A SUMMARY ON POLARISATION IN RUN-13 FOR 255 GEV

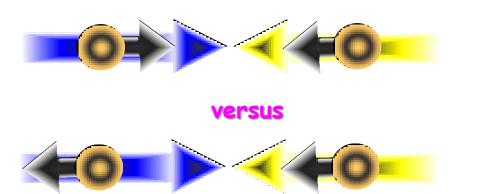
E.C. ASCHENAUER PRESENTING THE WORK DONE BY BILL, DIMA AND OLEG

> BROOKHAVEN NATIONAL LABORATORY

> > a passion for discovery



WHY IS POLARISATION CRITICAL



versus

Double-spin helicity asymmetry:

$$A_{LL} = \frac{1}{P_{1}P_{2}} \frac{N_{++}/\mathcal{L}_{++} - N_{+-}/\mathcal{L}_{+-}}{N_{++}/\mathcal{L}_{++} + N_{+-}/\mathcal{L}_{+-}}$$

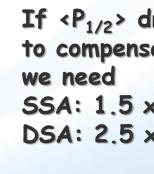
$$\delta A_{LL/TT} \sim \frac{1}{\sqrt{P_{1}^{2}P_{2}^{2} \int L dt}} = \frac{1}{P_{1}P_{2}\sqrt{\int L dt}}$$

Single-spin asymmetry:

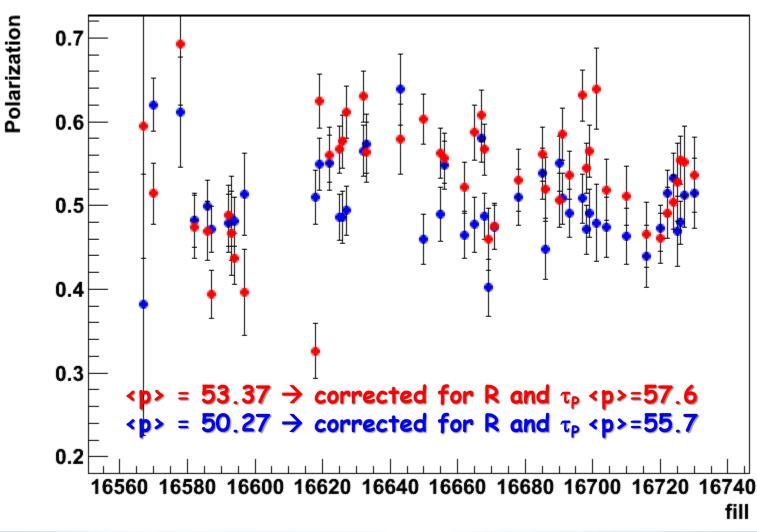
$$A_{N} = \frac{1}{P_{1}} \frac{N_{\uparrow}/\mathcal{L}_{\uparrow} - N_{\downarrow}/\mathcal{L}_{\downarrow}}{N_{\uparrow}/\mathcal{L}_{\uparrow} + N_{\downarrow}/\mathcal{L}_{\downarrow}}$$
$$\delta A_{L/T} \sim \frac{1}{\sqrt{P_{1}^{2} \int L dt}} = \frac{1}{P_{1} \sqrt{\int L dt}}$$

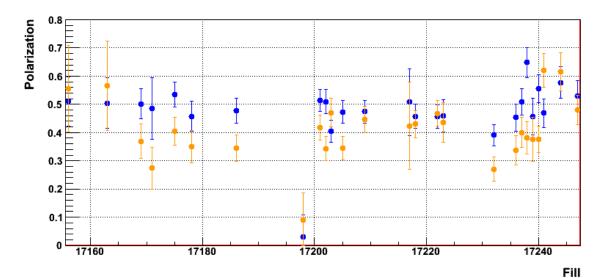
If $\langle P_{1/2} \rangle$ drops from 0.5 to 0.4 to compensate it with integrated lumi

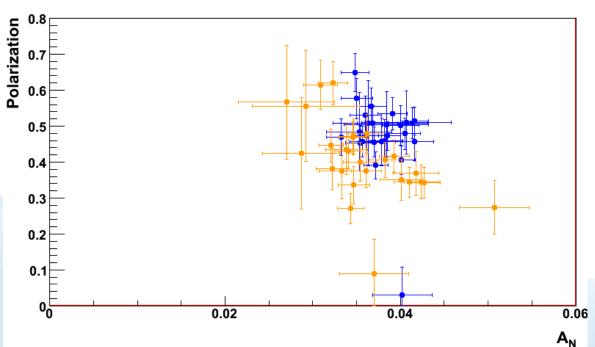
SSA: 1.5 x ∫Ldt DSA: 2.5 x JLdt



2012: H-JET RESULTS







H-JET RESULTS

polarisation for Blue and Yellow

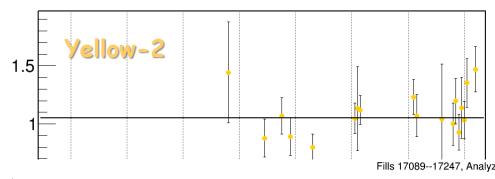
all calibrations applied

- → now can calibrate pC
- → one caveat correlation A_N to Beam Polarisation, need to check more
 → pol. Background ?



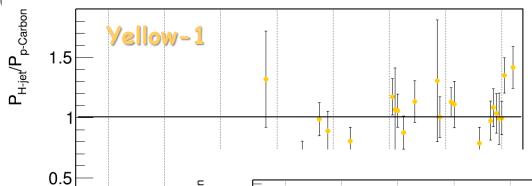
PC NORMALISATION FROM H-JET

Fills 17089--17247, Analyzed Tue Mar 19 11:40:36 2013, Version 1922, dsmirnov



Entries	397
Mean	1.721e+04
RMS	28.73
Underflow	0
Overflow	0
Integral	19.85
χ^2 / ndf	17.71 / 17
Prob	0.4076
p0	1.05 ± 0.04

Fills 17089--17247, Analyzed Tue Mar 19 11:40:36 2013, Version 1922, dsmirnov



Entries	545
Mean	1.721e+04
RMS	25.72
Underflow	0
Overflow	0
Integral	23.18
χ² / ndf	30.2 / 21
Prob	0.08811
p0	1.004 ± 0.033

Fills 17089--17247, Analyzed Tue Mar 19 11:40:36 2013, Version 1922, dsmirnov

Entries

Mean RMS

Underflow Overflow

Integral

χ² / ndf Prob

p0

1060 1.721e+04

25.76

24.64 28.36 / 21

 1.082 ± 0.029

0.1303

0.5 Blue - 1
⁰ 17100 17120 17140 17160 17180 17200 17220 17240

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17100 1712

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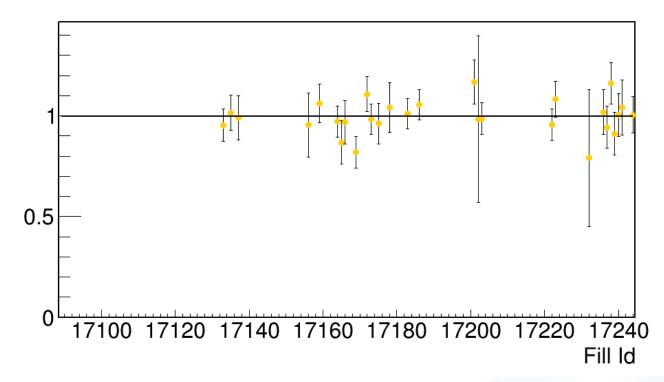
P_{H-jet}/P_{p-Carbon}

Fill Id



Ratio after scaling to H-Jet:

Fills 17089--17244, Analyzed Mon Mar 18 22:40:35 2013, Version 1922, dsmirnov



Entries	28
Mean	1.719e+04
RMS	35.57
Underflow	0
Overflow	0
Integral	27.82
χ² / ndf	17.72 / 27
Prob	0.9119
p0	0.9977 ± 0.0182

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



Polarization Rel. Diff., %



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

 $y_1: 0.9880487 \pm 0.0339154$

 $y2: 1.0318247 \pm 0.0413803$

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

$$k = \frac{P_{\text{H-jet}}}{P_{\text{p-Carbon}}}$$

100 GeV Scale 255 GeV Scale Factor

$$k = \frac{P_{\text{H-jet}}}{P_{\text{D.Carbon}}} \left(\frac{\Delta k}{k} \times 100\% \right)$$

$$63.0 \pm 4.4 (6.98)$$

Y2U
$$61.84 \pm 0.82 (1.32)$$

$$1.02 \pm 0.07 \, (7.10)$$

$$1.01 \pm 0.02$$

$$1.01 \pm 0.02$$

Factor

$$54.51 \pm 1.18$$
 (2.16)

$$1.16 \pm 0.08 (7.31)$$

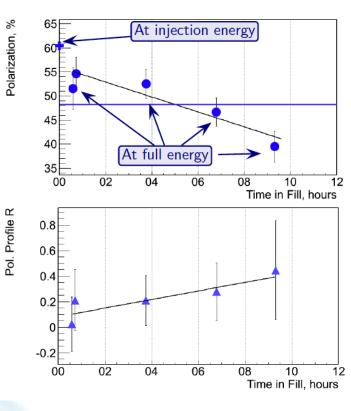
$$1.04 \pm 0.02$$

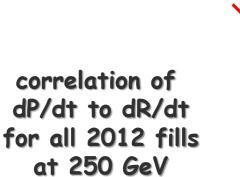
$$1.08\pm0.02$$

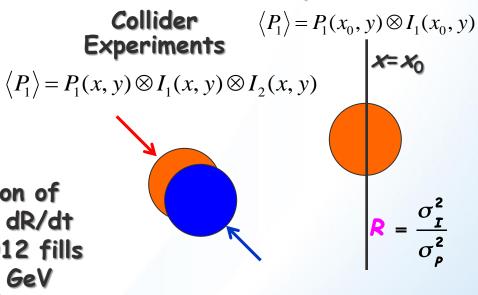
HADRON POLARISATION FOR EXPERIMENTS

Account for beam polarization decay through fill \rightarrow P(t)=P₀exp(-t/ τ_p) growth of beam polarization profile R through fill

pCarbon polarimeter







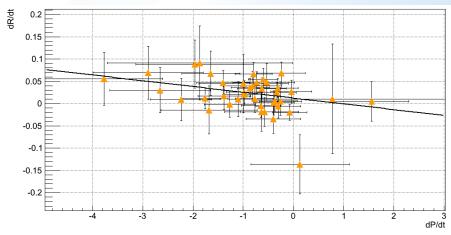
Polarization lifetime has consequences for physics analysis

→ different physics triggers mix over fill



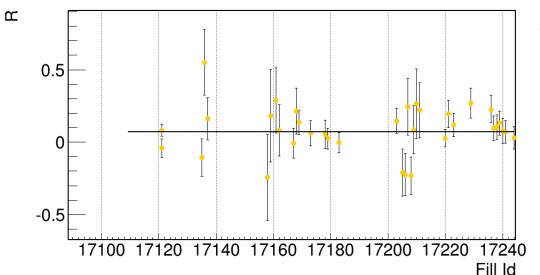
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2013/0



pC RESULTS: PROFILE R

Fills 17089--17244, Analyzed Mon Mar 18 22:40:35 2013, Version 1922, dsmirnov

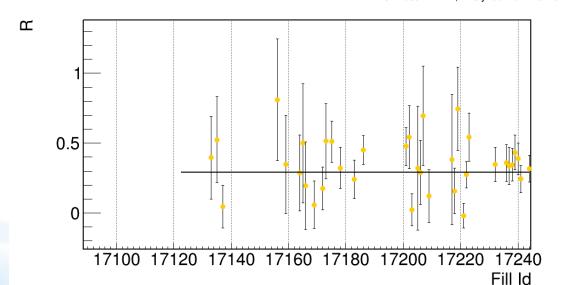


at injection 2012: Y1: 0.054+/-0.0104

 $\begin{array}{ccc} \chi^2 \, / \, ndf & 41.34 \, / \, 34 \\ \\ Prob & 0.1806 \\ p0 & 0.07191 \pm 0.01584 \end{array}$

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

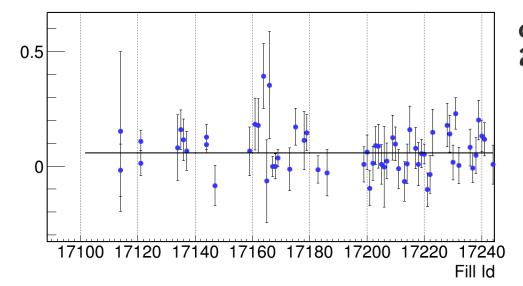
Fills 17089--17244, Analyzed Mon Mar 18 22:40:35 2013, Version 1922, dsmirnov



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

pC RESULTS: PROFILE R

Fills 17089--17244, Analyzed Mon Mar 18 22:40:35 2013, Version 1922, dsmirnov

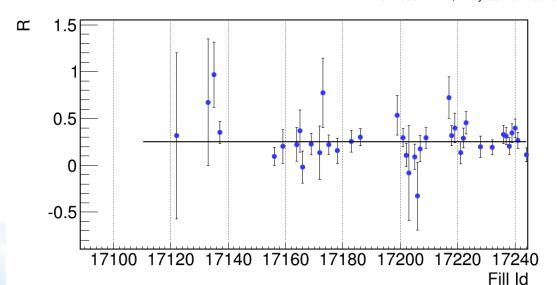


at injection 2012: B1:0.041+/-0.0093

 $\begin{array}{ccc} \chi^2 \, / \, \text{ndf} & 62.48 \, / \, 59 \\ \\ \text{Prob} & 0.3536 \\ \\ \text{p0} & 0.05815 \pm 0.009604 \\ \end{array}$

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

Fills 17089--17244, Analyzed Mon Mar 18 22:40:35 2013, Version 1922, dsmirnov

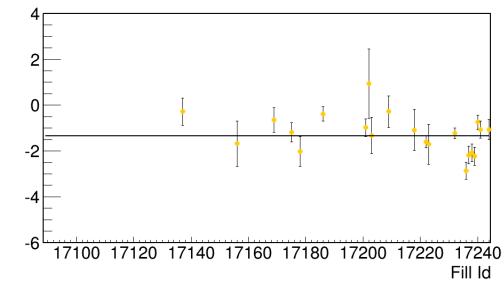


 $\begin{array}{lll} \chi^2 \, / \, \text{ndf} & 40.2 \, / \, 38 \\ \text{Prob} & 0.373 \\ \text{p0} & 0.2518 \pm 0.01967 \end{array}$

 α

PC RESULTS: POLARISATION DECAY

Fills 17089--17244, Analyzed Mon Mar 18 22:40:35 2013, Version 1922, dsmirnov

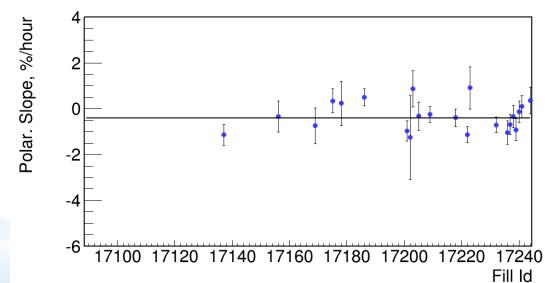


Entries	36
Mean	1.722e+04
RMS	28.91
Underflow	0
Overflow	0
Integral	-25.7
χ² / ndf	55.95 / 20
Prob	2.96e-05
p0	-1.349 ± 0.091

2012: Y1: -0.67+/-0.056

2012: B1: -0.61+/-0.056

Fills 17089--17244, Analyzed Mon Mar 18 22:40:35 2013, Version 1922, dsmirnov



39
1.721e+04
36.95
0
0
-7.127
29.49 / 21
0.1027
-0.4094 ± 0.1036

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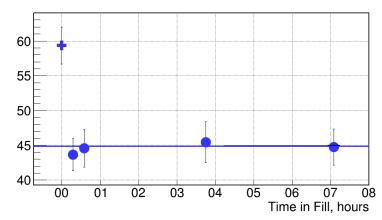
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Polar. Slope, %/hour

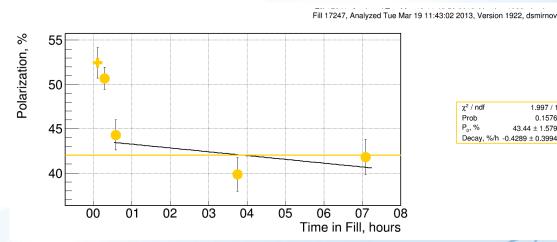
SOME RESULTS FOR INDIVIDUAL FILLS

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

Fill 17247, Analyzed Tue Mar 19 11:43:02 2013, Version 1922, dsmirnov



χ² / ndf 0.0528 / 1 Prob 0.8183 44.82 ± 2.511 Decay, %/h 0.02178 ± 0.5754

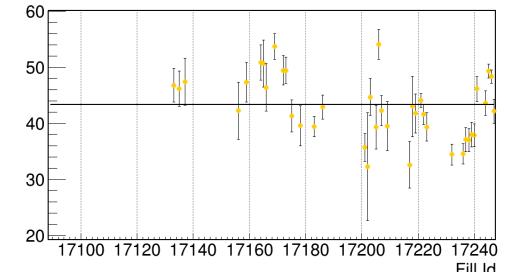


χ2 / ndf 1.997 / 1 0.1576 Prob Decay, %/h -0.4289 ± 0.3994

Polarization, %

pC: POLARISATION RESULTS PER FILL

Fills 17089--17247, Analyzed Tue Mar 19 11:40:36 2013, Version 1922, dsmirnov



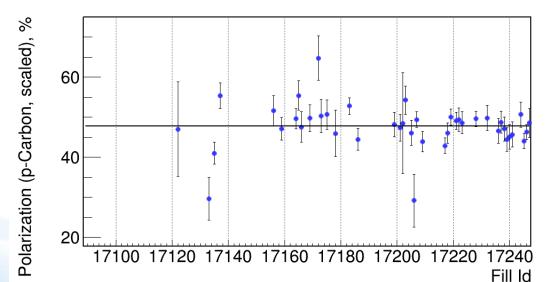
Entries	39
Mean	1.72e+04
RMS	34.53
Underflow	0
Overflow	0
Integral	1673
χ² / ndf	213.2 / 38
Prob	3.009e-26
p0	43.35 ± 0.37

at flat top

 $\langle p \rangle = 43.35 \rightarrow \text{corrected for R and } \tau_p

<math>\langle p \rangle = 47.75 \rightarrow \text{corrected for R and } \tau_p$

Fills 17089--17247, Analyzed Tue Mar 19 11:40:36 2013, Version 1922, dsmirnov



Entries	42
Mean	1.72e+04
RMS	34.7
Underflow	0
Overflow	0
Integral	2002
χ² / ndf	81.08 / 41
Prob	0.000192
p0	47.75 ± 0.44

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Polarization (p-Carbon, scaled), %



- 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: O horizontal and 6 vertical

B2: 6 horizontal and 0 vertical

Y1: 4 horizontal and 6 vertical

Y2: 2 horizontal and 2 vertical

