



**Dec 2003  
Brookhaven**

Deutsches Elektronen-  
Synchrotron, Hamburg  
Germany



**Experiences at  
HERA  
with new Interaction Regions**

Markus Hoffmann

- **The Hadron-Electron-Ring-Accelerator**
- **The new Interaction Regions**
- **Background & Vacuum Issues**
- **Pressure Development, Observations**





HERA

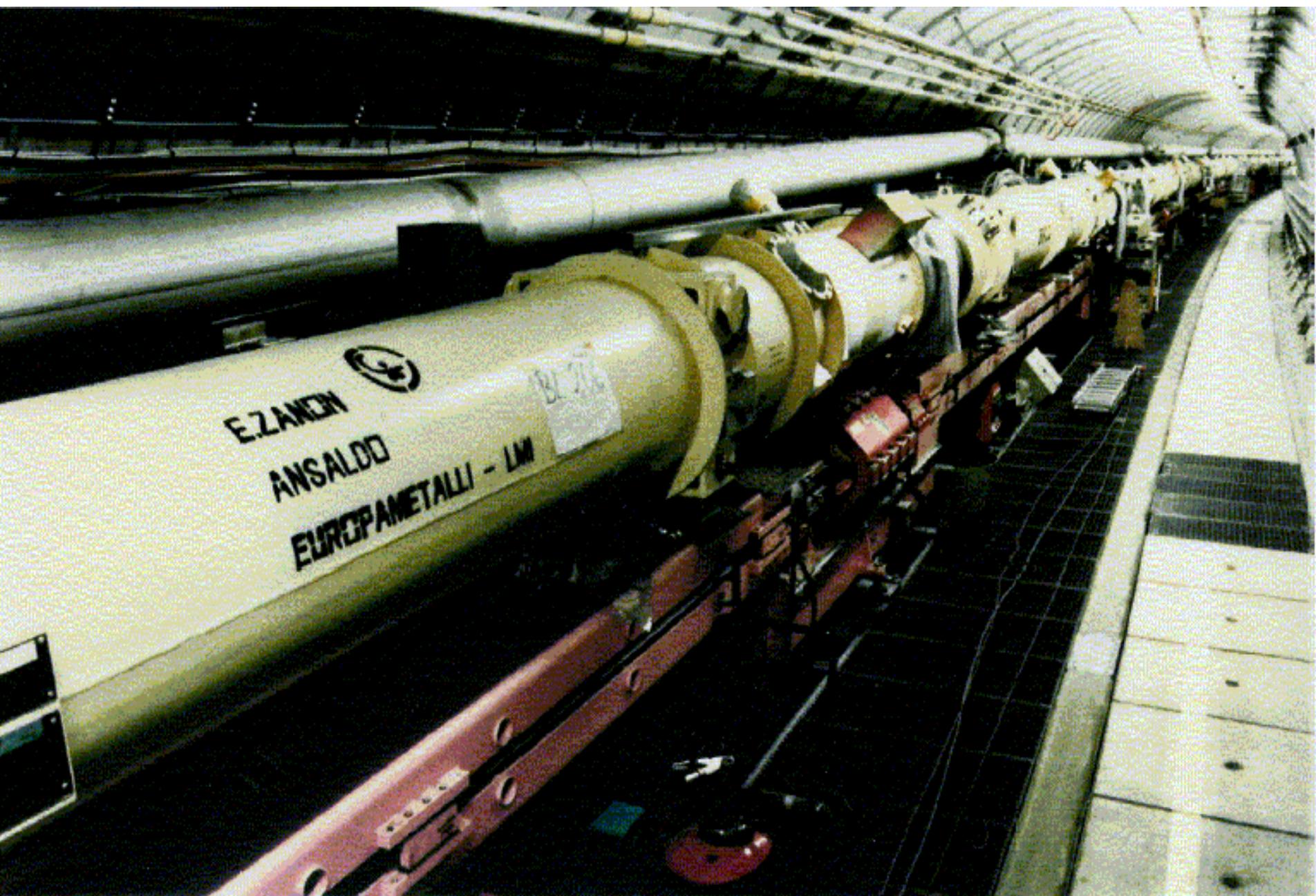
PETRA

N

S

W

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E.ZANDEN

ANSALDO

EUROPMETALLI - LM

2476

# HERA History

1981	<b>Proposal</b> for an e/p collider at DESY
1984	<b>acceptance</b> and start of construction
1988	commissioning <b>HERA-e</b>
1988–1990	construction <b>HERA-p</b>
1991	commissioning <b>HERA-p</b>
10/1991	<b>first e/p collisions</b> ←
1992	commissioning of detectors H1 and ZEUS
1994	installation of spin rotators for HERMES
1995	commissioning of HERMES
1996	installation of HERA-B
1998	p-energy increased to <b>920 GeV</b>
1999	<b>reached design luminosity</b> ←
200/2001	<b>luminosity upgrade</b> and spin rotators for ZEUS/H1
<b>2002</b>	<b>Background Problems</b> clog H1,ZEUS from data taking
03/2003	<b>Shutdown:</b> modifications to vacuum system
10/2003	Recommissioning: Background now promising

# Luminosity Upgrade

→ Gain: smaller Beam sizes

## Realization:

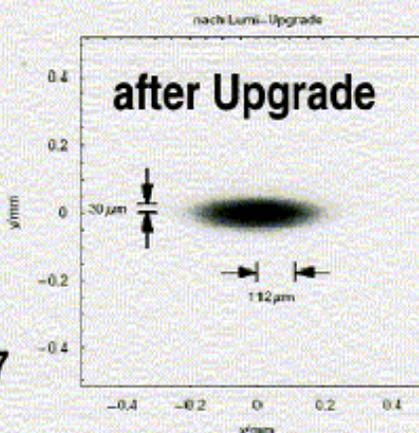
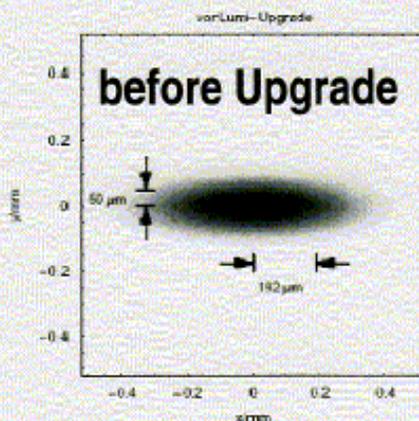
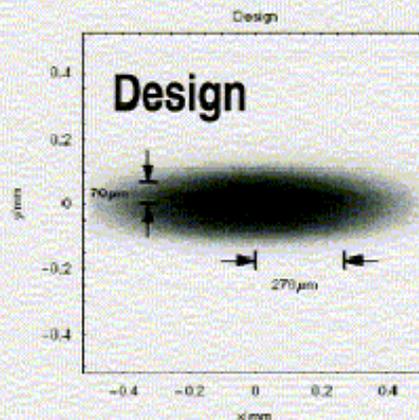
- combined function magnets (low Beta)
- early beam separation of e,p
- Proton Quadrupoles as close as possible to experiments !

## Challenging:

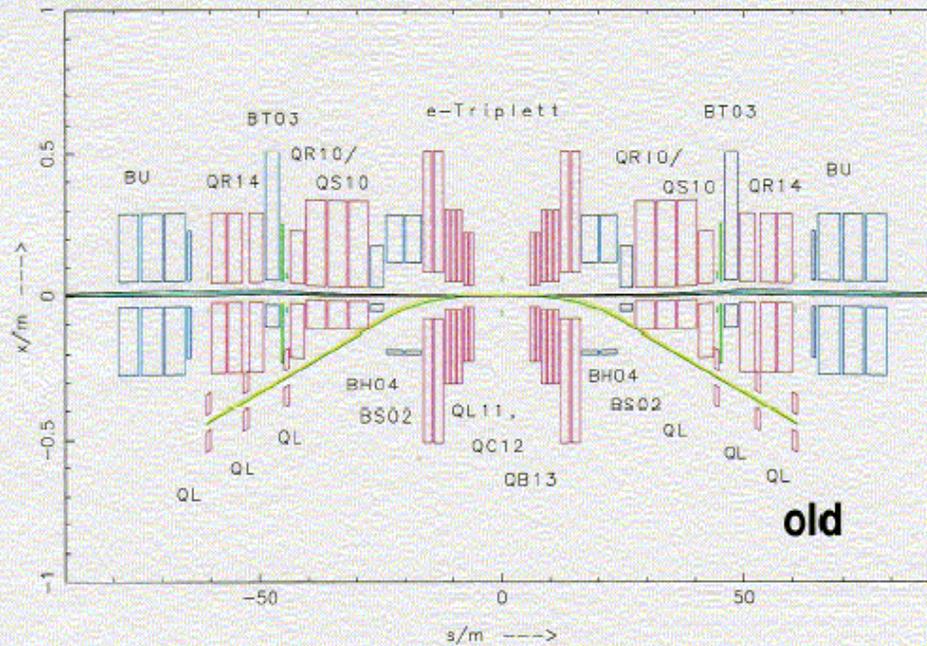
- Superconducting magnets (GO, GG) <sup>BNL</sup> very close to experiments
- Synchrotronlight power increased
- Synchrotron light has to go through the experiment
- Magnets are within the field of detector solenoid

! Polarization

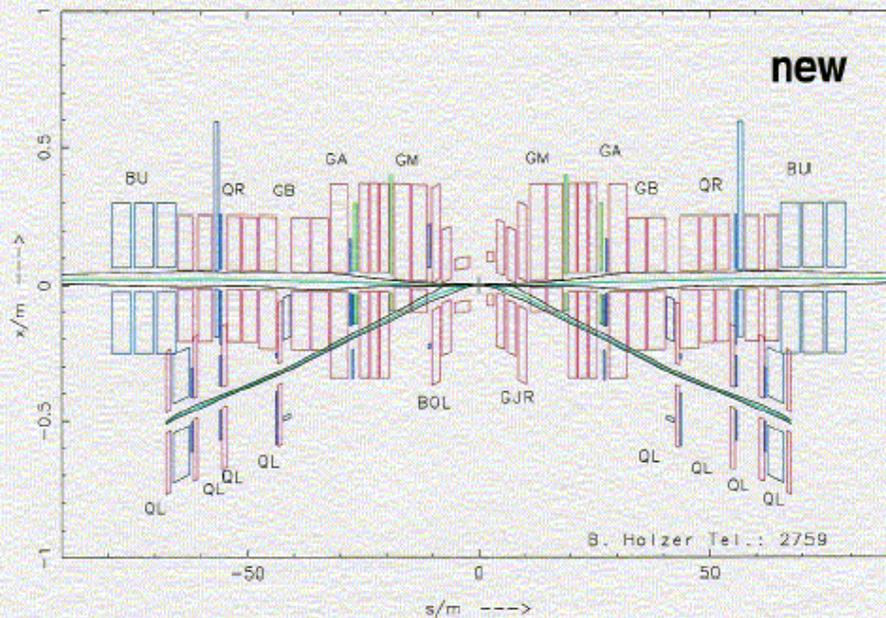
→ Specific Luminosity → 2.8  
→ with design currents → 4.7



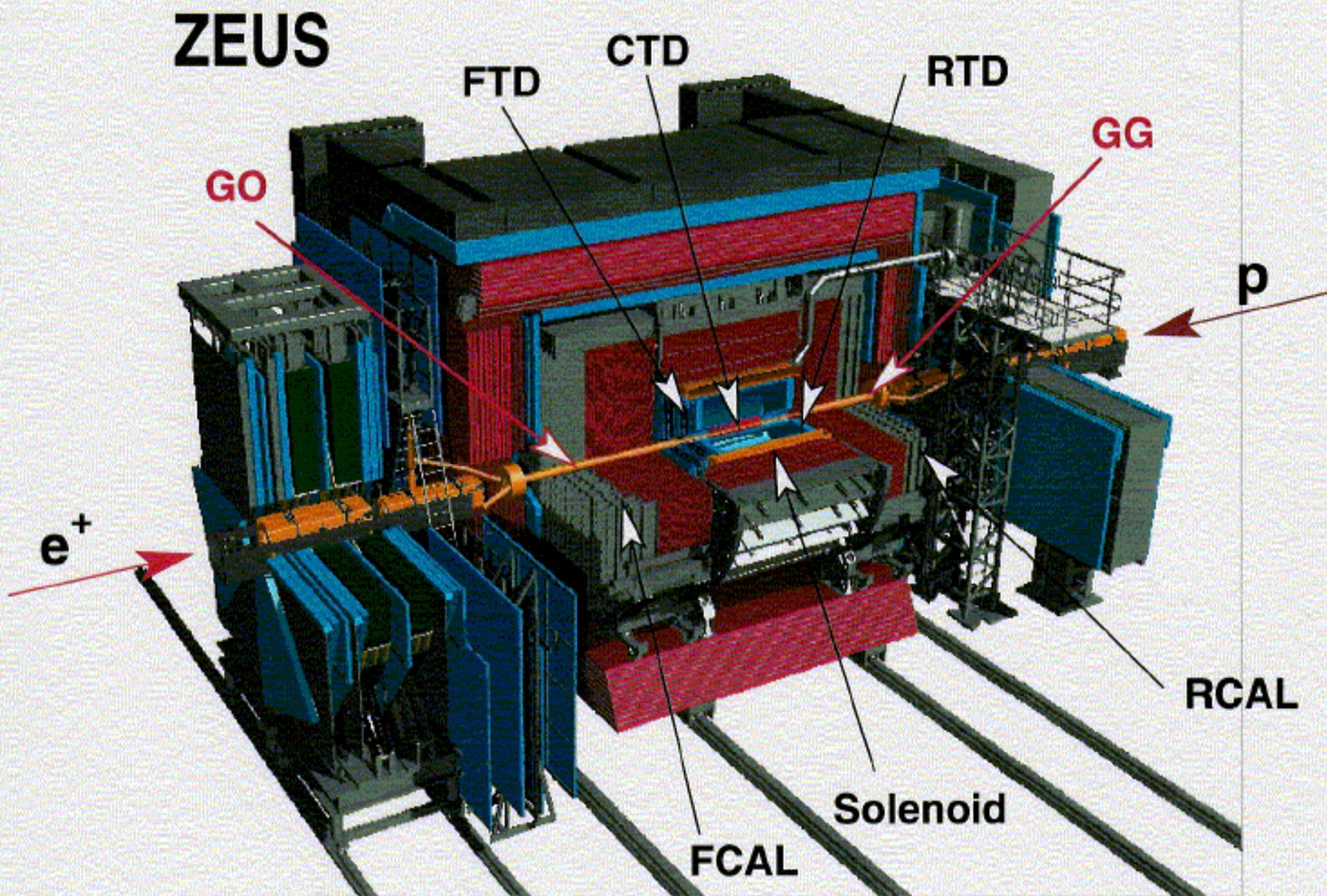
HERA-WECHSELWIRKUNGSZONE



HERA neue Wechselwirkungszone

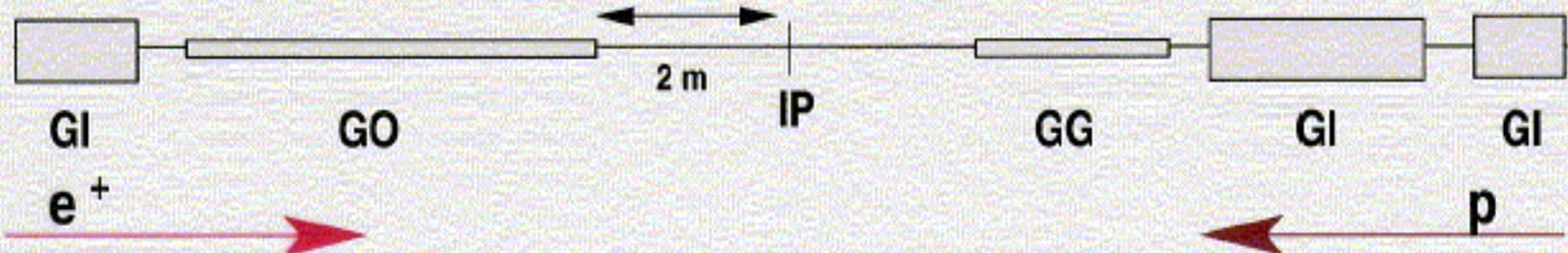
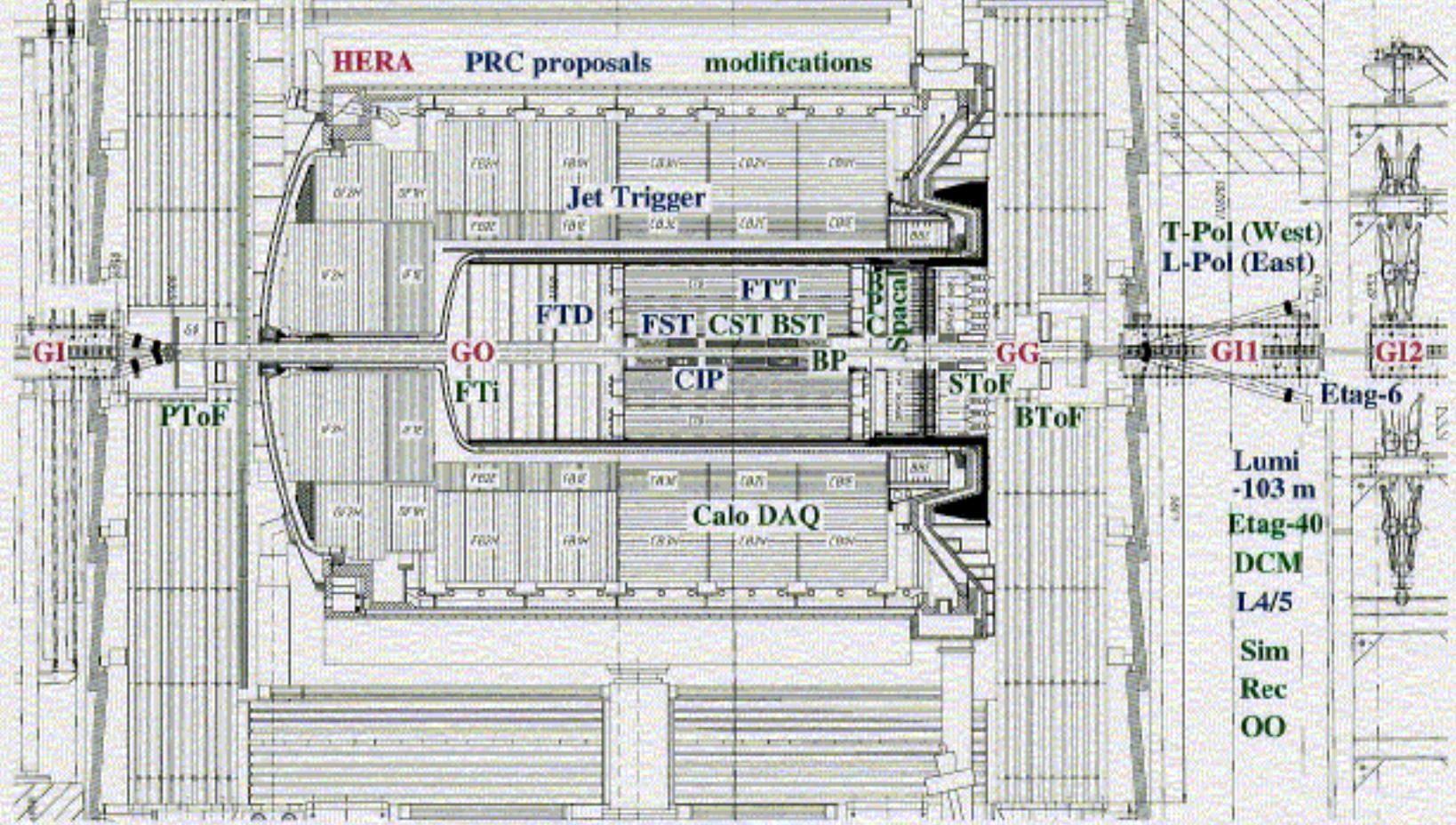


# ZEUS

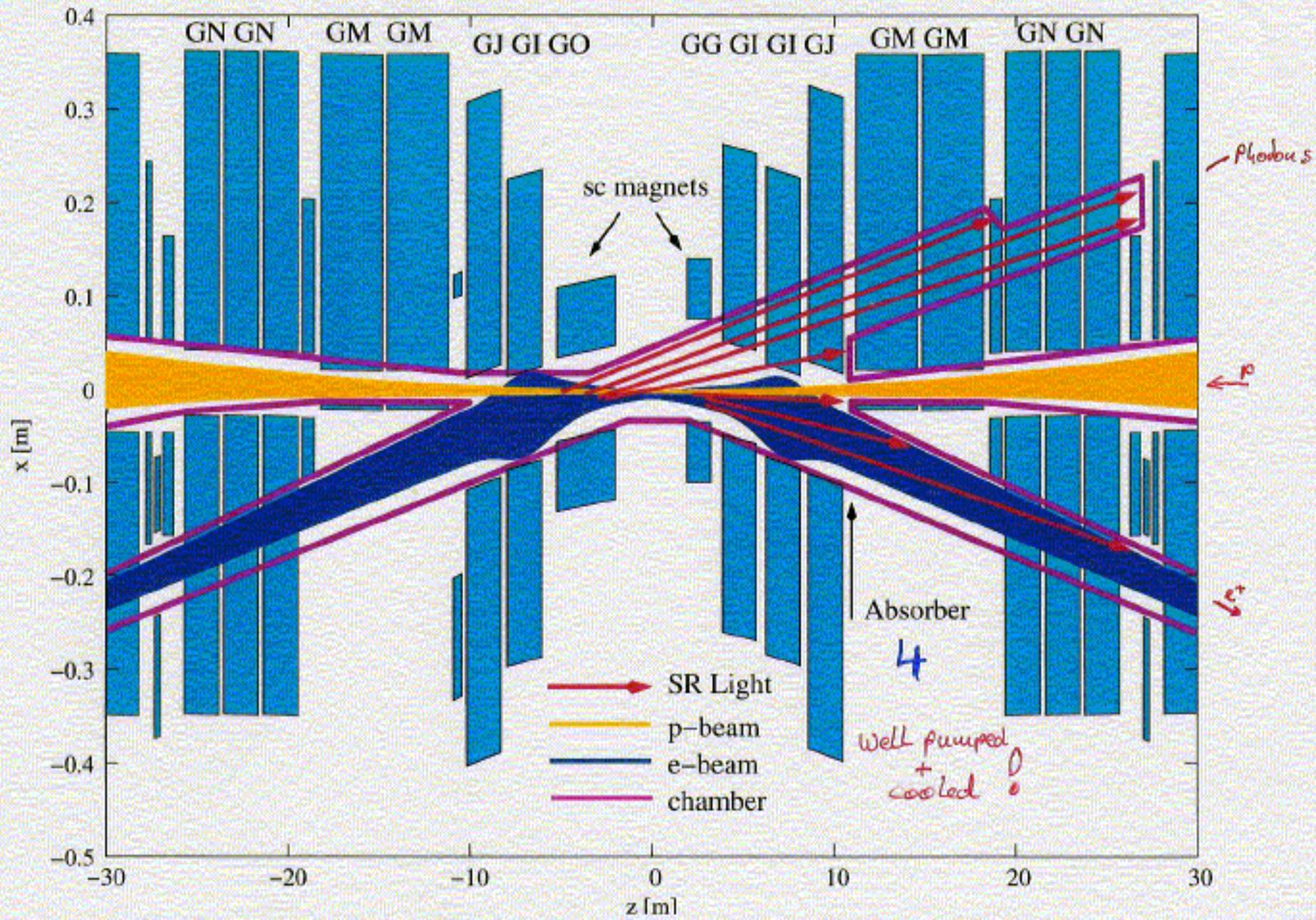


# H1

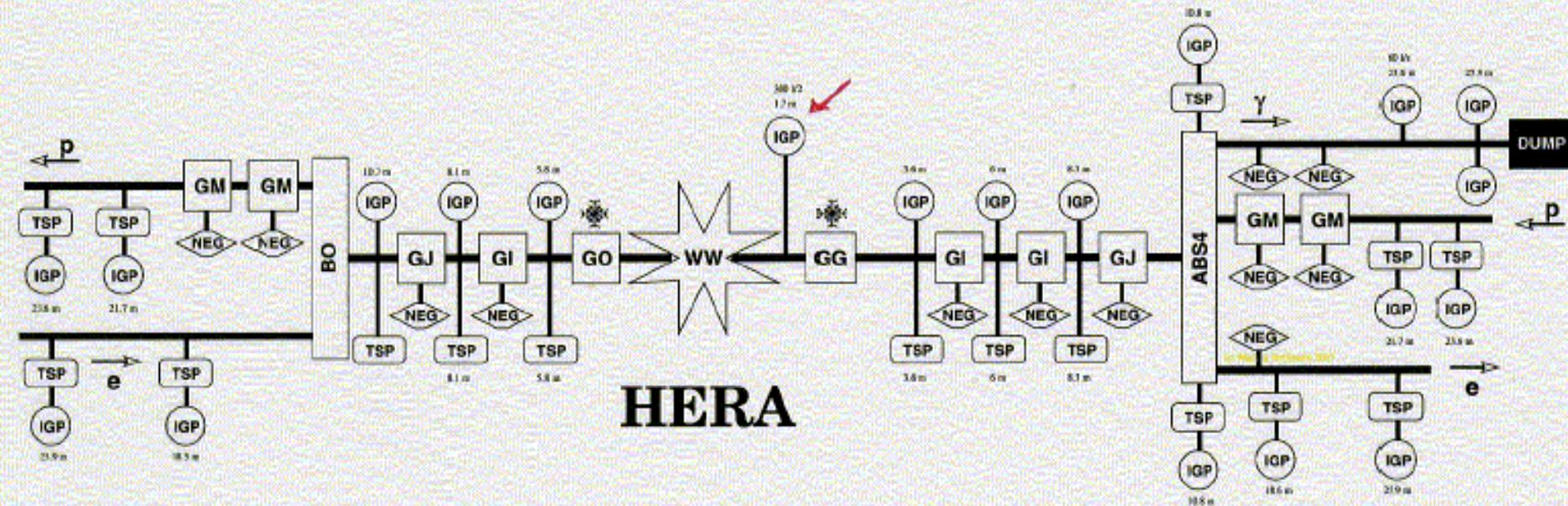
FNC 106 m  
FPS 60-90 m  
VFPS 220 m



# HERA IP region

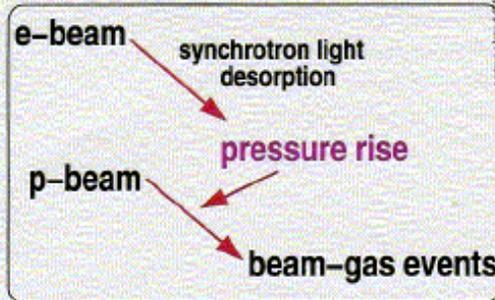


# Vacuum System of IP Region



# Background at Experiments

## Mechanism:

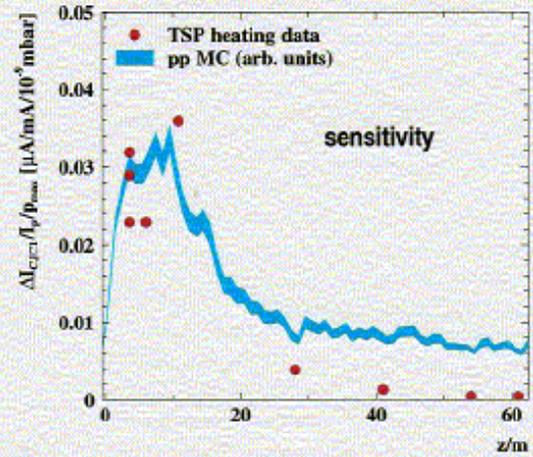
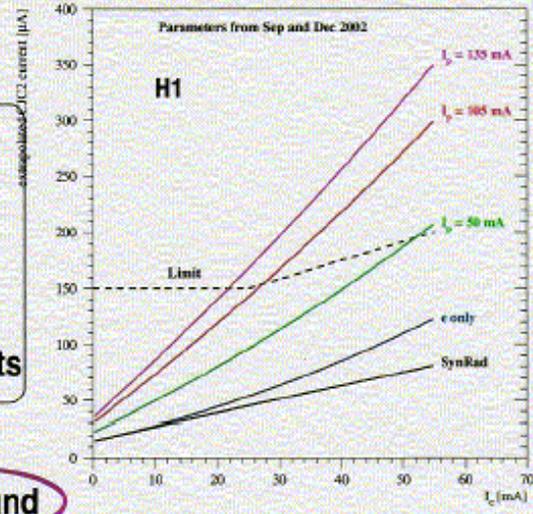


direct synchrotron light  
collimated steering under control

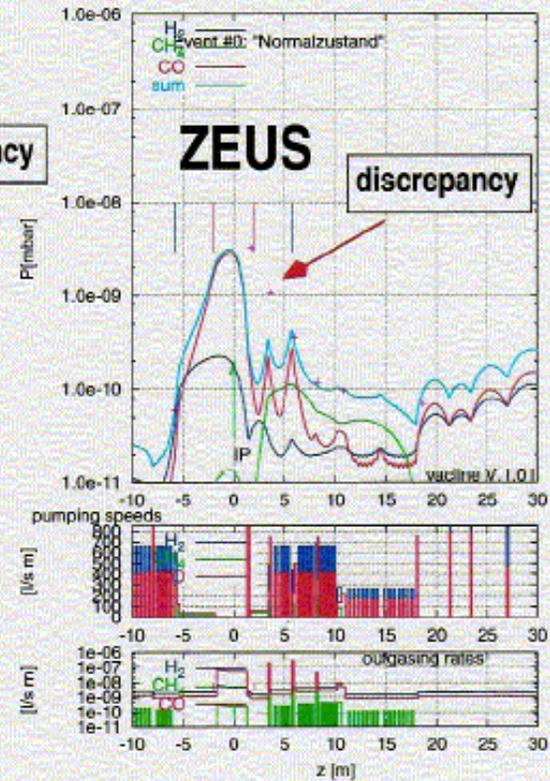
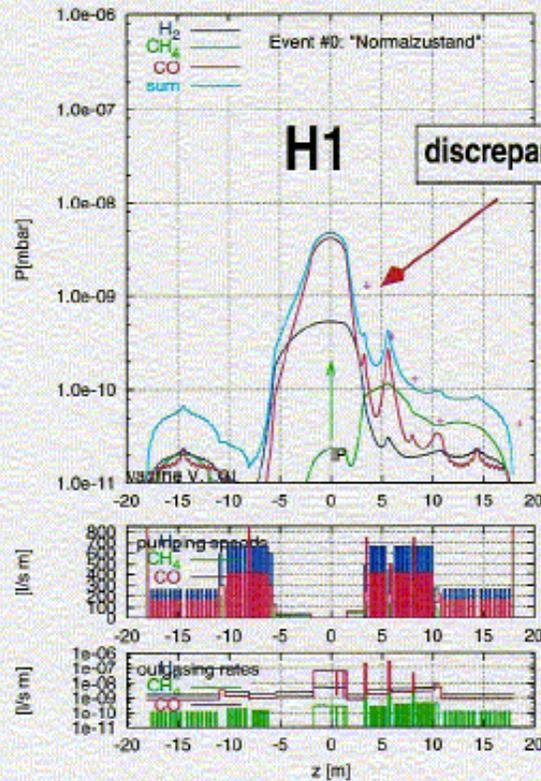
experiments are now a factor 1.6 more sensitive (by geometry) than before upgrade !

extreme requirements on the vacuum in the Interaction Region

chamber current dependency



# Pressure Profile Calculation

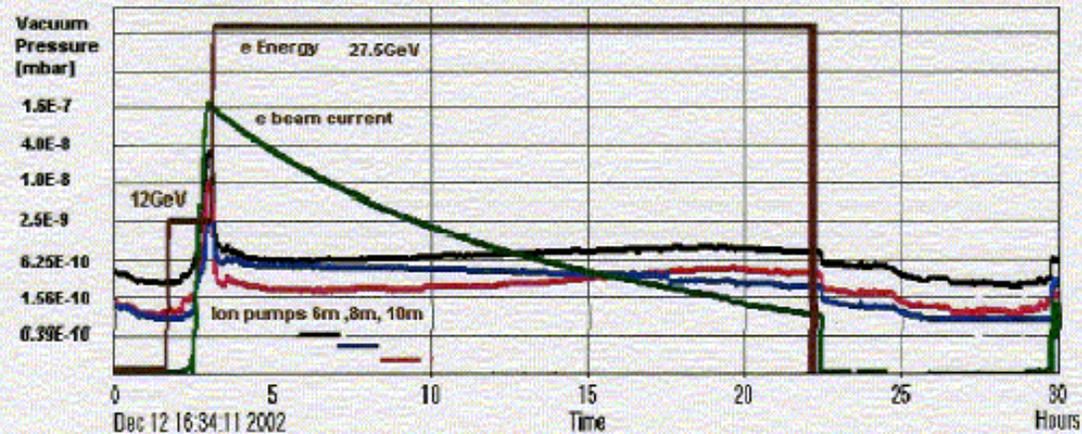


methane ?

cold magnets ?

other species ?

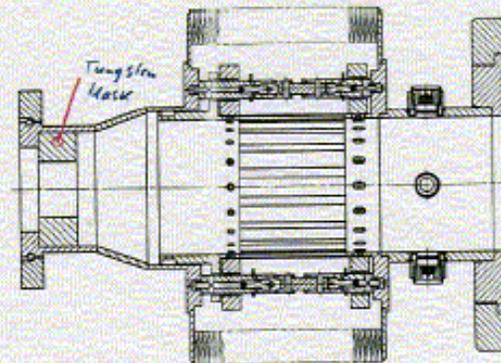
# Pressure Rise during an $e^+$ -only Run



Outgassing of species with high Z ?

- At injection:  
Higher Order Mode Heating ?  
EM calculations  
**not really understood !**

Tapering of collimator

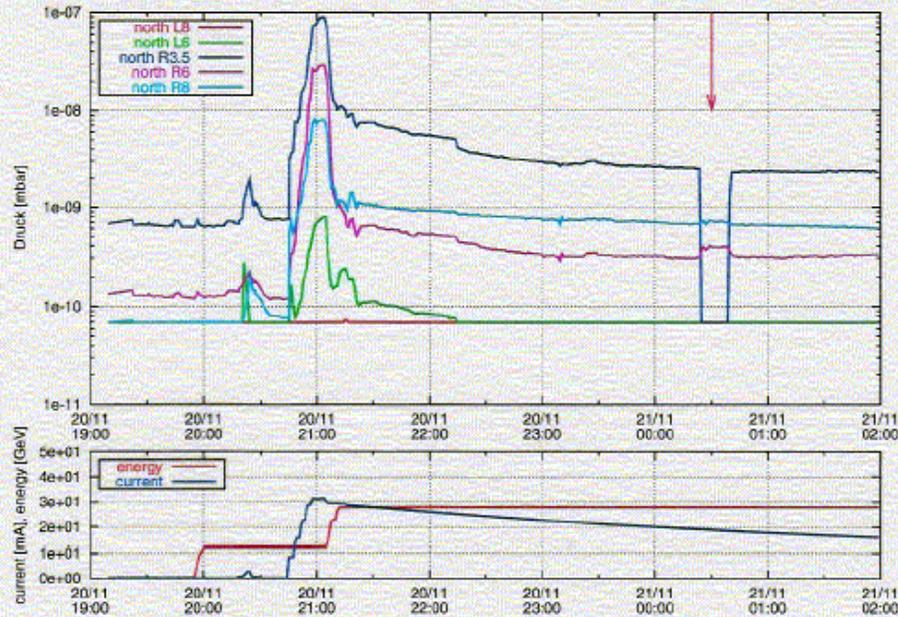
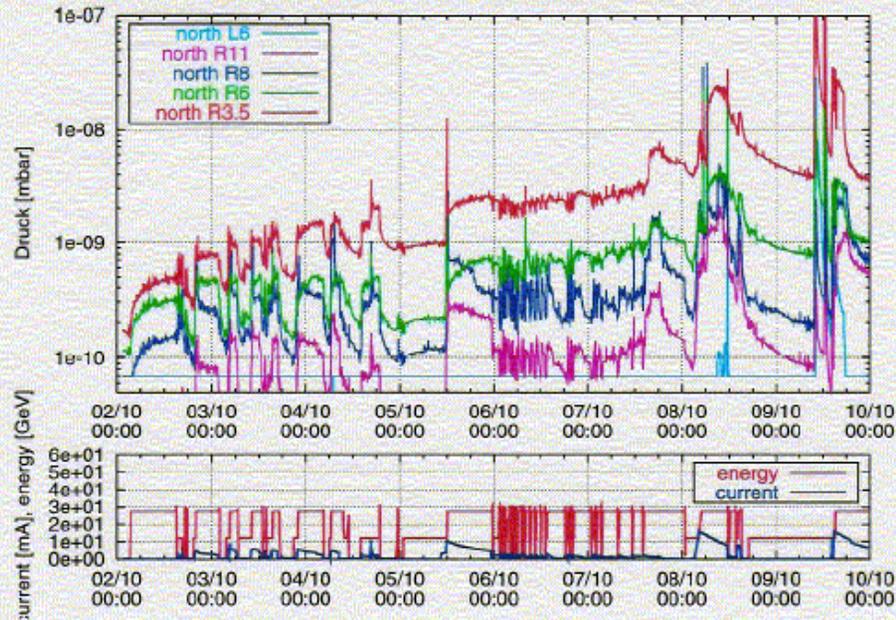


- Negative dynamic Pressure ?

Warming up of magnets

obscure effect &  
pile up !

# HOM heating (H1)



# Vacuum conditioning

TSP heating

baking out with synchrotron radiation

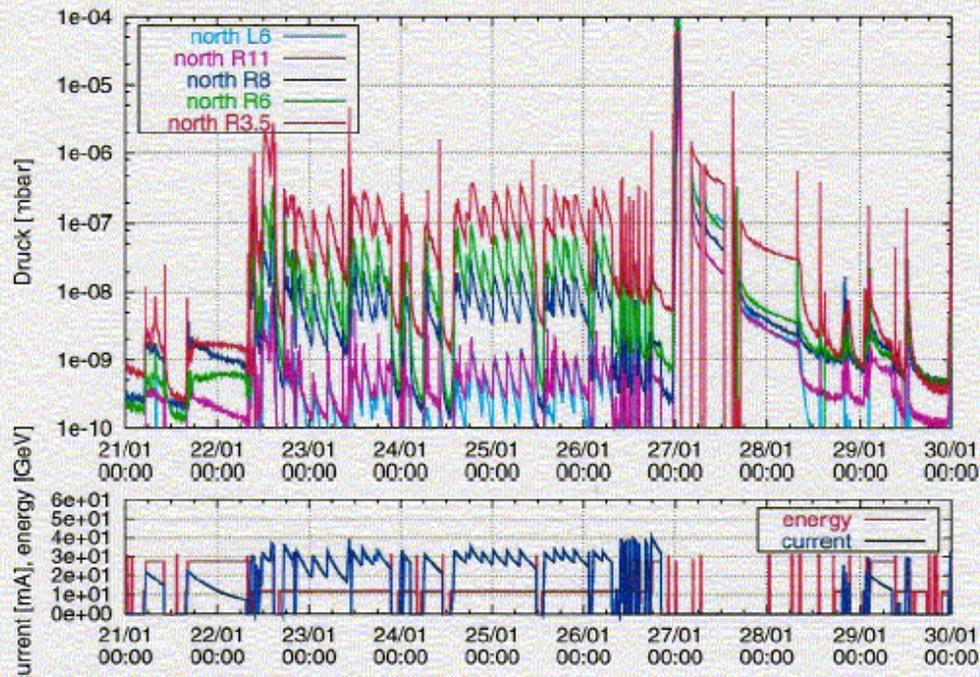
NEG activation

baking out with HOM heating

warming up cold magnets

(12 GeV, high currents)

1 week conditioning



HOM-heating of GG/GO flanges



outgassing saturates *very (!) slow*

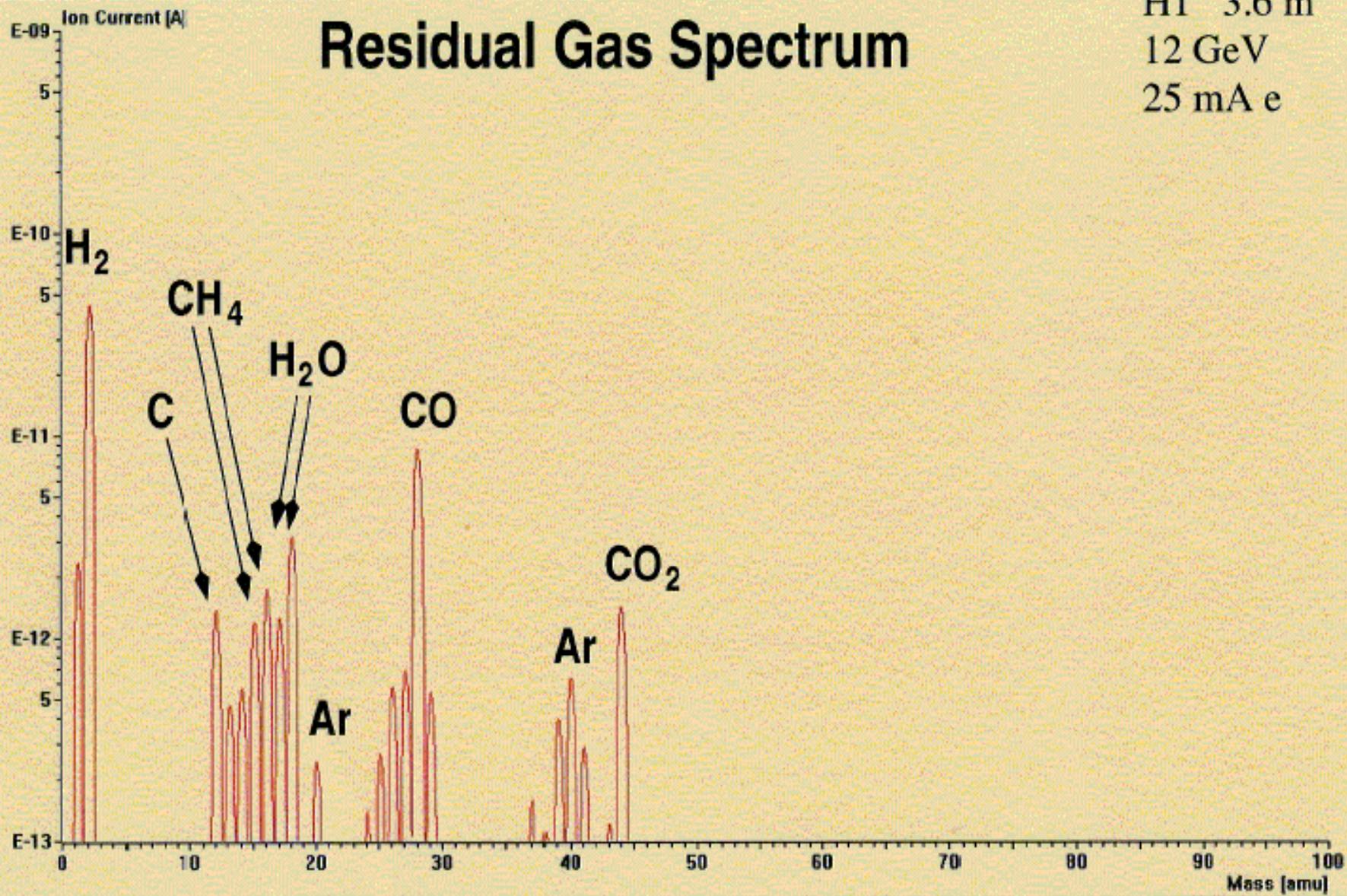
?

species with high binding energy  
or  
complicated mechanism

?

# Residual Gas Spectrum

H1 3.6 m  
12 GeV  
25 mA e



# Pressure at IP region

*very speculative!*

Complicated mechanism:

HOM-heating

cold magnets

desorption

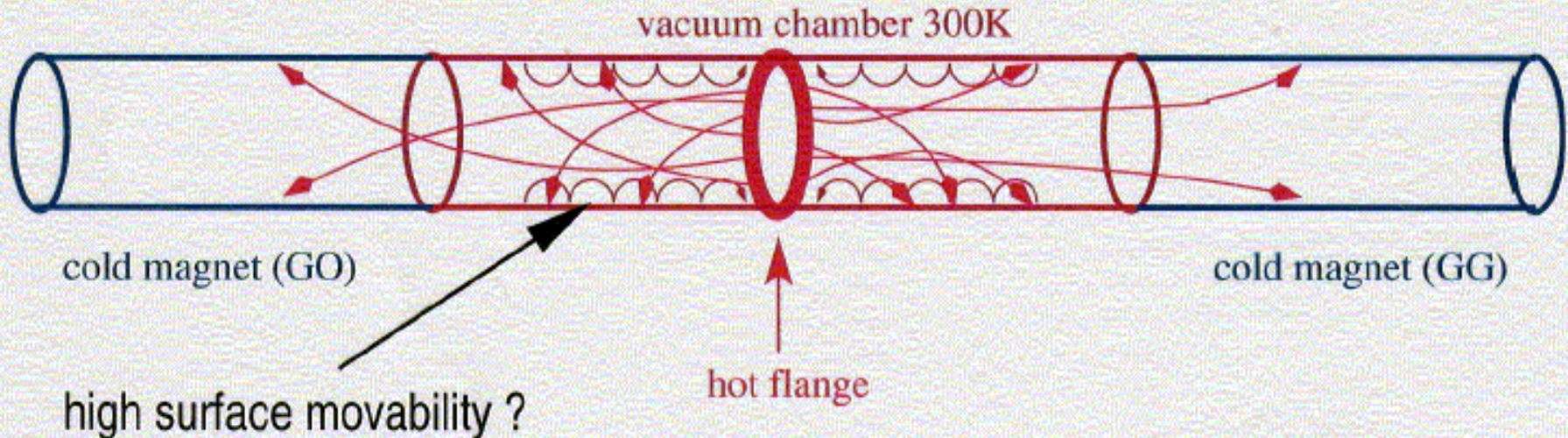
12 GeV

27.5 GeV

**measured:**

- temperature increase at GG and GO flanges (a very hot Mask at H1)
- very high pressure increase at 12 GeV

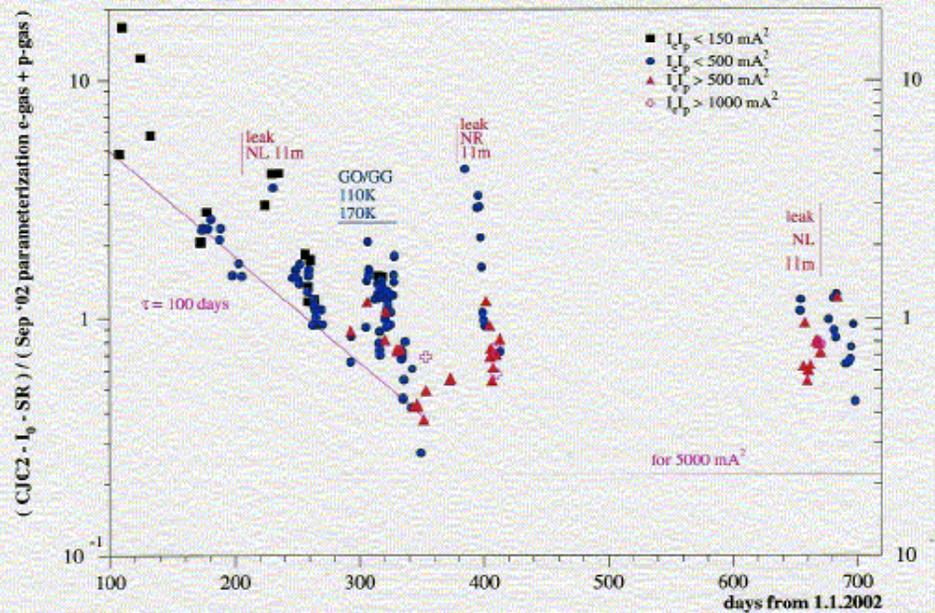
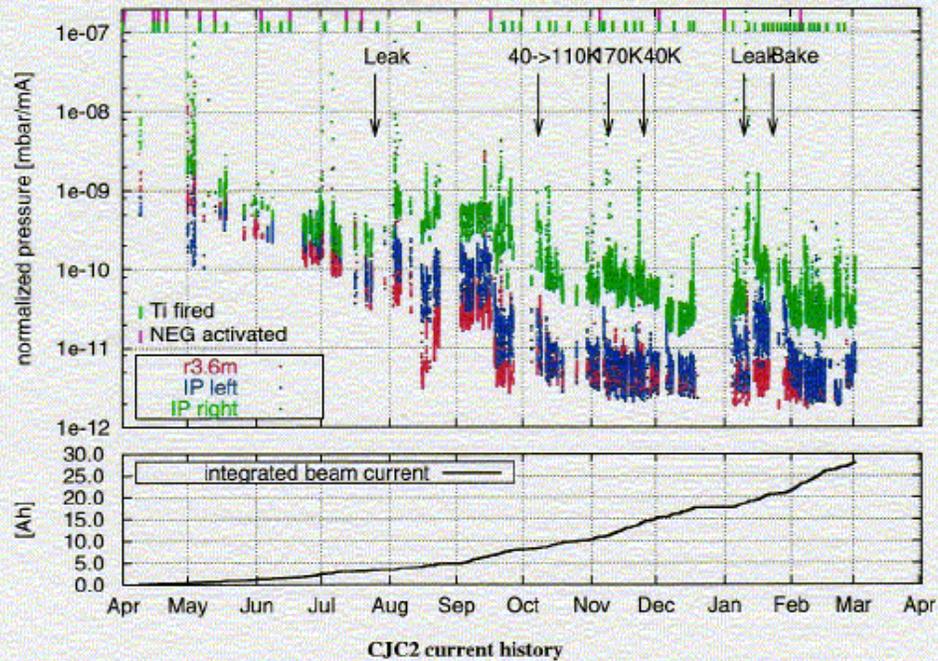
source of background at 27.5 GeV ?



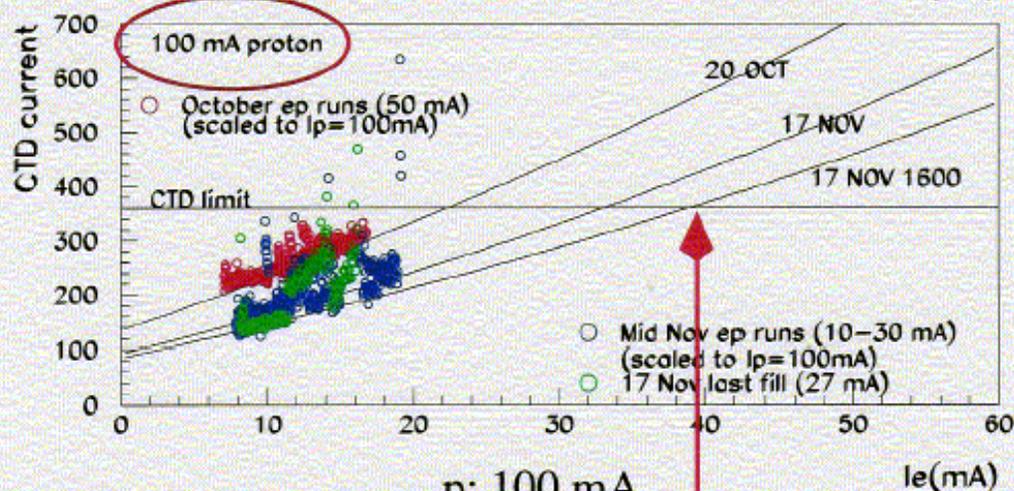
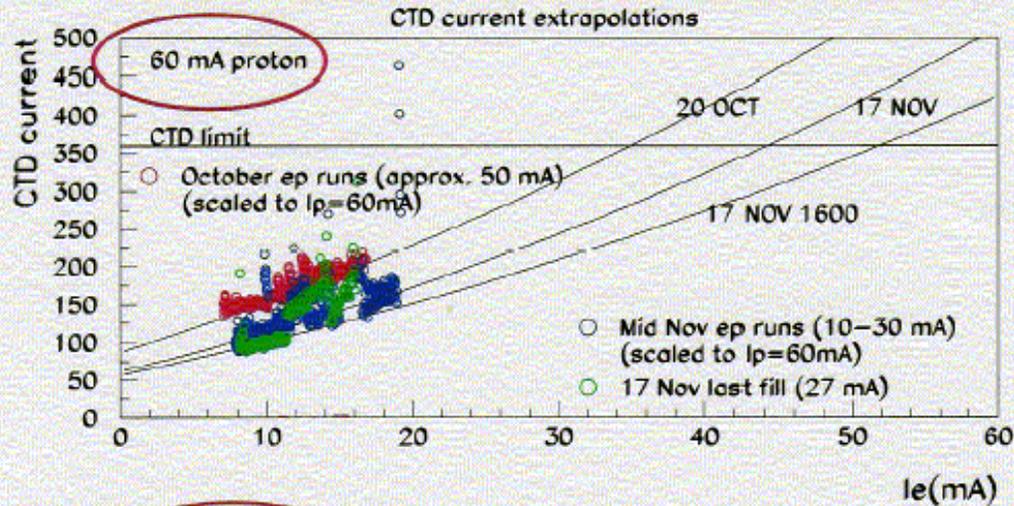
to be studied ...



# Background and Pressure



# ZEUS Background Extrapolation



p: 100 mA

e: 38 mA

very close to design currents !

## conclusions

- Unexpected high p-gas Background after Upgrade
- Very high demand of a good vacuum at interaction region
- High synchrotron light power has to be absorbed without pressure rises and high chamber temperatures which can produce leaks at flanges
- Pressure rises with HOM and cold surfaces mechanism is not very well understood
- Shutdown modifications increased pumping speed
- **Background situation for the experiments now promising !**
  - further conditioning of the vacuum system still a factor 2 required !
- Still temperature Problems limit e+ current