Backgrounds in H1

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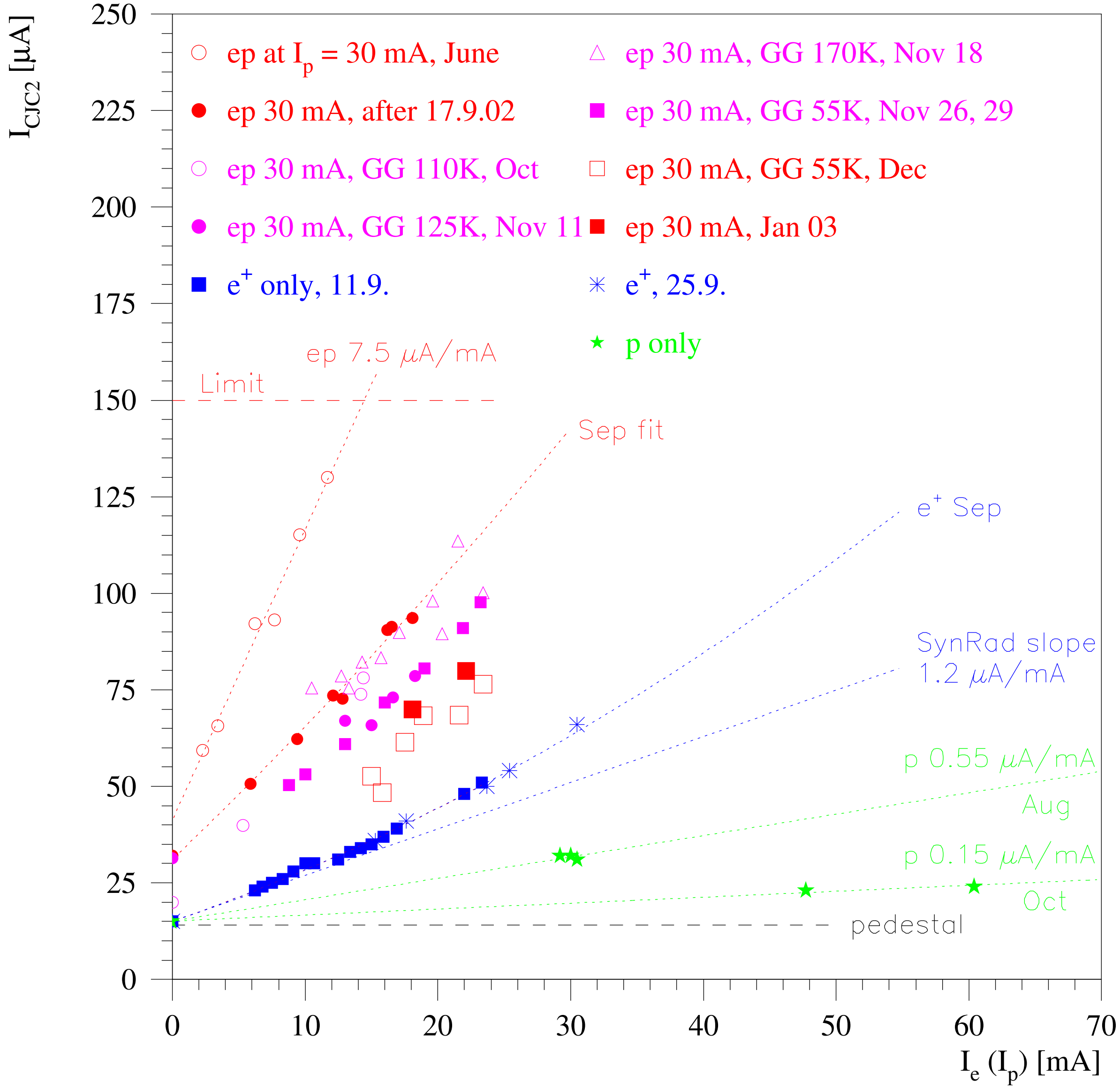
HERA Background review, 17.1.2003

- Chamber currents
- Injection studies
- Beam pipe temperature
- Remedies

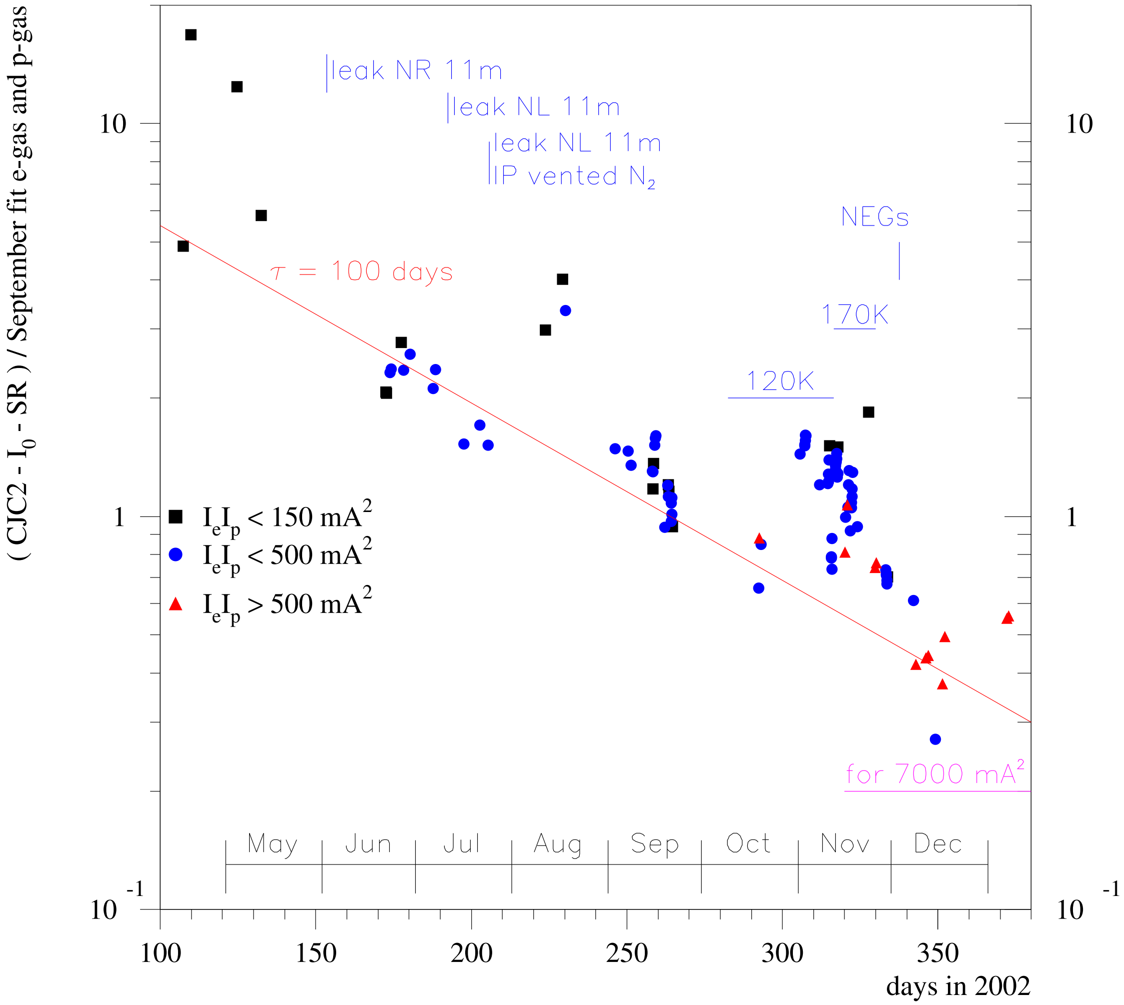
Chamber current vs beam current



- Factor 2 improvement from Sep to Dec.
- Stable operation up to $I_e \cdot I_p = 900\,\mathrm{mA}^2$.
- GO/GG beam pipe at 110 and 170 K not beneficial.
- e^+-only not investigated again.

Chamber current history

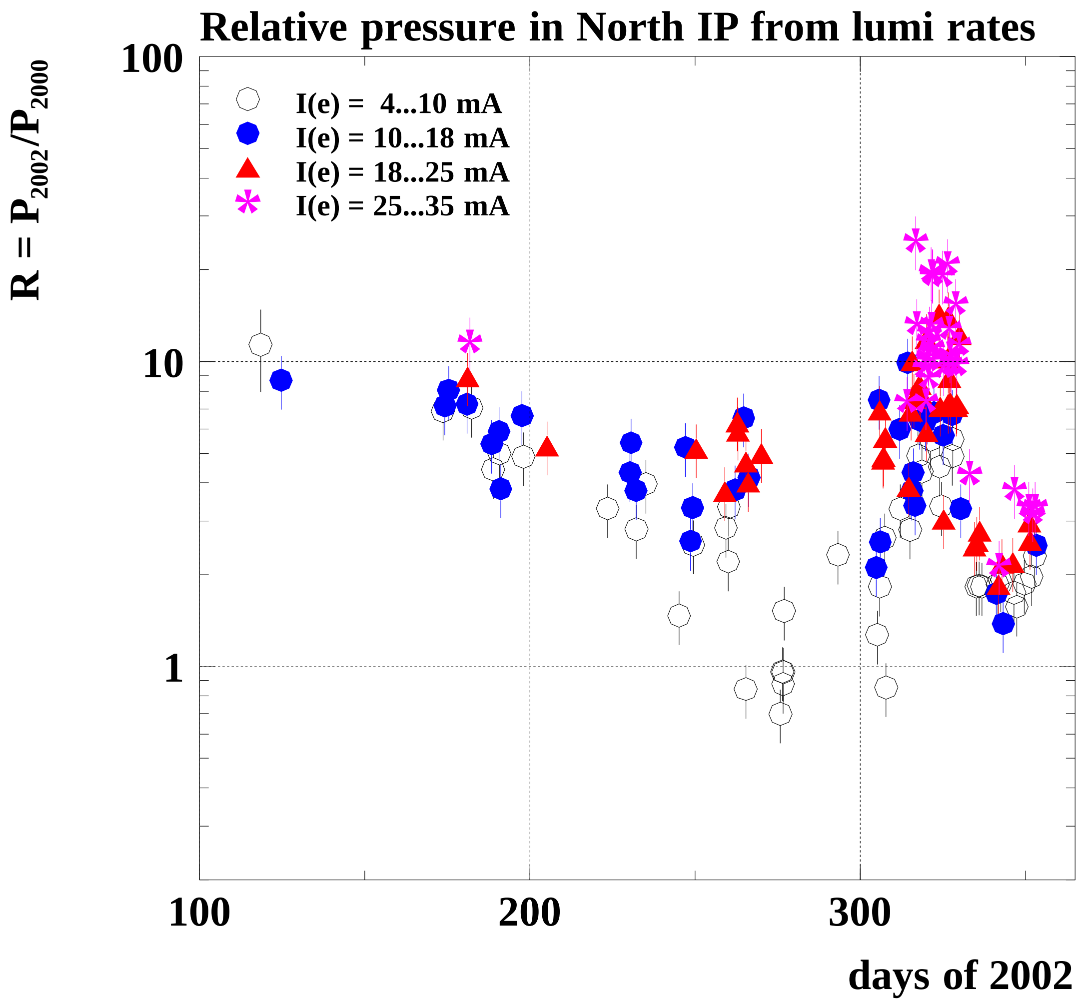
CJC2: pedestal and SynRad subtracted.
normalized to Sep 2002 fit:



- Long-term improvement by factor ≈ 20 with $\tau \approx 100$ days.
- Trend interrupted by venting in July and operating at higher GO,GG beam pipe temperatures in Oct/Nov.
- Flange leak on Sun 12.1.2003: beam pipe ± 26 m vented. Flange tightened and sealed again.

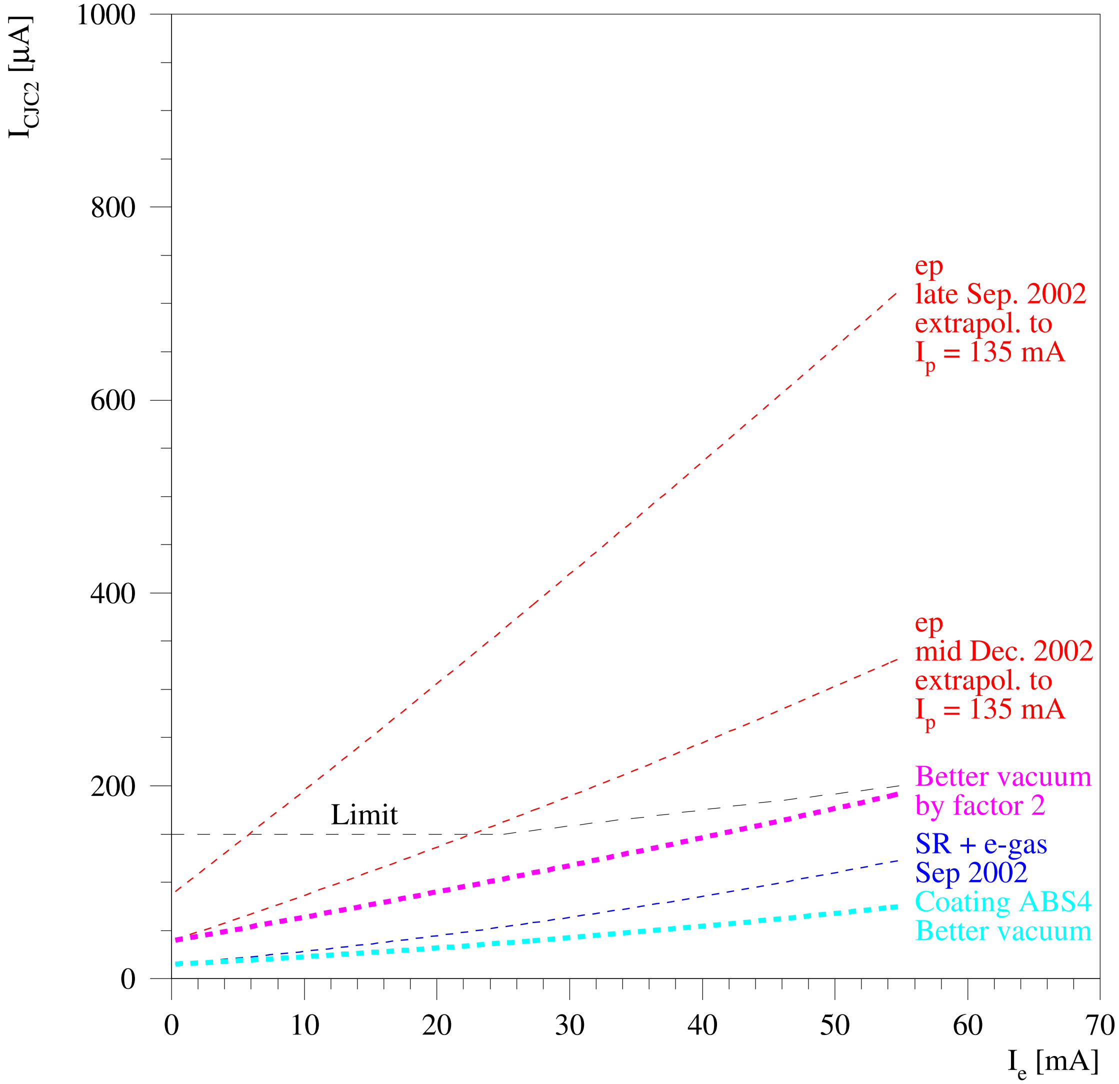
Lumi runs, full HV, after BG tuning.

Pressure history



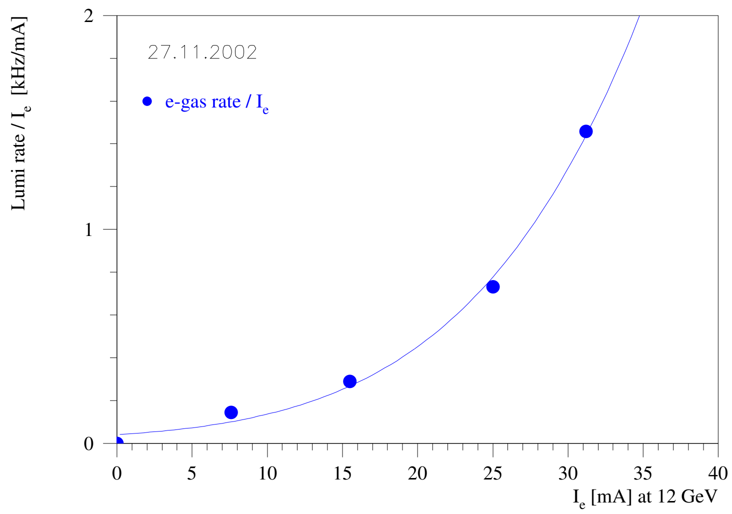
- Derived from e-gas Bremsstrahlung rate with pilot bunches.
- Measures the average pressure within ± 2 m around the IP.
- Long-term improvement by factor ≈ 8 with $\tau = 130$ days.
- Dec 2002: factor 2 above 2000 level for 25 mA at 27.5 GeV.
- Higher pressure with increased GO,GG beam pipe temperatures in Oct/Nov: cryo pump effect at 55 K.

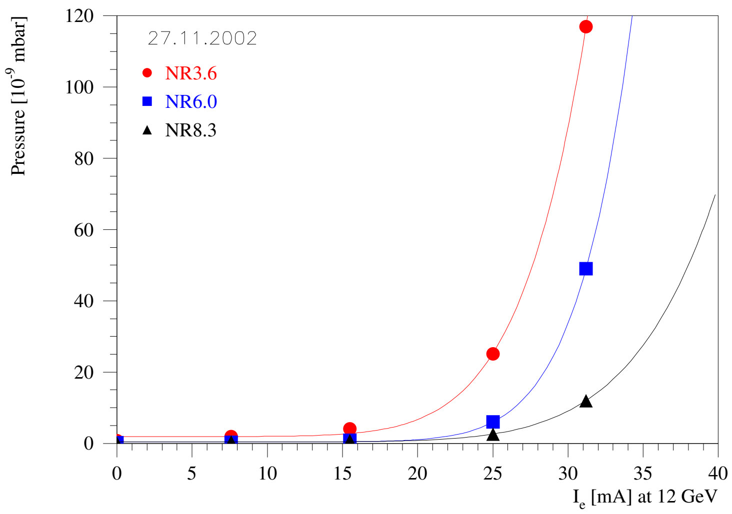
Extraction to $I_p = 135\,$mA



- Conditions from end Sep 2002 extrapolated to $I_p = 135\,$mA.
- Conditions from mid Dec 2002 extrapolated to $I_p = 135\,$mA.
- Improve vacuum by factor 2 everywhere
  Reduce SynRad by 1.7 (coating ABS4).
- e^+-only contribution Sep 2002.
- e^+-only contribution after improvements.
- Safety factor desired for more stable operation, and for e^- operation.

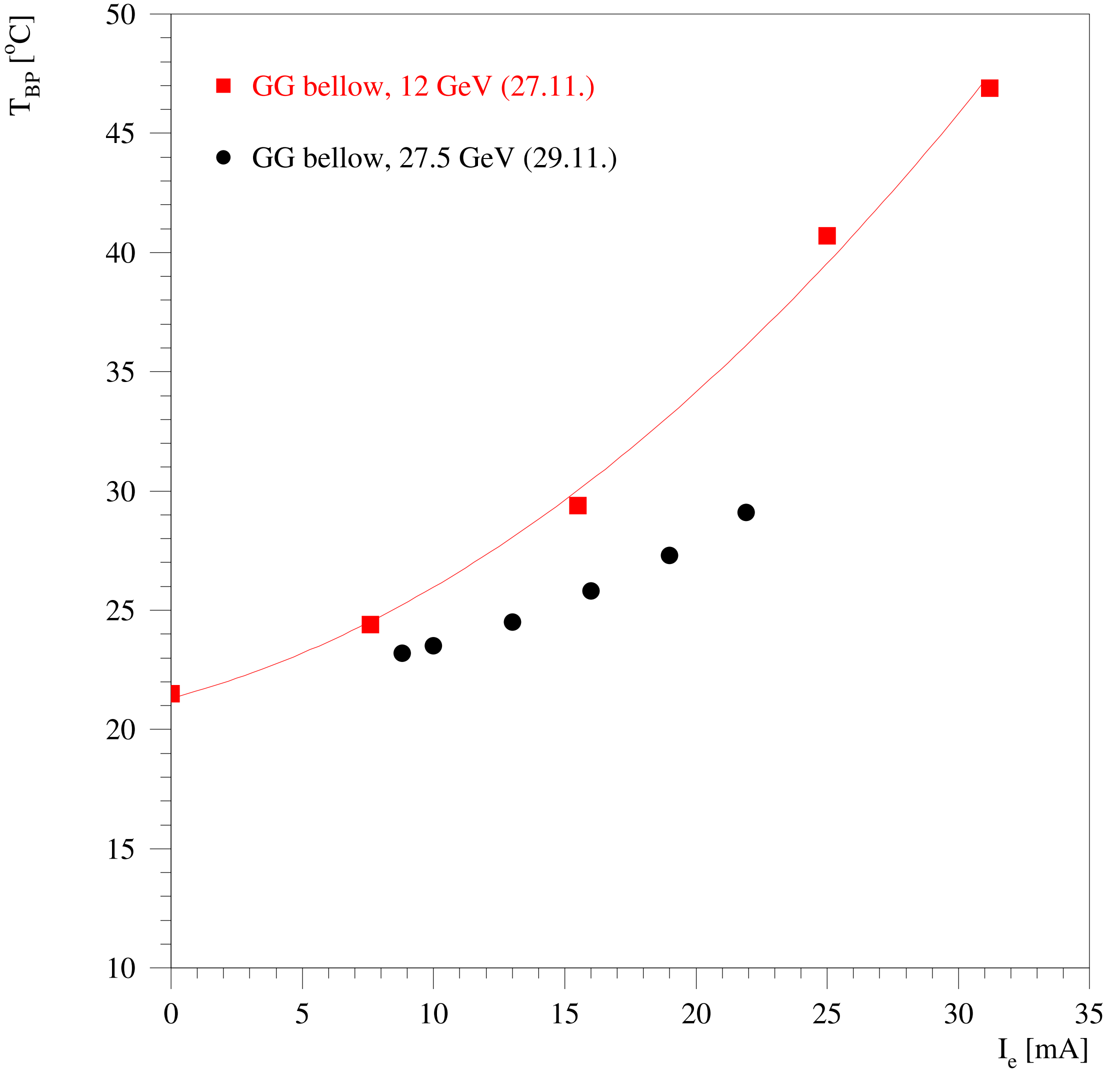
Pressure increase at 12 GeV





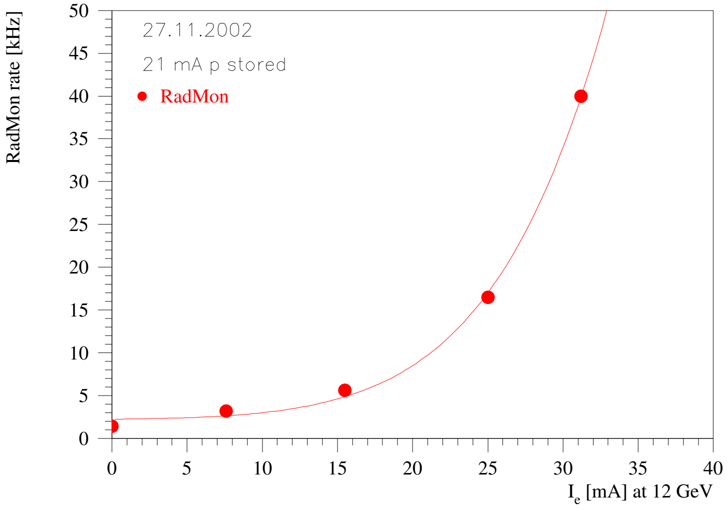
- Lumi rate measures pressure with ± 2 m of IP.
  Fit with Boltzmann factor.
- Pressure at IGPs NR3.6 to 8.3 m increases exponentially above 20 mA.

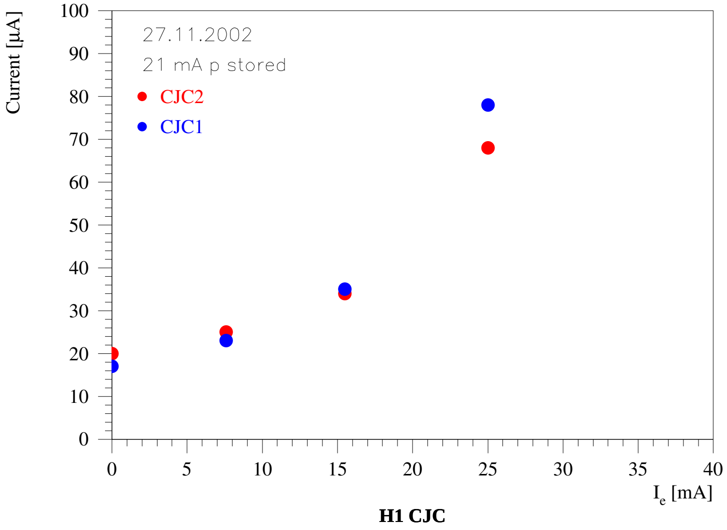
Beam pipe temperature



- H1 beam pipe warms up at injection with $\Delta T \sim I_e^2$.
- Hot spots are GO and GG transition bellows at $z = \pm 1.5$ m.
- At 27.5 GeV: gradual cool down with decreasing I_e.

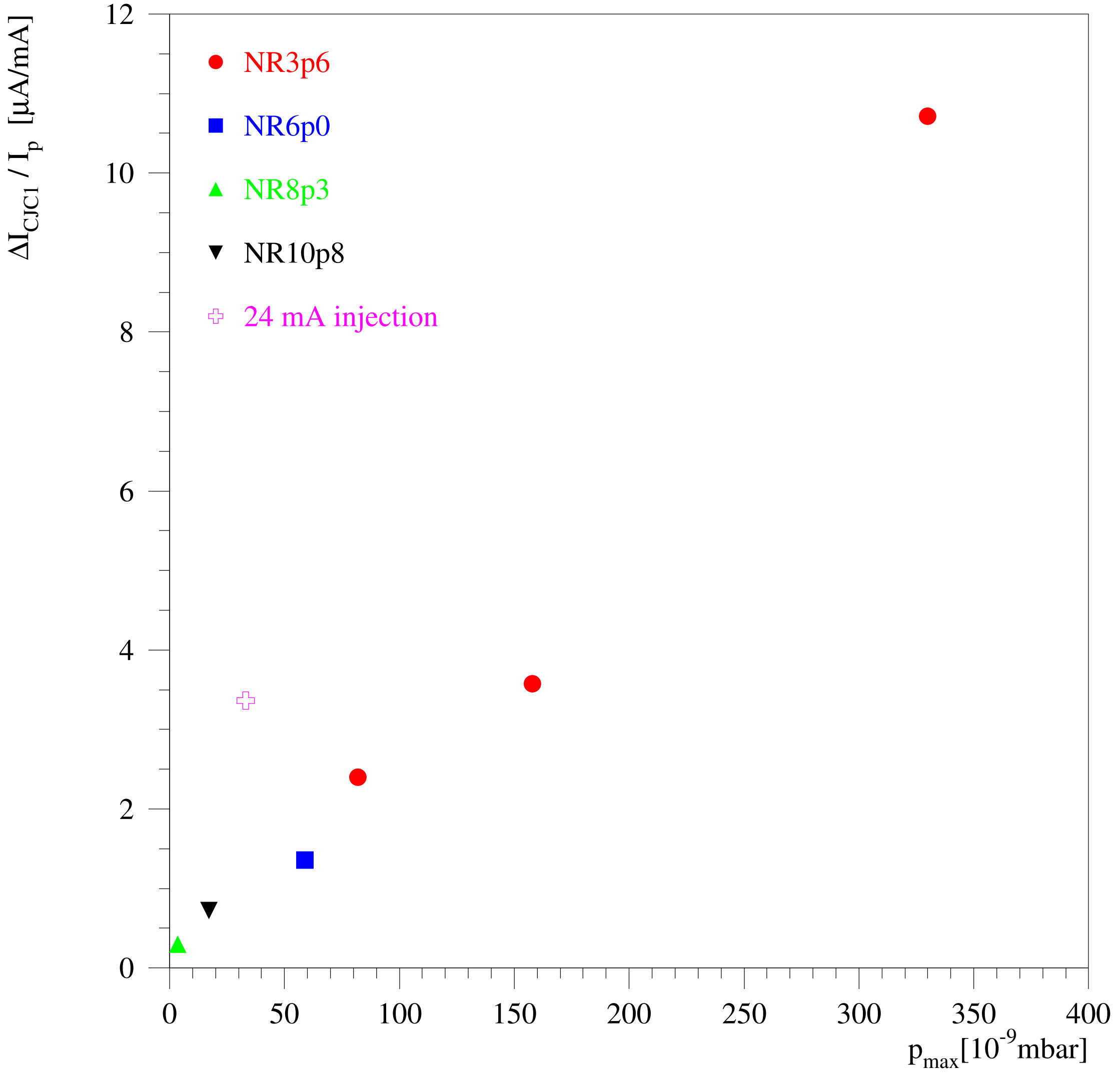
Backgrounds at 12 GeV





- Slow e^+ injection experiment with 21 mA p stored.
- Radiation monitor increases strongly, fit with Boltzmann factor.
  Warning level is 50 kHz.
- CJC current shows same trend.

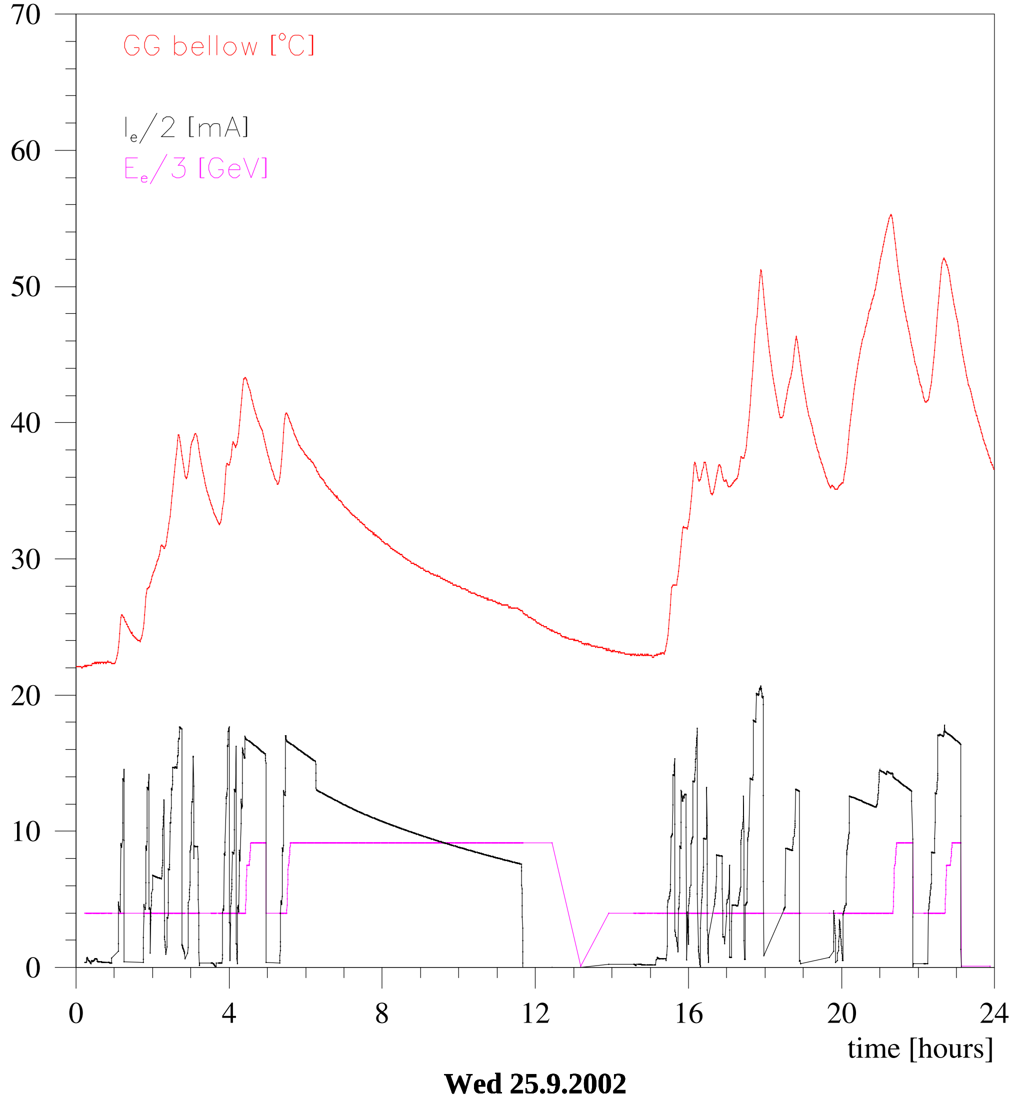
CJC1 in TSP heating and 12 GeV injection



- Sensitivity of CJC1 to local pressure peaks from TSP heating (H_2) with proton beam.
- Compare to pressure peak at 24 mA injection:
  - Extended region: IP to 11 m.
  - Released gas is heavier than H_2, e.g. H_2O, CO, or CH_4 (from multiplicity distribution).

  $\Rightarrow$ expect higher sensitivity.

Beam pipe temperature example

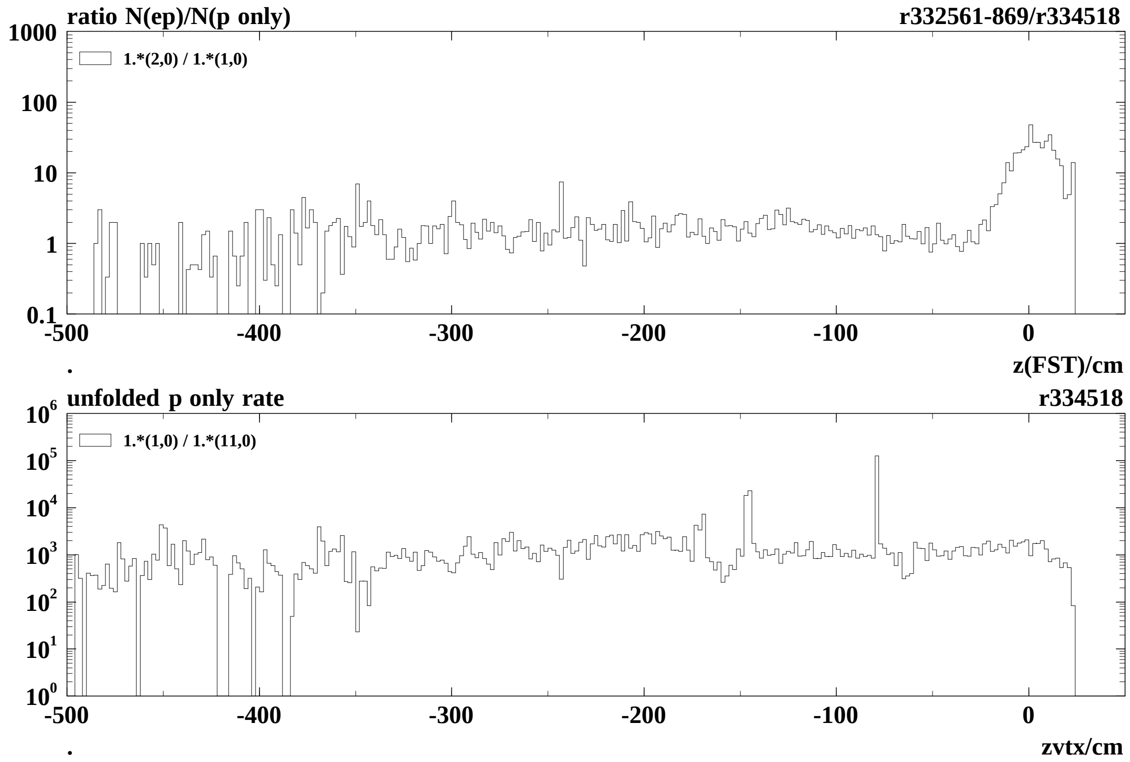


- Temperature rise time ≈ 0.5 h.
- Cool down as soon as E_e is ramped from 12 GeV.
- Faster cool down after beam dump.

$\Rightarrow$ Some beam heating also at 27.5 GeV.

BG study with the Forward Silicon Tracker

Extrapolate tracks from Forward Silicon Tracker back to beam line:

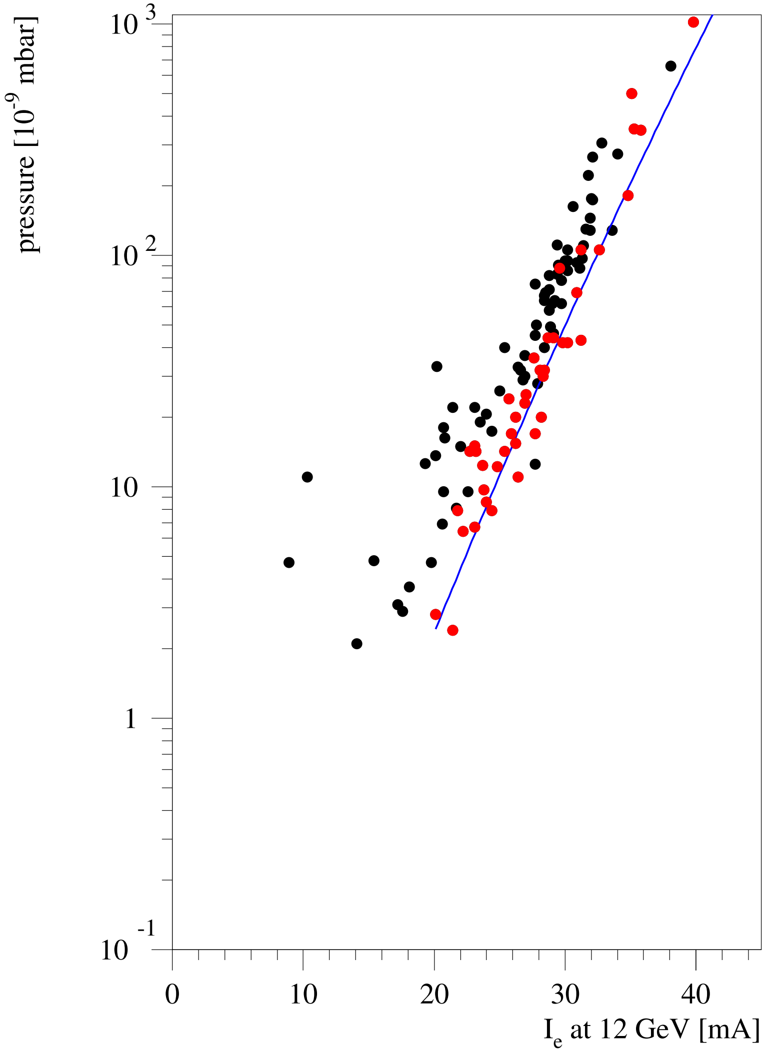


- Compare ep to p-only:
  - Peak at $z = 0$ from ep interactions.
  - No further bump out to $\approx -4\,\mathrm{m}$.

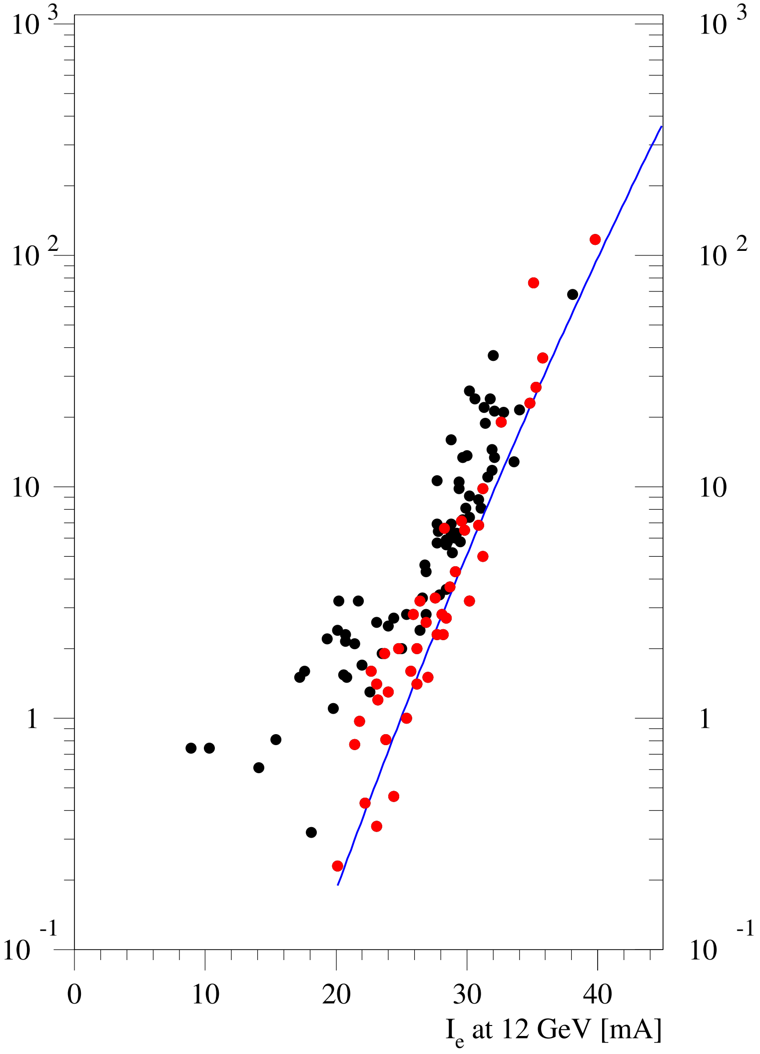
  $\Rightarrow$ No dominant local pressure peak inside H1, GG.

- Caveat: beam-gas and beam-wall interactions are not separated here.

Pressure peak at injection

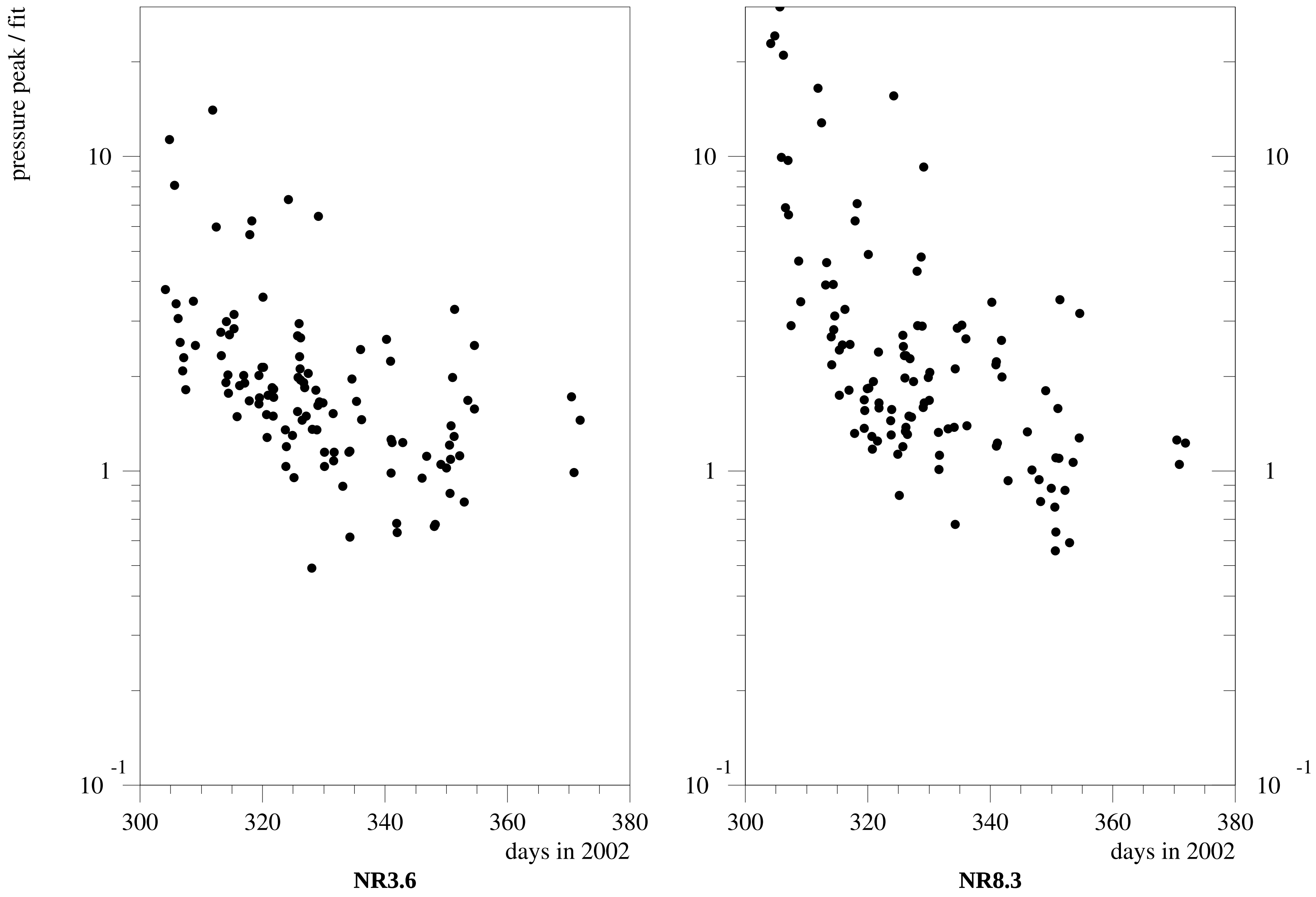


NR3.6

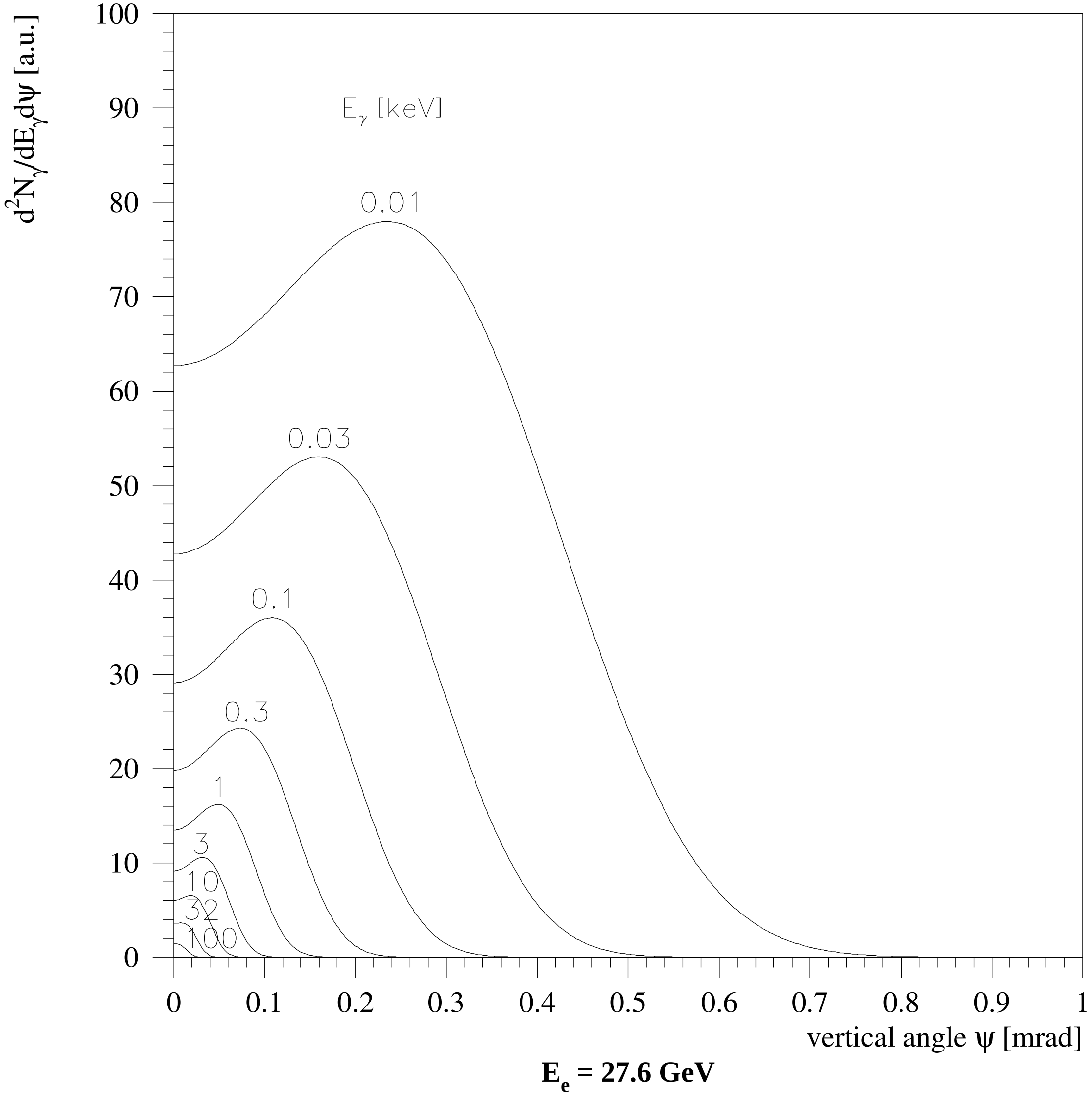


NR8.3

Pressure peak vs time Nov–Dec 2002



SynRad angular distribution



- Synchrotron radiation has intrinsic angular spread with

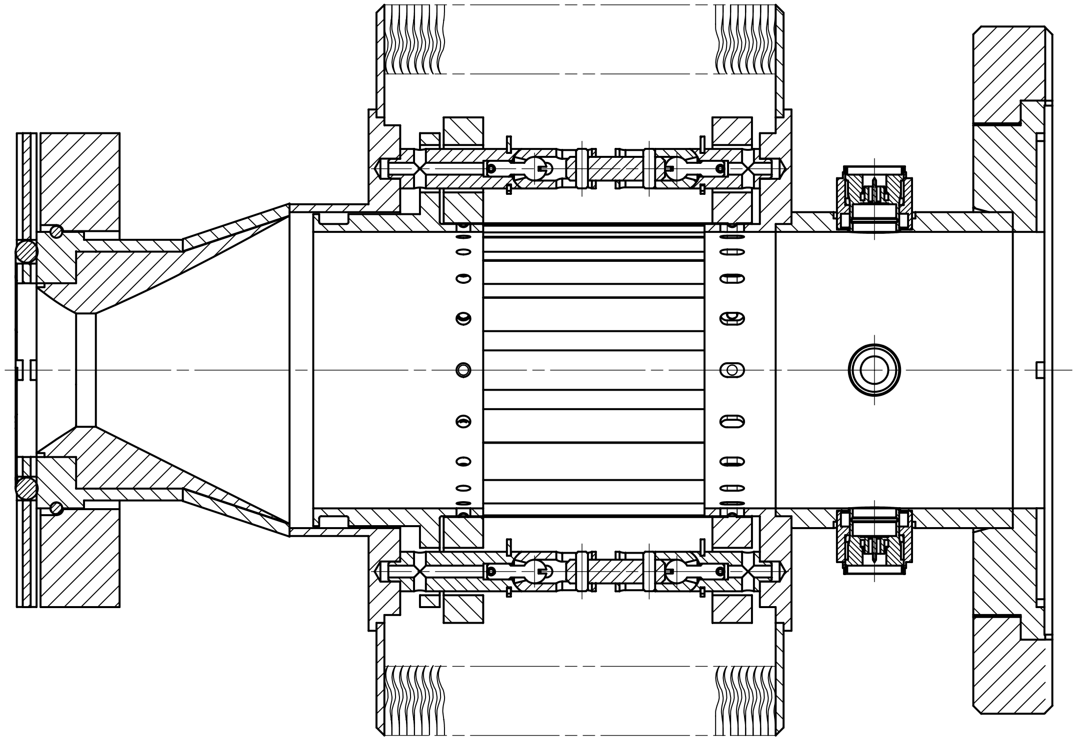
$$\psi_c = \frac{1}{\gamma}\left(\frac{E_c}{E_\gamma}\right)^{1/3}$$

$\Rightarrow$ $\psi_c = 0.02$ mrad at E_c (27.5 GeV).

$\Rightarrow$ $\psi_c = 0.4$ mrad at $10^{-4}\,E_c$.

- Compare to beam spread $\sigma_{y'} = 0.08$ mrad maximal at IP.
- ψ_c is neglected in SynRad tracking.
- Soft, wide angle SynRad may cause photodesorption in keyhole chamber $z = -3.6$ to -10.8 m.

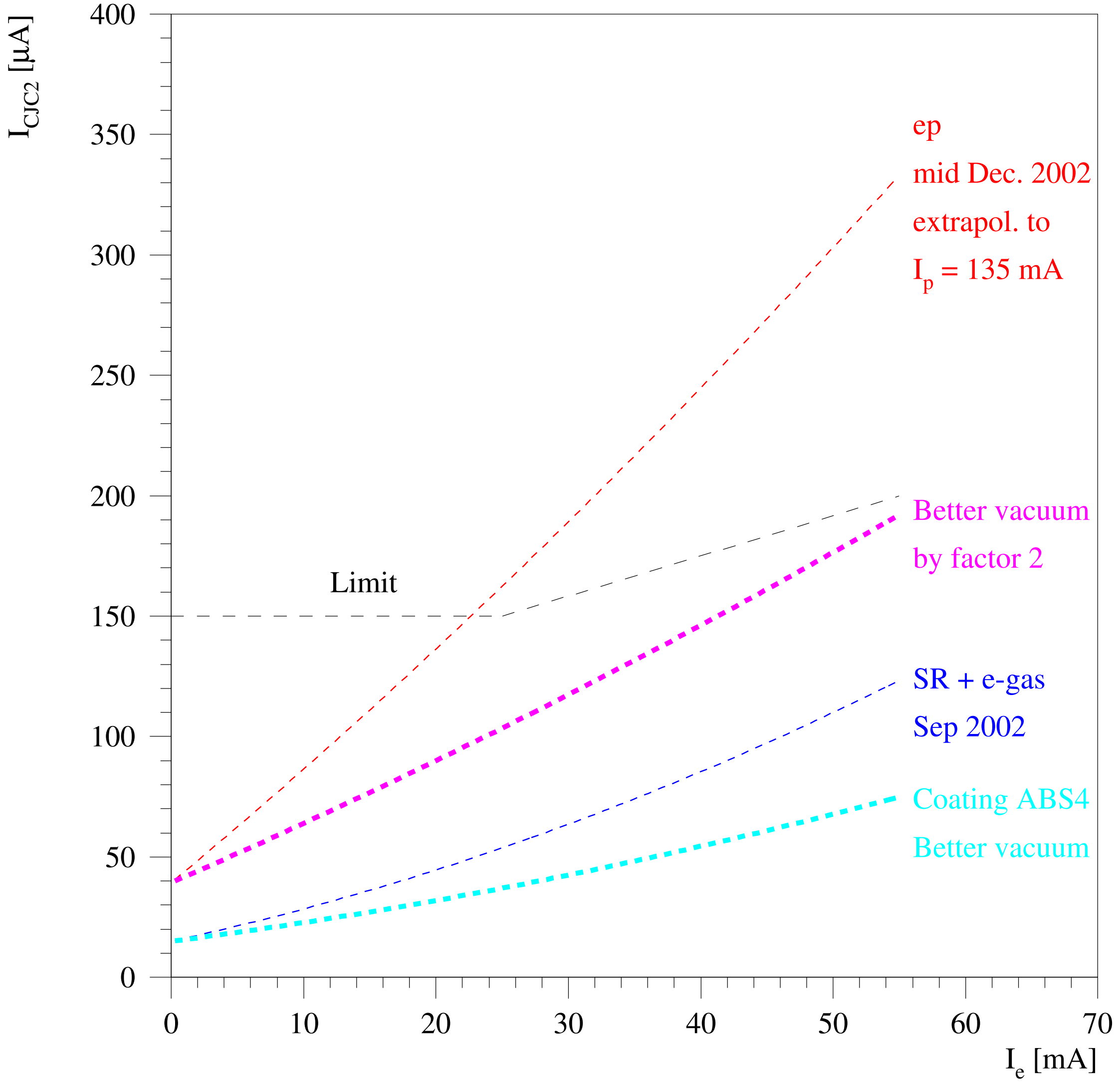
Remedies



C5B collimator at $z = -1.45$ m and GG transition bellow.
Design with IGP in progress.

- Make C5B thinner and add taper to reduce HOM heating. Design and calculations in progress.
- Install 400 l/s ion getter pump at $z = -1.5$ m utilizing the 1.16 T solenoid field. Design in progress, (old) parts at hand.
- Coat ABS4, 19 m, 26 m: factor 1.7 less backscattered SynRad. Under study by MVA.
- Install rest gas analyzers at -3.6 and -6.0 m. Available.

Summary



- Main background mechanism is understood and simulated in detail: p-rest-gas interactions, main sensitivity from IP and -15 m.
- More precise localization difficult, but on-going, with better modeling and new scintillators.
- Pressure and backgrounds improved by $\mathcal{O}(10)$ in 2002.
- Further improvement by $\mathcal{O}(3)$ still needed and expected from still strong outgassing at injection.
- Preparations will be ready for shutdown starting 3.3.2003.