RHIC Spin Group

https://wiki.bnl.gov/rhicspin/Polarimetry

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Polarimetry

Polarization of proton beams at RHIC is measured by the following polarimeters:

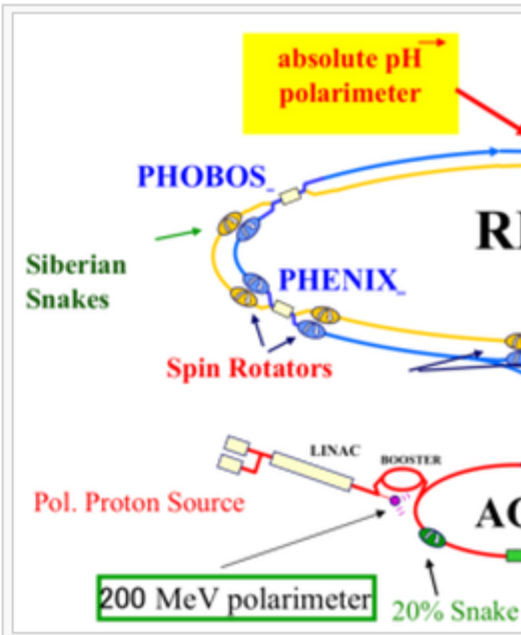
- H-jet polarimeter
- p-Carbon polarimeter

The polarimeters regularly take data during the time when particles spin in the accelerator. Collected data is then analyzed by the CNI polarimetry group and the results become available to the RHIC experiments. The offline analysis is based on the package developed by the CNI group over years. One can learn about it on the Data analysis page.

Another set of polarimeters is installed at AGS. The design of the main AGS polarimeter is similar to the p-Carbon ones used in RHIC. Although the AGS polarimeters are completely independent it is not surprising that the two systems have many common features in both online data taking and offline analysis.

- AGS polarimetry

One can learn more about the hardware and the data acquisition system used for RHIC and AGS polarimeters on this wiki.



A schematic drawing of the RHIC accelerator c
polarimeters highlighted in yellow are the main

http://www.phy.bnl.gov/cnipol/

RHIC Polarimetry Results

Summary Plots	A collection of plots to monitor the performance of the RHIC polarimeters for different time periods
Fill Results	Polarization of RHIC beams for the experiments. Currently only Run11 fills are listed but we plan to Run 9 results

RHIC Polarimetry Results by Fill

Run period: Run 15 ▾

Fill: Use "%" to match any number of characters, use "_" to match any single character

Type: ▾ **Beam energy:** ▾ **Table format:** user ▾

Select

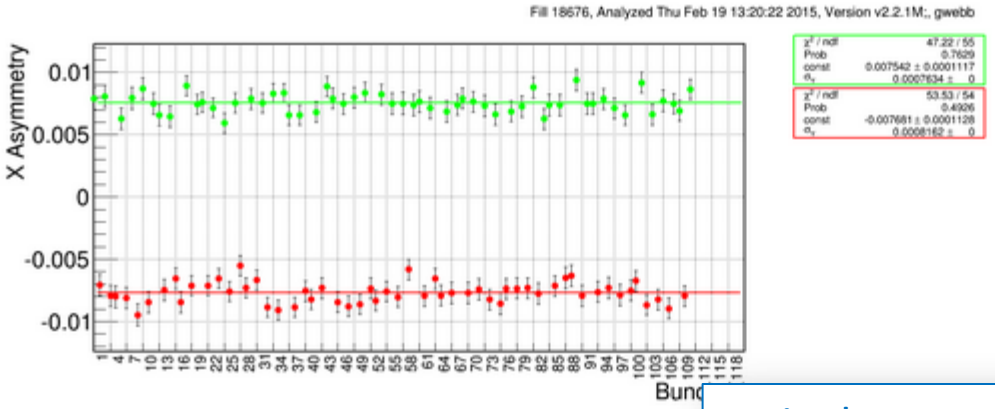
Fills selected: 47

Fill	Type	Beam Energy, GeV	Start Time	Polarization, % In collisions			
				Avrg.	P_0	Slope, %/h	Avrg.
18555	undef	24					
18603	phys	100	Feb 03, 2015 06:06:33 Tue	65.92 ± 6.27	65.59 ± 6.27	-0.56 ± 0.43	
18604	phys	100	Feb 03, 2015 06:46:27 Tue	57.75 ± 3.92	57.46 ± 3.92	-0.56 ± 0.43	
18607	undef	24					
18611	phys	100	Feb 04, 2015 04:48:51 Wed	67.55 ± 10.10	67.55 ± 10.10	-0.56 ± 0.43	
18612	phys	100	Feb 04, 2015 06:00:21 Wed	50.31 ± 7.42	50.31 ± 7.42	-0.56 ± 0.43	
18613	phys	100	Feb 04, 2015 06:51:48 Wed	63.89 ± 2.69	63.89 ± 2.69	-0.56 ± 0.43	58.67 ± 4.08
18625	undef	24					
18626	phys	100	Feb 06, 2015 06:31:04 Fri			-0.56 ± 0.43	63.12 ± 3.95
18641	phys	100	Feb 07, 2015 11:48:26 Sat	62.80 ± 3.83	62.54 ± 3.83	-0.56 ± 0.43	53.22 ± 2.79
18642	undef	24					
18643	undef	24					
18644	phys	100	Feb 07, 2015 18:58:27 Sat	62.50 ± 5.59	67.83 ± 4.40	-3.45 ± 1.88	77.10 ± 5.58
18645	phys	100	Feb 08, 2015 01:29:13 Sun	70.14 ± 4.78	67.42 ± 4.78	-0.56 ± 0.43	69.11 ± 5.43

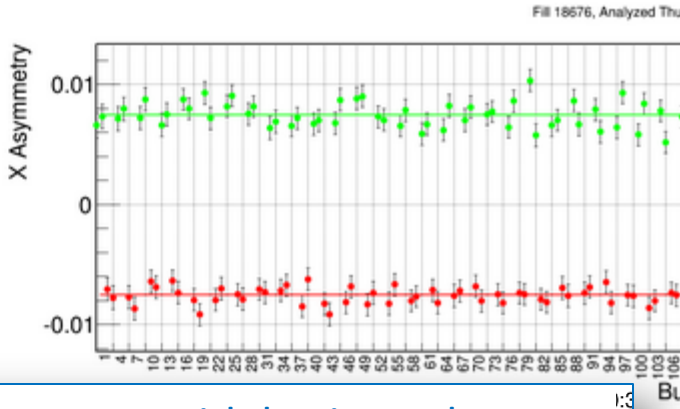
RHIC Fill 18676

List of measurements

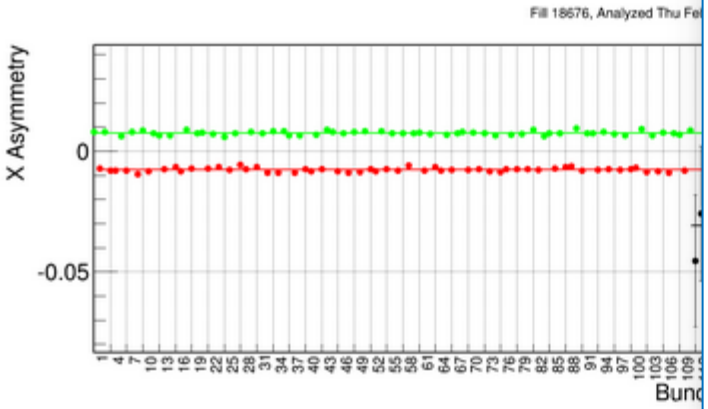
1 Results



Blue

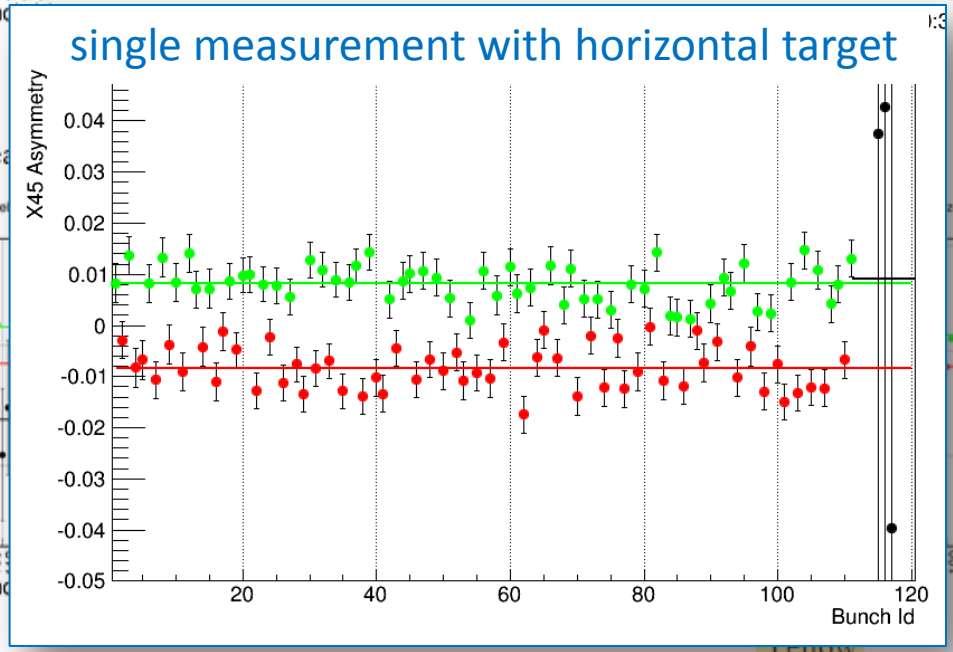


Asymmetry per bunch averaged over all p-Carbon mea



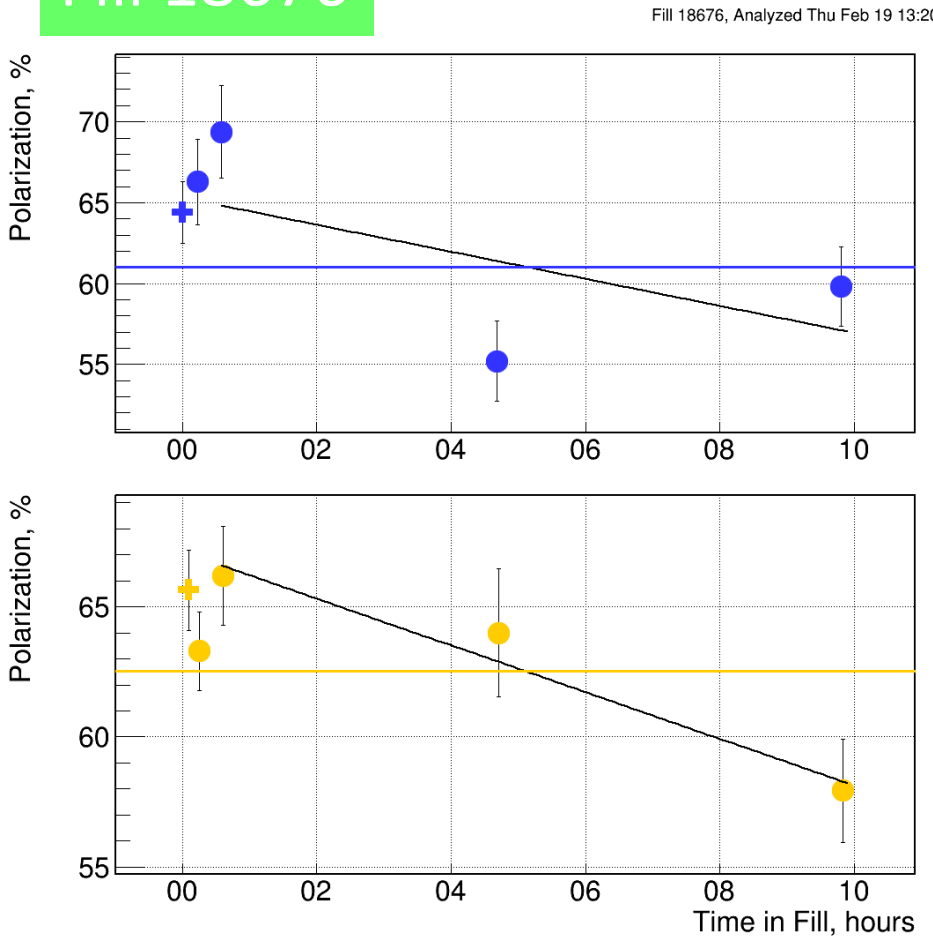
Blue

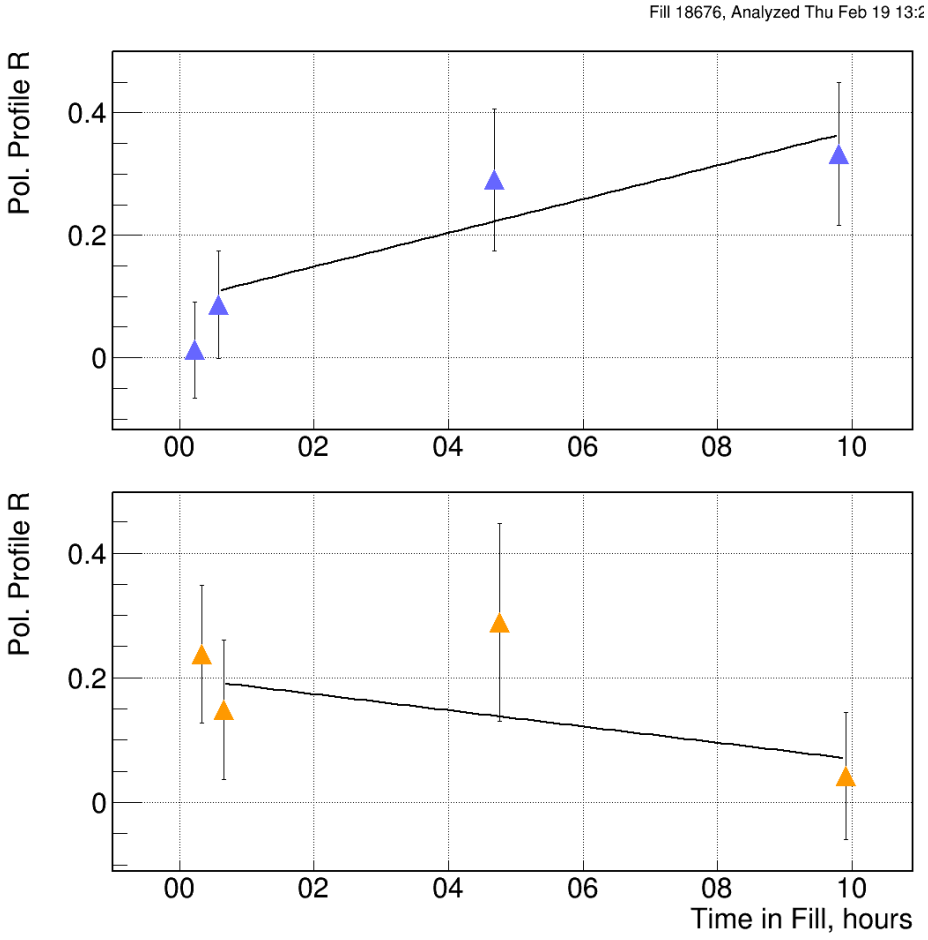
single measurement with horizontal target



Polarization Decay and Profile

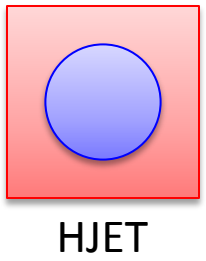
Fill 18676

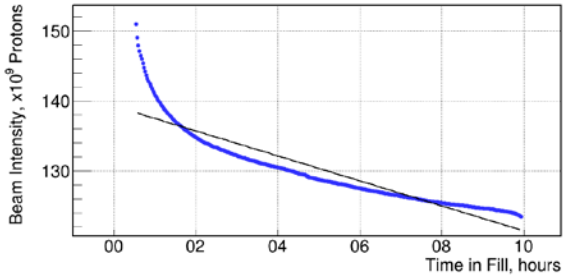




Tread with caution! Statistics!

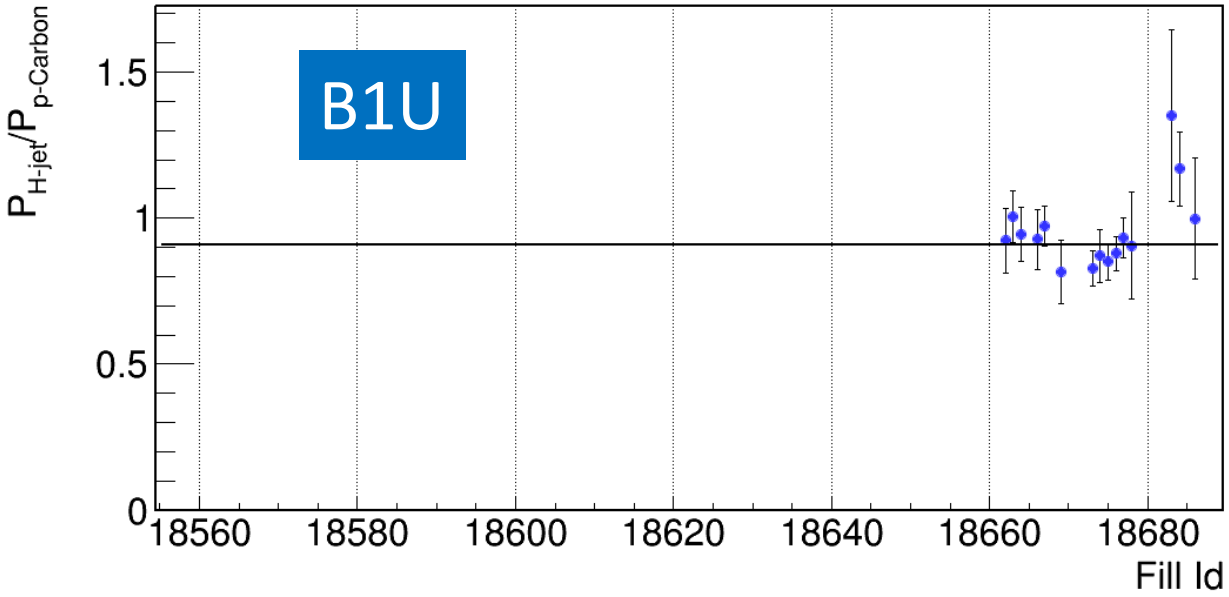
Normalization with HJET





Include beam profile and intensitiy

$$P_{jet} = \frac{\int dxdyP(x,y)I_B(x,y)}{\int dxdyI_B(x,y)}$$

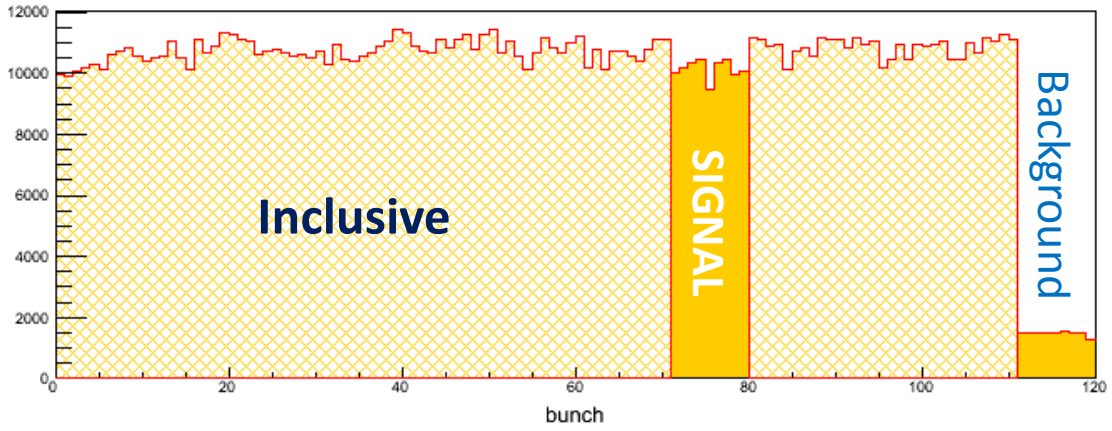


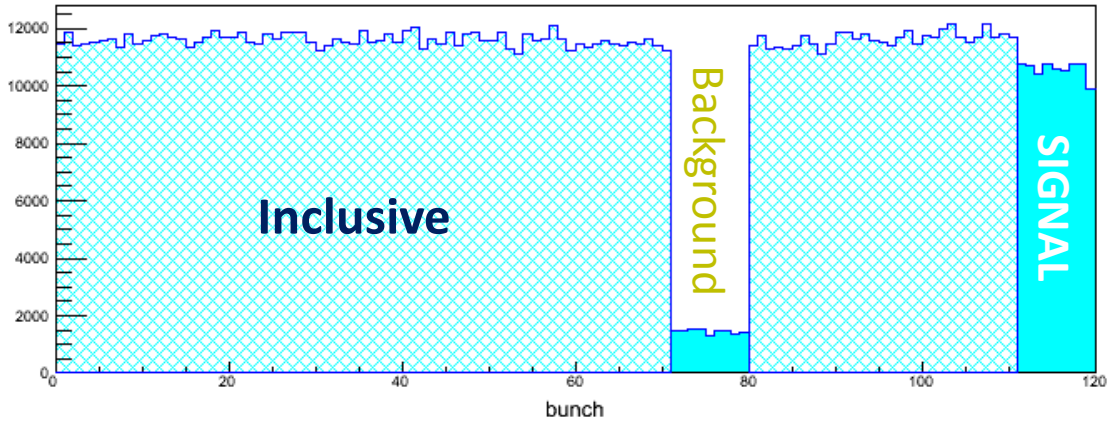
Entries	798
Mean	1.867e+04
RMS	7.789
Underflow	0
Overflow	0
Integral	14.37
χ^2 / ndf	12.73 / 14
Prob	0.5477
p0	0.9098 ± 0.0223

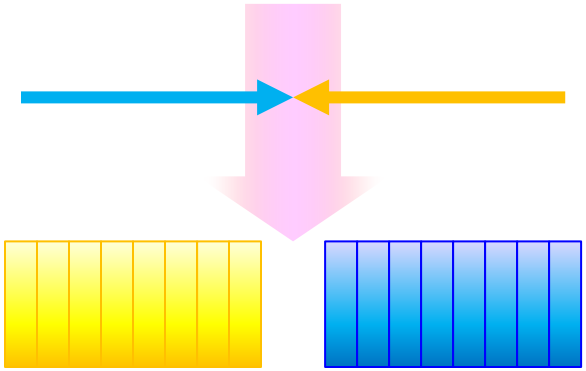
$$\frac{P_{hjet}}{P_{Carbon}} \approx 0.90?$$

About the same for other polarimeters B2D Y1D Y2U

Asymmetries & Background







$$P_Y = -\frac{\varepsilon_Y}{\varepsilon_T} P_T \qquad P_B = -\frac{\varepsilon_B}{\varepsilon_T} P_T$$

$$\varepsilon_S = \frac{\varepsilon - r \cdot \varepsilon_B}{1 - r}$$

Signal: ε_S

Background: ε_B

Inclusive: ε

Background fraction: r

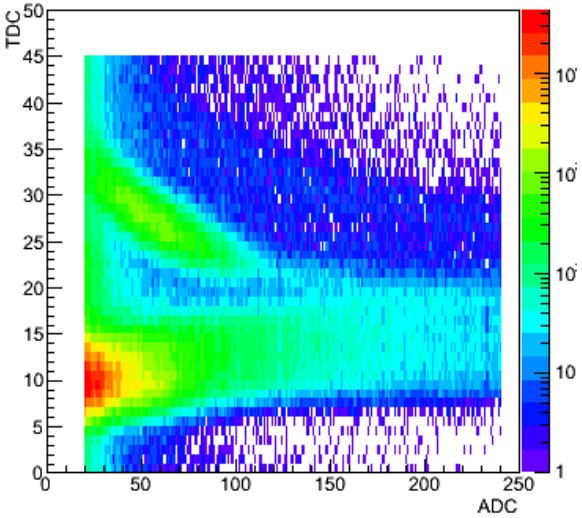
Elastic Recoil Protons

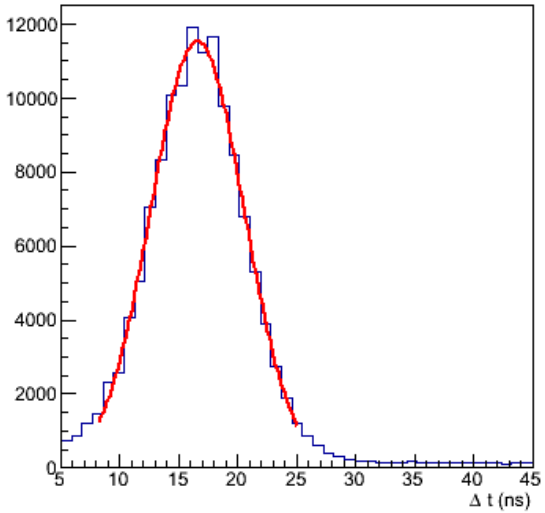
Example strip (68) from fill 17600 (2013)

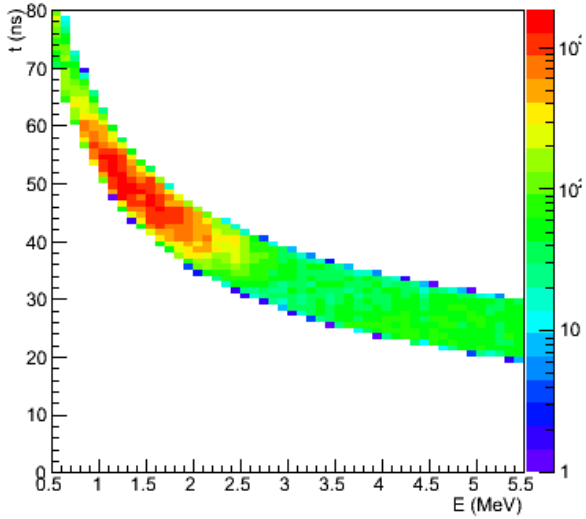
ADC & TDC from waveform
Energy (gain) calibration

Choose energy range for strip

Select elastic recoil protons:
$|\Delta t_{elastic}| < 5$ ns



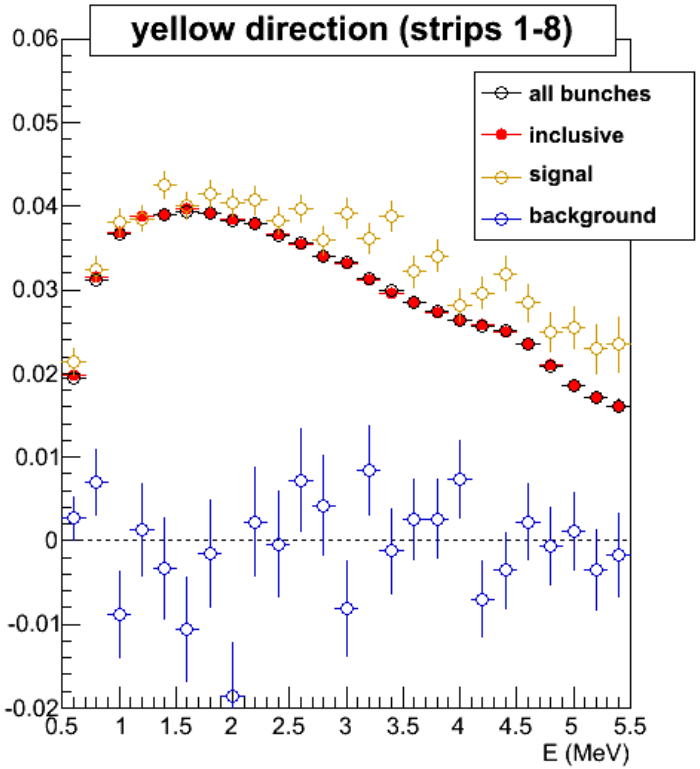


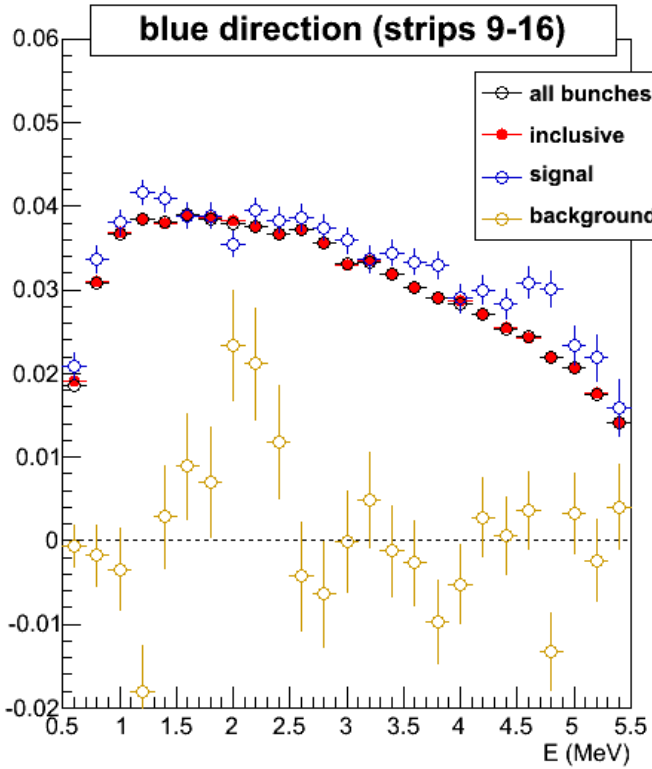


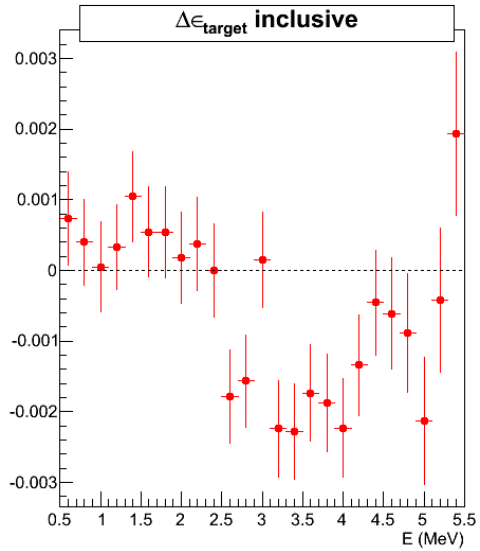
$$E_{kin} = \frac{1}{2} m_P v^2 = \frac{1}{2} m_P \left(\frac{d}{t - t_0} \right)^2$$

Jet Target Asymmetries

Full run 13 statistics!





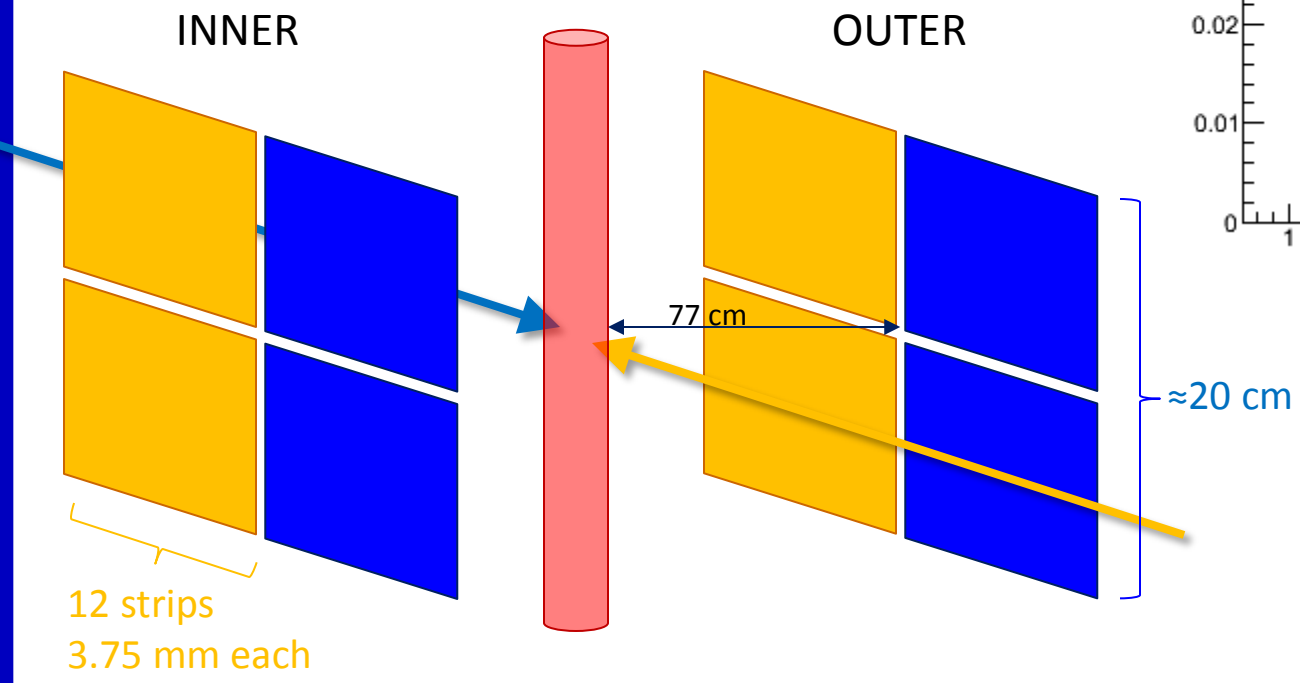


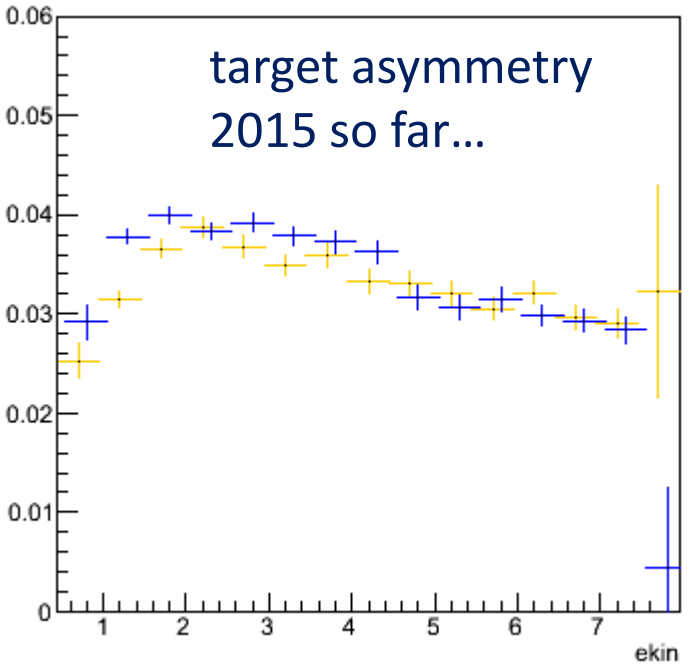
Asymmetries are transformed to blue beam coordinates (target asymmetry flipped)

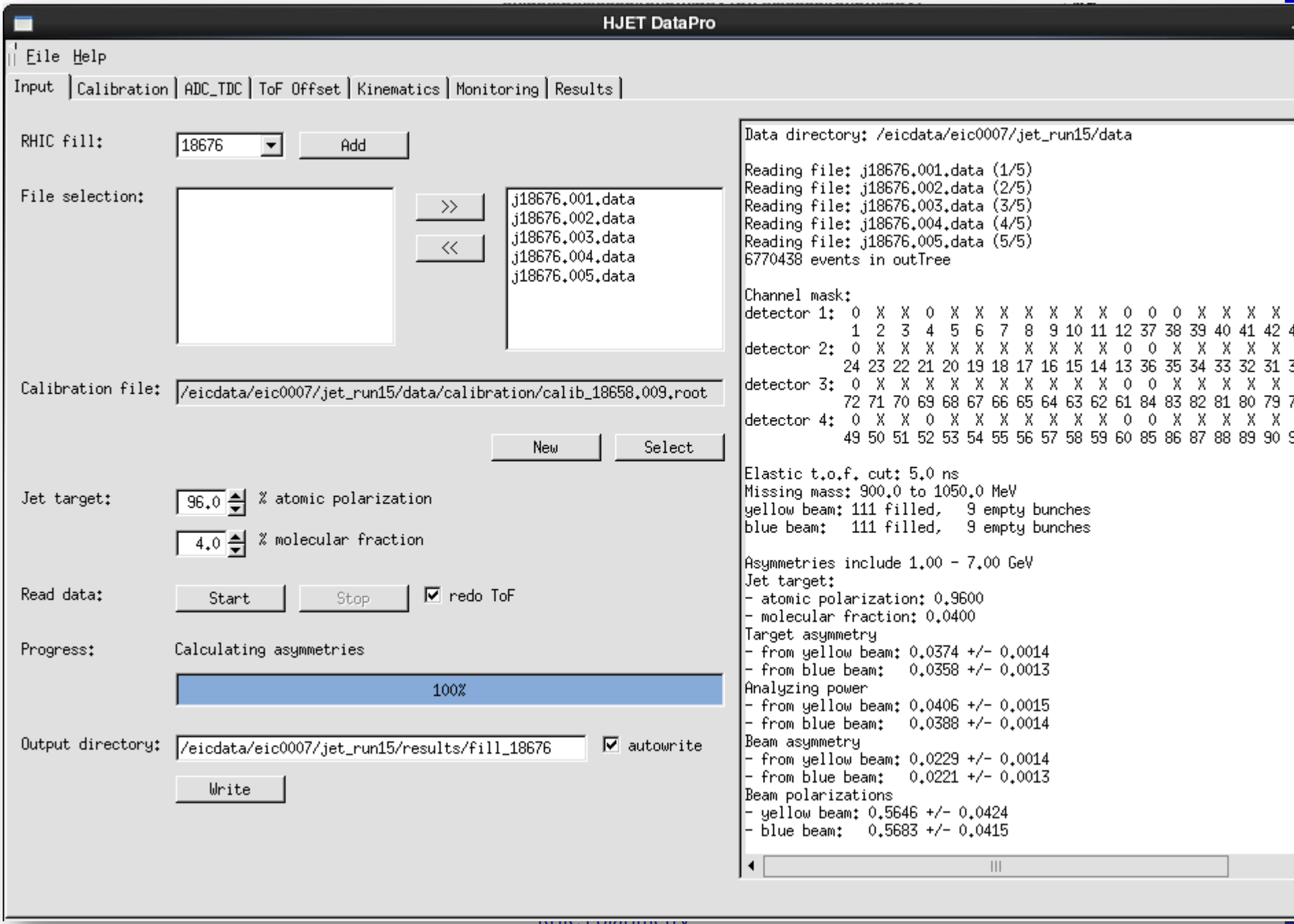
Difference between *signal asymmetries* is consistent with zero.

HJET in Run 2015

$$P_{Beam} = -\frac{\varepsilon_{Beam}}{\varepsilon_{Target}} P_{Target}$$





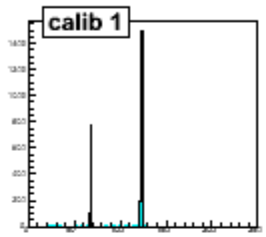

HJET DataPro
File Help
Input Calibration ADC_TDC ToF Offset Kinematics Monitoring Results
RHIC fill:
18676
Add
File selection:
>>
<<
j18676.001.data
j18676.002.data
j18676.003.data
j18676.004.data
j18676.005.data
Calibration file:
/eicdata/eic0007/jet_run15/data/calibration/calib_18658.009.root
New
Select
Jet target:
96.0
% atomic polarization
4.0
% molecular fraction
Read data:
Start
Stop
redo ToF
Progress:
Calculating asymmetries
100%
Output directory:
/eicdata/eic0007/jet_run15/results/fill_18676
autowrite
Write
Data directory: /eicdata/eic0007/jet_run15/data
Reading file: j18676.001.data (1/5)
Reading file: j18676.002.data (2/5)
Reading file: j18676.003.data (3/5)
Reading file: j18676.004.data (4/5)
Reading file: j18676.005.data (5/5)
6770438 events in outTree
Channel mask:
detector 1: 0 X X 0 X X X X X X X 0 0 0 X X X X
1 2 3 4 5 6 7 8 9 10 11 12 37 38 39 40 41 42 4
detector 2: 0 X X X X X X X X X X 0 0 X X X X X
24 23 22 21 20 19 18 17 16 15 14 13 36 35 34 33 32 31 3
detector 3: 0 X X X X X X X X X X 0 0 X X X X X
72 71 70 69 68 67 66 65 64 63 62 61 84 83 82 81 80 79 7
detector 4: 0 X X 0 X X X X X X X 0 0 X X X X X
49 50 51 52 53 54 55 56 57 58 59 60 85 86 87 88 89 90 9
Elastic t.o.f. cut: 5.0 ns
Missing mass: 900.0 to 1050.0 MeV
yellow beam: 111 filled, 9 empty bunches
blue beam: 111 filled, 9 empty bunches
Asymmetries include 1.00 - 7.00 GeV
Jet target:
- atomic polarization: 0.9600
- molecular fraction: 0.0400
Target asymmetry
- from yellow beam: 0.0374 +/- 0.0014
- from blue beam: 0.0358 +/- 0.0013
Analyzing power
- from yellow beam: 0.0406 +/- 0.0015
- from blue beam: 0.0388 +/- 0.0014
Beam asymmetry
- from yellow beam: 0.0229 +/- 0.0014
- from blue beam: 0.0221 +/- 0.0013
Beam polarizations
- yellow beam: 0.5646 +/- 0.0424
- blue beam: 0.5683 +/- 0.0415

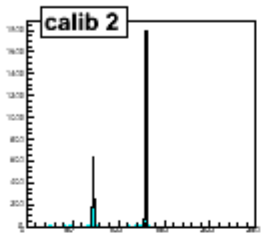
HJET DataPro

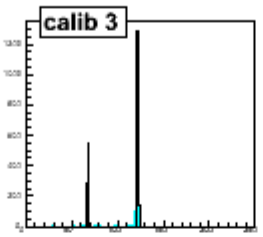
File Help

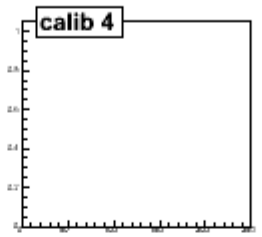
Input | Calibration | ADC_TDC | ToF Offset | Kinematics | Monitoring | Results

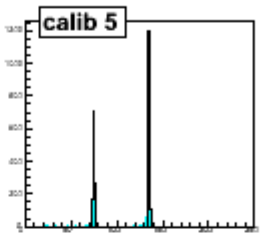
Summary | Detector 1 | Detector 2 | Detector 3 | Detector 4

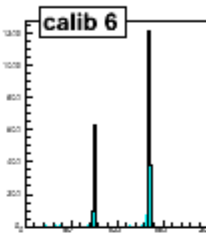


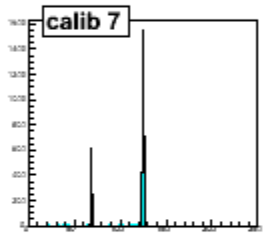


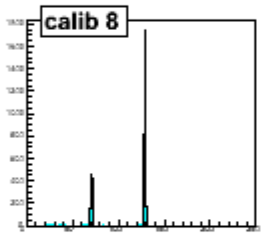


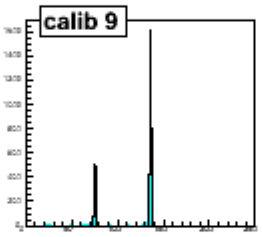


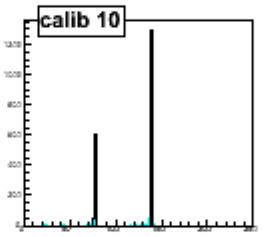


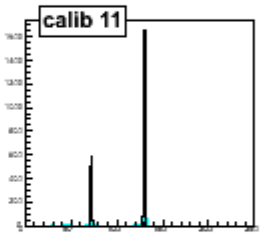


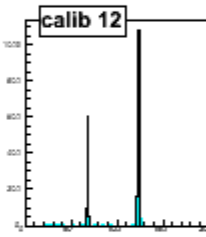


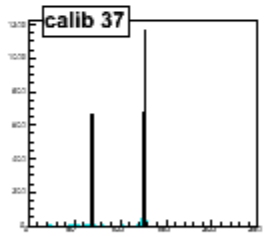


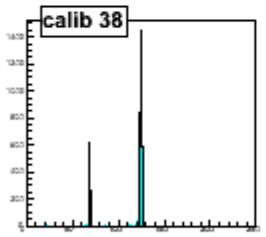


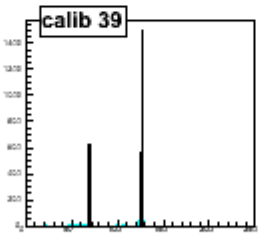


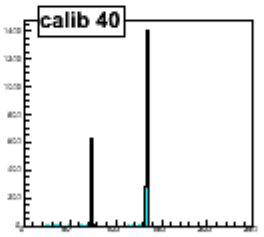


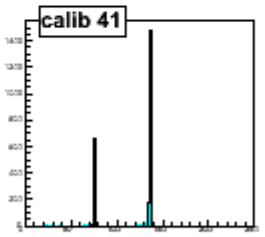


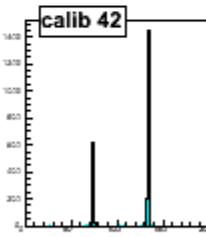


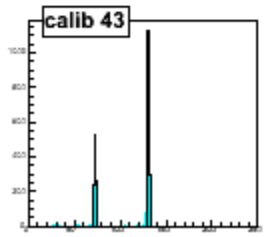


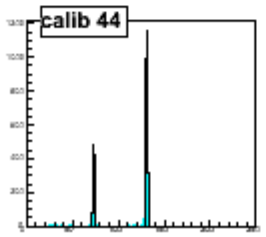


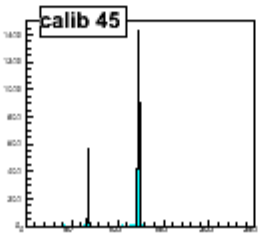


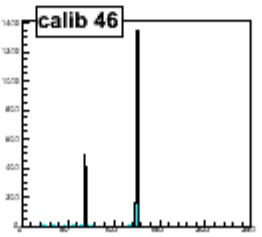


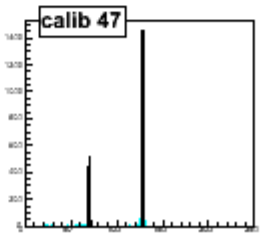


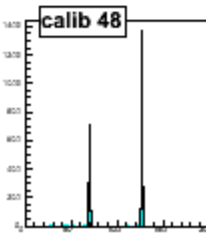










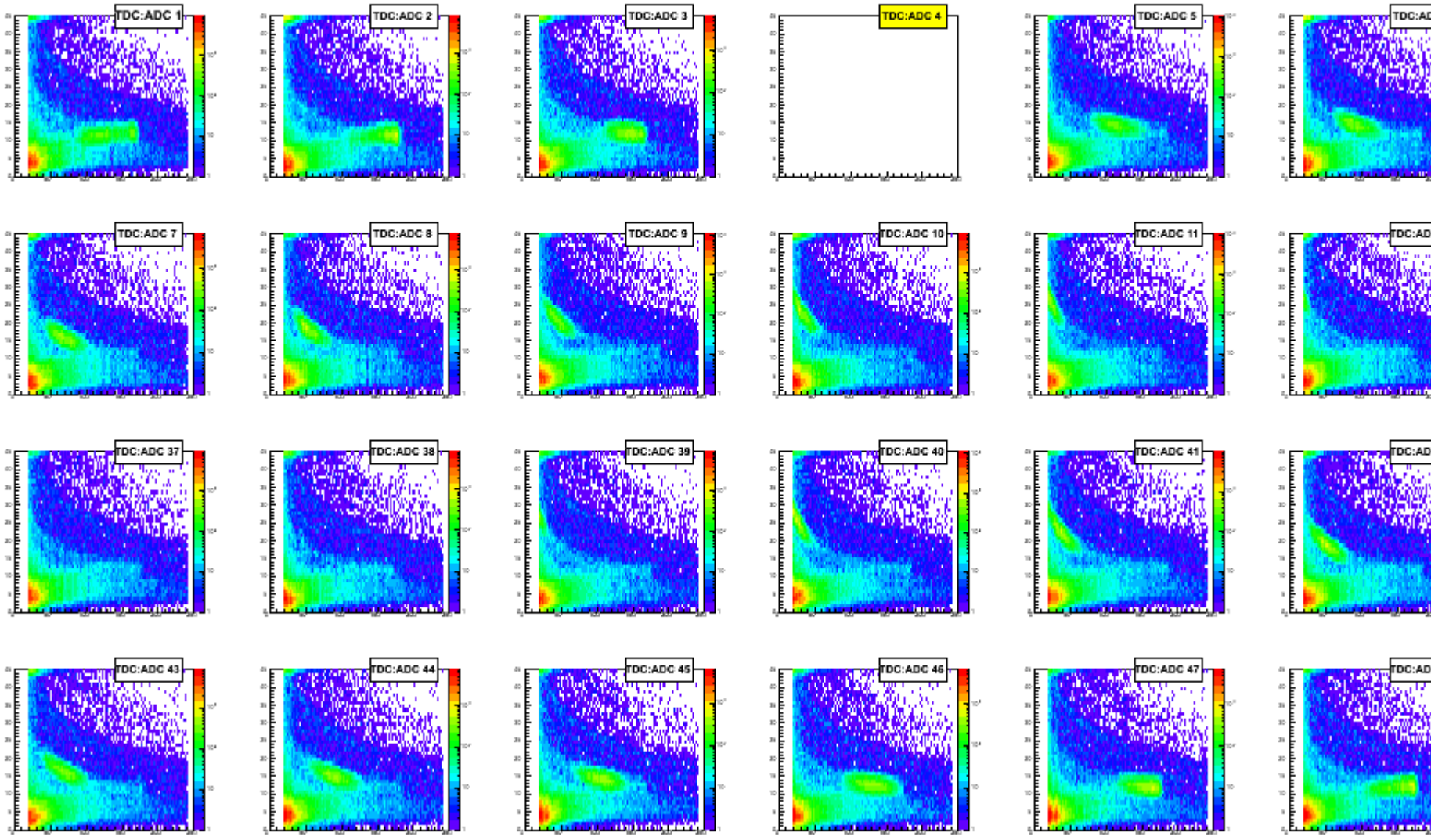


HJET DataPro

File Help

Input | Calibration | ADC_TDC | ToF Offset | Kinematics | Monitoring | Results

Detector 1 | Detector 2 | Detector 3 | Detector 4

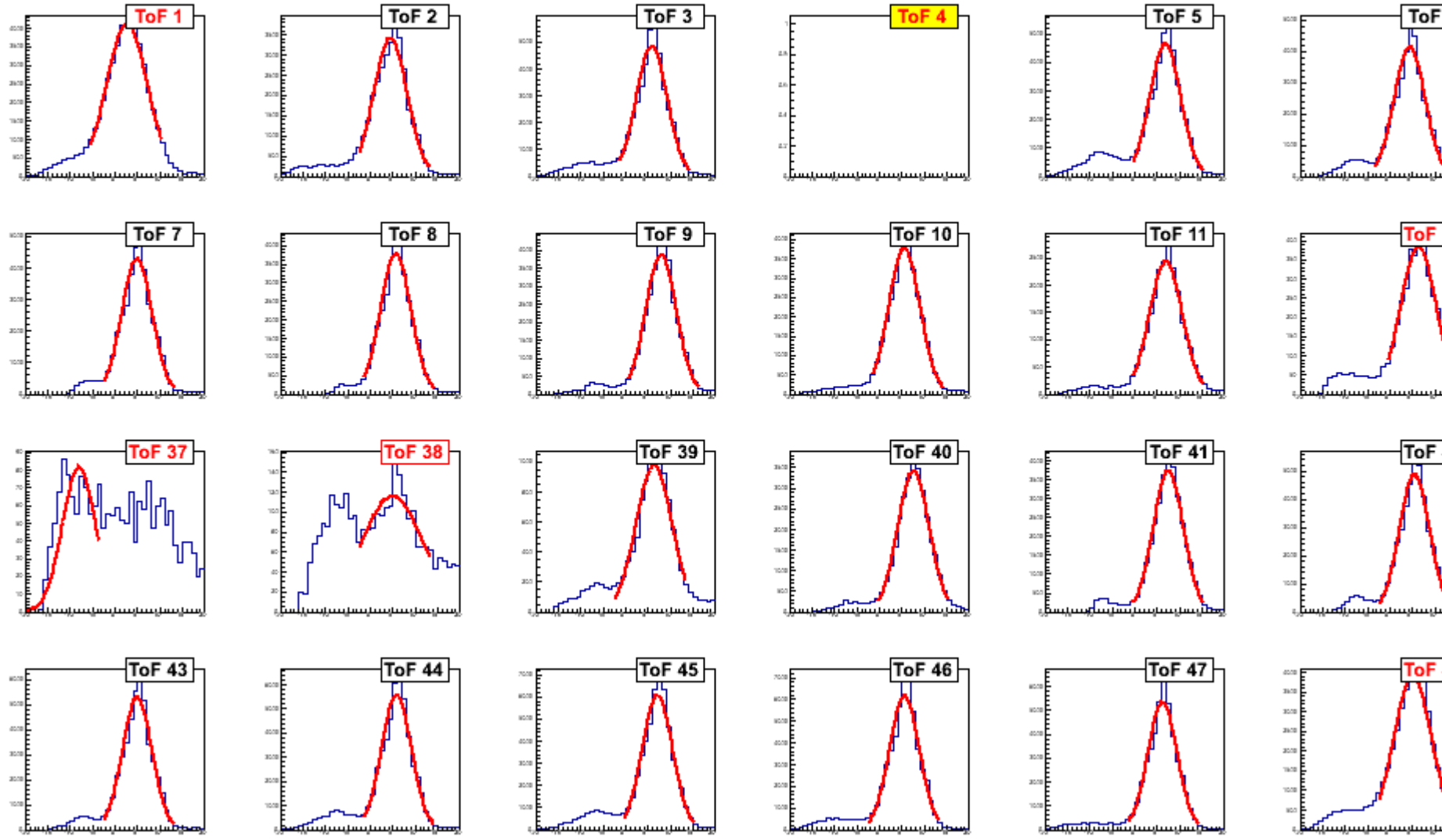


HJET DataPro

File Help

Input | Calibration | ADC_TDC | ToF Offset | Kinematics | Monitoring | Results

Summary | Detector 1 | Detector 2 | Detector 3 | Detector 4



HJET DataPro

File Help

Input | Calibration | ADC_TDC | ToF Offset | Kinematics | Monitoring | Results

Strip mask

Detector 1

Detector 2

Detector 3

Detector 4

Elastic signal (ns)

5.0

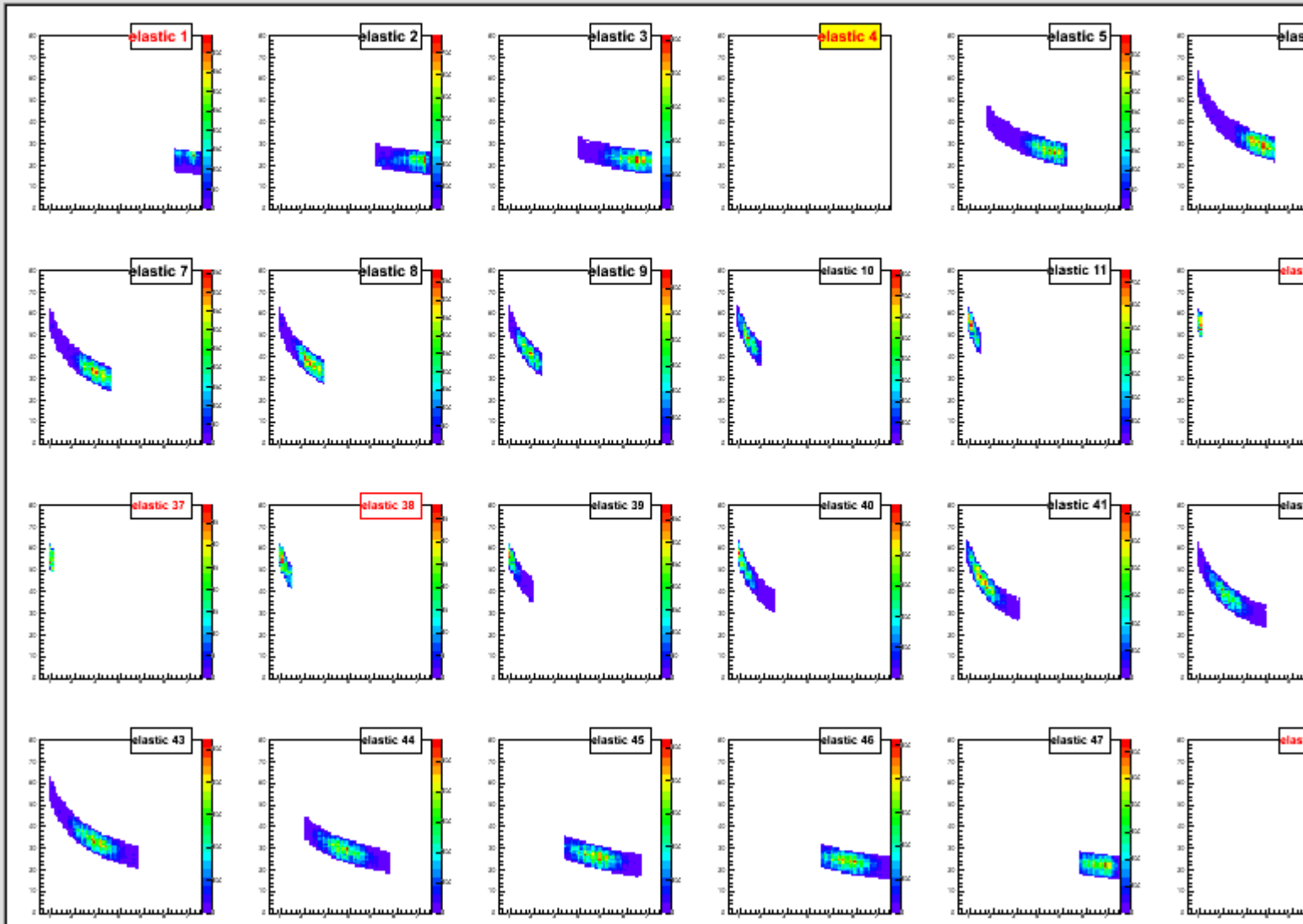
Missing mass (MeV)

900.0

1050.0

Reanalyze

Detector 1 | Detector 2 | Detector 3 | Detector 4

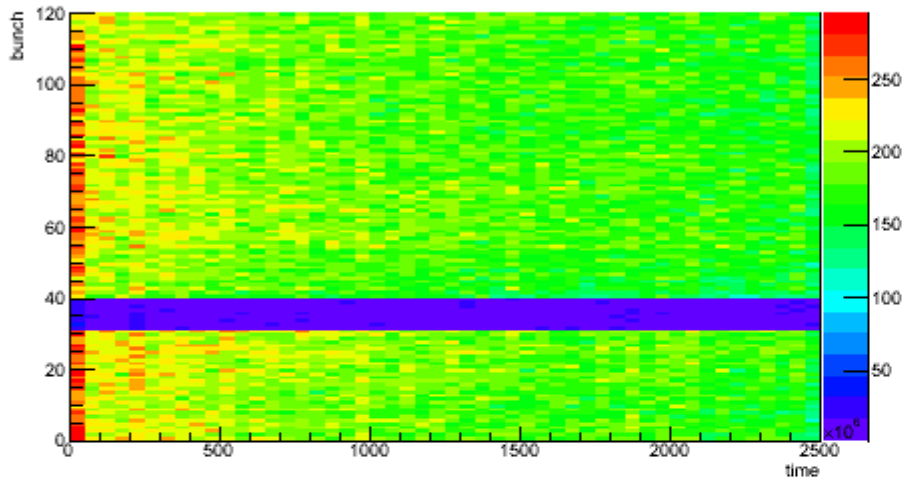


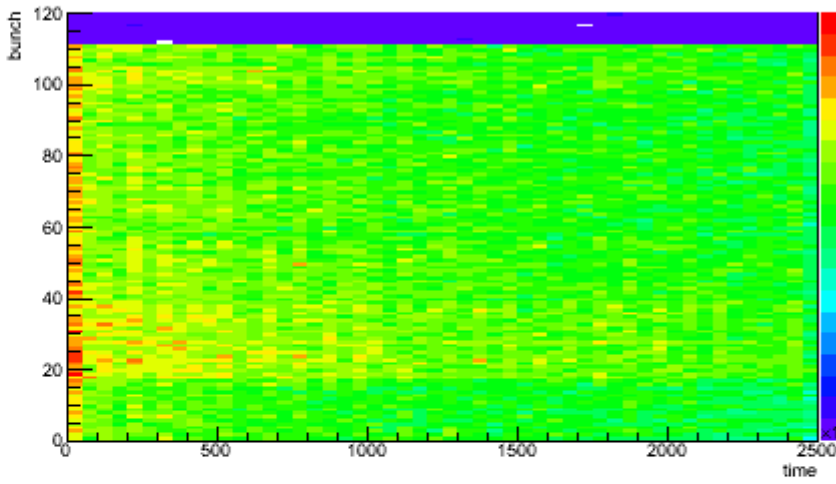
HJET DataPro

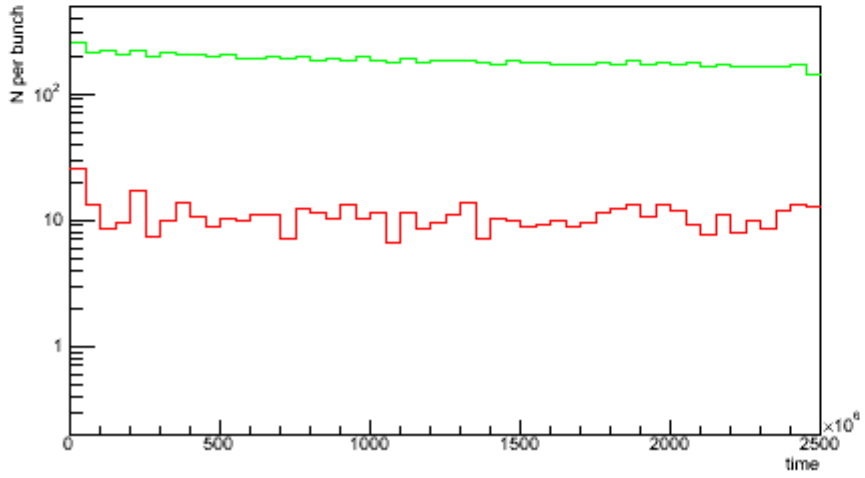
File Help

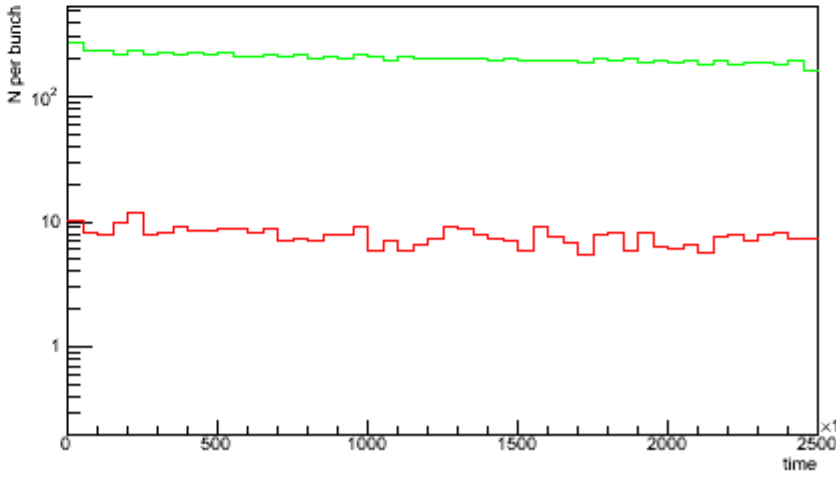
Input | Calibration | ADC_TDC | ToF Offset | Kinematics | Monitoring | Results

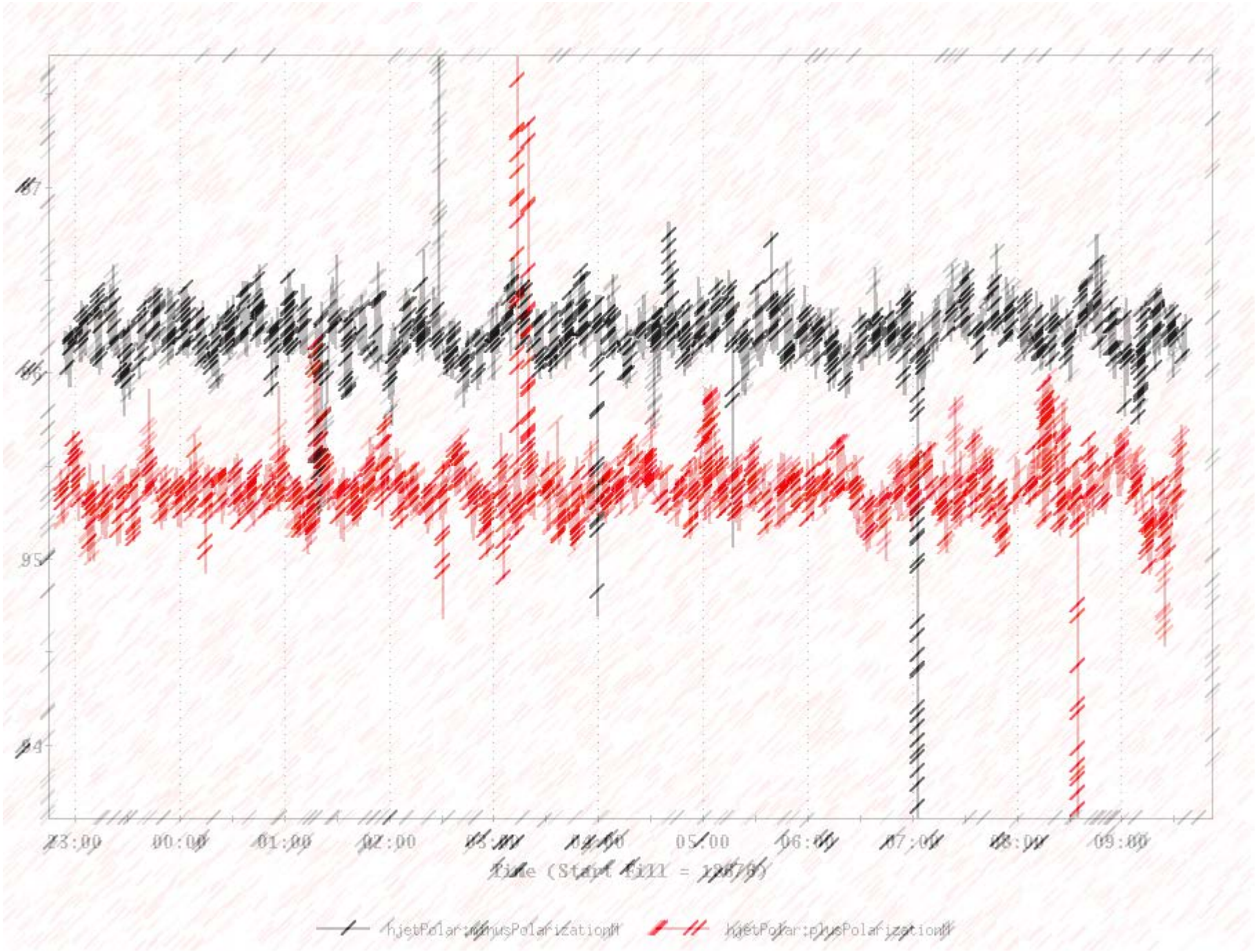
Summary | Detector 1 | Detector 2 | Detector 3 | Detector 4










97
96
95
94
23:00
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
Time (Start fill = 12870)
hjetPolar:minusPolarization
hjetPolar:plusPolarization

Summary

- Carbon polarimeters in regular use
  - Hickups with web page
  - Updated automatically now
  - Backlog 2013 and earlier (now recovered)
- Hydrogen jet polarimeter
  - New detectors: better energy resolution, wider kinematic range
  - Normalization for Carbon polarimeters off by ≈10%
  - Yellow and blue target asymmetries not consistent
  - Checking possible background contributions
  - Magnetic field correction and detector alignment
- It can only get warmer…