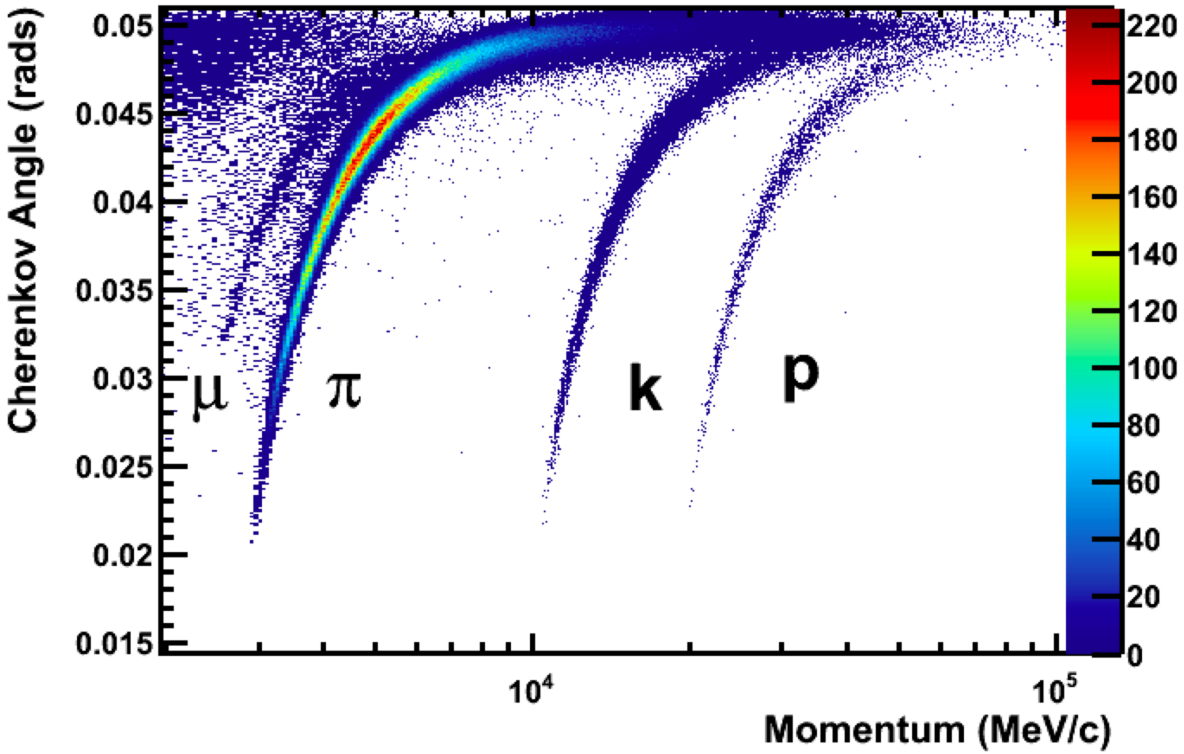
Status of the RICH subdetector

A summary from the recent RICH meetings



Plenary meeting 28 th June 2011

Clara Matteuzzi , on behalf of the RICH groups

Status of the RICH detector

Highlights on :

1. Operation of the RICH

2. Running conditions

3. Software : *detailed report on PID performance by Chris Jones on wednesday*

Operation of the RICH detector

- A few small things:
  - Still not sure why A0_7 becomes partially inactive.
  - C4_14 has been permanently disabled.
  - Automatic reset when HPDs are disabled by the monitoring.
- Corona effects (or beam induced fluorescence)
- Tests of up to $4x10^{32}$

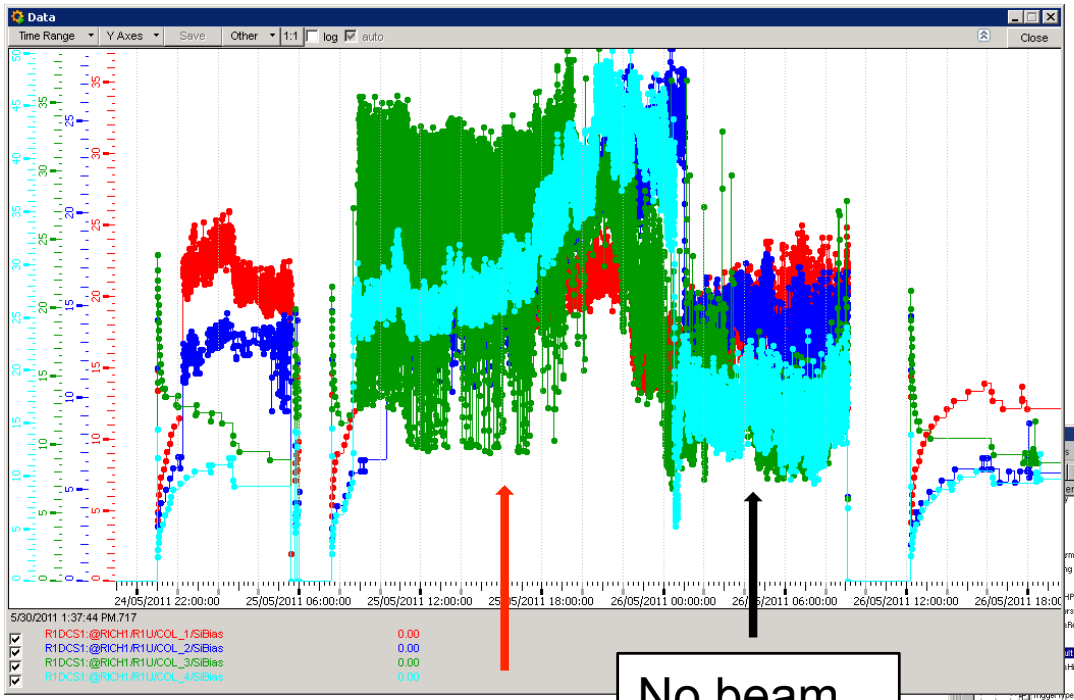
Operation of the RICH detector

The “corona” effect

- Light can be seen by other HPDs.
- Activity related to HV, stops below 10 kV, more or less proportional to HV above 10 kV.
- If HV is taken to zero, and then above 10 kV, activity re-appears.
  - ➢ But if whole system switches off and cools down, activity re-appears only with beam.
- Lowering HV to 15 kV on U1 reduced the effect, but it was still there.
- Corona was spreading to more columns.
- High hit rate was affecting the L1 (throttling)
  - ➢ Disabled two HPDs.

Operation of the RICH detector

Si bias currents



Beam

No beam
No LV

480 hits/event

Operation of the RICH detector

- Experimental evidence that CO_2 suppresses fluorescence better than N_2.

- 26/5/2011:
  - Switched from N_2 to CO_2.
  - Lowered HV to 15 kV for the whole of RICH1.
  - MDMS scan of RICH1.
    - MDMS corrections the same within errors.
- No more activity.
- **RICH1 back at 18 kV 28/5/2011 19:00**
  - **No obvious problems since...**

CO2 also in RICH2

HPD status

9 HPDs in house available for replacement

Status of on-going HPD reprocessing campaign, as of 24th June:

- 38 HPDs available for reprocessing:
  - 36 HPDs removed during shutdown in January
    (of which 5 already were processed twice but were decided to be reused due to the scarcity of tubes)
  - 2 HPDs removed during short LHC technical stop in March

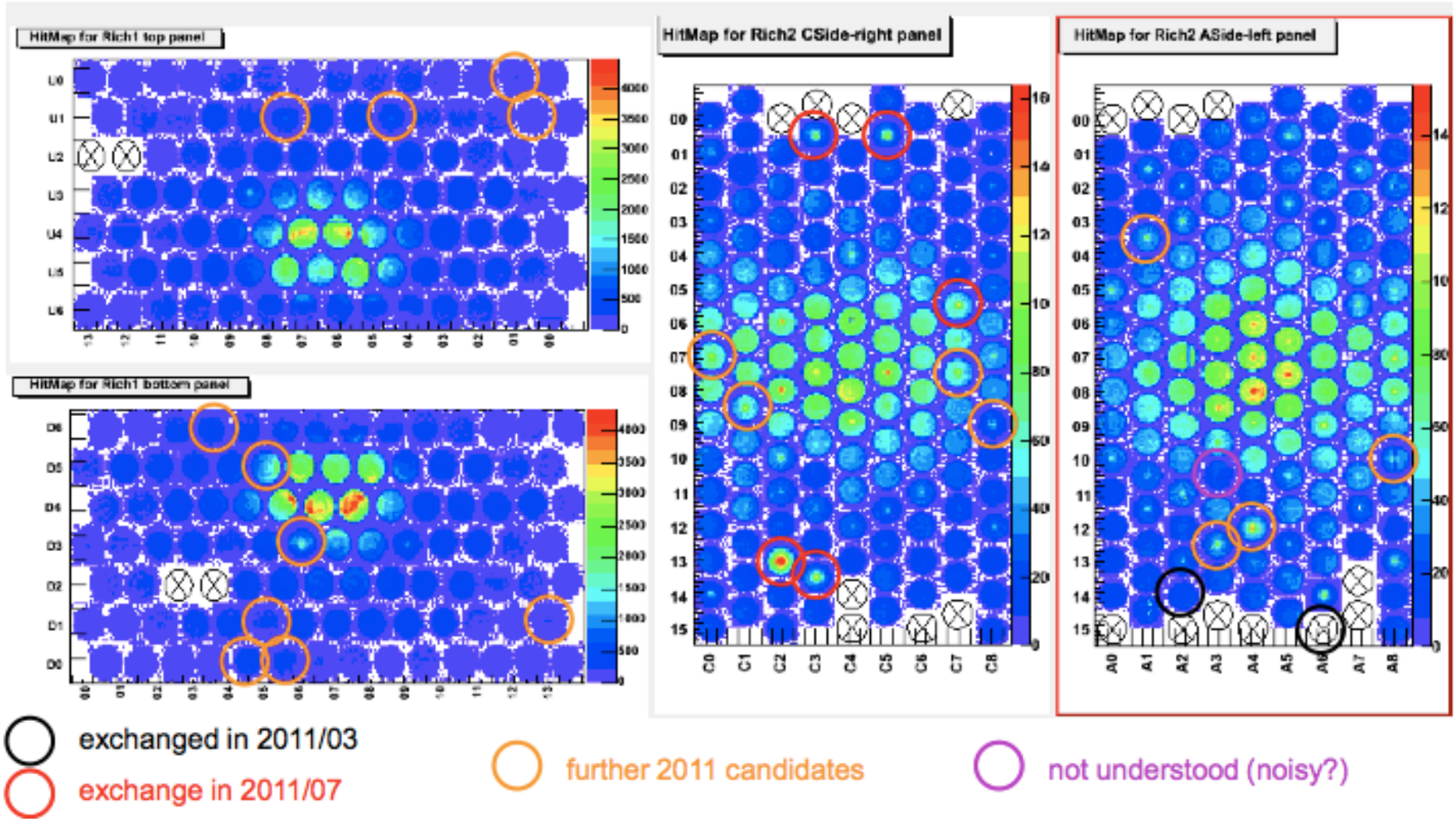
Repaired tubes will arrive at Edinburgh/CERN in autumn

Used strategy:

- replace only glowing or closest to glowing HPDs
- leave best few HPD as emergency spares which can be used at future technical stops (especially if needed for central HPD)

In the coming TS replace 5 HPD (in RICH-2)
leaving 4 spares

HPD status


HitMap for Rich1 top panel
HitMap for Rich1 bottom panel
HitMap for Rich2 CSide-right panel
HitMap for Rich2 ASide-left panel
exchanged in 2011/03
exchange in 2011/07
further 2011 candidates
not understood (noisy?)

HPD status

New HPD manufacturing

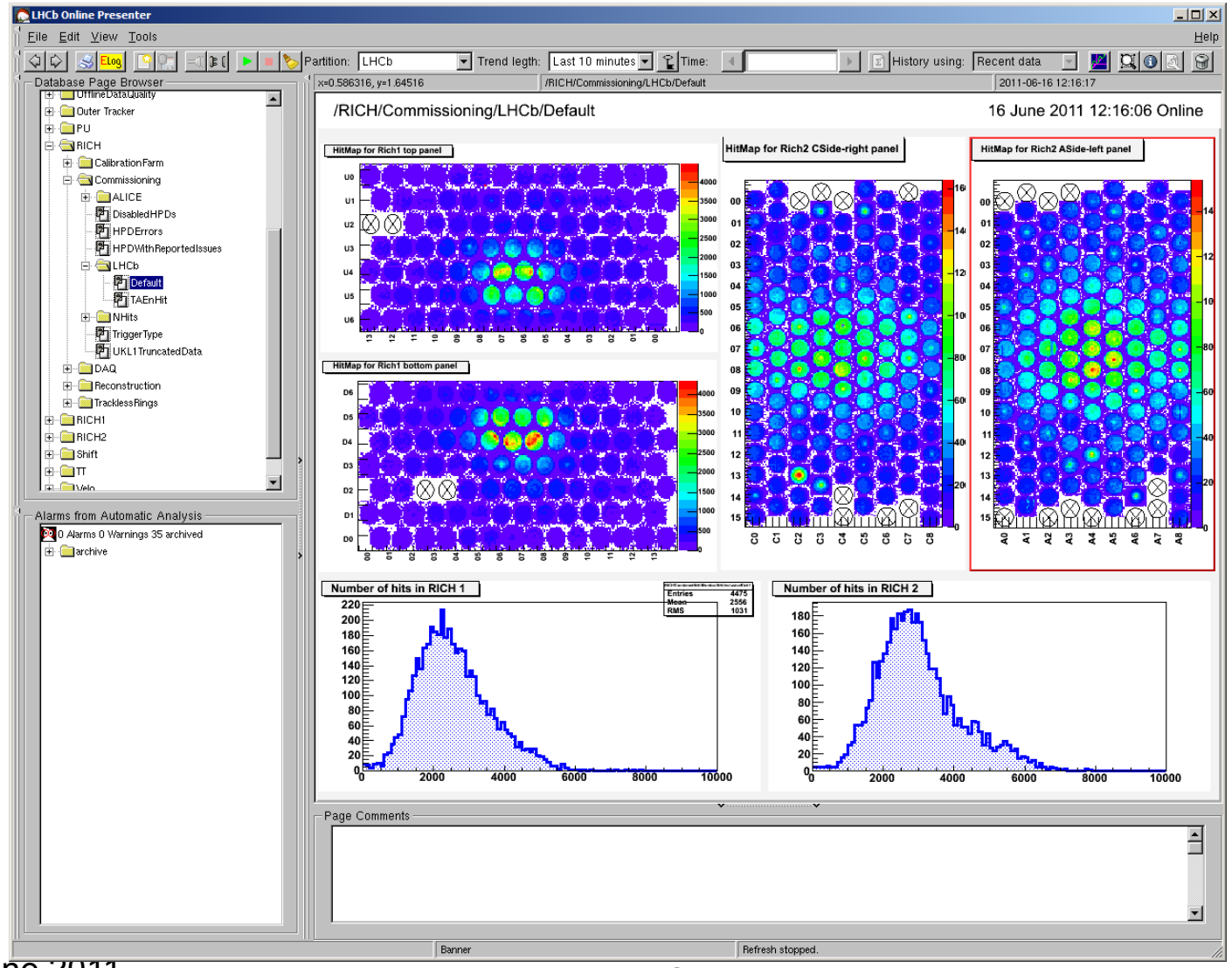
- Available spare anodes: 10-15
- Unit cost = “full” cost
- Status idle – depend on “consolidation” money

High Luminosity test

- Tested high luminosity running, up to 4e32
- Both RICH detectors at 15 kV.
- Throttling from R1UKL106, R1UKL104.
  - load balancing, disabled 3 busy HPDs.
    updated DB
- Changed TCK, L0 rate down, no more throttling.
- After 20 min at 4e32, RICH2 at 18 kV.
  - No problems
- Total time at 4e32 about 2 hours.

Still room to improve adding new UKL1 boards around mid july

Hit map at $4x10^{32}$



Running conditions

If HPD are operated at 15 KV (instead of 18 KV ‘nominal’)

Some facts :

- measurement of the resolution
- efficiency / measurement of photoelectrons yield

Running conditions

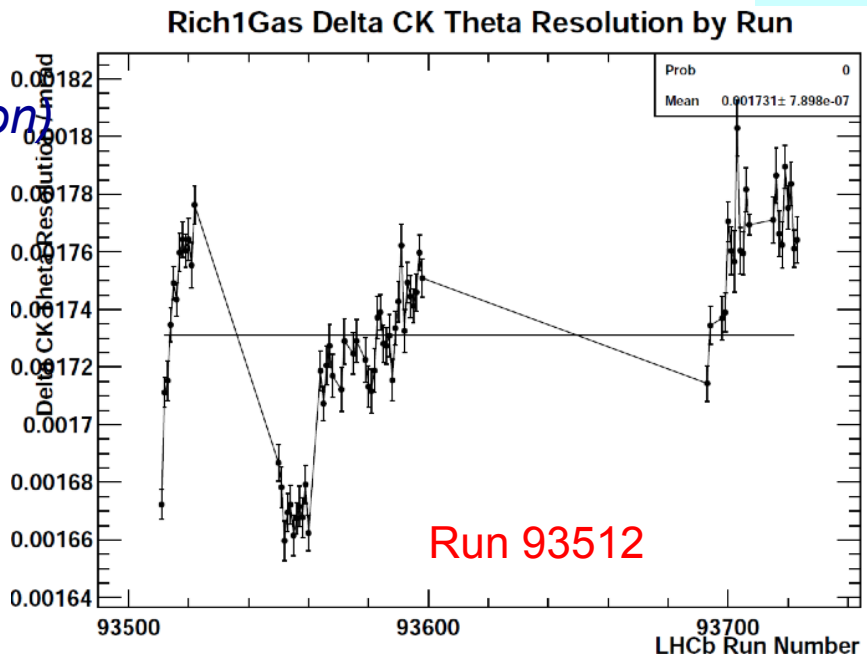
Compare runs from several fills

- **Fill 1867 –Nominal HV (18kV)**
  - Run 93512 (near start of fill) mu 1.5 lumi $3x10^{32}$
- **Fill 1868 – HV at 15kV**
  - Run 93553 (near start of fill) mu 1.5 lumi $3x10^{32}$
- **Fill 1871 –RICHes at 15kV at the start. RICH2 moved to 18kV (run 93700 onwards).**
  - Run 93696 mu 1.6 lumi $3x10^{32}$ (40 mins into fill)
  - And 93700 mu 1.4 lumi $2.8x10^{32}$ (80 mins into fill)
  - And 93715 mu 2.1 lumi $4x10^{32}$ (270 mins into fill)

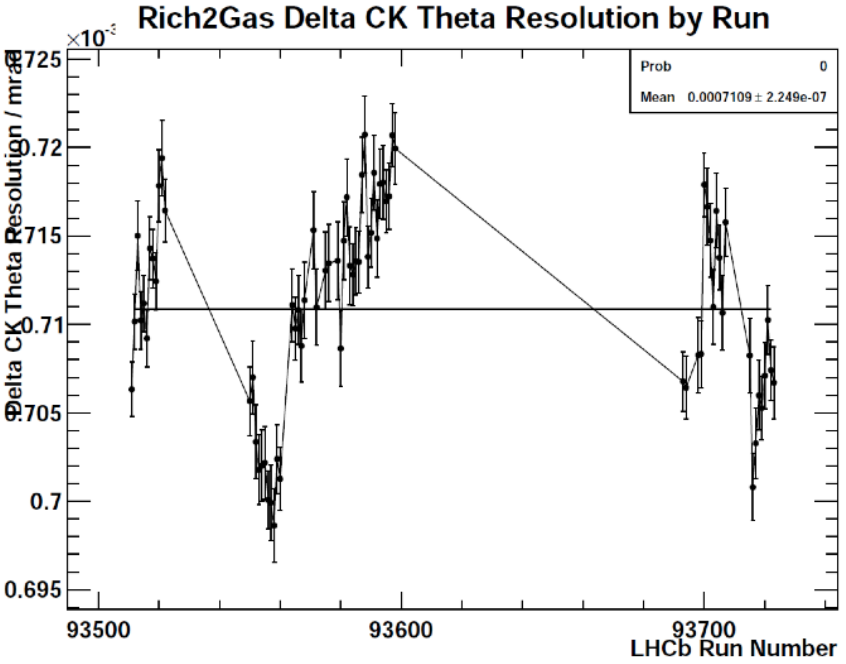
Angular resolution study

(using average HPD image calibration)

RICH-1

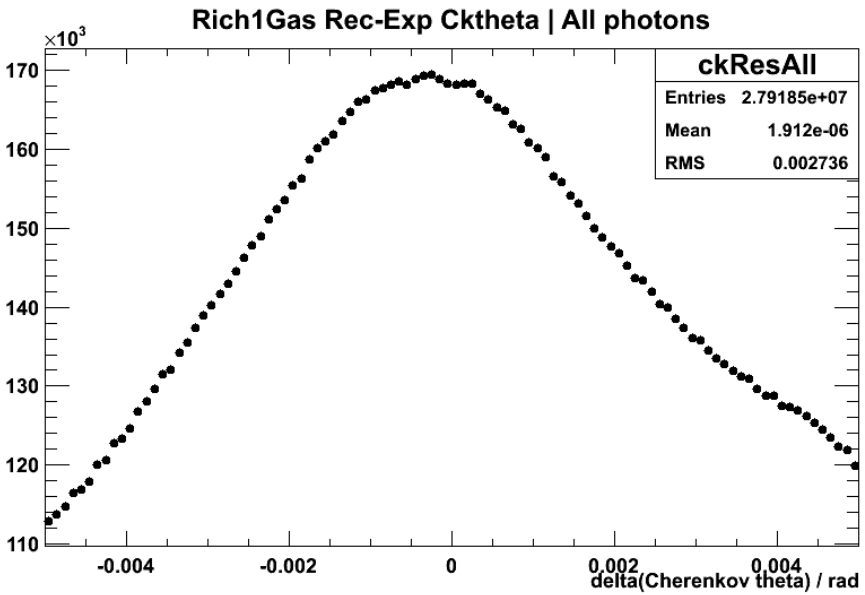


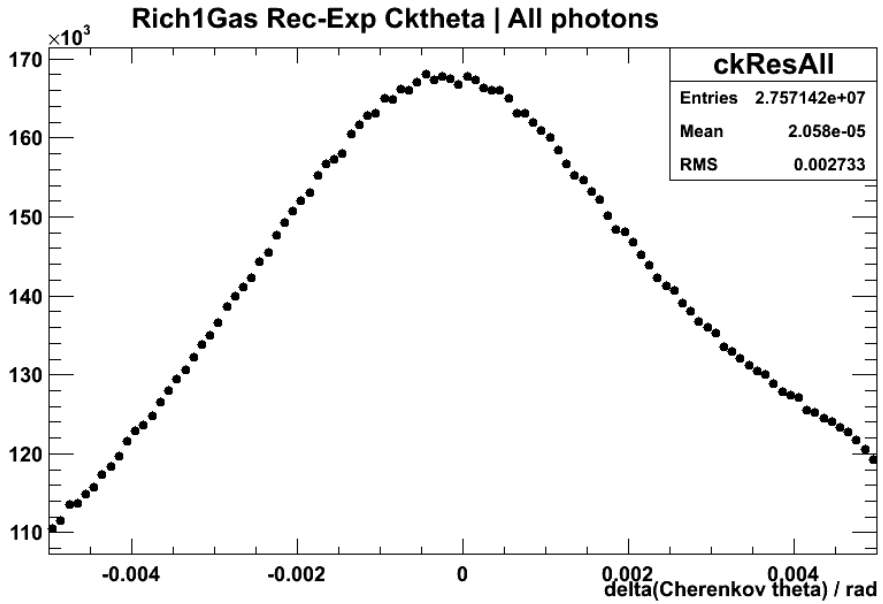
RICH-2



Running conditions

Cherenkov angle resolution





Run @ 15 kV

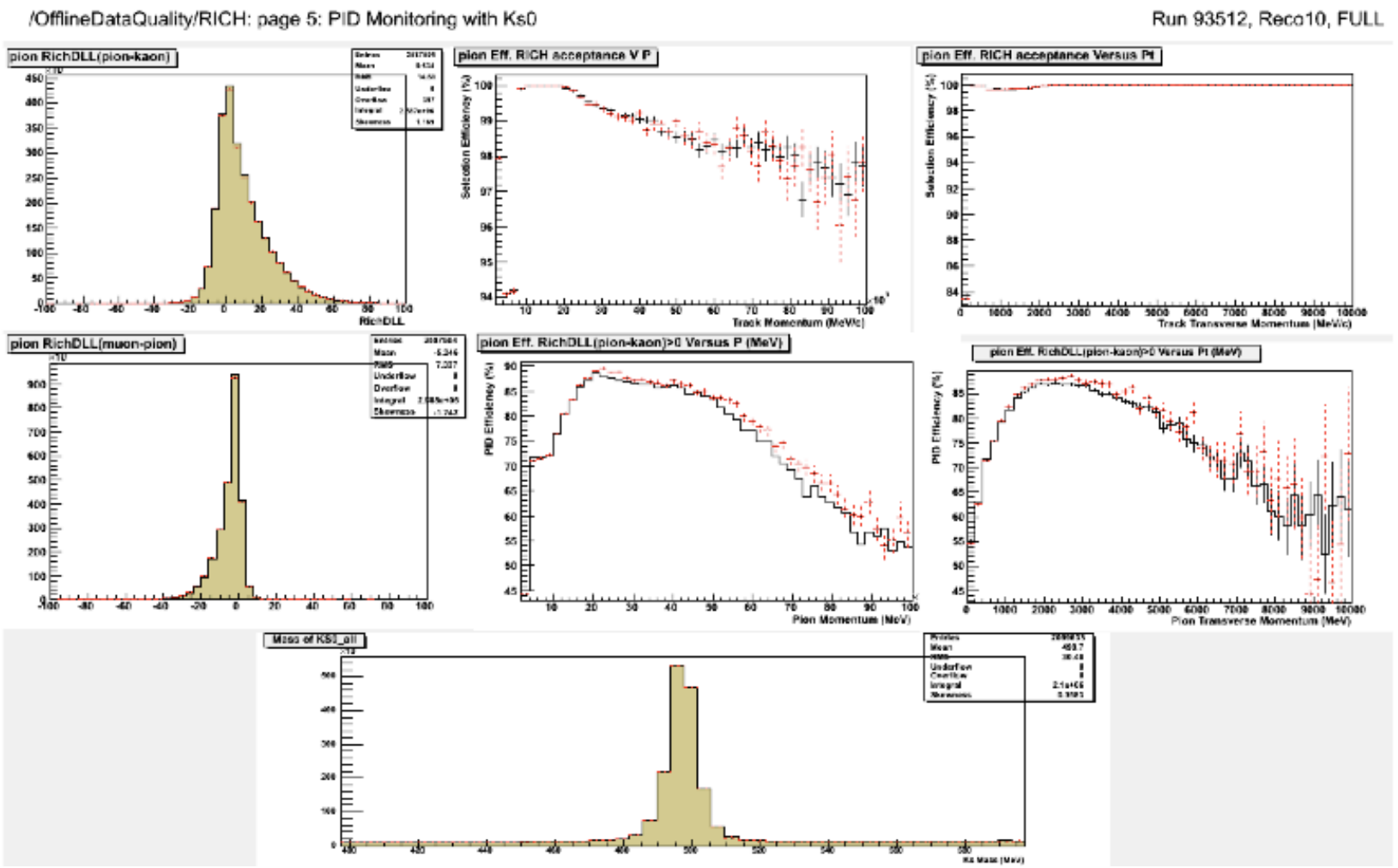
Run @ 18 kV

No difference

RUN 93512 mu=1.5 L= 3x10^{32}

-18 KV

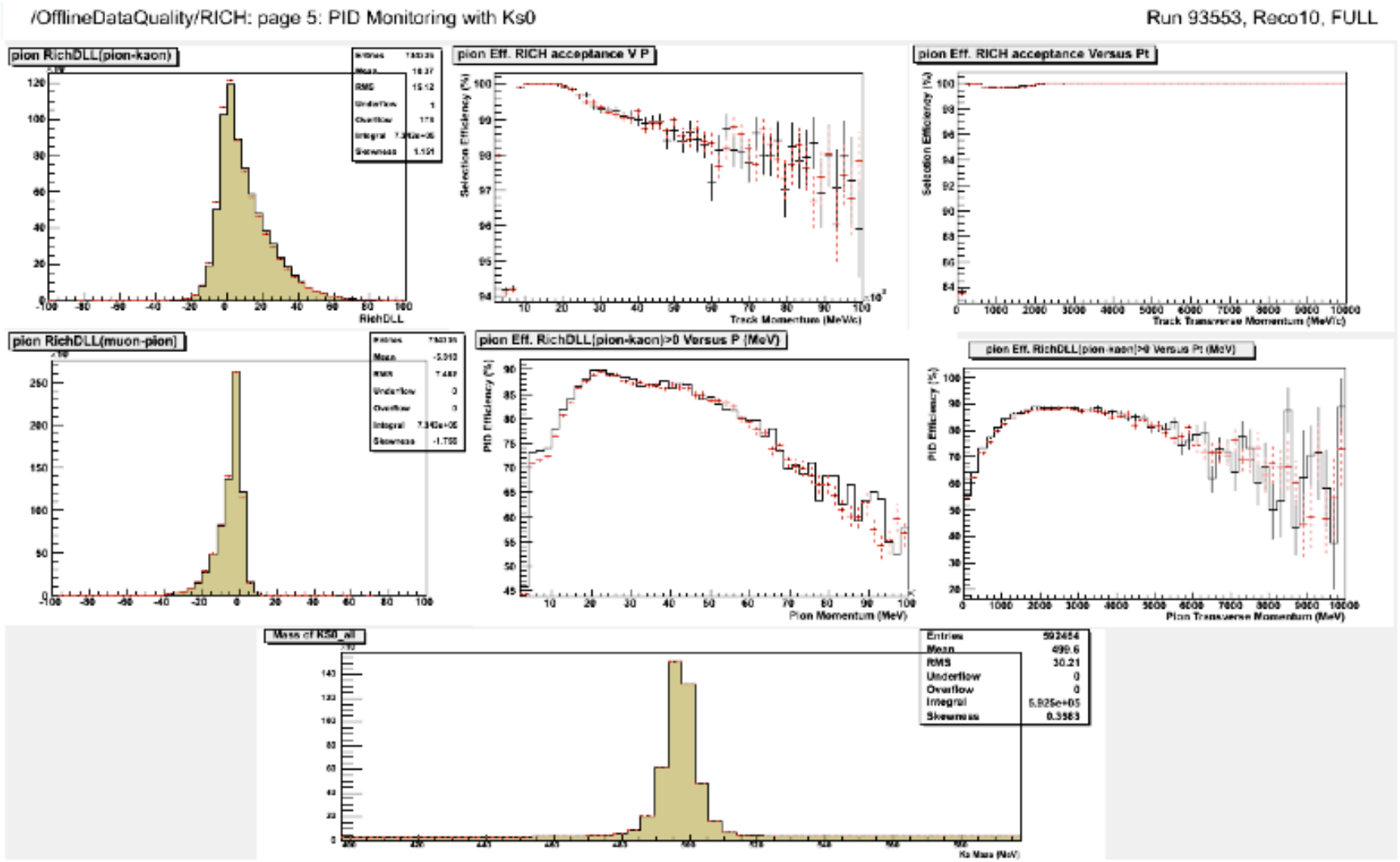
At start of the fill



RUN 93553 mu=1.5 L= 3x10^{32}

- 15 KV

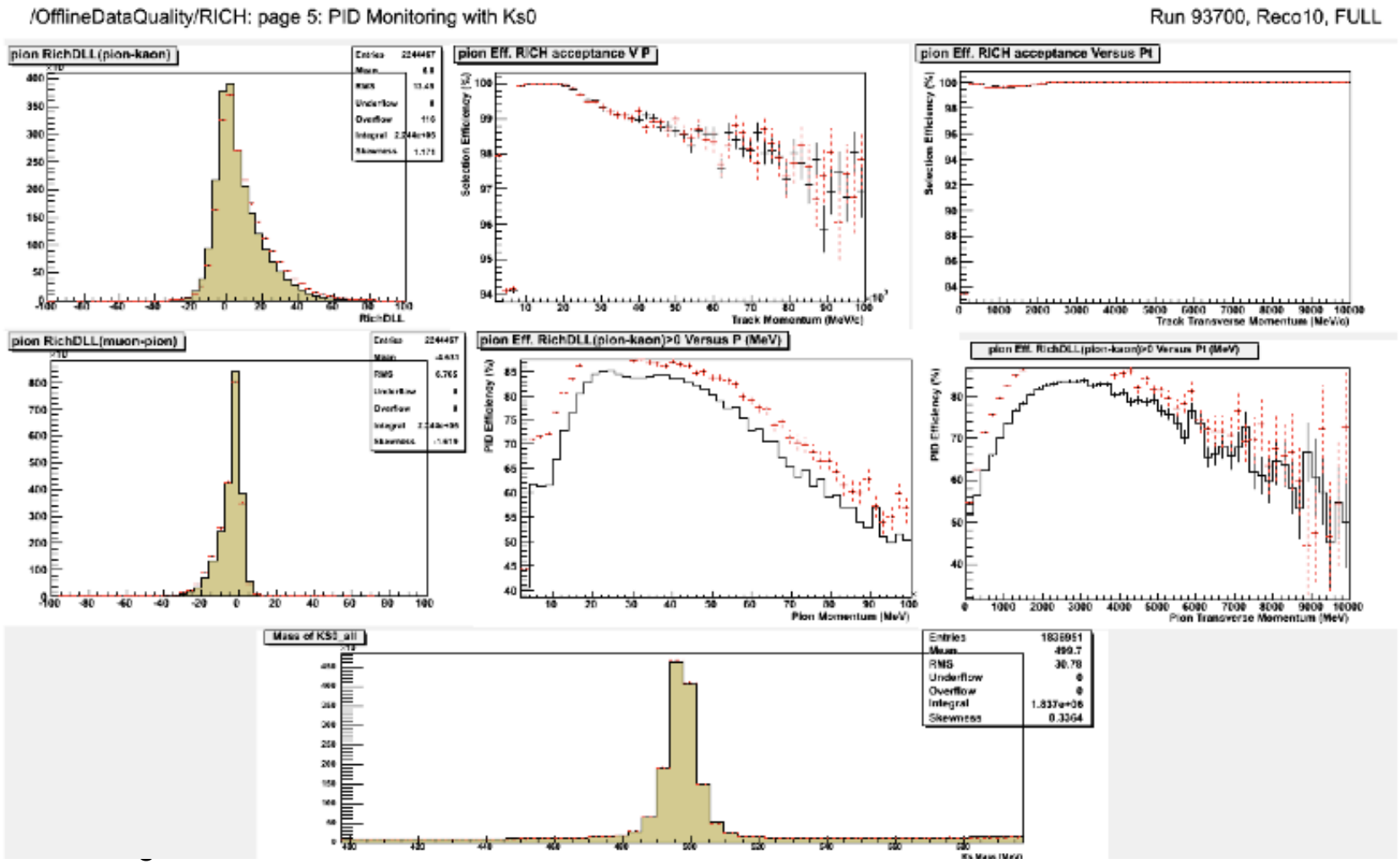
At start of the fill



RUN 93700 mu=1.4 L= 2.8x10^{32}

RICH-1 at 15 KV
RICH-2 at 18 KV

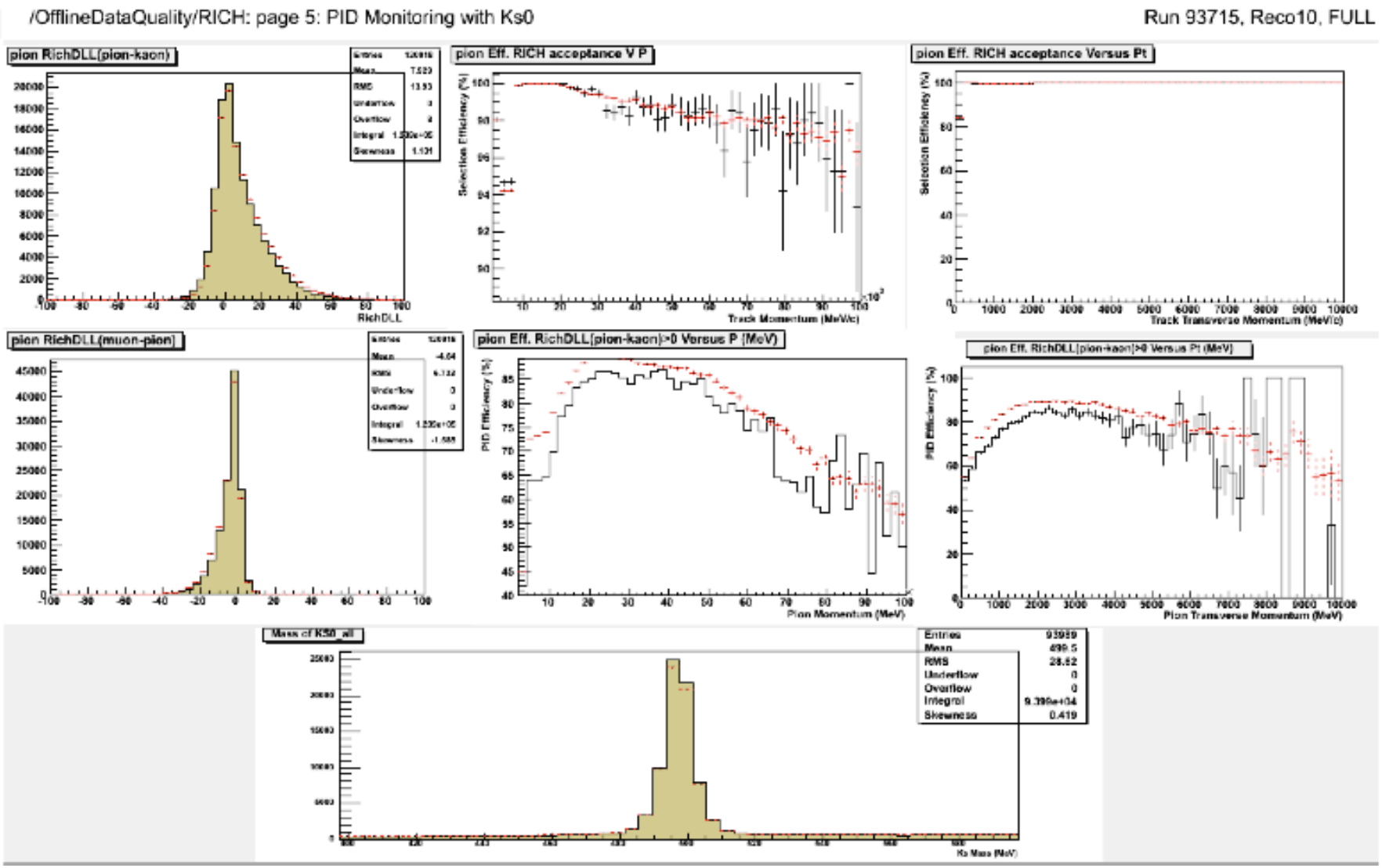
80 mn into the fill



RUN 93715 mu=2.1 L= 4 x10^{32}

RICH-1 at 15 KV
RICH-2 at 18 KV

270 mn into the fill



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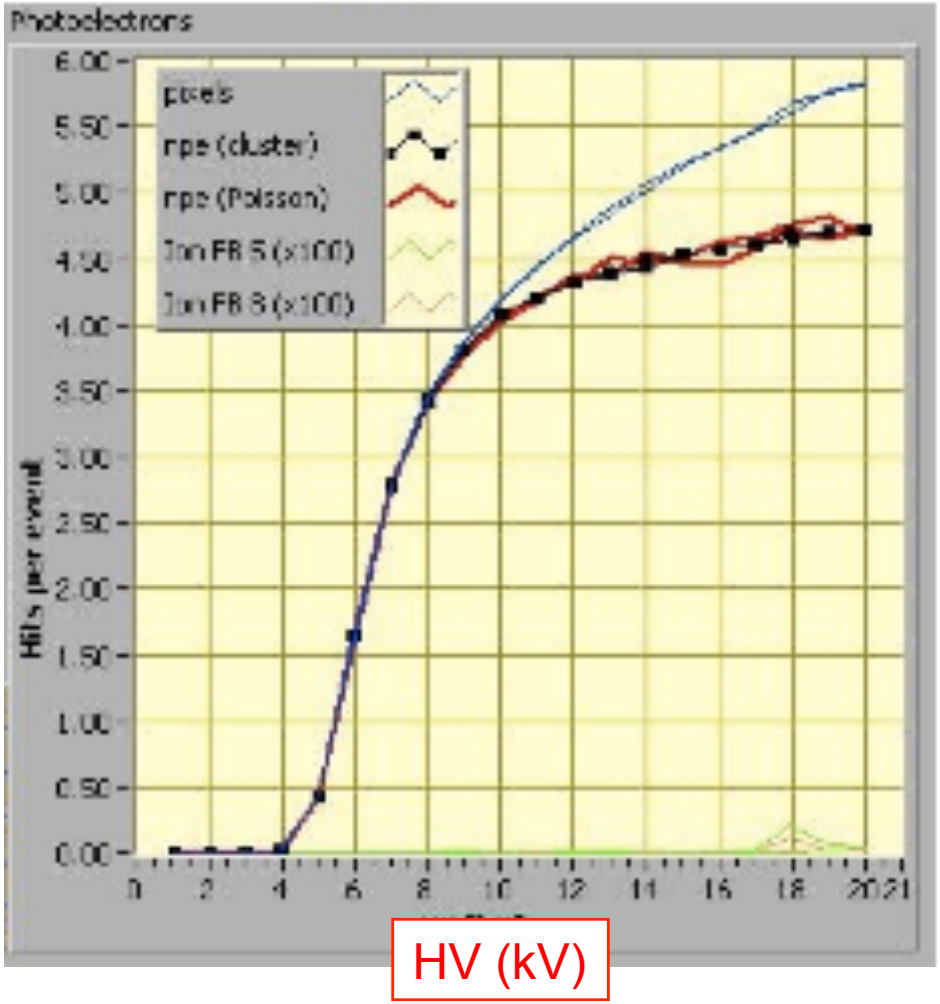
Running conditions

Photoelectron counting

Number of p.e. vs HV (as measured for each tube in Edinburgh PDTF

eff

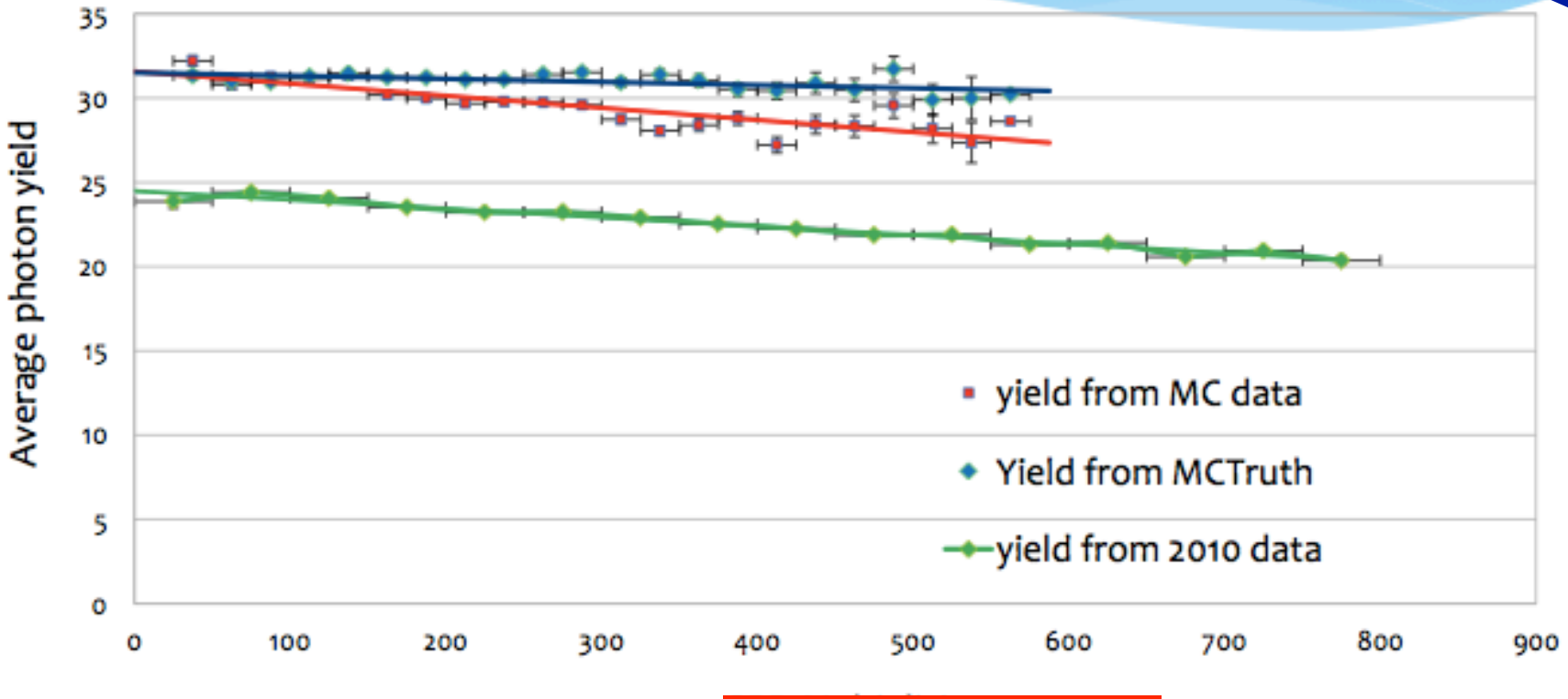
From 18 to 15 KV: -4.3 %



Photoelectron yield

D* Monte Carlo and real data – C_4F_{10}

preliminary



Error bars: statistical error on mean yield

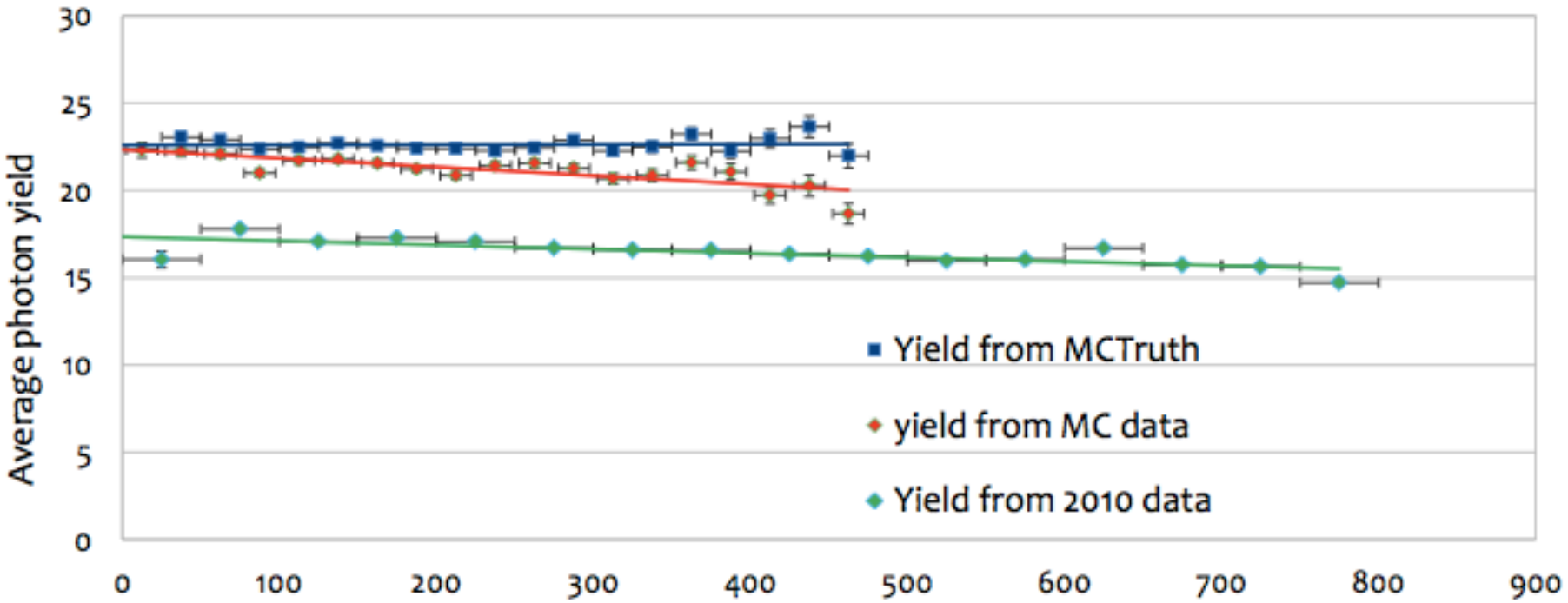
SPD multiplicity

Photoelectron yield

D* Monte Carlo and real data – CF_4

preliminary

Average photon yield vs. SPD multiplicity (CF_4)



Error bars: statistical error on mean yield

SPD multiplicity

Photoelectron yield

preliminary

From 2010 D* calibration data:

Radiator	Value of yield at multiplicity = 0			Data yield as % of MC yield
	MC truth	MC data	2010 data	
C_4F_{10}	31.5 ± 0.2	31.6 ±0.3	24.5 ± 0.1	77.5±1.1%
CF_4	22.6 ± 0.2	22.3 ± 0.3	17.3 ± 0.2	77.6±1.8%
aerogel	5.9 ± 0.1	6.4 ± 0.2	5.4 ± 0.4	84.4±8.5%

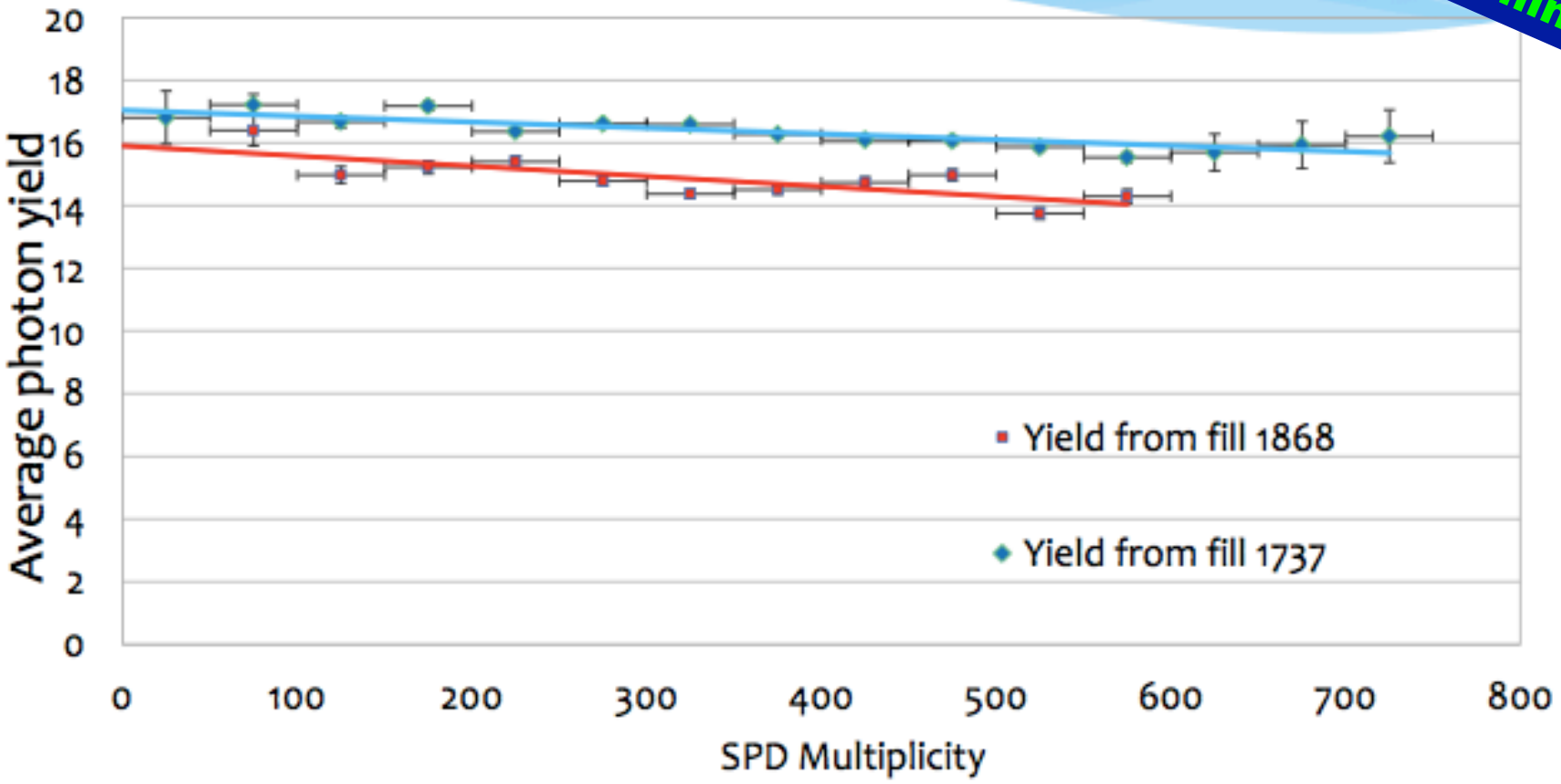
Selected tracks:

momentum cut (saturated rings)
cut on distance of the ring from the beam pipe

Photoelectron yield

2011 data with different voltages

Very preliminary



Photoelectron yield

2011 data with different voltages

Very preliminary

C_4F_{10}	
Fill number	Extrapolated Yield at SPD mult. = 0
1737	24.1±0.5
1868	21.9±0.3
End of 1871 (15 kV)	20.7±0.8
Start of 1871 (15 kV)	22.8±0.2

CF_4	
Fill number	Extrapolated Yield at SPD mult. = 0
1737	17.0±0.2
1868	15.9±0.3
End of 1871 (18 kV)	14.7±0.1
Start of 1871 (15 kV)	16.6±0.6

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Summary

- Cerenkov angle resolution seems stable with different HV setting
- At the start of the fill no difference in PID performance between 15 and 18 KV
- Difficult to separate effects from several different factors: mu, lumi, TCK, HPD image drift, ….
- Ultimately the answer comes from the efficiency plots offline after full calibration of RICH and tracking

  …….available in some time

Summary

On the basis of these considerations the RICH groups recommand:

When running at high luminosity 3-4 x 10e32 , set HV at 15 KV and study the behaviour of the RICHes over about 1 month
Reset to 18 KV if stability and HPDs proper behaviour has Been proven

During this week :
Discussion at the TB on the hardware aspects
More details on software in the presentation by Chris on PID

SPARE SLIDES