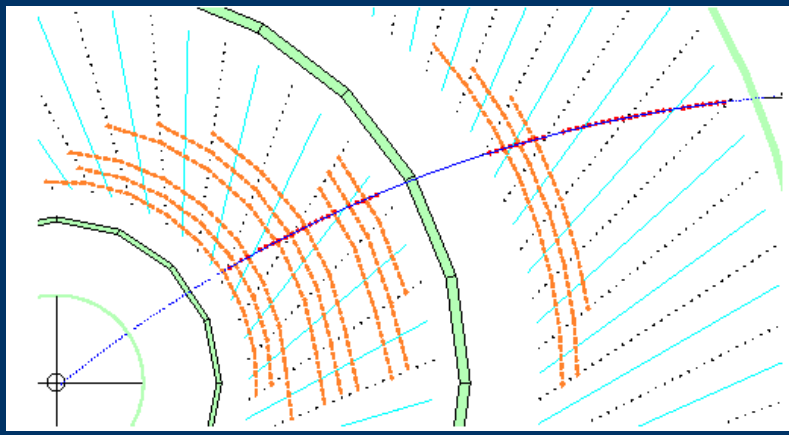
Allows to reconstruct *z* position of vertex for triggering purposes

- Broken readout chips and cooling problem:
  only 2−3 layers out of 5 available
  => Insufficient for trigger
  => Needs repair in shutdown
- Everything else works!

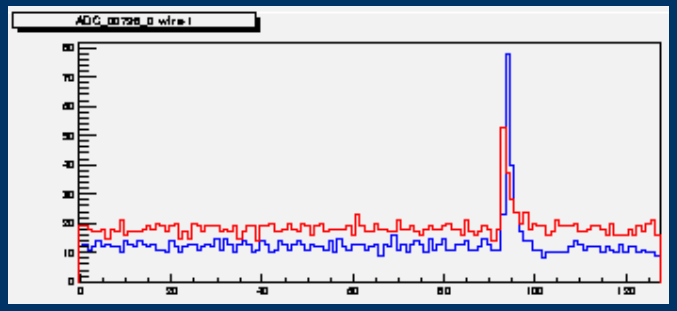
Fast Track Trigger FTT

Status:

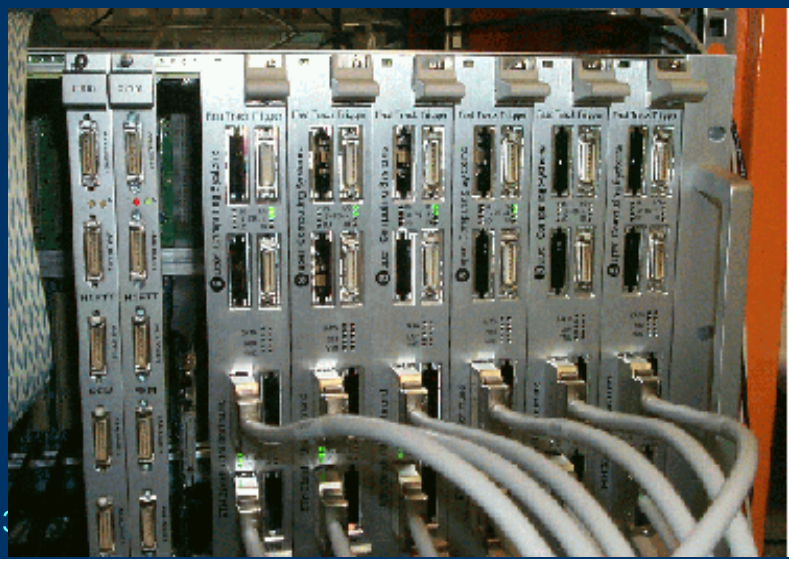
- All hardware has been delivered and tested O.K.
- Programming of chips 80% completed
- Commissioning hardware, debugging firmware
- FTT expected to be fully operational next summer



The FTT uses 12 drift chamber layers for a fast track fit with good momentum resolution



First analog hits seen



Hardware existing

Very Forward Proton Spectrometer VFPS

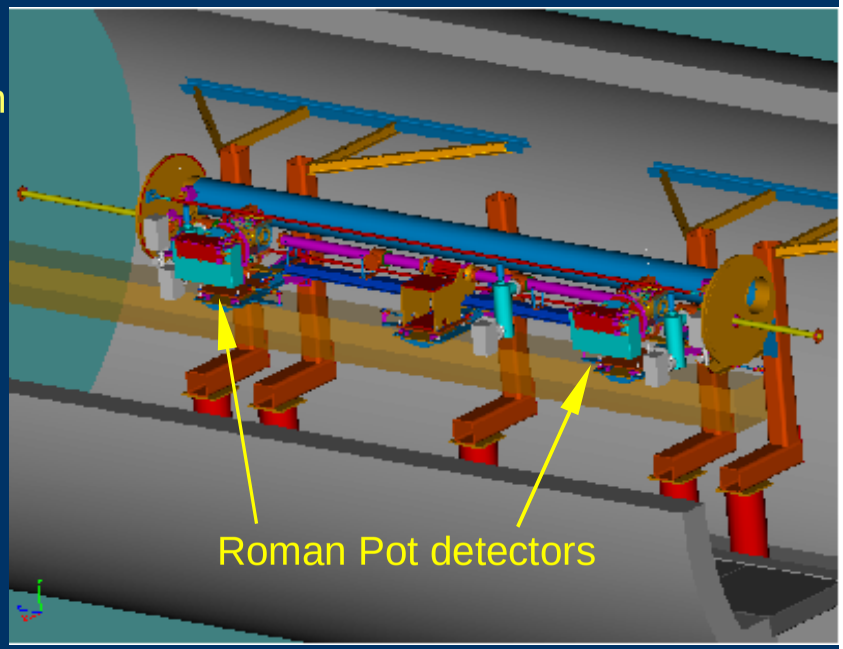
Measures diffractively scattered protons: $E'_p \sim 920\text{GeV}$, $p_t < 0.7\text{GeV}$

Located 200m away from IP in region with sc proton magnets

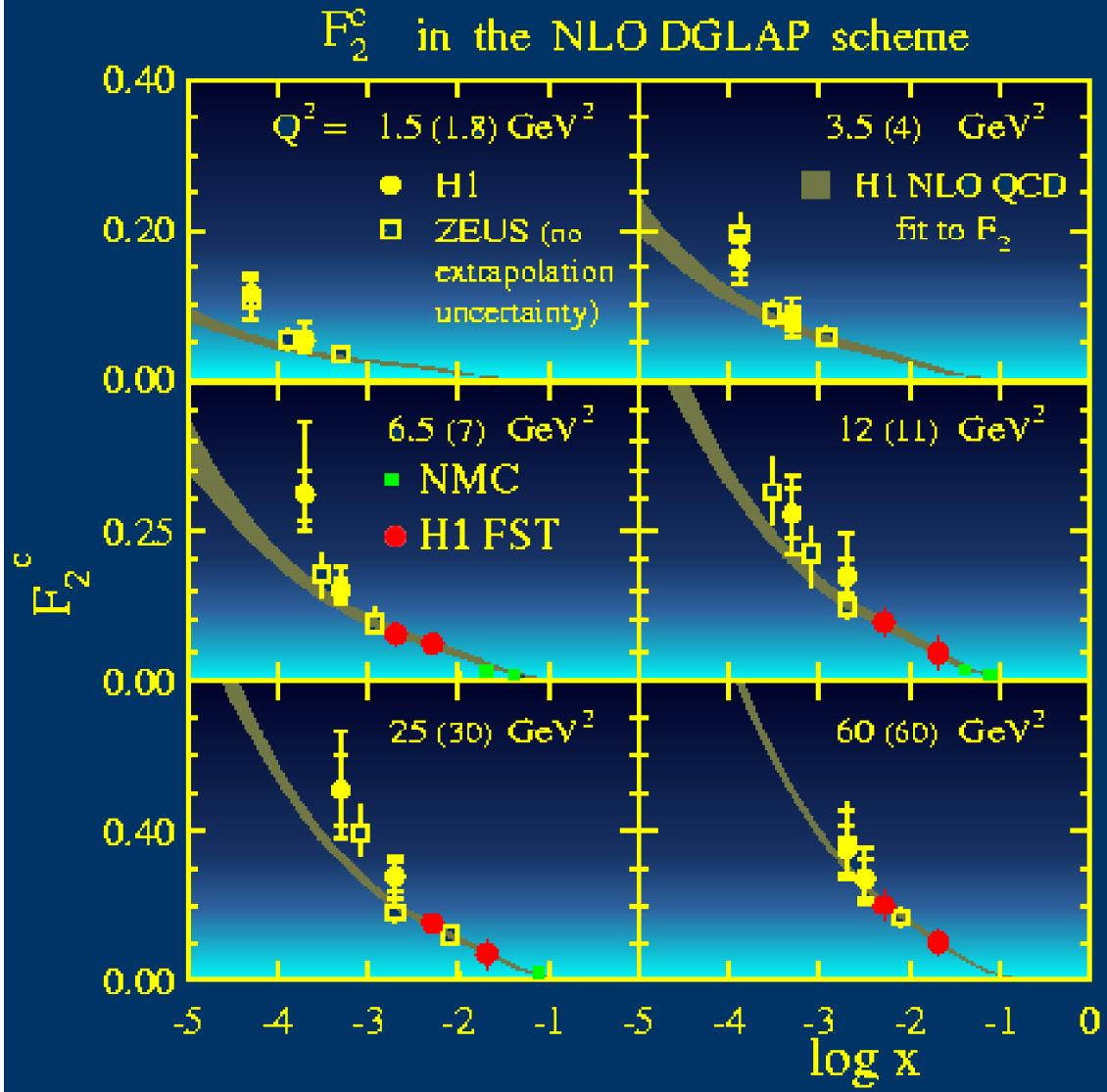
- Cold bypass for helium in production, detectors are being tested with cosmics
- Ready for installation in coming shutdown

Construction of the bypass

Design of the bypass at 200m



Physics before the Shutdown

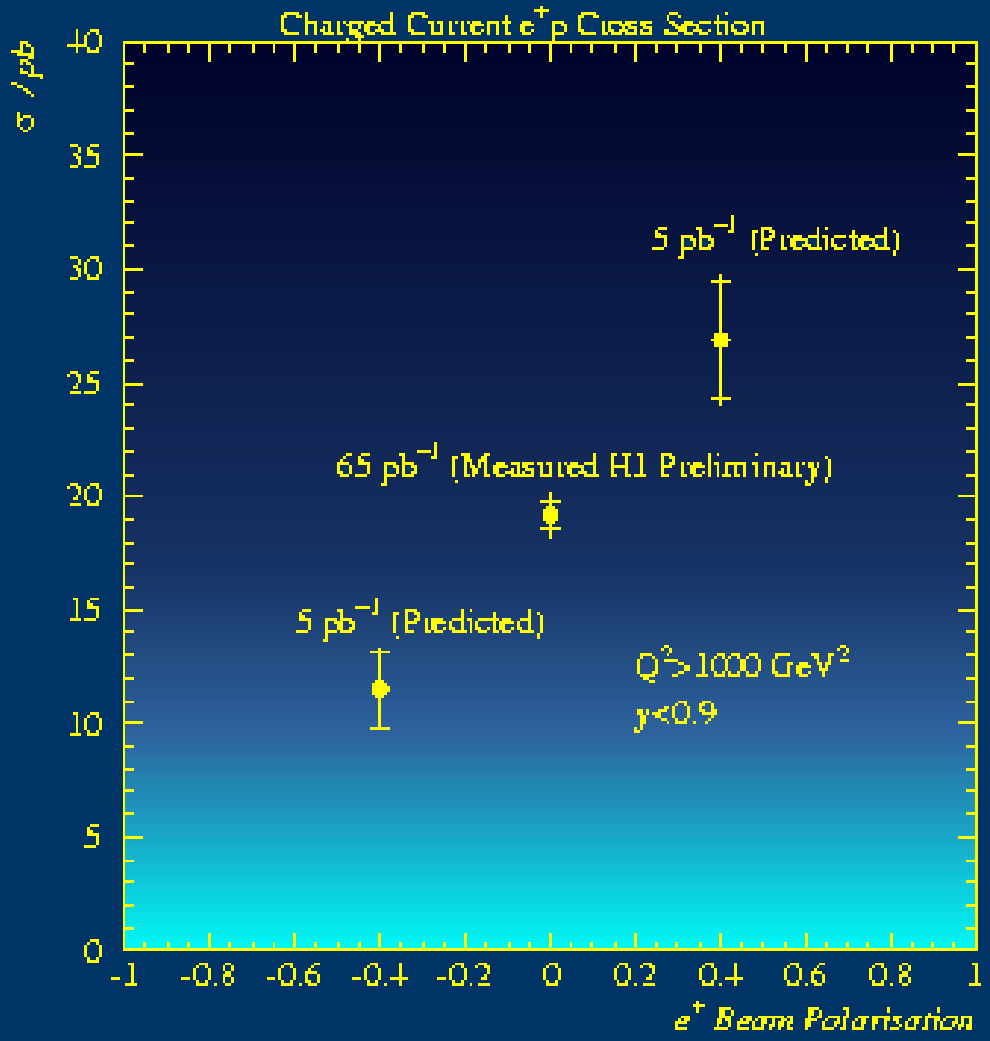


F_2c: Can be measured with FST and forward tracker

Projection with 10pb^{-1} shows potential for interesting measurement

MC study showing the possible statistical accuracy of an F_2^c measurement with 10pb^{-1} using the new H1 forward detectors

Physics plans, cont'd



Polarized e+p scattering:
A central HERA−II task!

$\sigma = \sigma_0 (1+P/2)$

The chiral structure of the standard model has never been tested in ep scattering.

Requests for Running

- Understanding background has priority
- Currents: $I_e\ I_p \sim 1000\ mA^2$
- Integrated Luminosity of $10pb^{-1}$
- Polarization

We look forward to continued cooperation with the machine group and the other HERA experiments and anticipate a rapid solution to our background problems.