A SUMMARY ON POLARISATION IN RUN-13 FOR 255 GEV

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PRESENTING THE WORK DONE
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BROOKHAVEN NATIONAL LABORATORY
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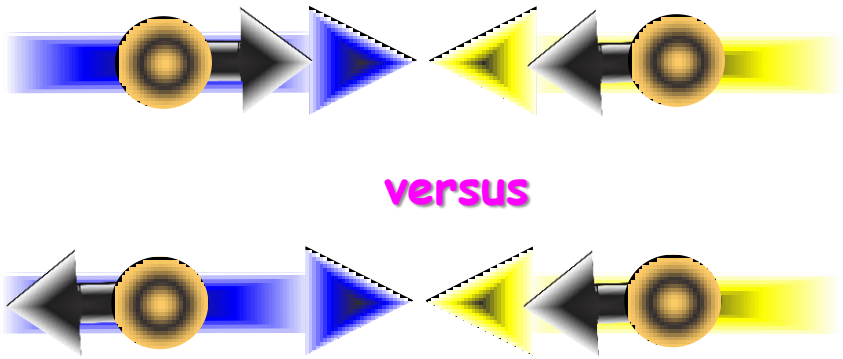
WHY IS POLARISATION CRITICAL



Double-spin helicity asymmetry:

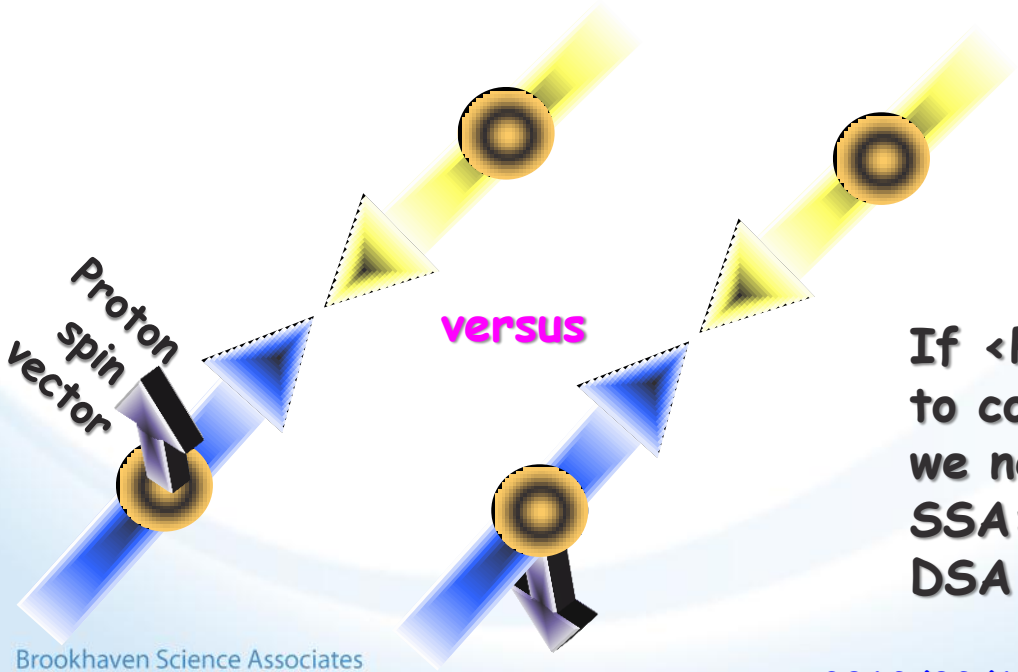
$$A_{LL} \equiv \frac{1}{P_1 P_2} \frac{N_{++}/\mathcal{L}_{++} - N_{+-}/\mathcal{L}_{+-}}{N_{++}/\mathcal{L}_{++} + N_{+-}/\mathcal{L}_{+-}}$$

$$\delta A_{LL/TT} \sim \frac{1}{\sqrt{P_1^2 P_2^2 \int L\,dt}} = \frac{1}{P_1 P_2 \sqrt{\int L\,dt}}$$

Single-spin asymmmetry:

$$A_N \equiv \frac{1}{P_1} \frac{N_\uparrow/\mathcal{L}_\uparrow - N_\downarrow/\mathcal{L}_\downarrow}{N_\uparrow/\mathcal{L}_\uparrow + N_\downarrow/\mathcal{L}_\downarrow}$$

$$\delta A_{L/T} \sim \frac{1}{\sqrt{P_1^2 \int L\,dt}} = \frac{1}{P_1 \sqrt{\int L\,dt}}$$

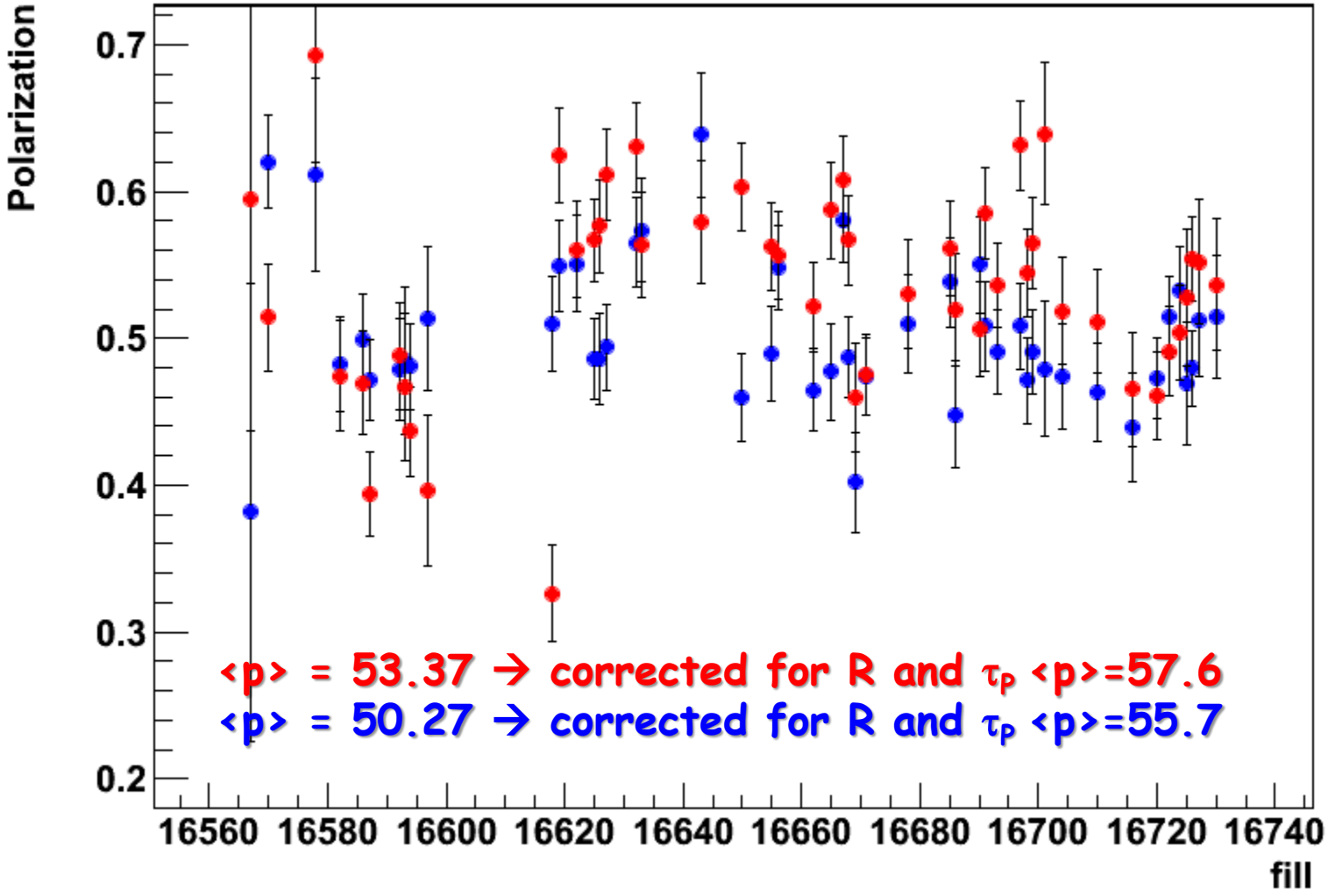


If $\langle P_{1/2} \rangle$ drops from 0.5 to 0.4 to compensate it with integrated lumi we need

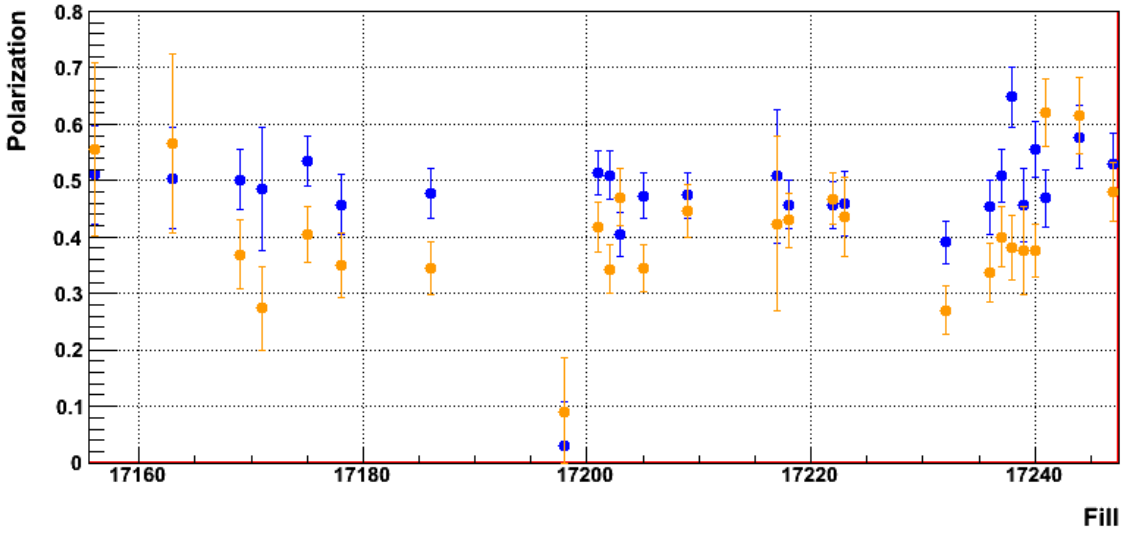
SSA: 1.5 x ∫Ldt

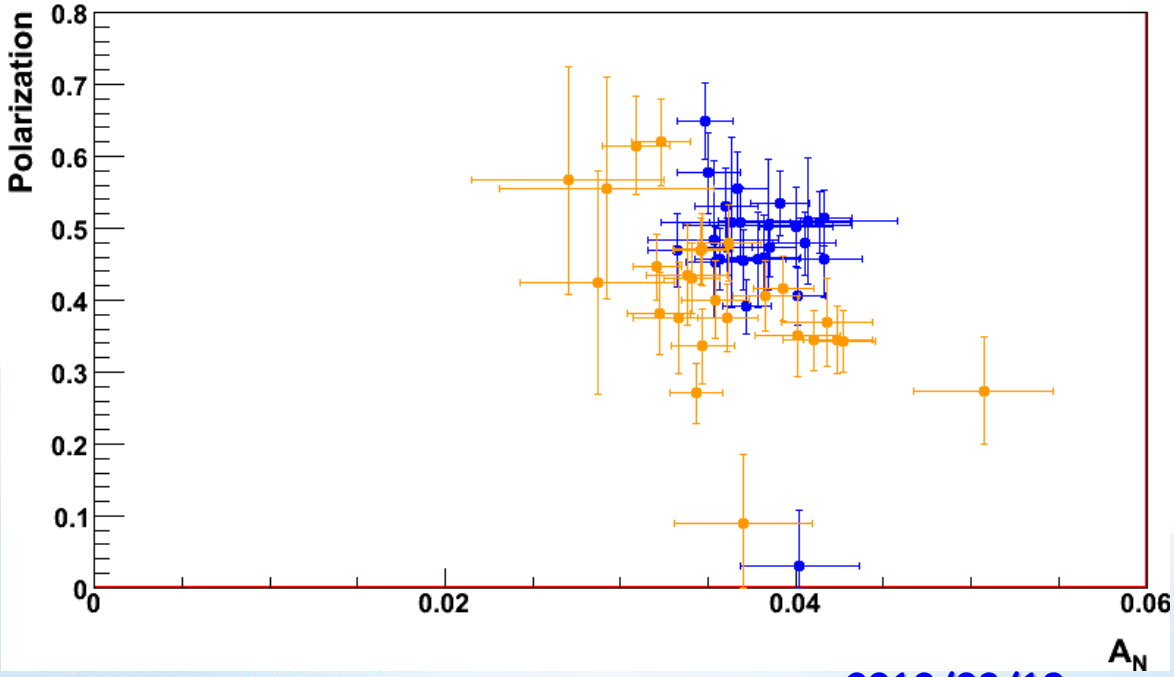
DSA: 2.5 x ∫Ldt

2012: H-JET RESULTS



H-JET RESULTS





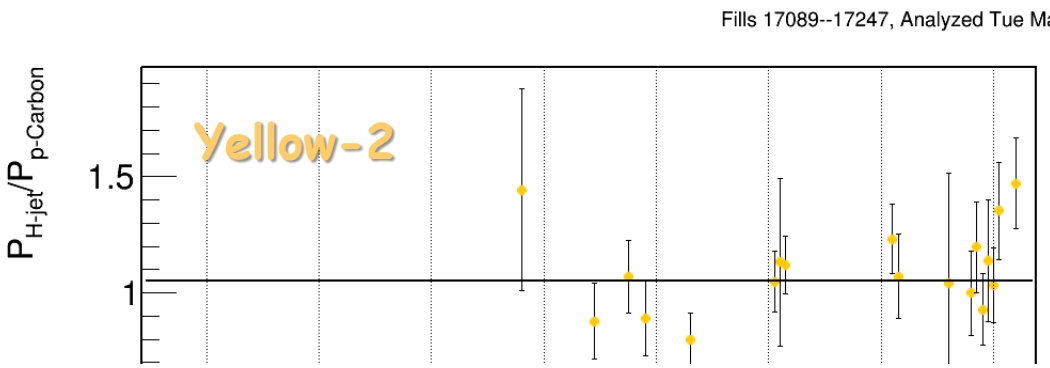
polarisation for
Blue and Yellow

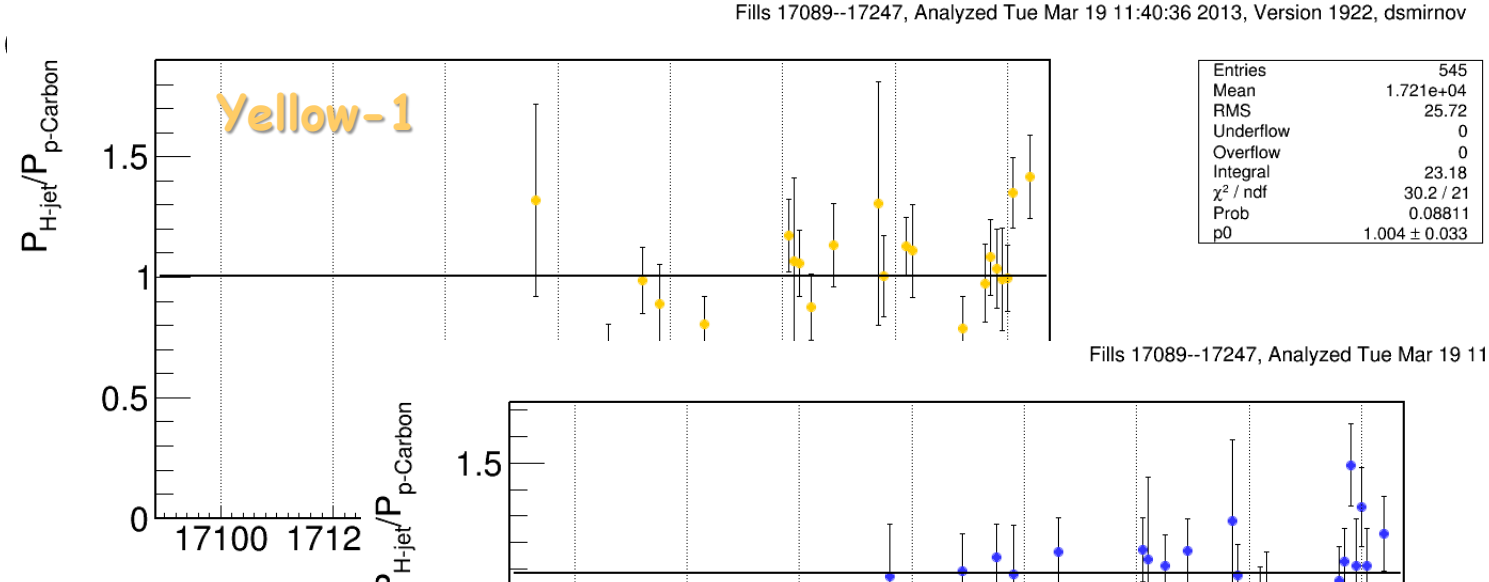
all calibrations applied

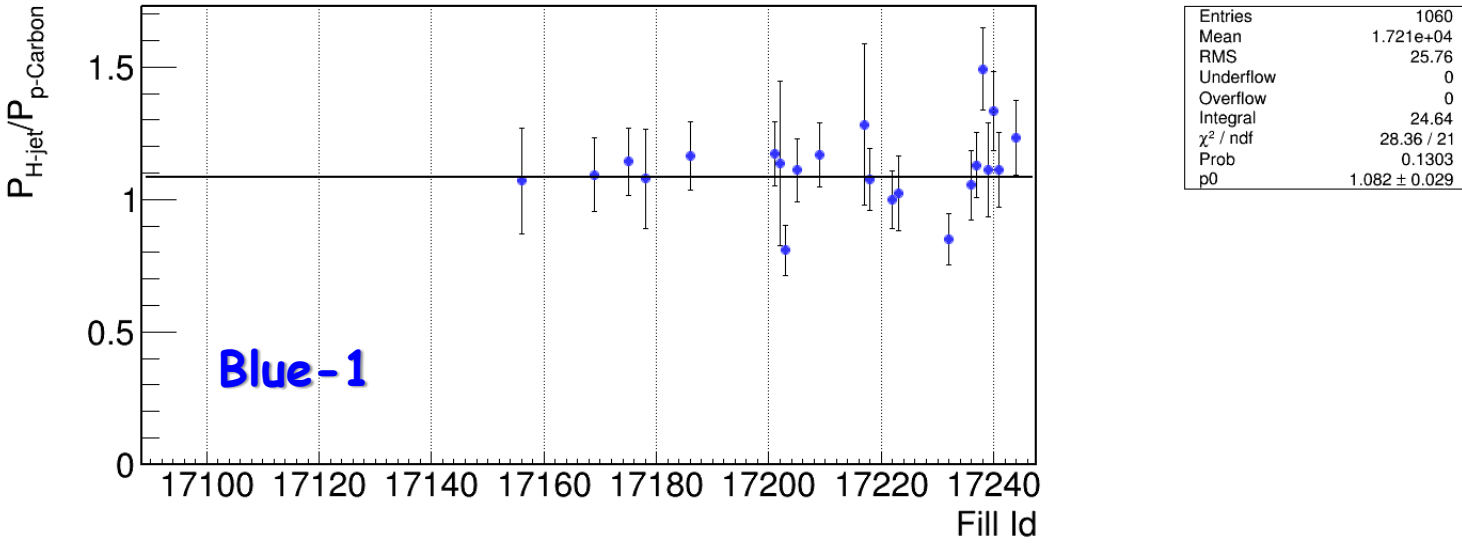
→ now can calibrate pC

→ one caveat correlation A_N to Beam Polarisation, need to check more
→ pol. Background ?

PC NORMALISATION FROM H-JET

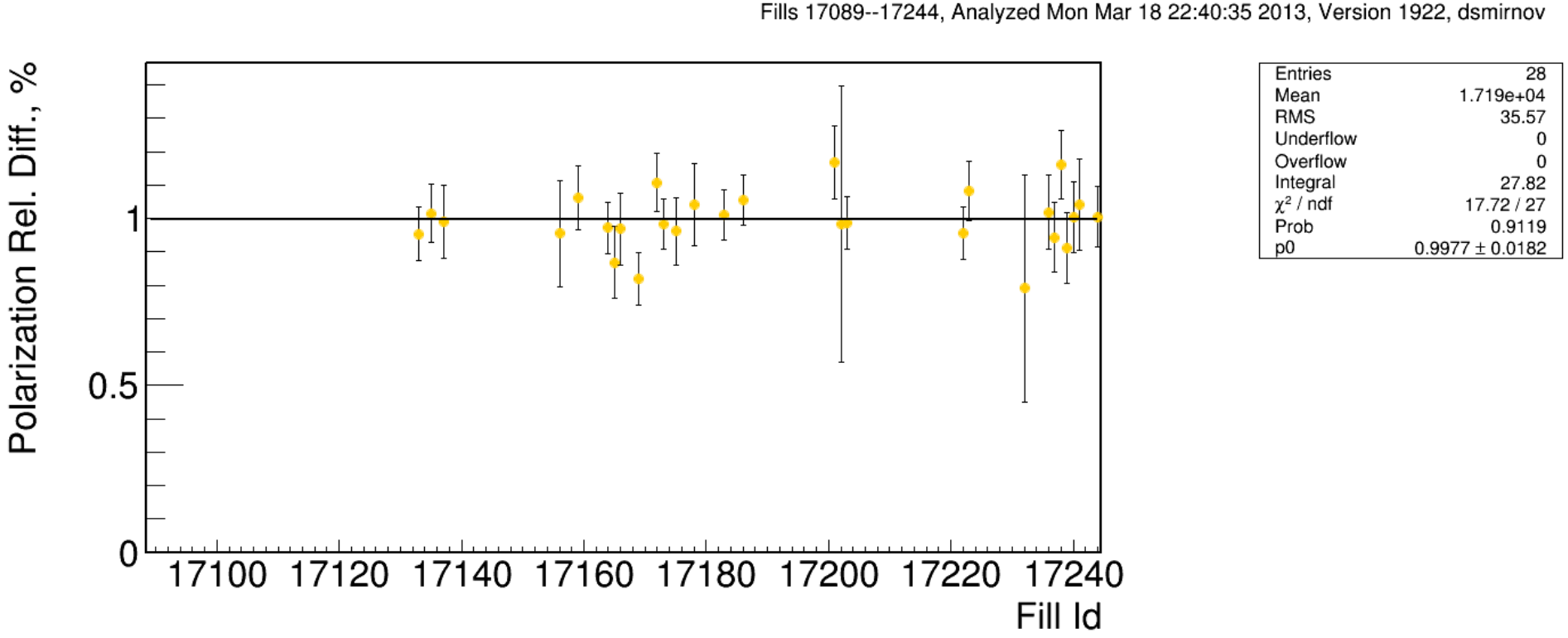






Y1-Y2 RATIO

Ratio after scaling to H-Jet:



not possible for Blue polarimeters as we have not enough B2 measurements

pC RESULTS

Note:
ALL offline numbers have now normalisation to H-Jet !!!
CDEV get reloaded and all past measurements are also corrected
measured analyzing power for injection, 100GeV and 255 GeV in run 11/12
have not seen an energy dependence of pC/H-jet normalization
→ can use the same normalization factor for flat top and injection
→ so injection measurements will be pretty accurate

→ fills shown in all plots: > 17200 for B1 and Y1

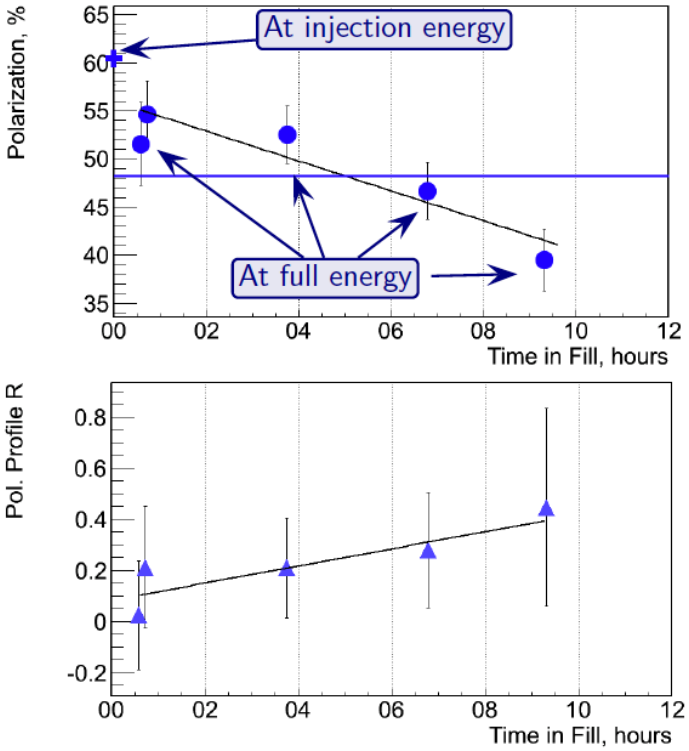
2013 255 GeV:
B1: 1.0755888 ± 0.0291998
B2: 1.0177234 ± 0.0941812
Y1: 0.9880487 ± 0.0339154
Y2: 1.0318247 ± 0.0413803

2012: https://wiki.bnl.gov/rhicspin/Run_12_injection_study

	Polarization, % $P \pm \Delta P \left(\frac{\Delta P}{P} \times 100\%\right)$	24 GeV Scale Factor, fill 16737 $k = \frac{P_{\text{H-jet}}}{P_{\text{p-Carbon}}} \left(\frac{\Delta k}{k} \times 100\%\right)$	100 GeV Scale Factor	255 GeV Scale Factor
H-jet	63.0 ± 4.4 (6.98)			
Y2U	61.84 ± 0.82 (1.32)	1.02 ± 0.07 (7.10)	1.01 ± 0.02	1.01 ± 0.02
Y1D	54.51 ± 1.18 (2.16)	1.16 ± 0.08 (7.31)	1.04 ± 0.02	1.08 ± 0.02

HADRON POLARISATION FOR EXPERIMENTS

Account for
beam polarization decay through fill → $P(t)=P_0\exp(-t/\tau_p)$
growth of beam polarization profile R through fill



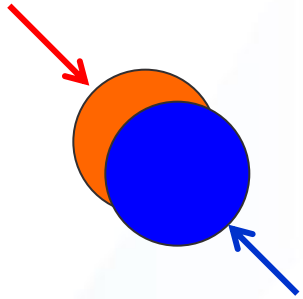
correlation of dP/dt to dR/dt for all 2012 fills at 250 GeV

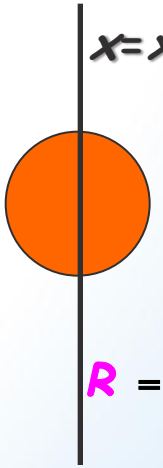
pCarbon polarimeter

Collider Experiments

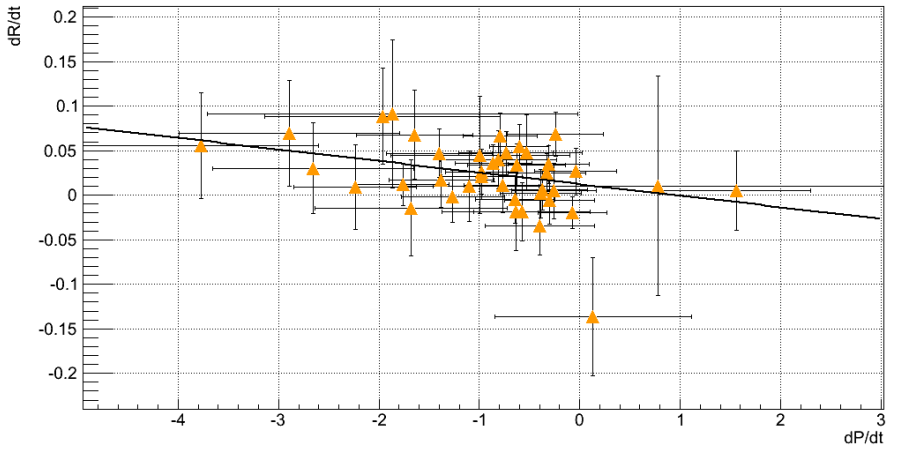
$$\langle P_1 \rangle = P_1(x_0, y) \otimes I_1(x_0, y)$$

$$\langle P_1 \rangle = P_1(x, y) \otimes I_1(x, y) \otimes I_2(x, y)$$



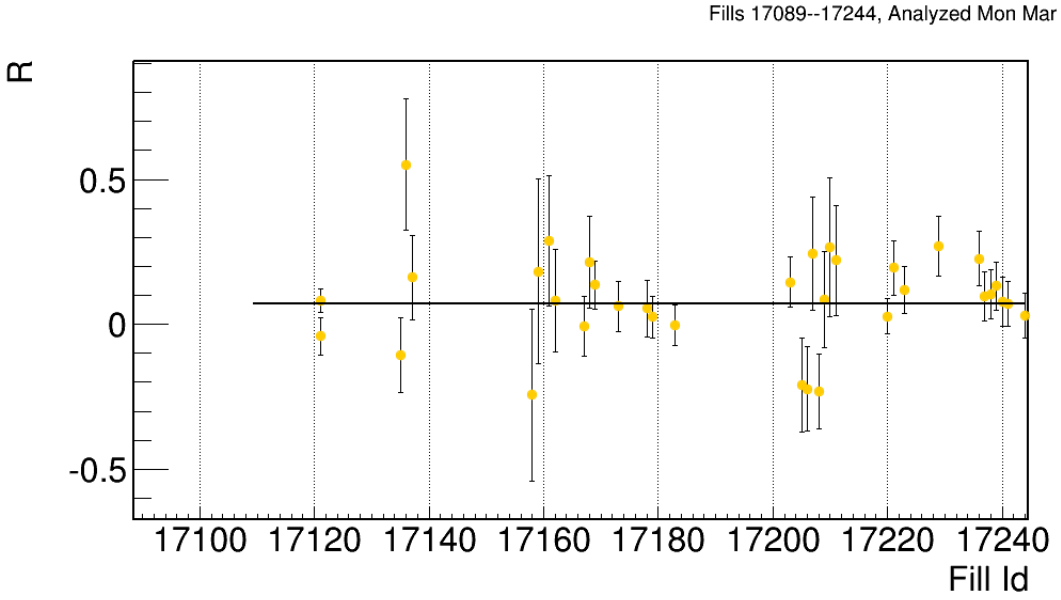


$$R = \frac{\sigma_I^2}{\sigma_P^2}$$



Polarization lifetime has consequences for physics analysis
→ different physics triggers mix over fill
→ different <P>

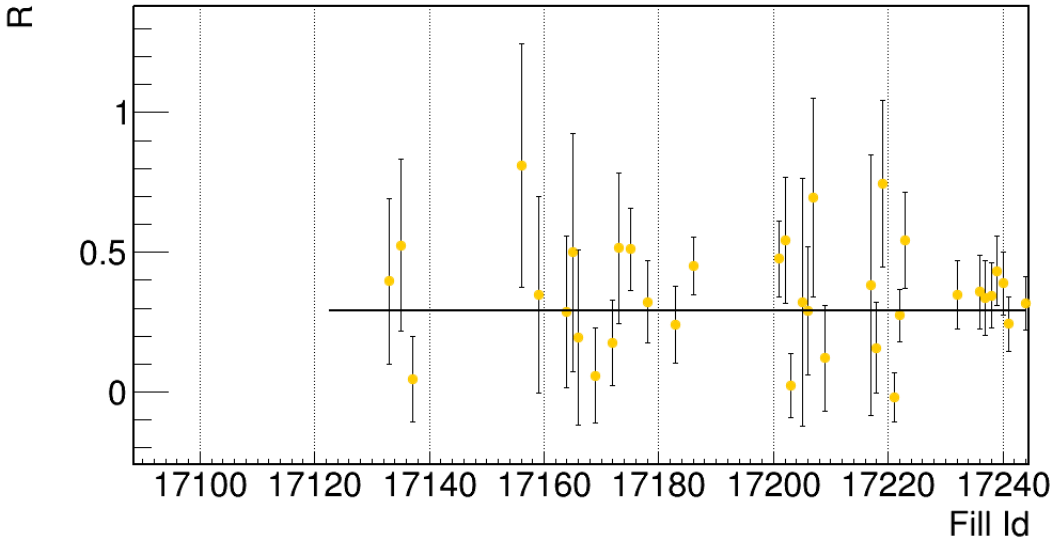
pC RESULTS: PROFILE R



at injection
2012: Y1: 0.054+/-0.0104

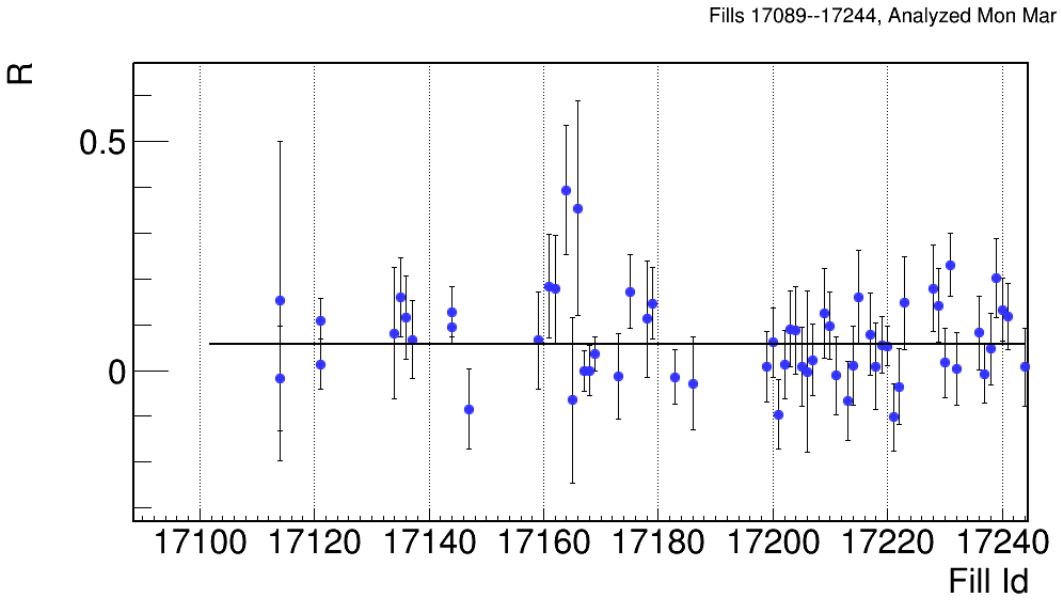
χ^2 / ndf	41.34 / 34
Prob	0.1806
p0	0.07191 ± 0.01584

at flat top
2012: Y1: 0.1295+/-0.01253



χ^2 / ndf	44.1 / 35
Prob	0.1392
p0	0.2916 ± 0.02505

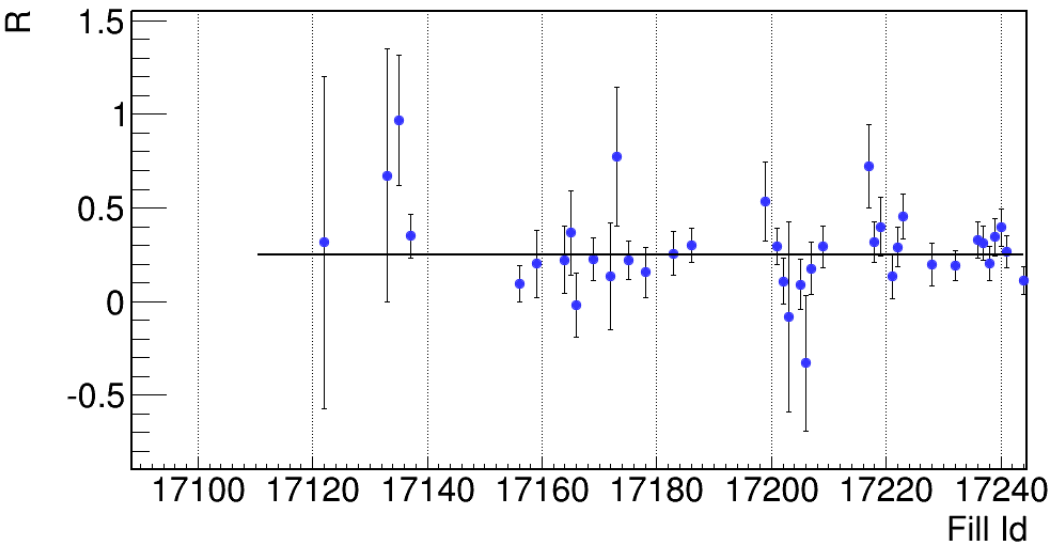
pC RESULTS: PROFILE R



at injection
2012: B1:0.041+/-0.0093

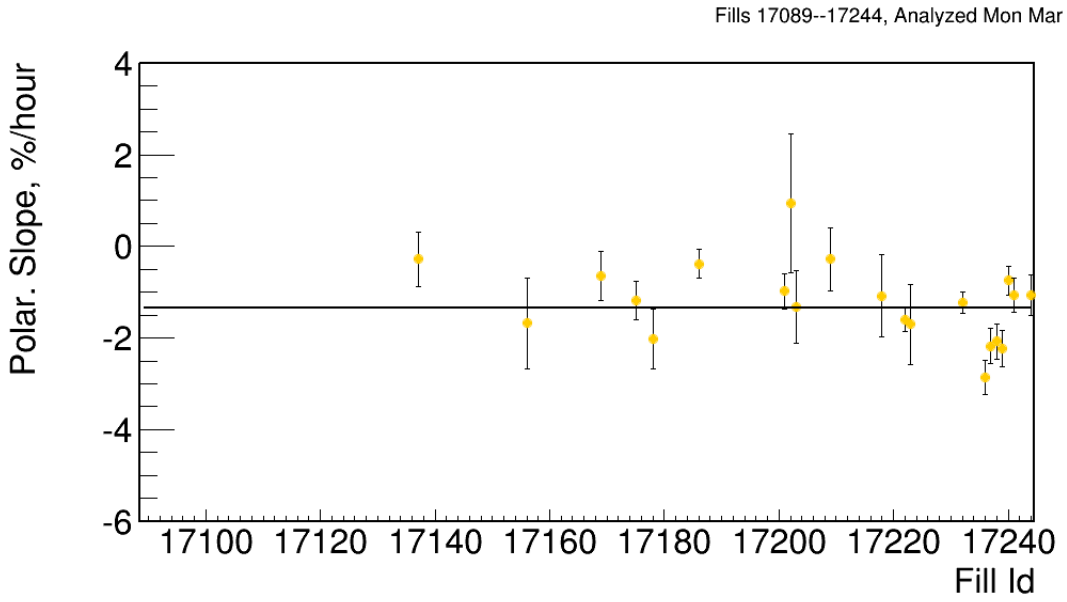
χ^2 / ndf	62.48 / 59
Prob	0.3536
p0	0.05815 ± 0.009604

at flat top
2012: B1:0.205+/-0.011



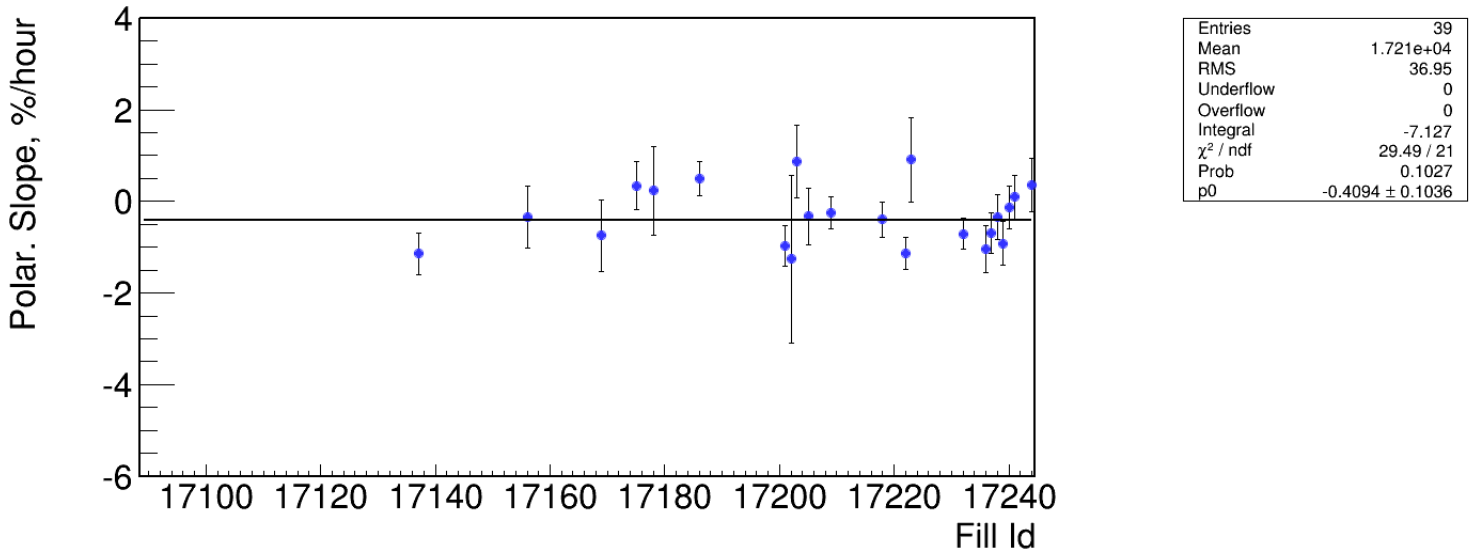
χ^2 / ndf	40.2 / 38
Prob	0.373
p0	0.2518 ± 0.01967

pC RESULTS: POLARISATION DECAY



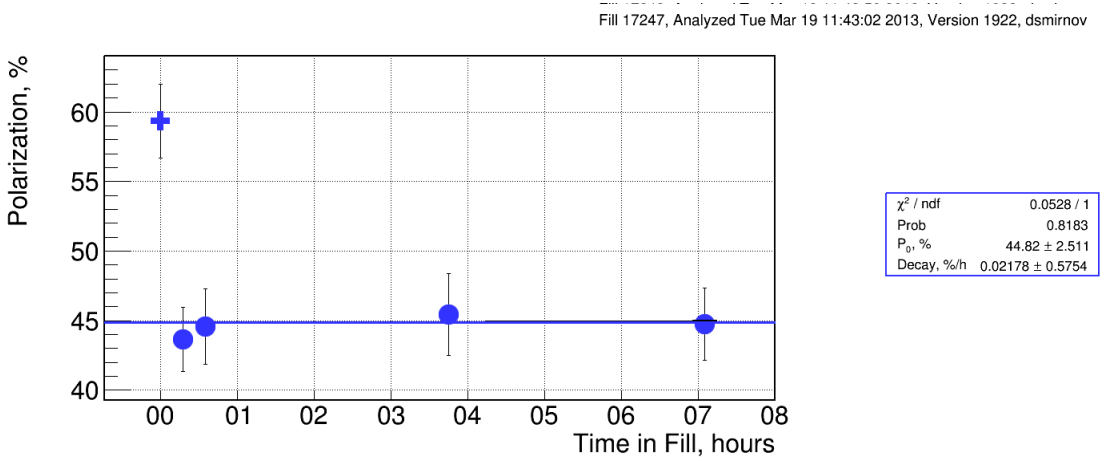
2012: Y1: -0.67+/-0.056

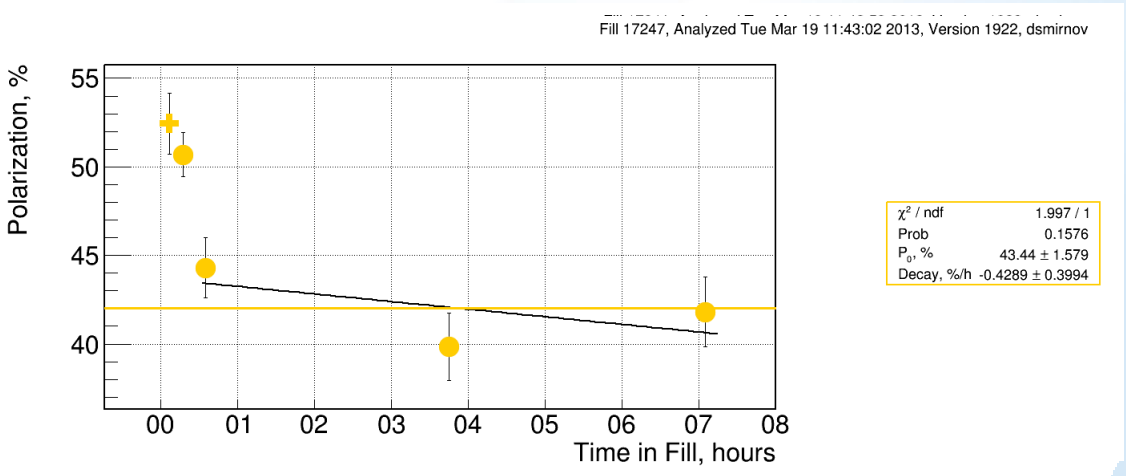
2012: B1: -0.61+/-0.056



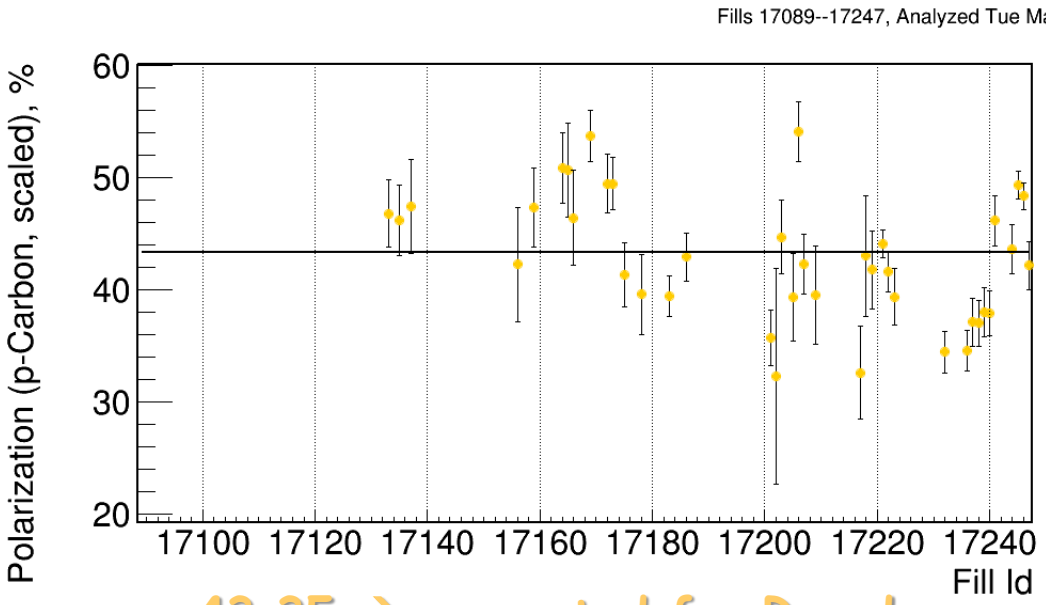
SOME RESULTS FOR INDIVIDUAL FILLS

See: http://www.phy.bnl.gov/cnipol/fills/ 17237 - 17347





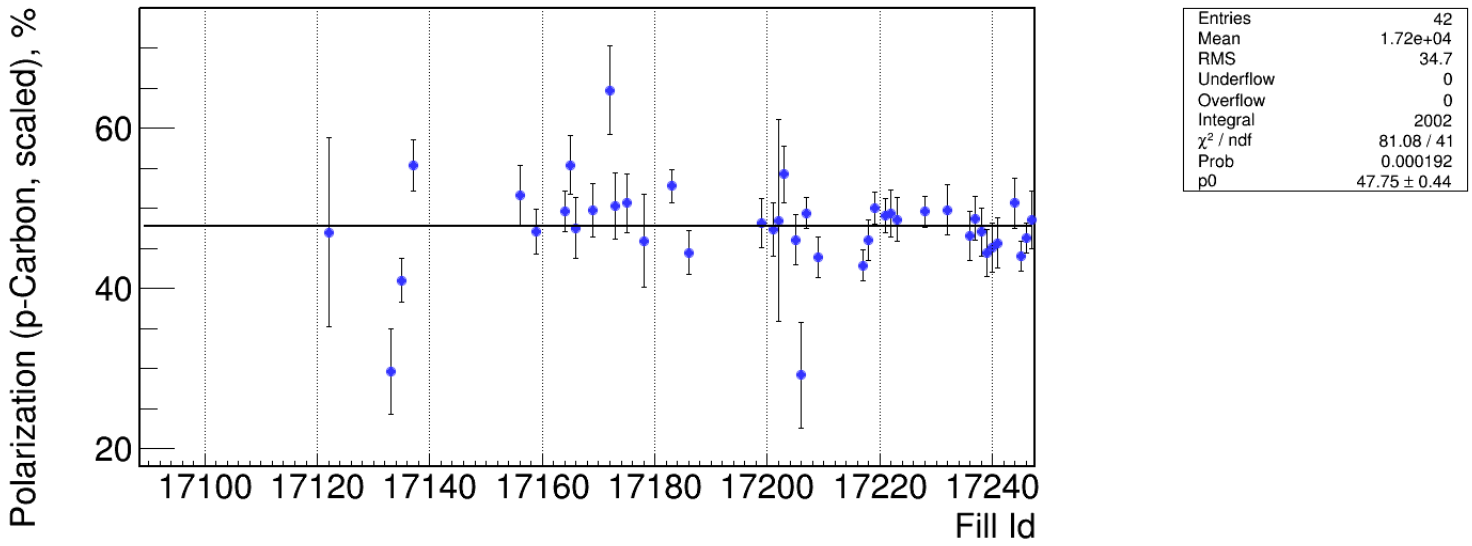
pC: POLARISATION RESULTS PER FILL



at flat top

<p> = 43.35 → corrected for R and τ_p <p>=46.73

<p> = 47.75 → corrected for R and τ_p <p>=52.34



SUMMARY

- Polarisation lifetime
  - yellow still worse than in 2012
  - blue looks the same or even sometimes better as 2012
- Ramp efficiency
  - still varies sometimes loose all on the ramp to flat top
  - sometimes still loose through the rotator ramp different for blue and yellow
- Polarisation profile
  - currently both in blue and yellow bigger as in 2012
- targets:
  - will change targets both in blue and yellow
  - it seems to put targets further away from beam in park position and not having the 200MHz on during measurements helps

Remaining Targets as of today:

B1: 0 horizontal and 6 vertical
B2: 6 horizontal and 0 vertical
Y1: 4 horizontal and 6 vertical
Y2: 2 horizontal and 2 vertical