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LICs: Summary of experimental results

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Outlook

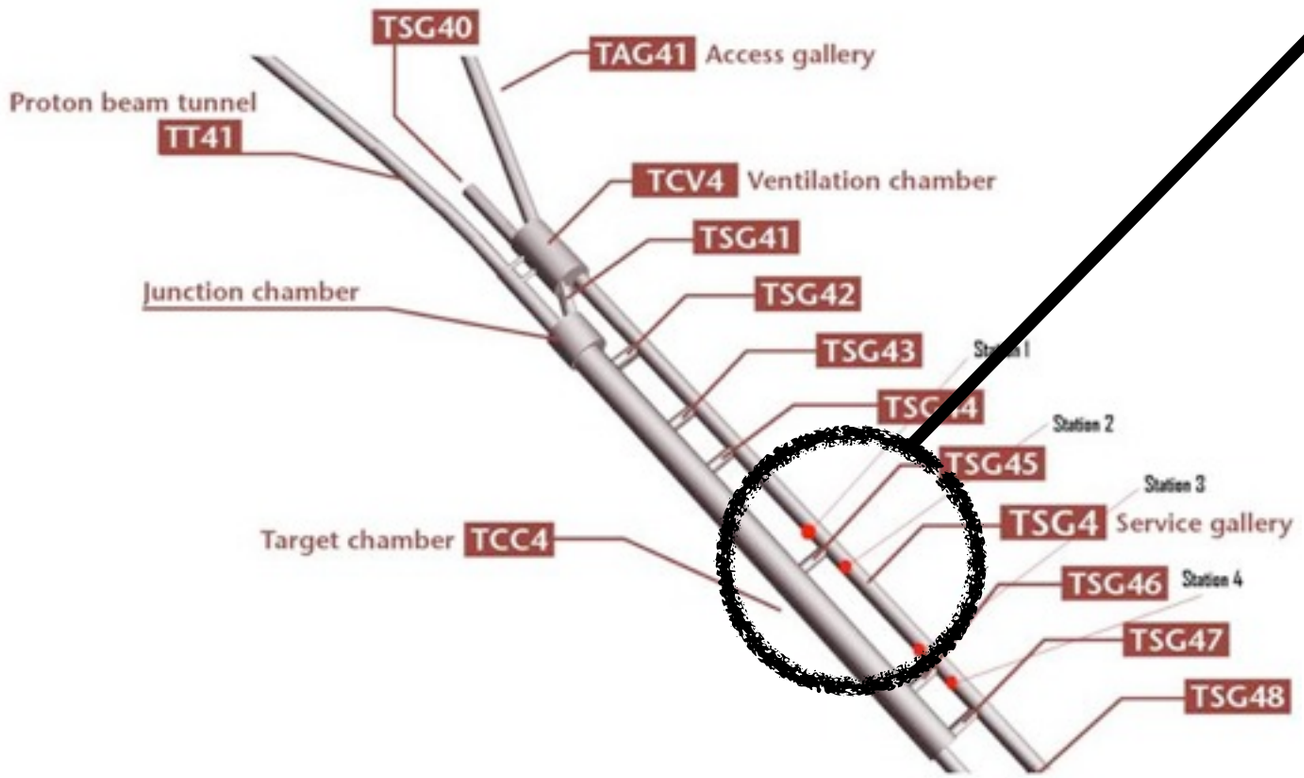
- Overview of measurements with LIC and comparison to LHC-ICs
  - CNRad. Mixed field irradiation
  - PSB dump line. Proton irradiations
  - HiRadMat. Mixed field irradiation
  - LHC (new LIC-FIC detectors)

- For details on BLMs affected, layout, threshold/noise related issues ... see slides from Barbara.

- Summary and conclusions

Mixed field irradiation – CNRad

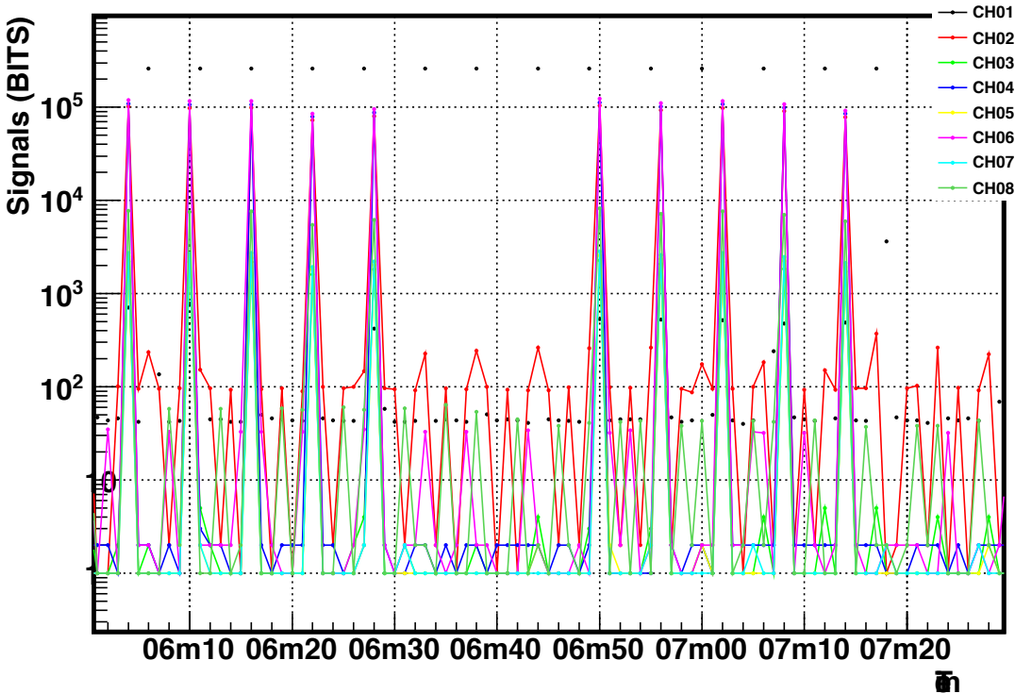
- 8 detectors on metallic cross (TSG 45)
  - thee ICs for calibration purposes
  - LIC prototypes (1.1 bar, 0.1 bar)
  - LIC final prod (0.4 bar)
- LHC-like electronics (CFC + RSs)
- HV (nominal) ~ 1500V

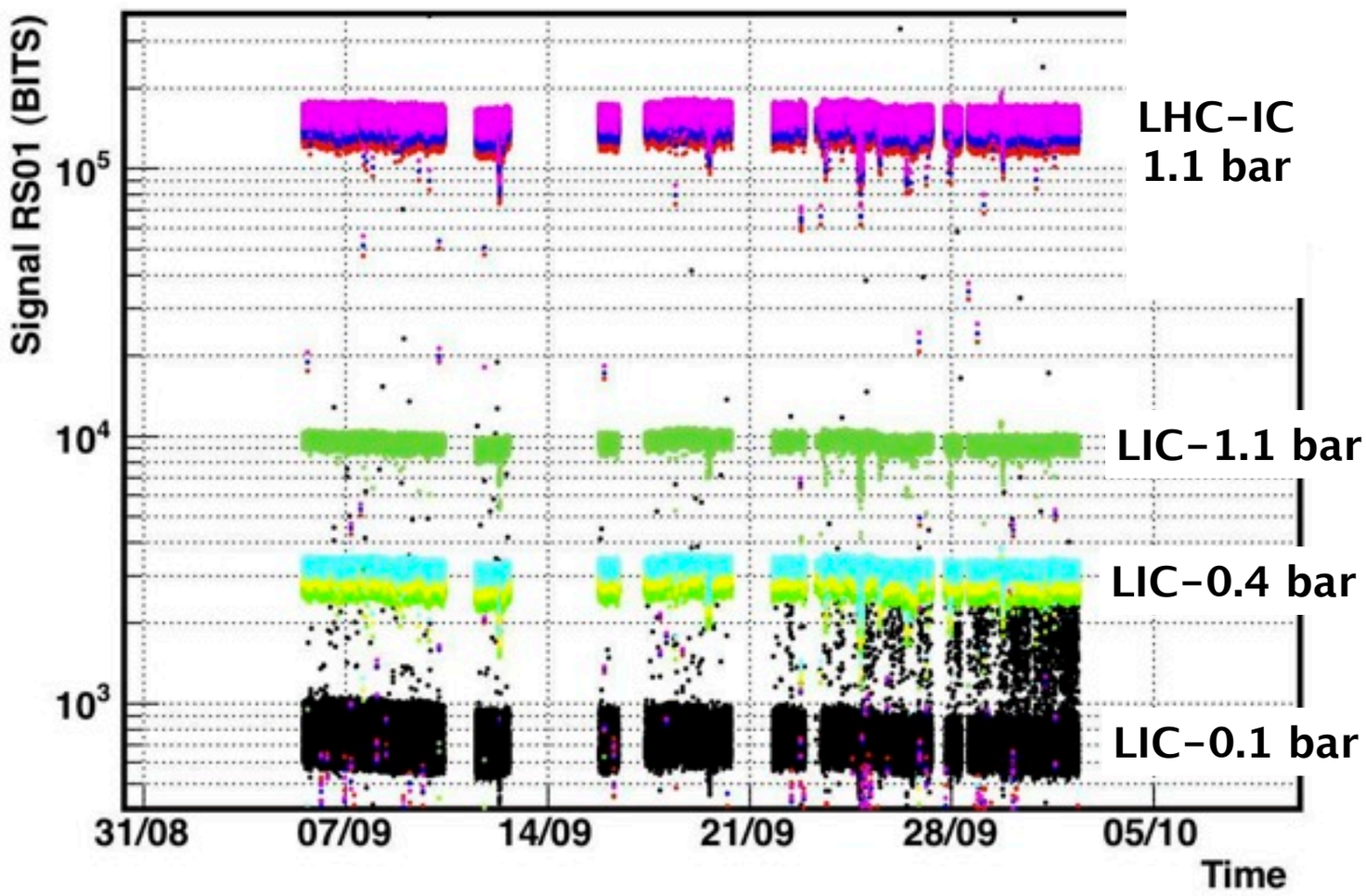


- 450 GeV protons onto graphite target
- Two pulses (10 us) separated by 50 ms per extraction

Mixed irradiation – CNRad

- More than 1 month of data accumulated with very stable beam conditions
- Clear effect on both volume and filling pressure reduction
- LIC at 0.1 bar showed erratic behaviour





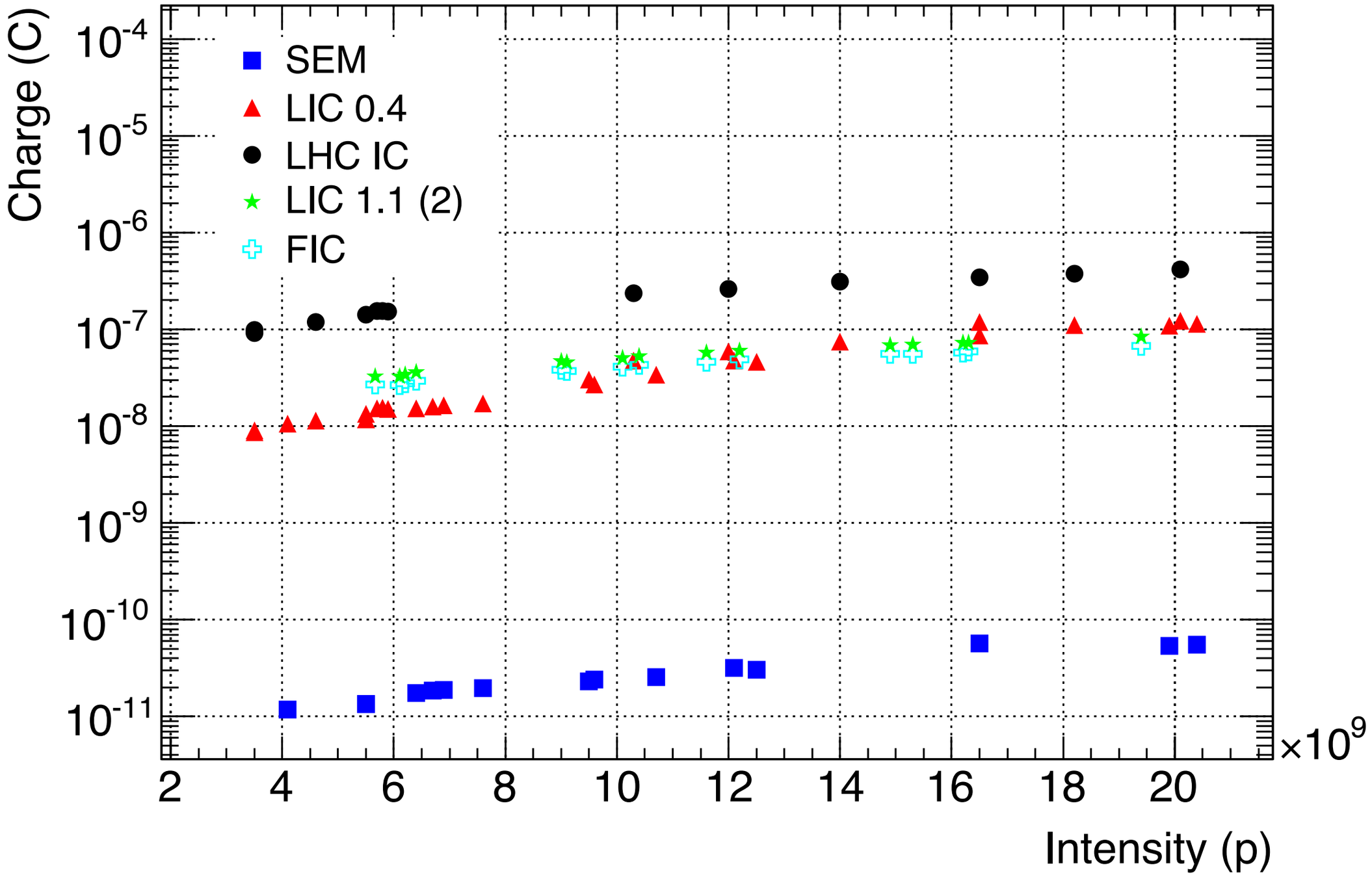
signal ratio to LHC-IC

P (bar)	RS01	RS04	RS08
0.1	152.0	193.0	10.5
1.1	14.0	16.5	16.3
0.4	45.9	58.9	51.2
0.4	44.6	56.8	49.4
0.4	43.9	56.6	50.1

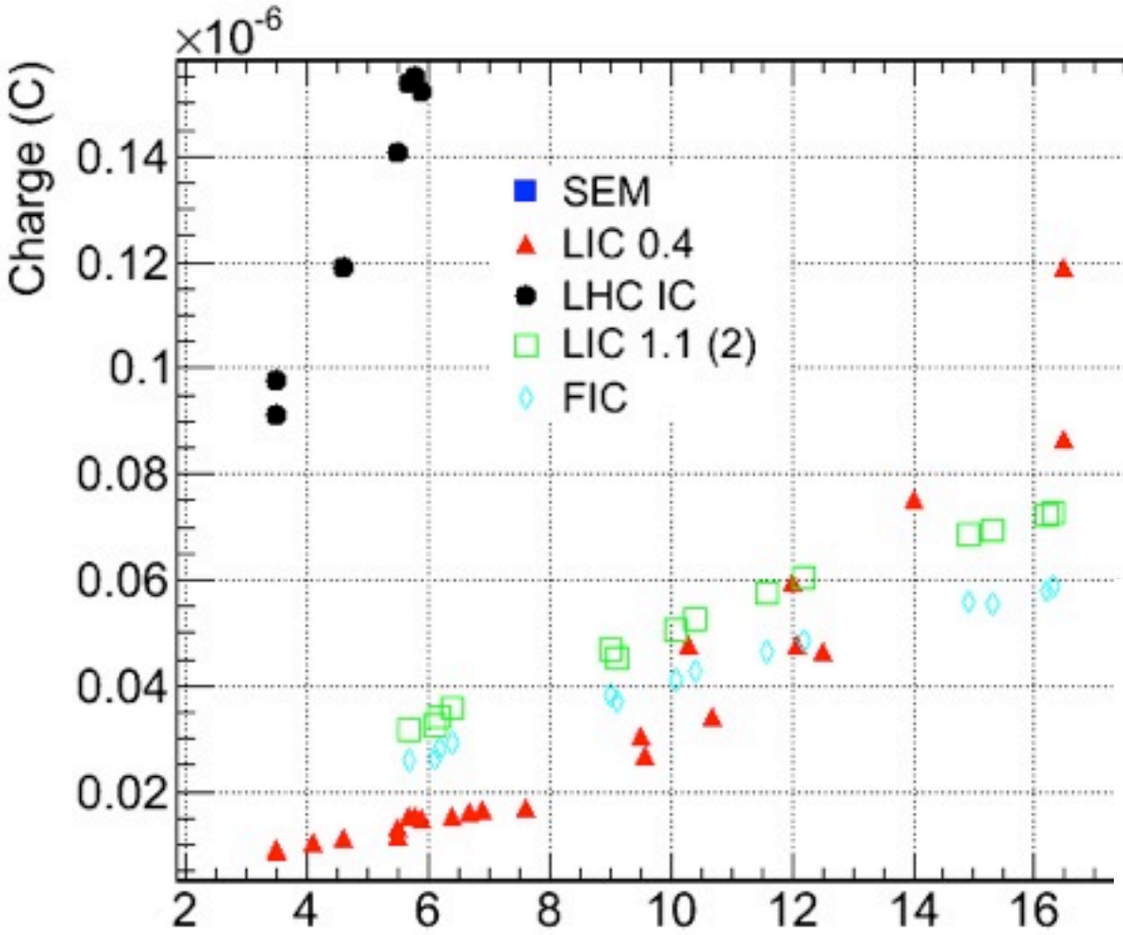
Proton irradiation (PSB dump line)

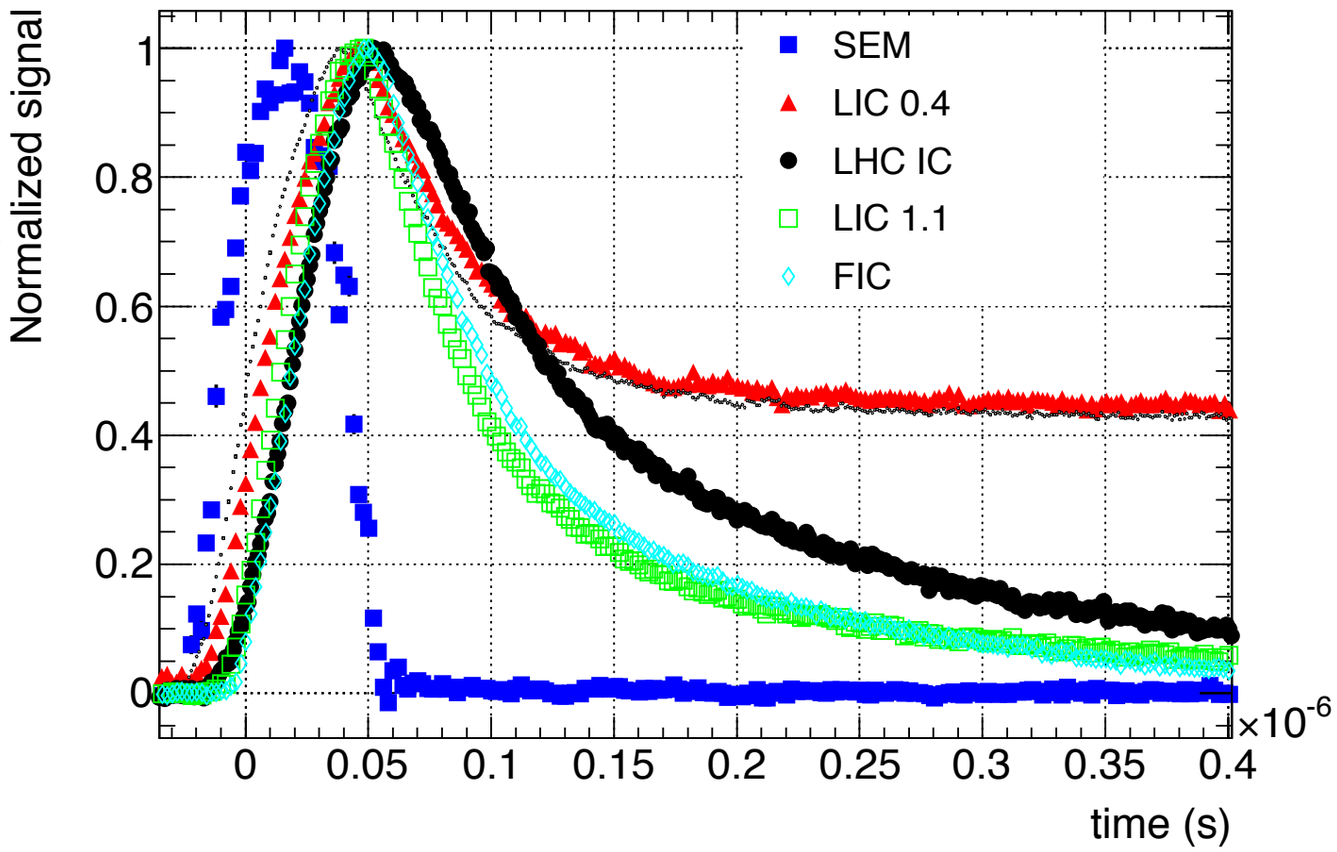
- Beam directed onto chambers
- 1.4 GeV protons, ~10^{+10} p/bunch
- Bunch length ~60ns
- Beam size ~ 1 mm.
- Multiple detectors tested with this setup: SEM, LIC 0.1 bar, LIC 0.4 bar, LIC 1.1 bar , FIC and LHC-IC
- Readout -> Scope

Proton irradiation (PSB dump line)



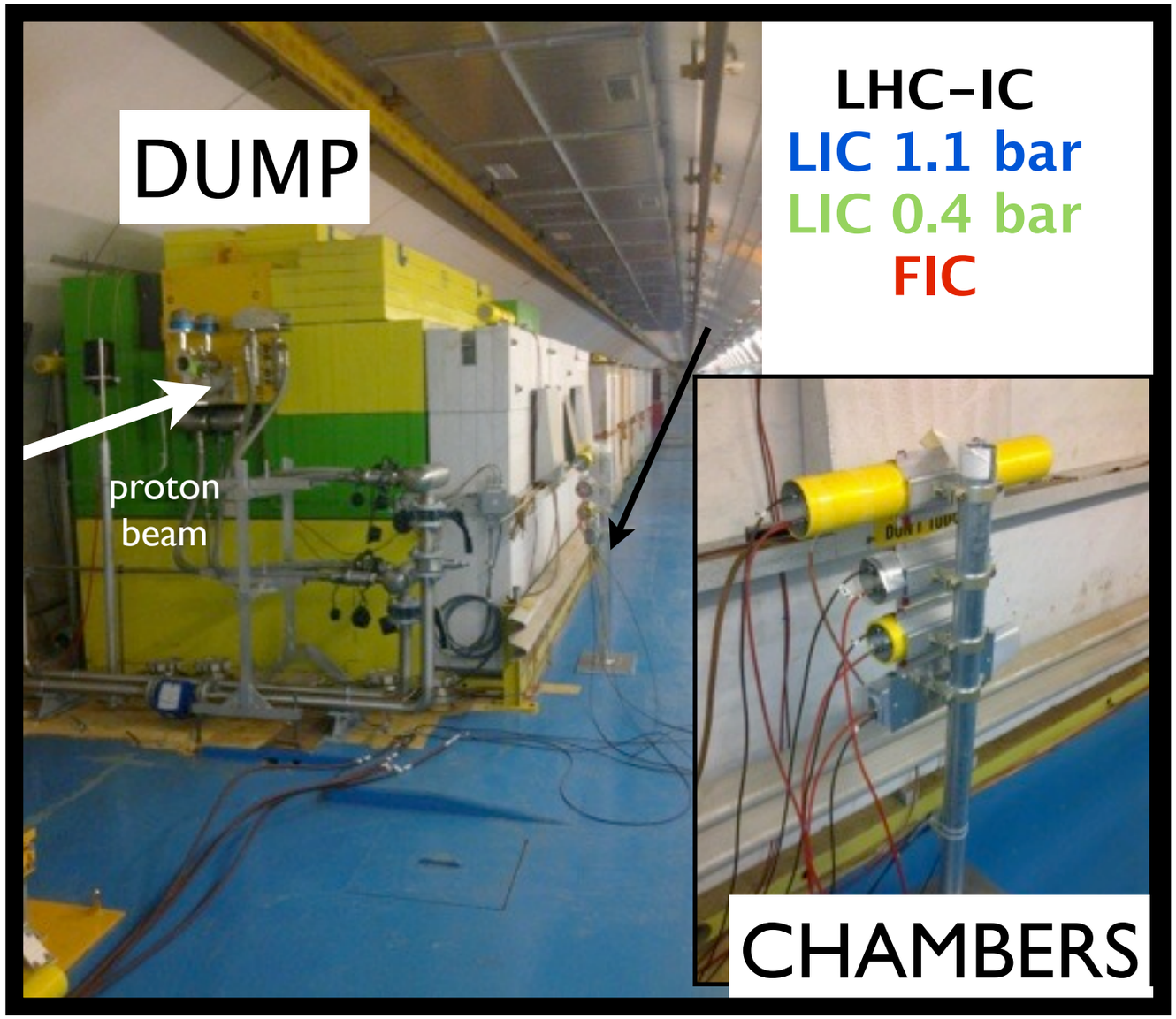
Proton irradiation (PSB dump line)



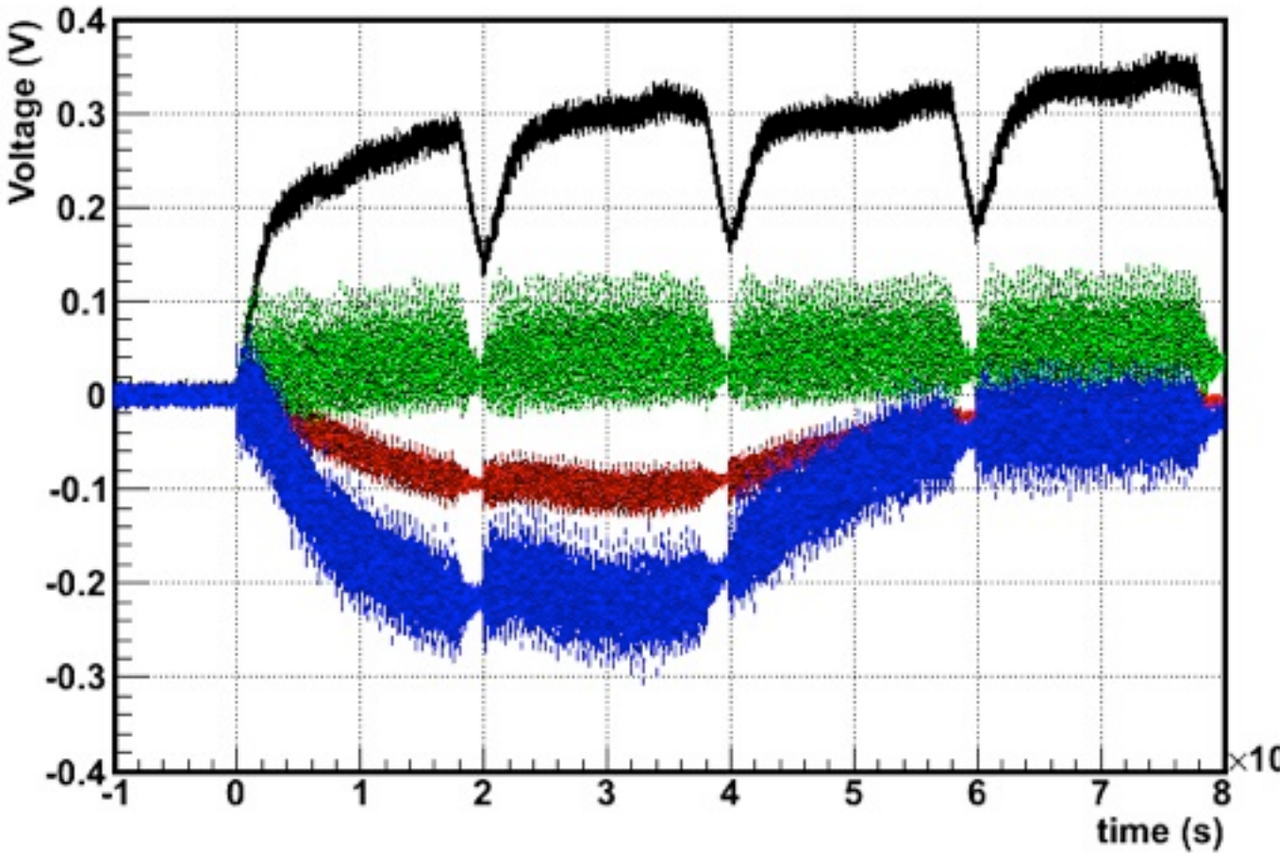


Mixed field irradiation – HiRadMat

- Beam onto dump block
- 450 GeV protons, ~1.0 10^{+11} p/bunch
- From 1–144 bunches (separated 50 ns)
- Beam size ~ 1 mm
- CFC + Scope



Mixed field irradiation (HiRadMat)

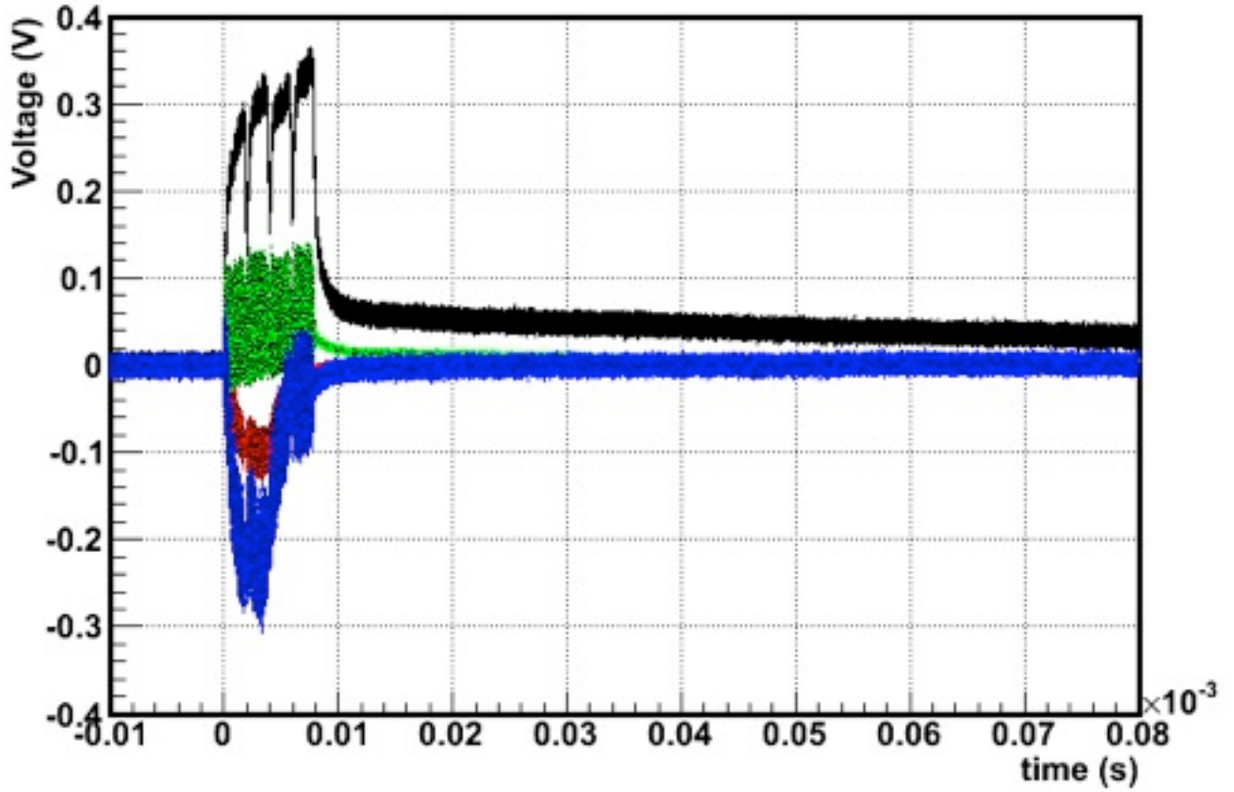


I = 1.95 10^{+13} p

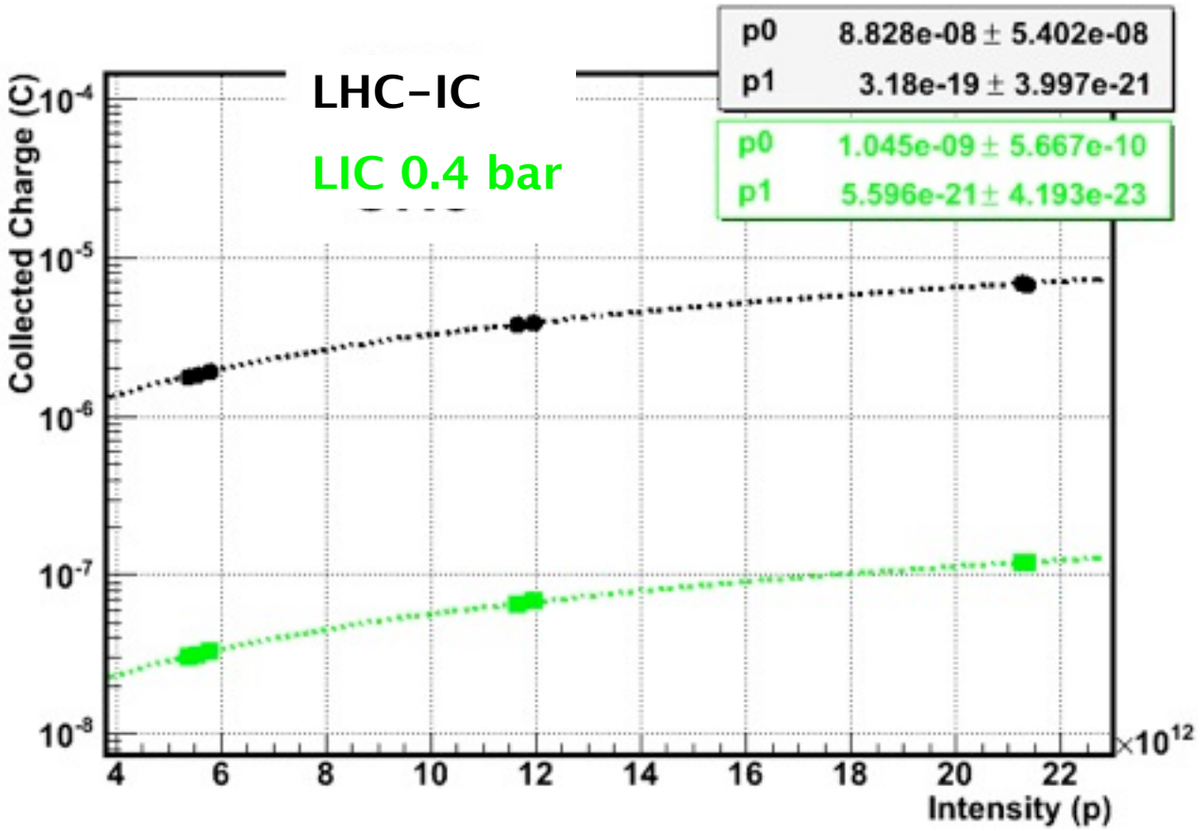
144 bunches

bunch length ~1 ns

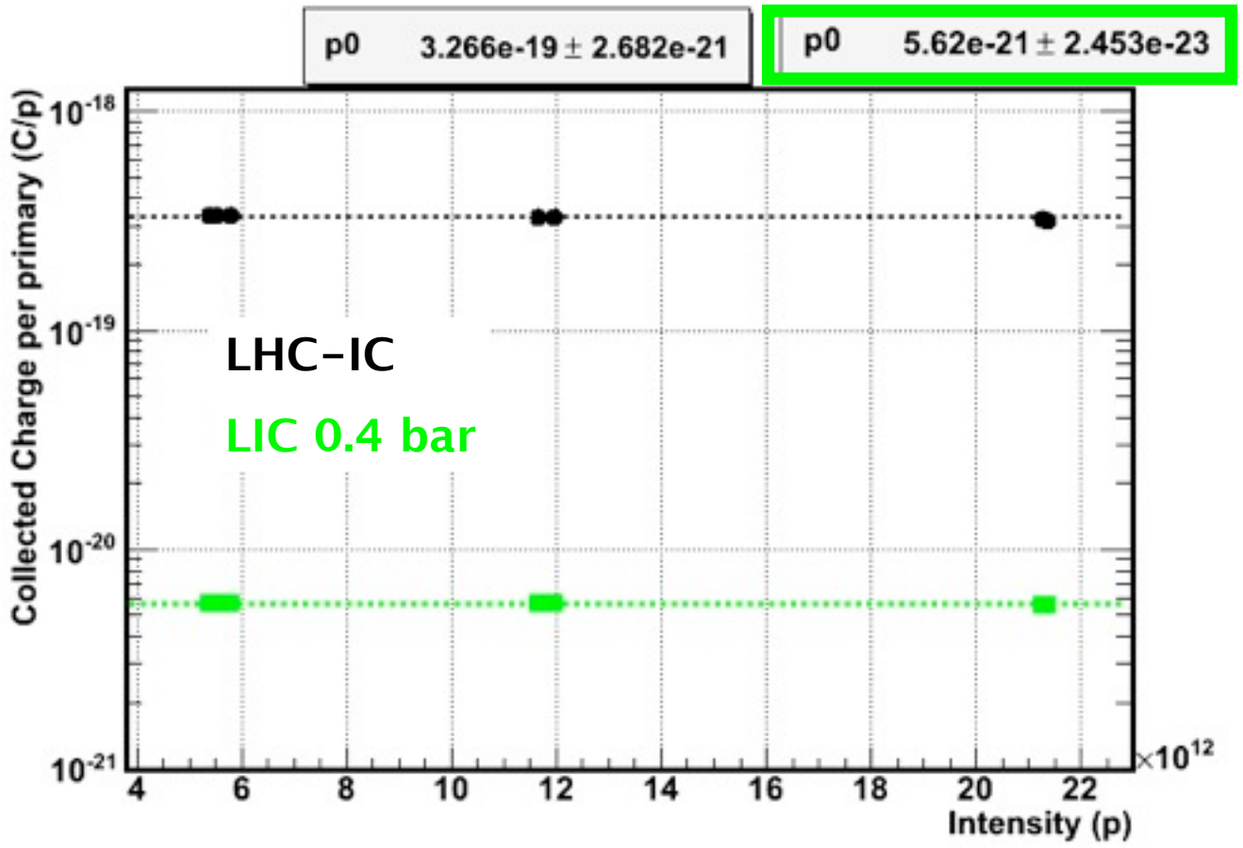
bunch charge ~ 1.35 10^{+10} p



Mixed field irradiation – HiRadMat



- Signals integrated with LHC electronics (1.3 s) **LHC-IC** and **LIC 0.4** bar.
- Linear dependence with intensity found in both chambers.



- Constant (within 3-1 %) normalized signal vs intensity (small space charge effect)
- S_{IC}/S_{LIC} = 58 (similar to previous measurements).

Mixed field irradiation – LHC

- Focussing on new installation: LIC 1.1 bar + FIC 1.1 bar + LIC 0.4 bar
  - BLMEF.04L2.B1E20_TDI.4L2.B1 dcum 3254.727
  - **BLMEL.04L2.B1E10_TDI.4L2.B1 (0.4 bar) dcum 3251.027**
  - **BLMEL.04L2.B1E11_TDI.4L2.B1 (1.1 bar) dcum 3251.027**

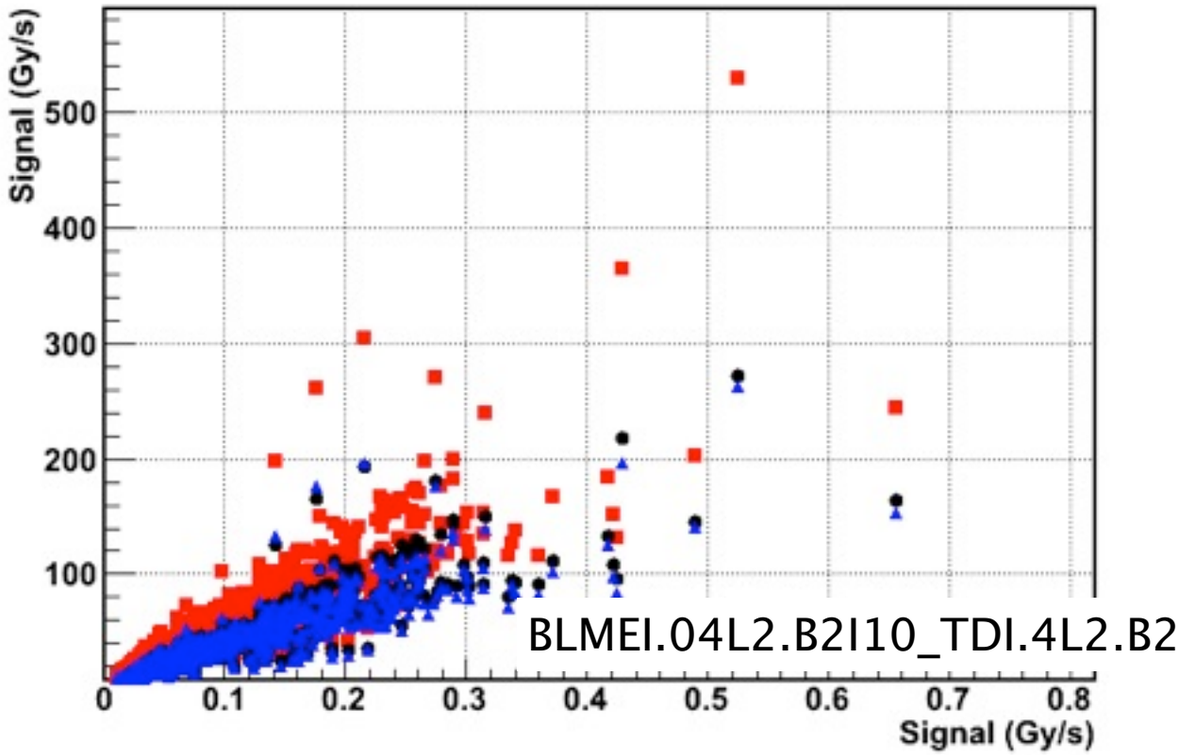
- Signals compared with reference ionization Chambers
  - BLMEI.04L2.B1E20_TDI.4L2.B1 dcum 3254.727 FILTER (180)
  - BLMEI.04L2.B2I10_TDI.4L2.B2 dcum = 3248.327 FILTER (180)
  - BLMEI.04L2.B1E10_TCDD.4L2 dcum = 3262.260

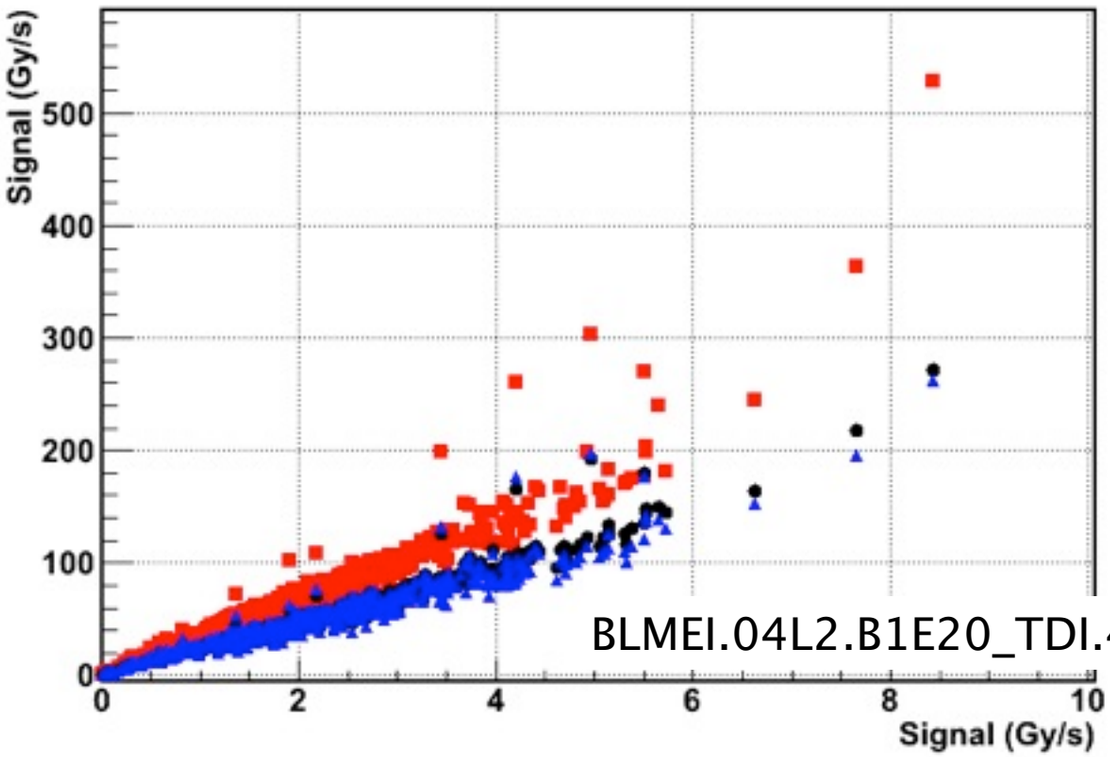
- Analyzed all signals (08/11/2012 →15/02/2013) during INJPHYSICS mode

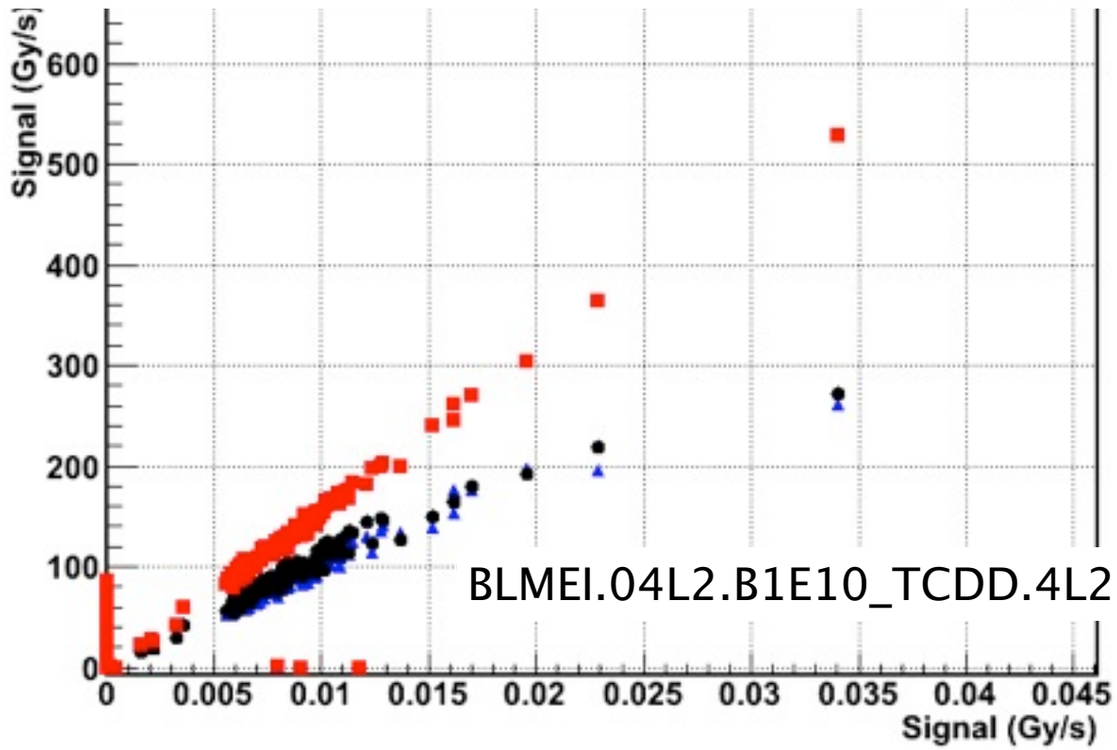
Mixed field irradiation – LHC

FIC
LIC 1.1 bar
LIC 0.4 bar

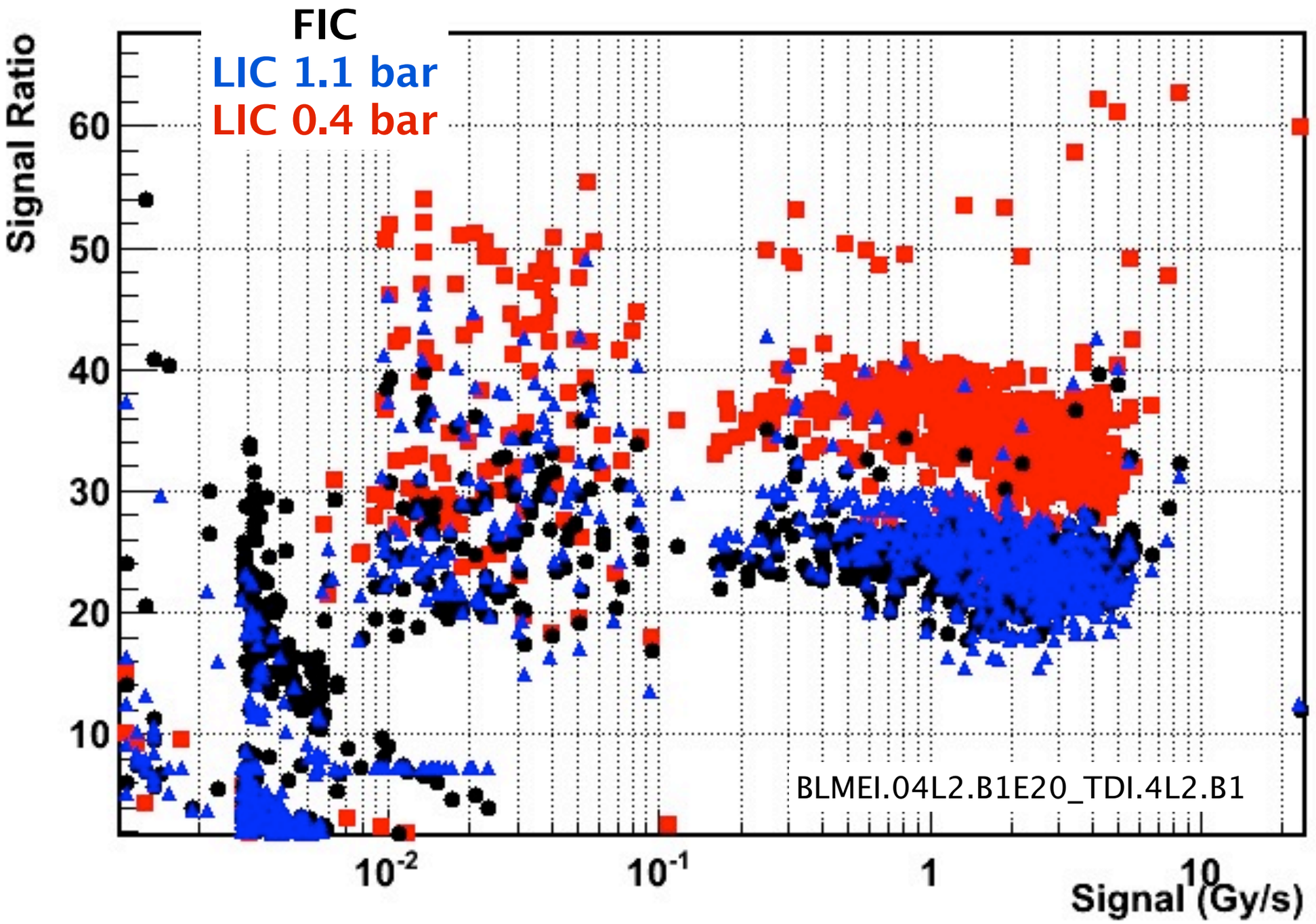
COMPARISON TO LHC-IC







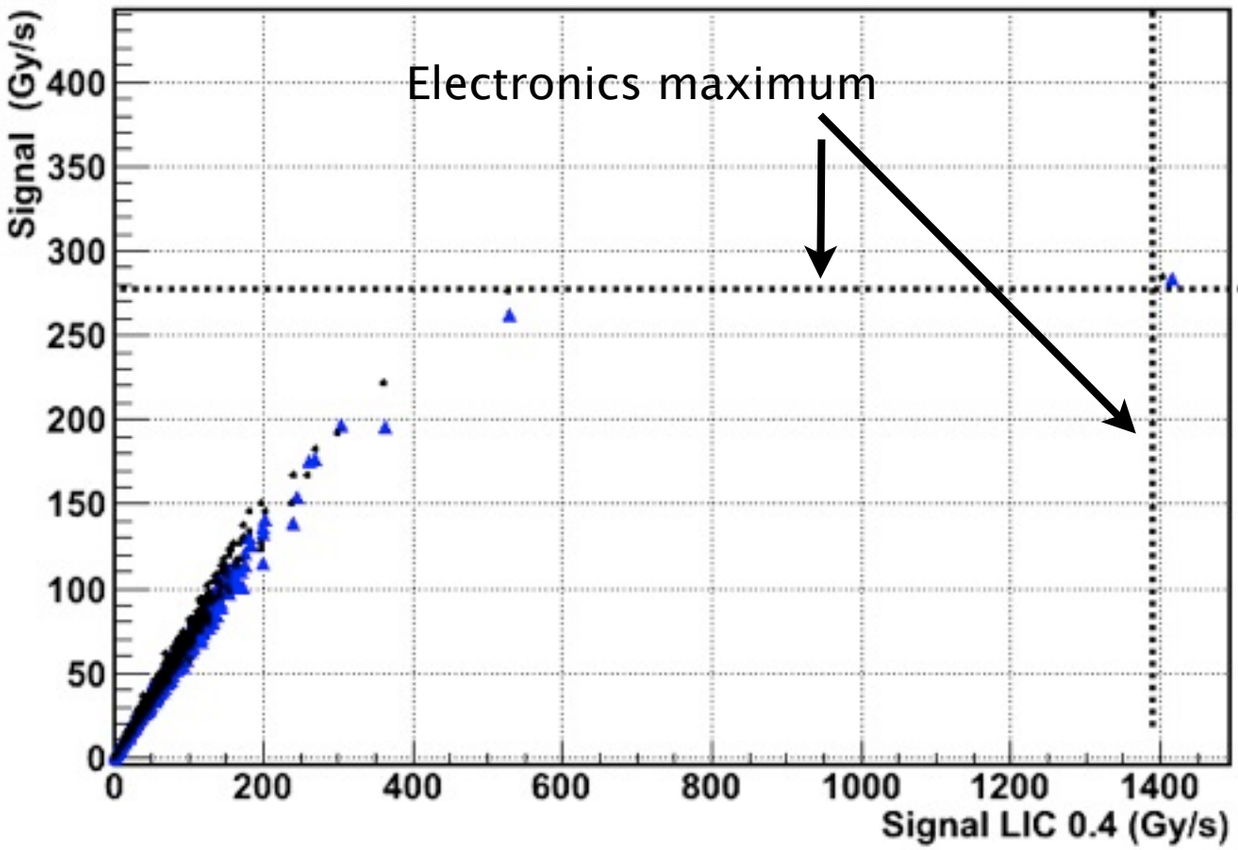
Mixed field irradiation – LHC

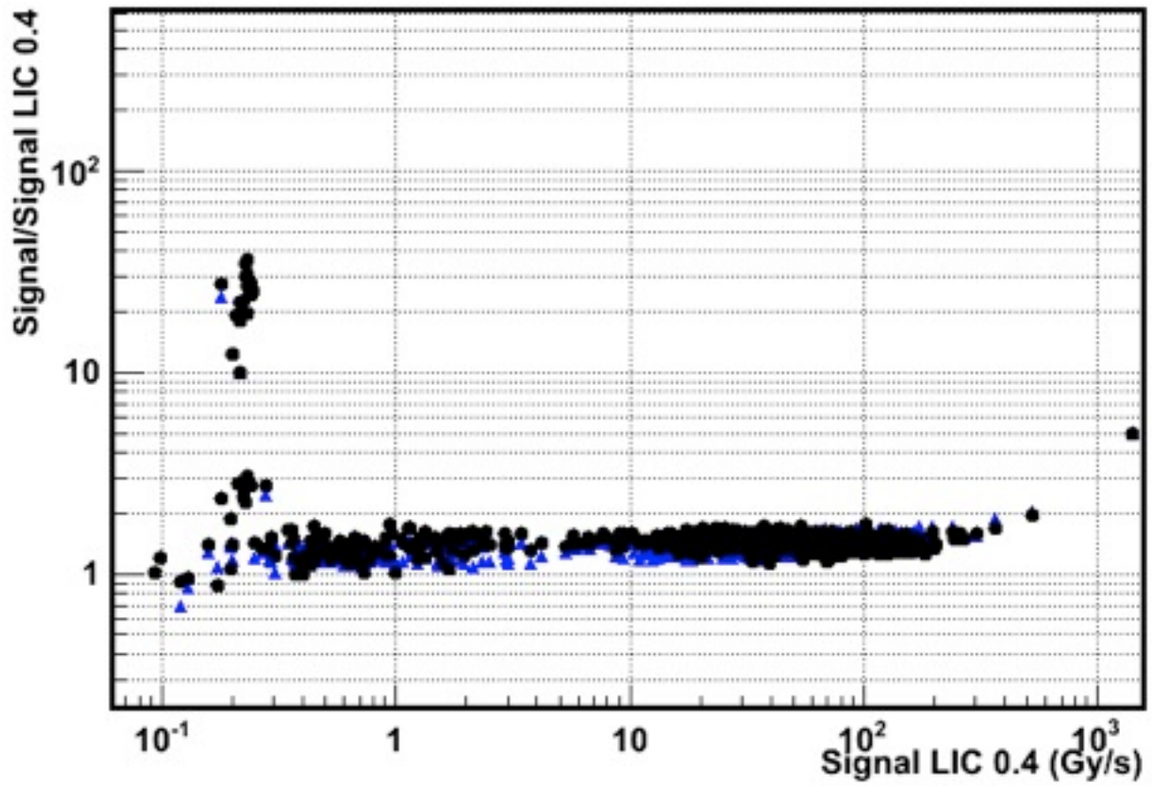


Mixed field irradiation – LHC

FIC
LIC 1.1 bar

COMPARISON TO LIC
0.4 bar





Summary and conclusions

- Several experiments conducted in order to study the response of LICs and various other detectors
- Issue found for high particle densities going through chamber for low Pressure (not present at nominal pressure)
- Sensitivity gain for 0.4 bar confirmed (~60) in independent measurements
- Sensitivity gain for 1.1 bar 12-16

Detector	P (bar)	Ratio to IC Measured Homogeneous mixed radiation field
LIC	0.4	57.7 ± 2.0
LIC	1.1	12.4 ± 4.0
FIC	1.1	(no measurement available. Assumed same value as for 1.1 bar LIC)

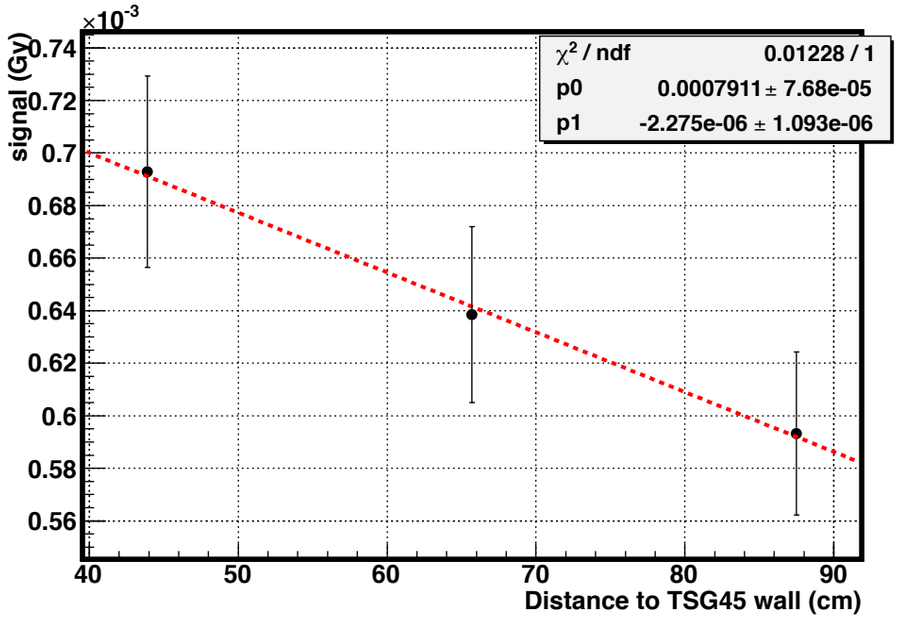
Back up slides

Mixed field irradiation – CNRad

BLM dosimetry

Radiation environment: CNGS cycle = 2 extractions of 10us duration separated by 50 ms.

RS01 (40 us) and RS02 (640 us) provided dose per single extraction. RS07 (81.9 ms) and RS09 (1.3 s) provide dose from the two extraction. Clear factor 2 increase in dose from RS04 to RS07 (one vs two extractions). Differences in Dose/pot from RS04 to RS09 attributed to noise and offset current. RS01 affected by charge collection time scales and signal delays produced by readout cables



23/04/2011 - 25/04/2011

RS01 (mGy)	RS04 (mGy)	RS7 (mGy)	RS09 (mGy)
0.389 ± 0.071	0.618 ± 0.008	1.349 ± 0.017	1.352 ± 0.017
0.462 ± 0.089	0.733 ± 0.010	1.576 ± 0.020	1.580 ± 0.020
0.336 ± 0.064	0.533 ± 0.007	1.143 ± 0.015	1.145 ± 0.015
$(10^{-17}Gy(N_2)/pot)$	$(10^{-17}Gy(N_2)/pot)$	$(10^{-17}Gy(N_2)/pot)$	$(10^{-17}Gy(N_2)/pot)$
1.67 ± 0.22	3.01 ± 0.06	3.30 ± 0.05	3.30 ± 0.05
1.99 ± 0.26	3.58 ± 0.07	3.85 ± 0.06	3.86 ± 0.06
1.44 ± 0.19	2.60 ± 0.04	2.79 ± 0.04	2.80 ± 0.04

29/09/2011 - 01/10/2011

RS01 $(mGy(N_2))$	RS04 $(mGy(N_2))$	RS7 $(mGy(N_2))$	RS09 $(mGy(N_2))$
0.370 ± 0.079	0.596 ± 0.010	1.308 ± 0.019	1.310 ± 0.019
0.399 ± 0.110	0.641 ± 0.010	1.394 ± 0.021	1.396 ± 0.021
0.438 ± 0.130	0.696 ± 0.011	1.498 ± 0.023	1.501 ± 0.022
$(10^{-17}Gy(N_2)/pot)$	$(10^{-17}Gy(N_2)/pot)$	$(10^{-17}Gy(N_2)/pot)$	$(10^{-17}Gy(N_2)/pot)$
1.82 ± 0.22	3.27 ± 0.008	3.60 ± 0.09	3.60 ± 0.09
1.98 ± 0.24	3.52 ± 0.009	3.83 ± 0.11	3.84 ± 0.11
2.16 ± 0.26	3.82 ± 0.10	4.12 ± 0.11	4.12 ± 0.11

Doses to be compared with:

- RadFets 2.84E-17 Gy(Si)/pot
- BLM radiation test 2009. Dose (1-4.8)E-17 Gy(N2)/pot

About 15% variation of the recorded Dose in the BLMs due to position relative to the TSG45 wall

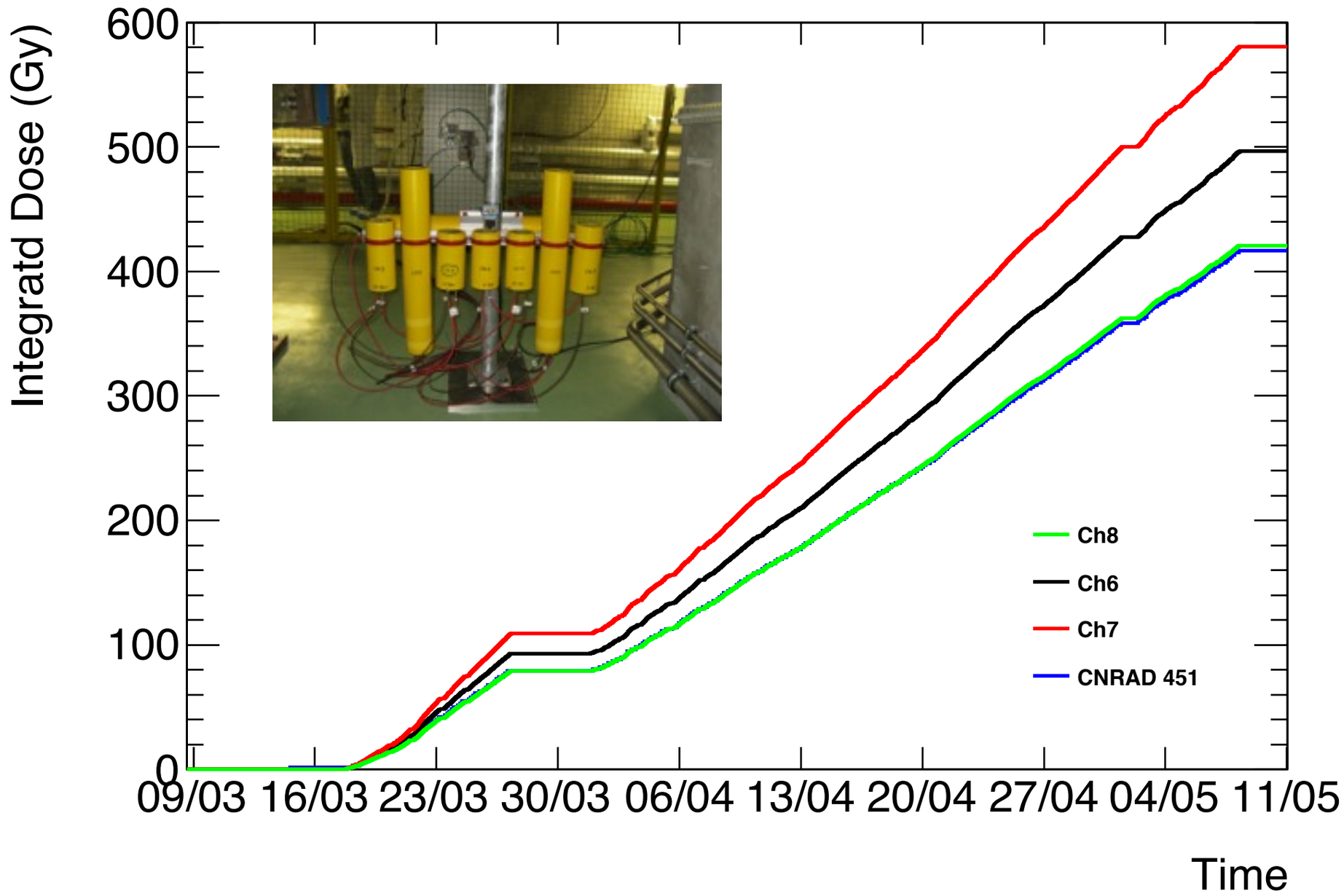
Mixed field irradiation – CNRad

BLM dose computed by using the 81.92 ms integration window, i.e. including both CNGS extractions, exclusively during extractions.

IC CH 8 within 1% of RadFet

IC CH 6 within 20% of RadFet

IC CH 7 within 40% of RadFet



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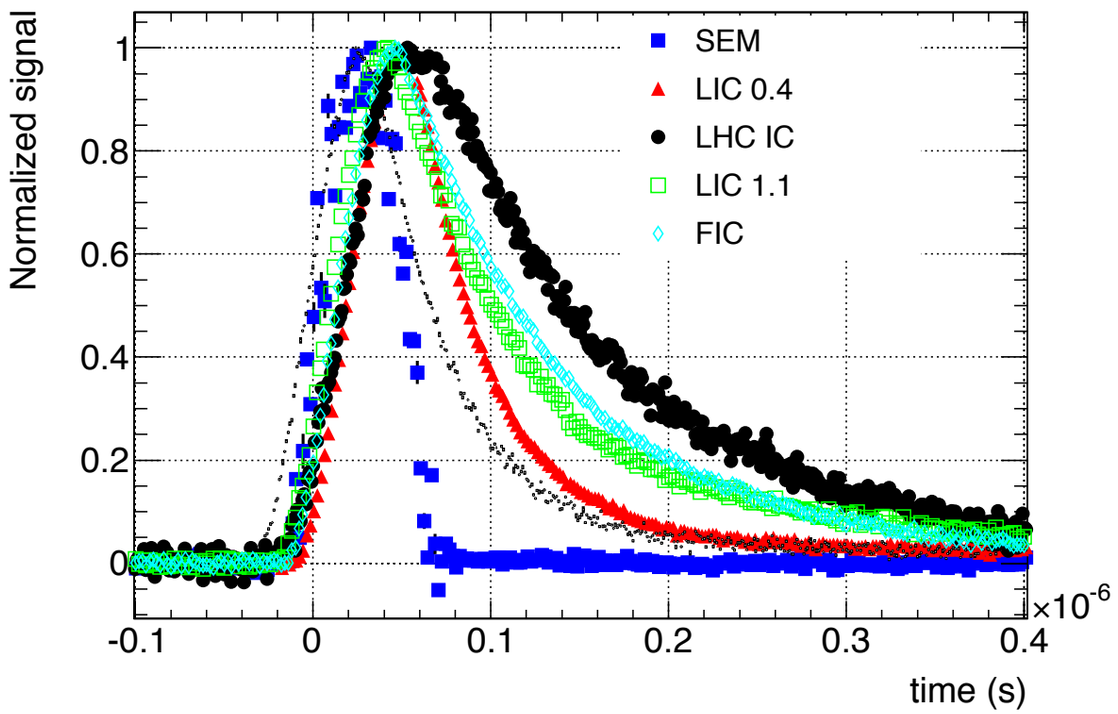

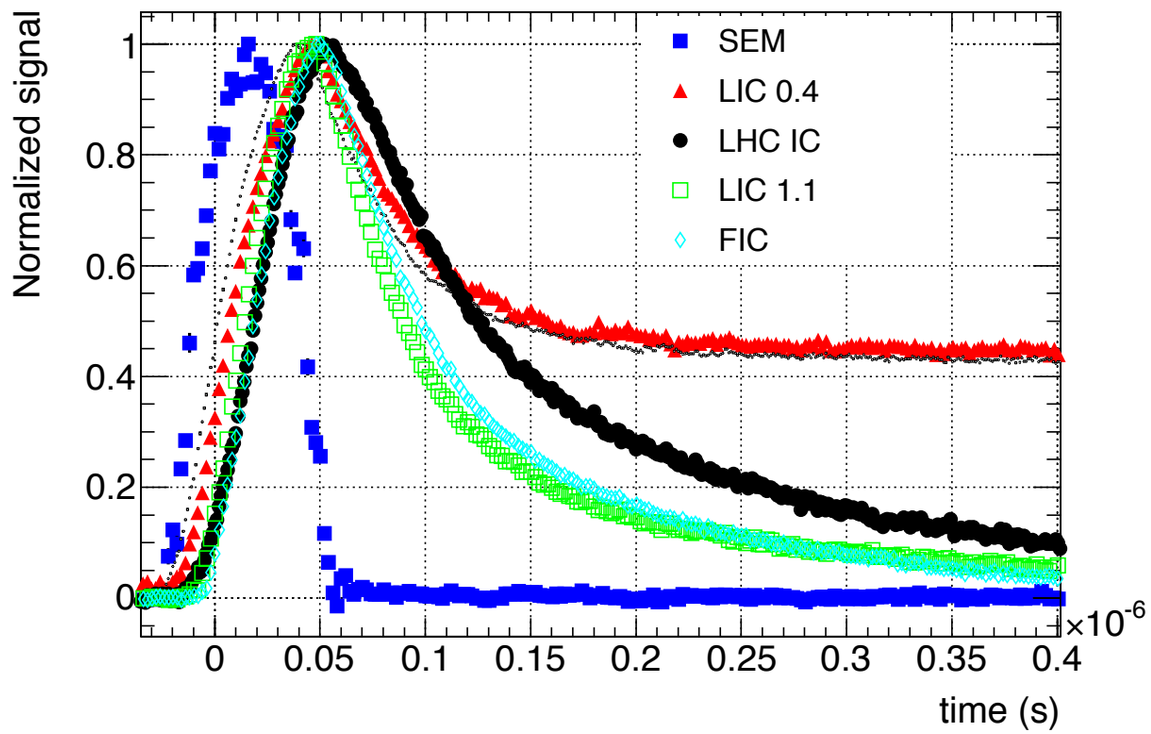

Proton irradiation (PSB dump line)