

Status: HERA + Experimente

Jahrestreffen KET

23 November 2002, Bad Honnef

Robert Klanner

Status der Experimente

Status HERA und Untergrundprobleme

Strategie und Pläne

Status ZEUS

Detektor betriebsbereit

- neue (2000) Komponenten werden eingelaufen (**kleinere** Probleme)
- wegen hohem Untergrund wird CTD bei 95% HV betrieben
- $\sim 1\text{pb}^{-1}$ **e-p Daten** genommen - **große Untergrundprobleme**



Photon Cal. und Lumi Spektrometer



Straw-Tube Tracker



Zeus Mikro Vertex Detektor

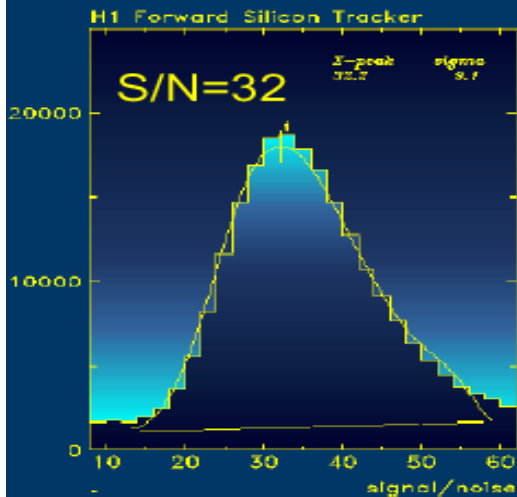
Status H1

Detektor betriebsbereit

- neue (2000) Komponenten werden eingelaufen (kleinere Probleme)
- $\sim 3\text{pb}^{-1}$ e-p Daten genommen - ($\sim 1\text{pb}^{-1}$ mit HV an)
- **große Untergrundprobleme**

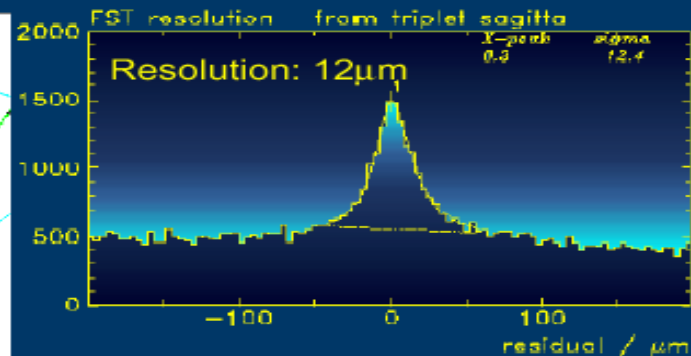
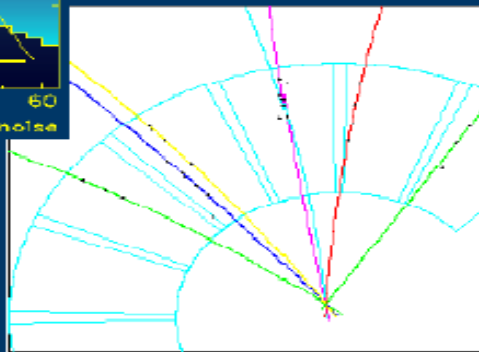


Forward Silicon Tracker FST

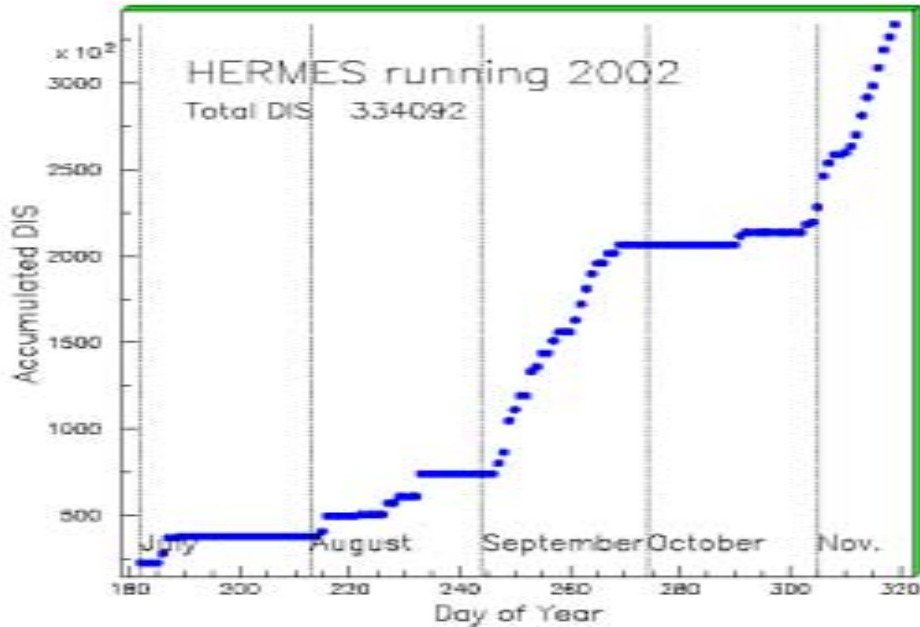


- ◆ All sensors operational
- ◆ Very good Signal/Noise = 32
- ◆ Simulation&Reconstruction work
- ◆ Alignment in Progress

FST Event with 7 fitted tracks

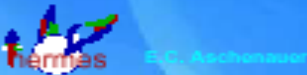


Status HERMES

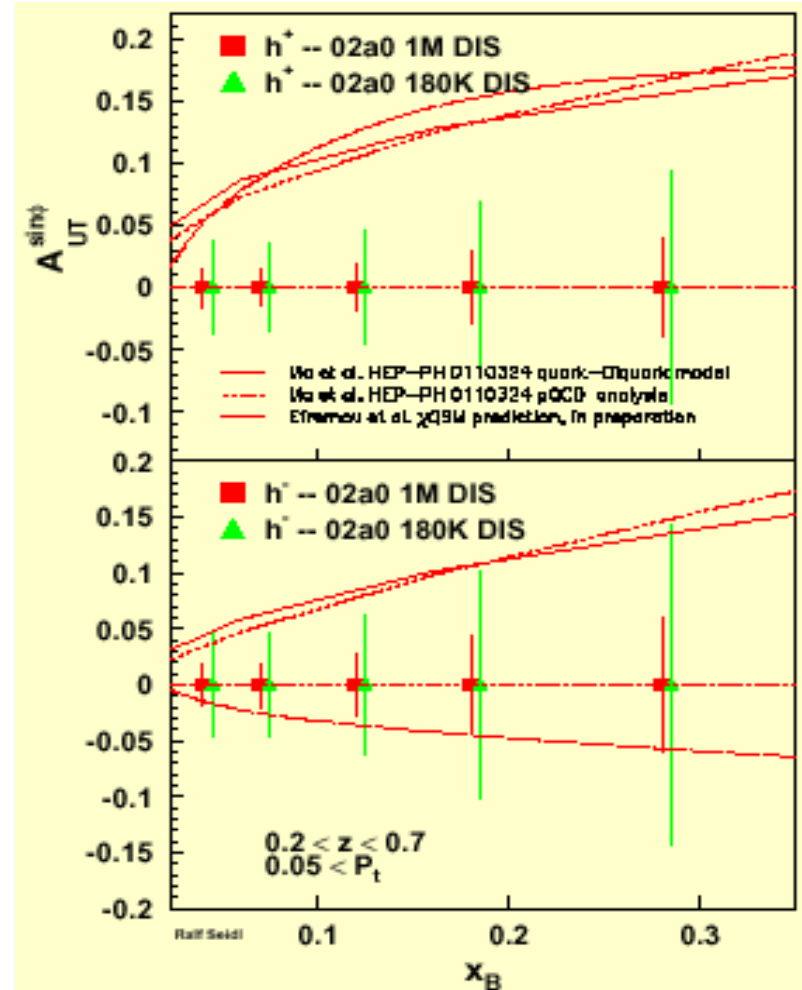


Keine Probleme mit Datennahme:
350k DIS-Ereignisse mit transversal pol. Protonentarget genommen

Need 1.4 Million DIS
Data rate:
70 DIS / mA h \rightarrow 20 Ah



Single Spin Asymmetries in 2002



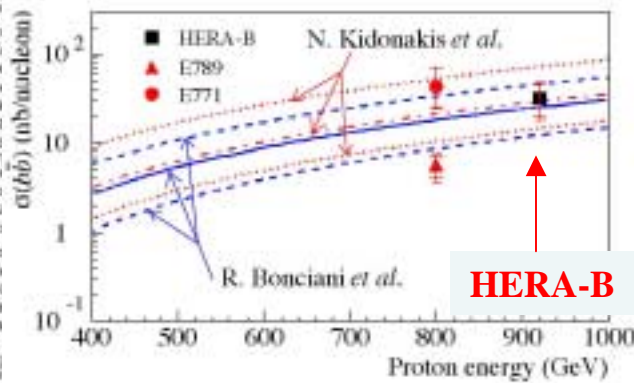
Status HERA-B

Measurement of the bb Production Cross Section in 920 GeV Fixed-Target Proton-Nucleus Collisions

The HERA - B Collaboration

I. Abt¹, A. Abyzov²⁸, M. Adams¹¹, H. Albrecht¹³, V. Amara¹, A. Amorim², S. J. Apin¹², A. Arévalo²⁹, I. Arthro¹, M. Alys³⁰, V. Aulchenko^{14,15}, V. Balagura²³, M. Bargiotti⁶, S. Barsuk²⁰, D. Barsukov²⁸, V. Baur¹, Bauer^{22,32}, M. Beck²⁰, A. Belikov²⁸, Ar. Belikov²⁸, I. Belokobov²⁸, I. Belyanin^{14,15}, chernoz²², M. Bocker¹¹, A. Bogachov²³, G. Böhm²⁴, D. Borgmann², M. Briaux^{16,17}, M. Brusch¹, P. Buchholz¹¹, M. Buchler¹⁸, T. Buran¹⁹, M. Capelans¹, maning²⁷, B. X. Chen¹, R. Christov²⁵, M. Chroscinski¹, A. Christensen²⁹, P. Conde¹, C. Cruz¹, M. Dam¹, K. M. Danielsen²⁰, M. Danilov²⁸, S. De Castro¹, H. Deckers¹, K. Dehmett¹⁹, H. Depe²⁹, B. Dolgosheev¹⁷, X. Dong¹, H. B. Dreier¹⁸, M. Droscher¹⁹, D. Dujmic¹, R. Eckmann¹, V. Egorychev¹³, F. Ekelund¹¹, V. Elisei¹, C. Ekdahl¹, R. Engelbrecht¹³, C. Ewerdt¹³, C. Ewerdt¹³, L. Fabbri¹⁰, P. Facchini¹, S. Fauriol¹, K. E. K. G. I. Corboun¹, T. Hamach¹, A. Höltsche¹, D. Igonkina¹, A. Kacukh¹, H. Kim¹, Y. C. Krause¹, G. LeTers¹, R. Manner¹, M. Mariani¹, B. Mezhour¹, Pardo de V. Yu. Pavlenko¹, M. A. Pleš¹, S. Ramach¹, I. Riu¹³, P. F. Saad-Li¹, P. Schier¹, H. D. Schultz¹³, U. Schwank¹⁴, A. J. Schwartz², A. S. Schwarz²³, B. Scheueringer⁵, B. Schwingenheuer²⁸, R. Schwitters¹, F. Sciaccad¹, S. Semenov¹, N. Semprini-Cesarf¹, E. Soxav²², L. Seybold²⁵, J. Shiu¹², S. Shwalow²⁵, I. Sloczynski¹, D. Sirk¹⁹, L. Sözlér¹³, A. Soldatov^{20,13,14}, S. Sokolov²⁸, A. Somov¹³, S. Somov^{13,30}, V. Spivakov²⁴, M. Spahn¹, J. Spengler¹, R. Spighi¹, A. Spiridonov^{14,25}, S. Spratti¹¹, A. Stanovnik^{10,19}, M. Stari¹⁴, R. StDenis^{25,13}, C. Stegmann^{25,5}, S. Steinbeck¹⁰, O. Steinkamp¹⁹, D. Steiler²⁰, U. Straumann¹⁸, F. Sun²⁴, H. Sun², M. Symalla¹, S. Takachi¹², N. Tesch¹², H. Thum¹², I. Tikhomirov²⁵, M. Titov²⁵, U. Trunk¹⁹, P. Trüro²⁰, I. Tsakov^{13,12}, U. Ueber¹⁹, V. Vagnon¹, C. van Eldik¹¹, R. van Steen¹, Yu. Vassilev^{25,11}, M. Villa¹, A. Vitale¹, I. Vukotic¹, G. Wagner²⁵, W. Wagner²⁸, H. Wahlberg²⁰, A. H. Wakita²⁸, M. Walter²⁴, T. Walter²⁴, J. J. Wang¹, Y. M. Wang¹, R. Wanke¹, D. Wegener¹, P. J. Weisberg¹, H. Wollers¹, R. Wurth¹³, A. Wurz²⁴, S. Xella-Hansen¹, J. Yang¹, Yu. Zaitsev²⁵, M. Zavarzayev^{13,30}, G. Zech¹, T. Zeman²⁵, A. Zhelezov²⁵, Z. Zheng¹, Z. Zhu¹, R. Zimmermann¹⁰, T. Žitko¹⁹, A. Zocco¹, J. Zwißig^{13,10}

in press



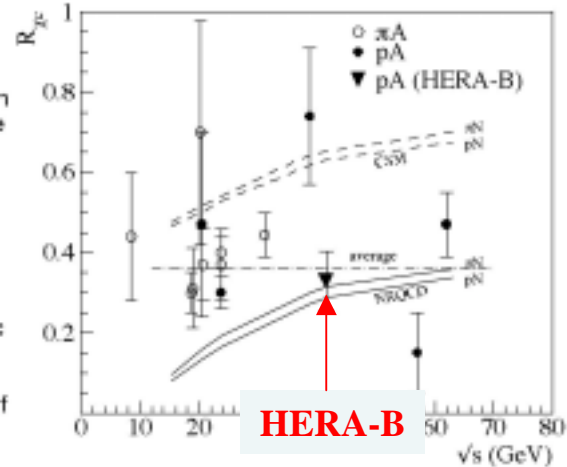
HERA-B

J/ψ Production via c Decays in 920 GeV pA Interactions

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submitted



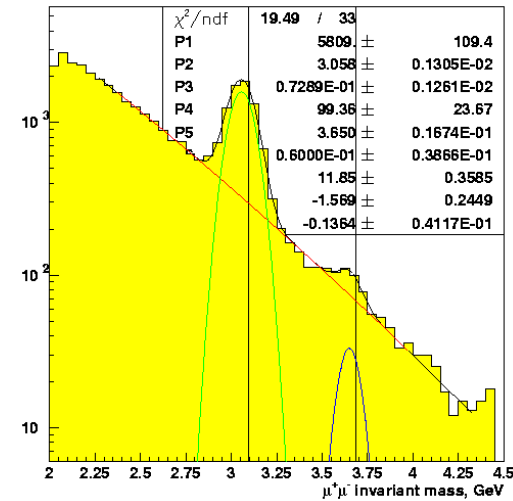
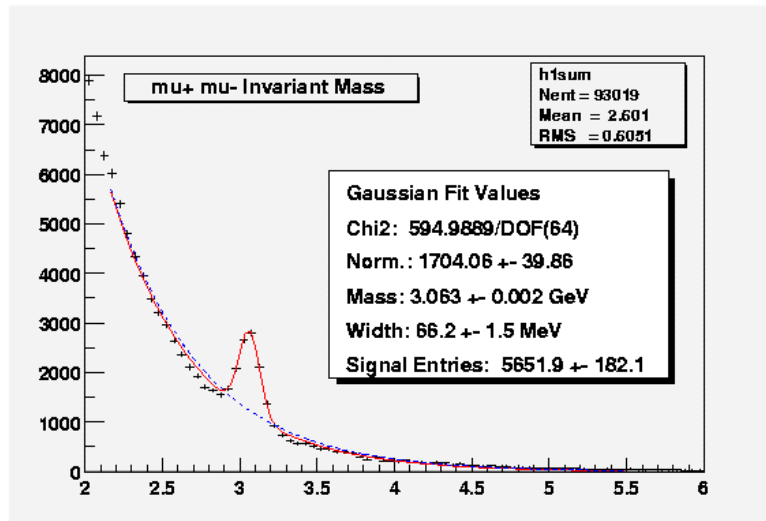
HERA-B

Erste Physikergenergebnisse
HERA-B von 2000 Daten

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³ Institute for High Energy Physics, Beijing 100039, P.R. China
⁴ supported by the U.S. Department of Energy (DOE)
⁵ supported by the CICYT contract AEN99-0483

Status HERA-B

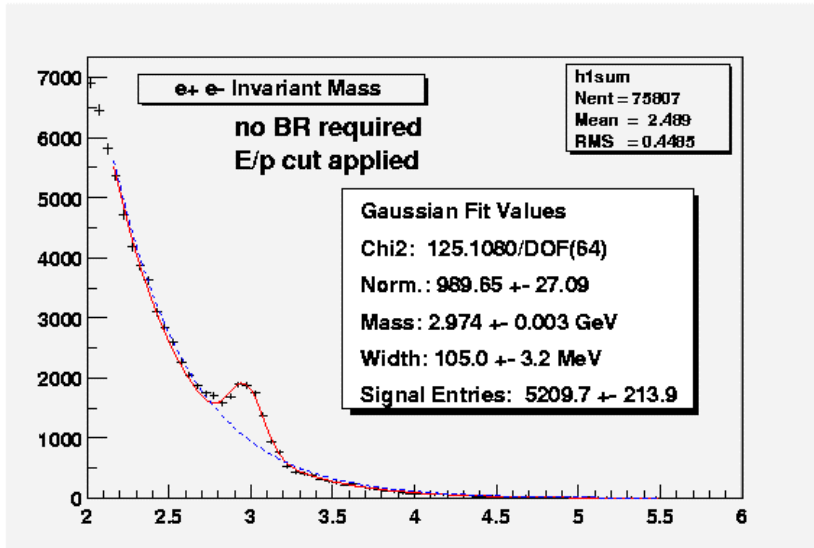
J/ψ



**HERA-B Spektrometer
in gutem Zustand**

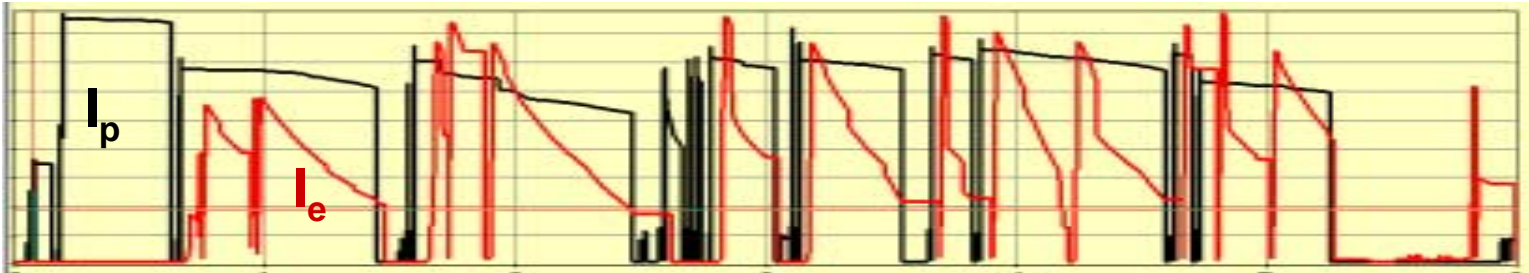
Datenrate: 1000 J/ψ pro Stunde erreicht
75,000 J/ψ registriert

**Alle vier HERA-Experimente
sind bereit Daten zu nehmen**



HERA Operations

Week of September 18: Luminosity Operation with 60 bunches



HERA operations (as expected) much more difficult than before 2000

beam optics, non compensated solenoids, low- β quadrupoles in detectors, sensitive detectors close to beam, etc.

→ special tools had to be developed (major effort from HERA team)

orbit stabilization feedback, semi-automatical SR background optimisation, automated operation procedures, electronics logbook, etc.

→ operational issues solved

→ HERA is able to deliver luminosity but background in collider experiments H1 and ZEUS prevents high luminosity operation

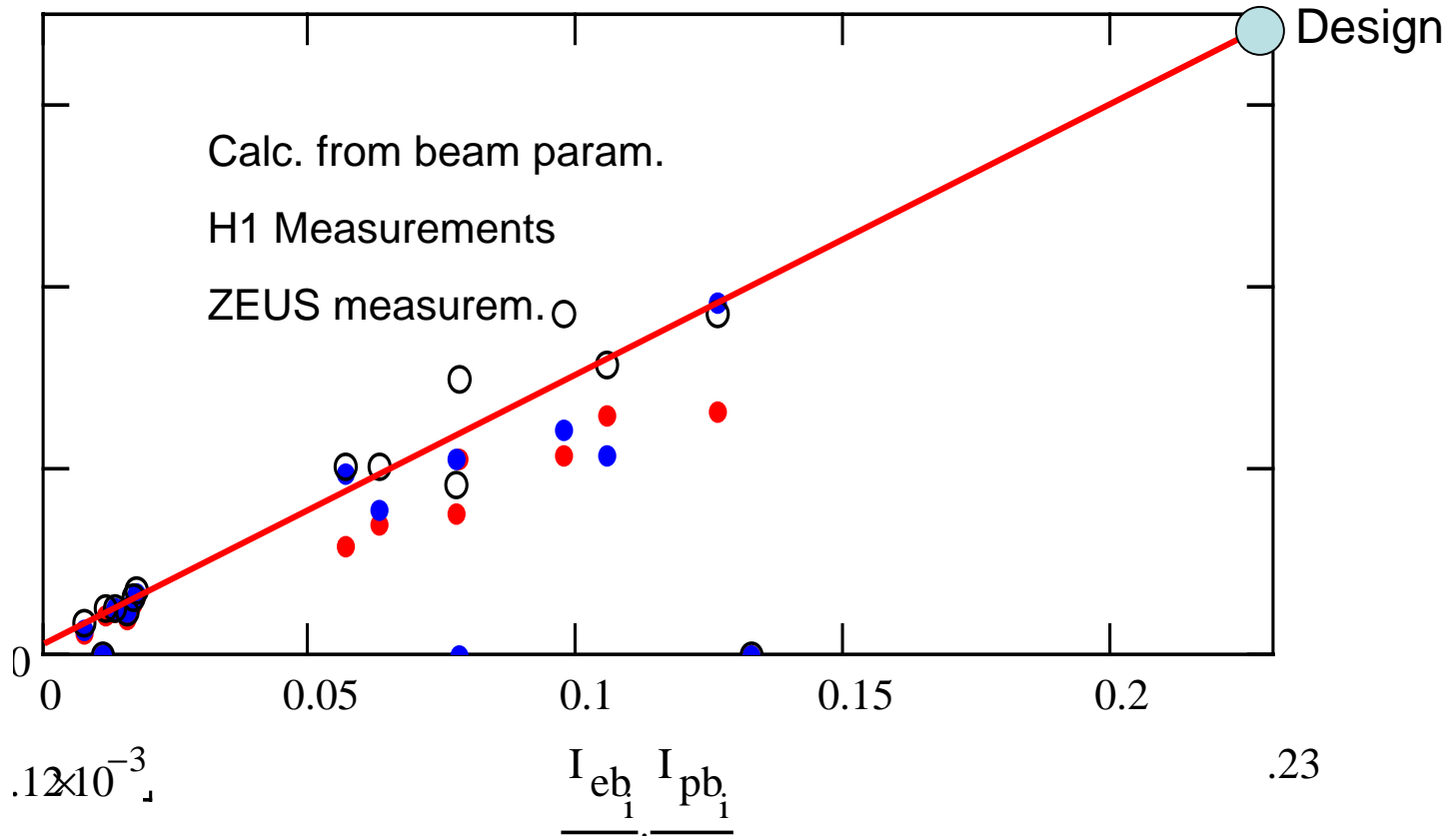
Beam Current Limitations - Luminosity

beam currents in luminosity operations are (mainly) limited by experimental backgrounds and radiation damage considerations
 $I_p \times I_e < 1000 \text{ mA}^2$ (y2000 value 5000 mA²; design is 8000 mA²)

Meas.Lumi. scaled to full # of bunches

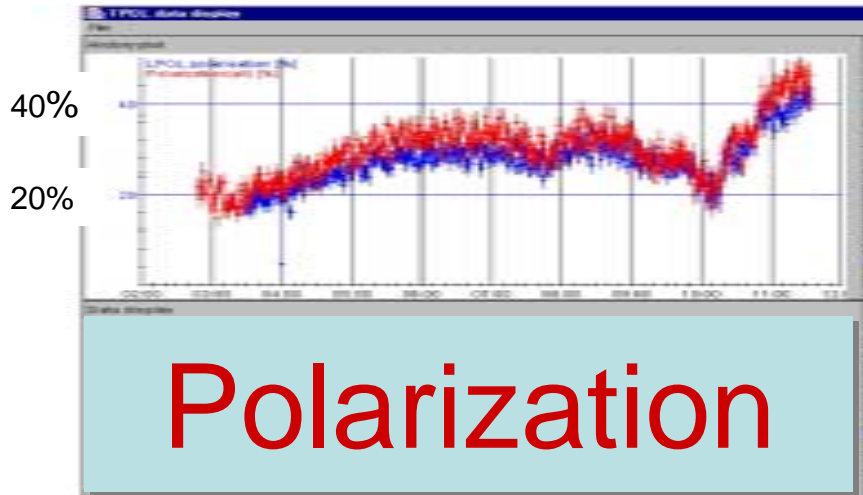
Luminosity

[10³¹cm⁻²sec⁻¹]



→ within ~ 20% of expectations (some accelerator physics issues still remain)

Positron Polarization



polarization with ZEUS
and H1 solenoids off,
October 17 2002

Tpol & Lpol

Six tuning steps

- 1) North & South Rotators flat, Solenoids off
- 2) North & East Rotator on
- 3) North & South & East Rotator on
- 4) All Rotators + Solenoids on
- 5) All Rotators + Solenoids, large vertical emittance (3.5nm)
- 6) Polarization during Luminosity operation

week41/42 ok

postponed
to (early?) 2003

→ still quite some work needed but no intrinsic problem seen so far

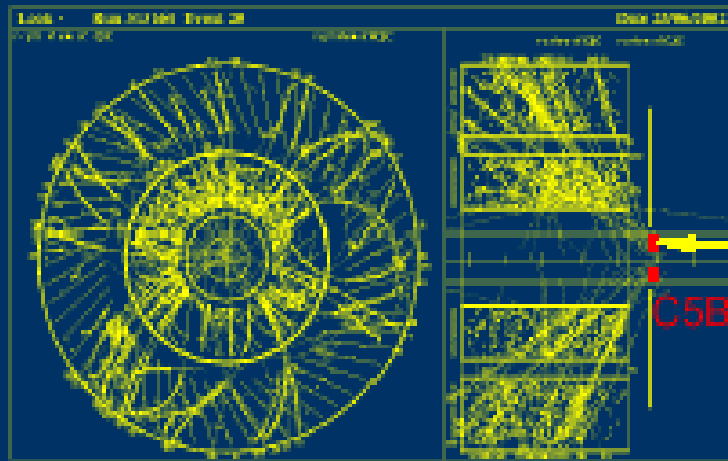
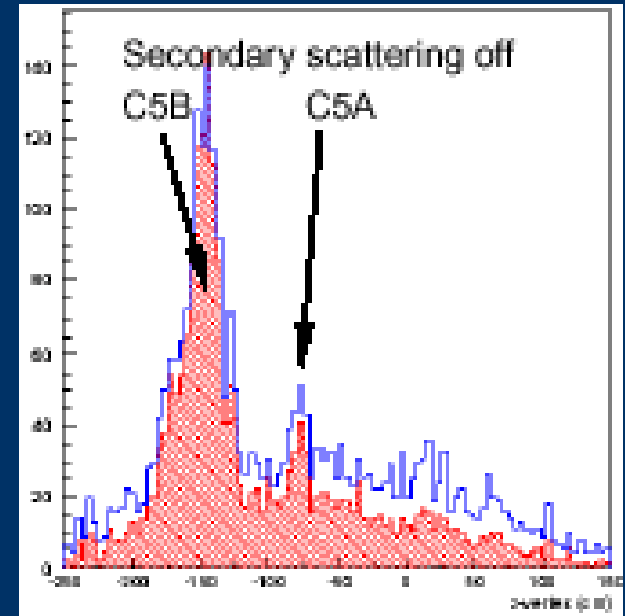
Backgrounds in H1 and ZEUS

Four sources of background:

- direct synchrotron radiation: tolerable after tuning
- back-scattered synchrotron radiation: shielding needs to be improved - viable solutions
- positrons which have lost energy upstream via bremsstrahlung (collimators not very effective for e⁺): improve vacuum O(2) - conditioning by scrubbing with beam ?
- proton background - beam gas interactions close to IP - positron beam degrades vacuum, which the is the target of the proton beam:
biggest problem - no solutions yet
- detailed understanding of background has been achieved - result of an impressive common effort by HERA and the HERA experiments
- further understanding of the source/origin of the vacuum degradation and search for solution is under way - it has the highest priority
- in addition beam losses/background during injection which causes problems/ damage to components of collider experiments close to beam

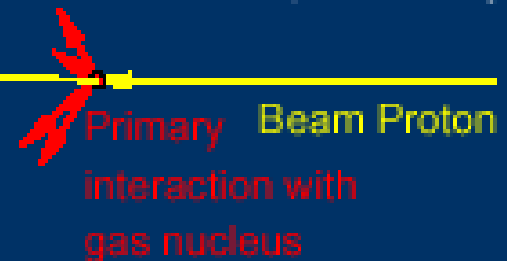
Backgrounds in H1 and ZEUS

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

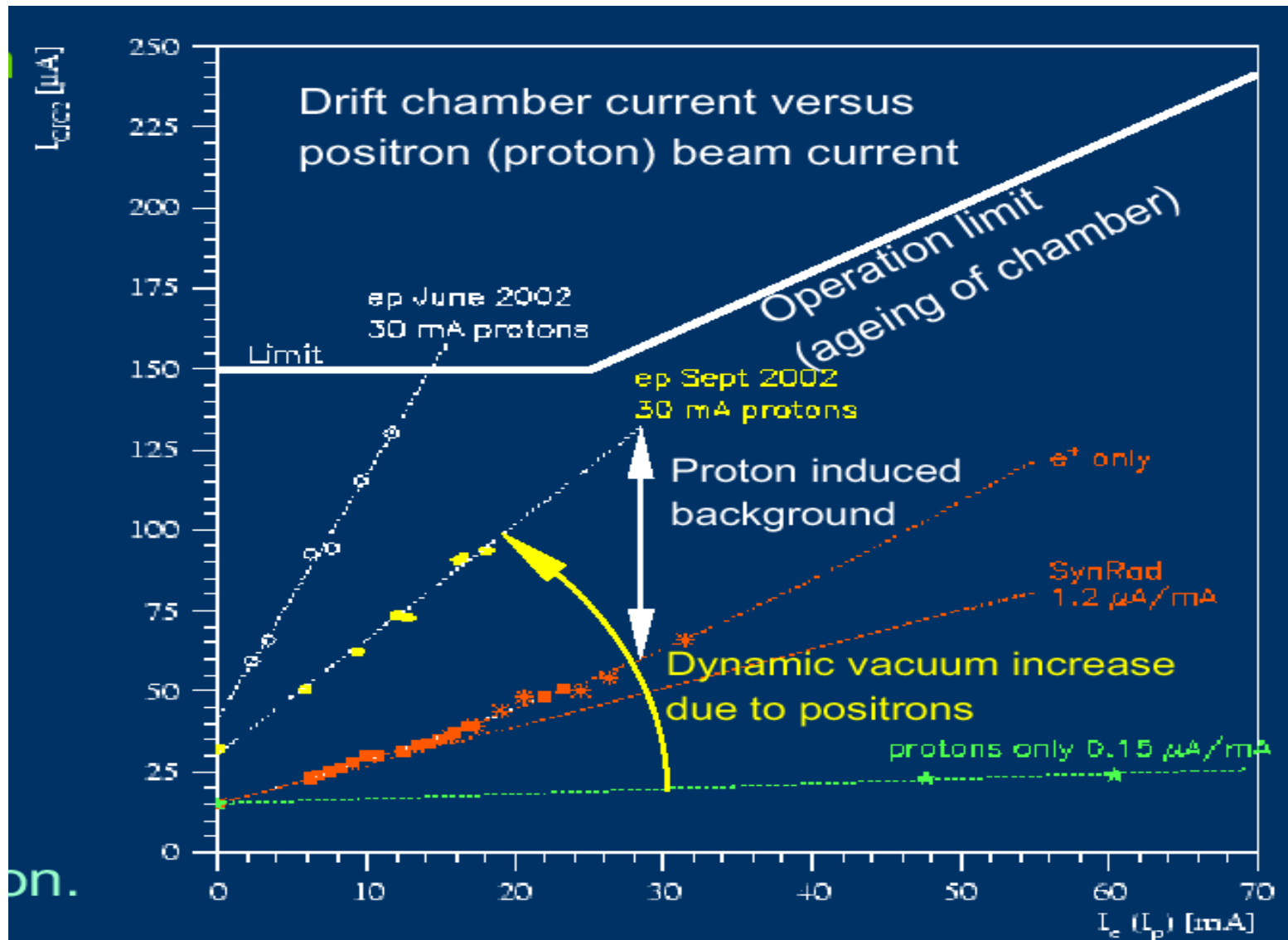


Vertex distribution of random triggered events in a proton-only run

Secondary Particle



Backgrounds in H1 and ZEUS



External expert group and help

Workshop on Synchrotron Radiation- and Particle Background in HERA

July 23-24, 2002
at DESY

Review on HERA Background and Vacuum Issues

October 21-23, 2002
at DESY

Committee

A. Miller, TRIUMF(chair)
D. Rubin, Cornell
B. Parker BNL
R. Hseuh, BNL
W. Kosanecki (SACLAY)
A. Schwarz (DESY)
R. Brinkmann (DESY)

Next meeting

Jan. 16-17, 2003 at DESY

General Recommendations

- Progress towards better understanding of all the problems will be best served by giving highest priority to developing and refining routine and reliable HERA two-beam operations at ever higher beam currents, with emphasis on the lepton current for vacuum surface processing
- Further background studies should be designed to be done as much as possible within the context of developing lumi operation using e.g. isolated pilot bunches in both beams
- This two-beam operation could include collisions provided that it does not seriously impede the pursuit of the main goals of surface processing, machine development and parasitic background studies
- All possible effort should be devoted to better understanding the present vacuum limitations in the relevant region $0 < z < -20\text{m}$. This includes operating the "cryosurfaces" at higher temperatures, identifying the sources and composition of the dynamic gas load, and possibly optimizing the mix of pump technologies
- Simulations of the HERA I and HERA II proton beam gas backgrounds should be compared in an effort to better understand the HERA II problems
- Continuing efforts should be devoted to integrating the measured pressure profiles with the beam-gas simulations to determine how well the severity of these backgrounds is understood
- The additional goal of identifying before the spring shutdown any fundamental impediment to full operation with polarised beam appears to threaten the pursuit of solutions to urgent *known* problems, in particular the backgrounds. With luck it might be possible to show the opposite — that there is no such problem with polarisation. But to confirm and identify a fundamental problem would probably take weeks of dedicated studies. Hence it is recommended that beam polarisation be given a lower priority for now.

Strategy and Plans

For legal reasons (TÜV- interlock tests): shutdown starting March 2003

highest priorities until then:

- understand the background problems (dynamic vacuum due to e^+)
- clean machine with e^+ -scrubbing
- find technical solutions for improving the background conditions
- prepare technical modifications
- demonstrate that HERA can deliver the nominal luminosity
- provide sufficient data to all experiments to demonstrate detector performance
 - requirements for a “long” shutdown to modify H1 and ZEUS interaction regions
 - review situation with External Committee 16-17 Jan. 2003

next priorities:

- establish and consolidate efficient HERA (luminosity) operation
- provide protons for HERAB, positrons for HERMES and collisions for H1/ZEUS
- demonstrate longitudinal polarisation for H1, ZEUS and HERMES (if time left):

→ HERA running until the end of the Year02:

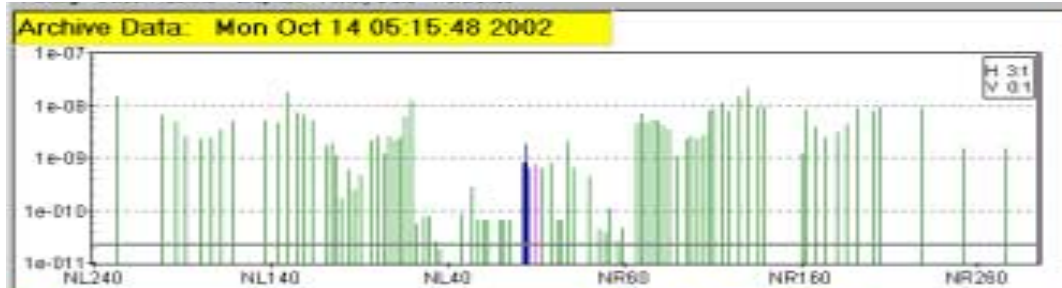
- 20mA of **protons** in 180 bunches and 20mA (→ 40) of **positrons** in 190 bunches for all 4 experiments
- on average 2 days/week for additional background/machine studies
- Jan-Feb.03 reserved for colliding beam operation and polarization studies

Zusammenfassung

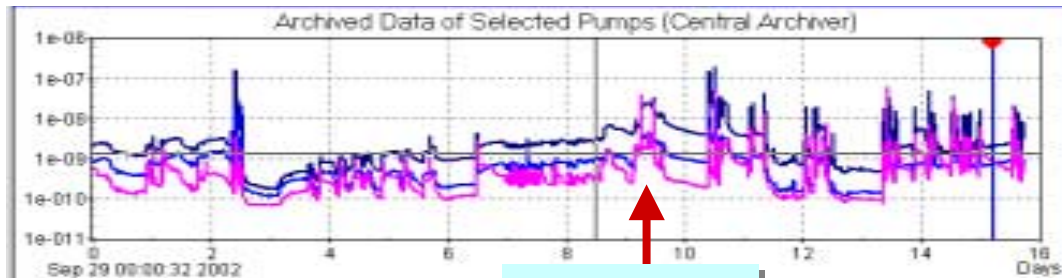
- HERA hat die operationellen Probleme weitgehend gelöst und ist in der Lage routinemäßig Luminosität zu liefern.
- Die 4 HERA Experimente sind bereit (**mehr**) Daten zu nehmen.
- Der Untergrund ist verstanden - seine Ursache allerdings nur zum Teil - die Lösung der Probleme ist (**noch**) nicht gefunden
- Das Hauptproblem sind p-Gas Wechselwirkungen im Bereich der Experimente - Verschlechterung des Vakuums durch den Positronenstrahl (**$\sim 7 \times 1.7$** schlechter als in 2000) - Ursache??
- Shutdown im März 03 - Priorität bis dann Lösungen zu finden, umzusetzen und ab Juli 03 wieder zu laufen - langer shutdown allerdings nur wenn überzeugende Lösungen gefunden!!!

HERA Vacuum Tests: what is the influence of the 40K cold Beam pipes in the IR's?

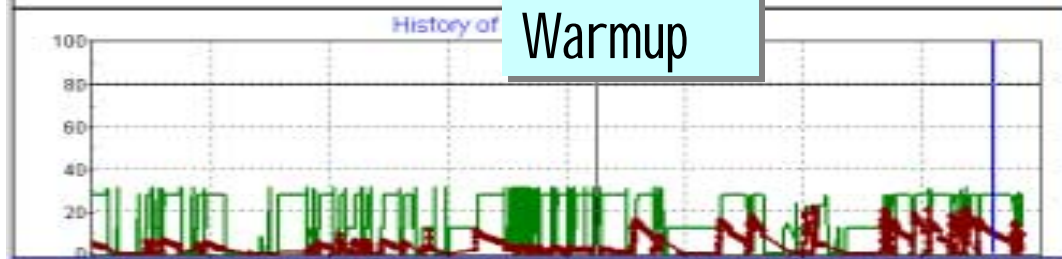
➔ running with increased temperatures of 110K



IR Vacuum over 16 Days



Warmup



110K GG beam pipe since October 10

protons only:

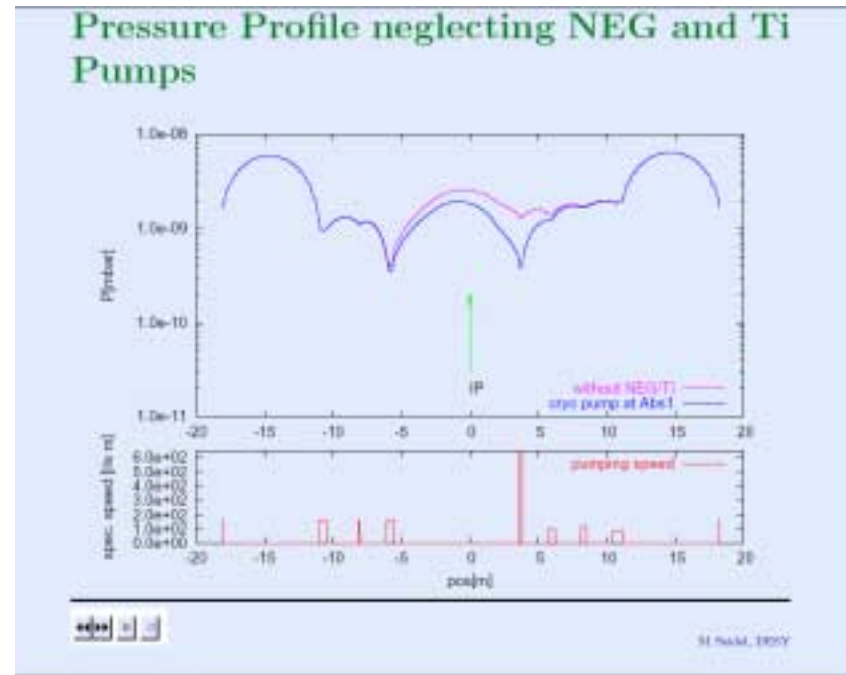
experimental backgrounds seem to be significantly lower

ep running:

no improvements seen yet

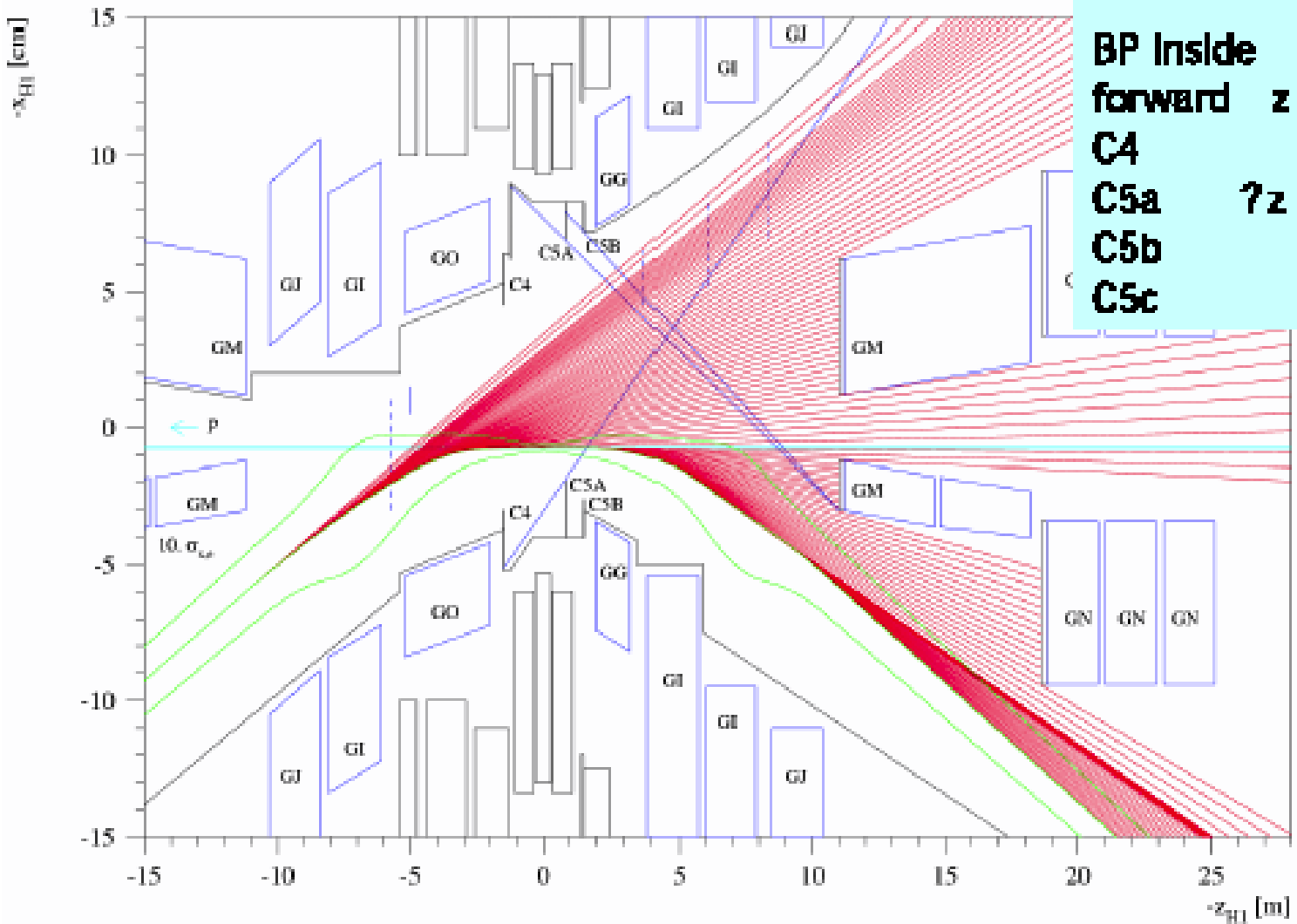
Vacuum Studies and Plans

- model and understand vacuum around cold beampipes in the IR
- understand the production of hydrocarbons in IR vacuum
- increase IR pumping: improve pumping port conductance and install additional pumps (e.g cryopumps, integrated IonP)



Backgrounds in H1 and ZEUS

Top-view of H1 Interaction Region



	Differences	
	H1	ZEUS
BP Inside forward	33	25mm
C4	$z > 0.4$	$z > 0.32$
C5a	?z 20	not in GO
C5b		50mm
C5c		only outside similar C5b