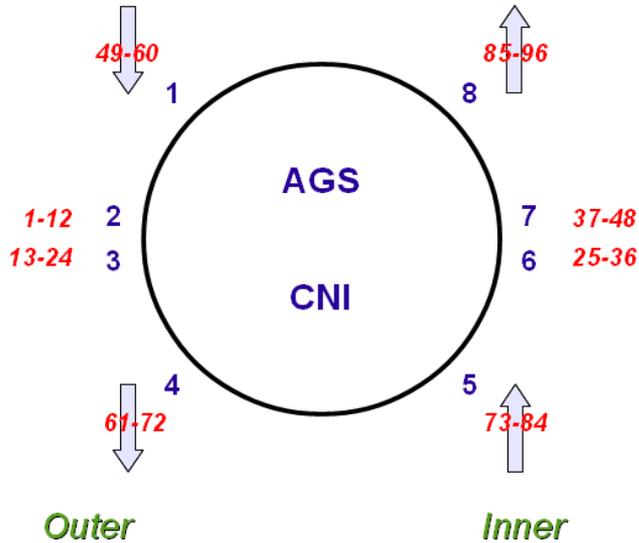


AGS CNI Polarimeter 2011

(Updated presentation at Spin Meeting 2011.08.11)

AGS CNI Polarimeter 2011

3 different detector types:



1,8 - Hamamatsu, slow preamplifiers

2,3,6,7 - BNL, fast preamplifiers

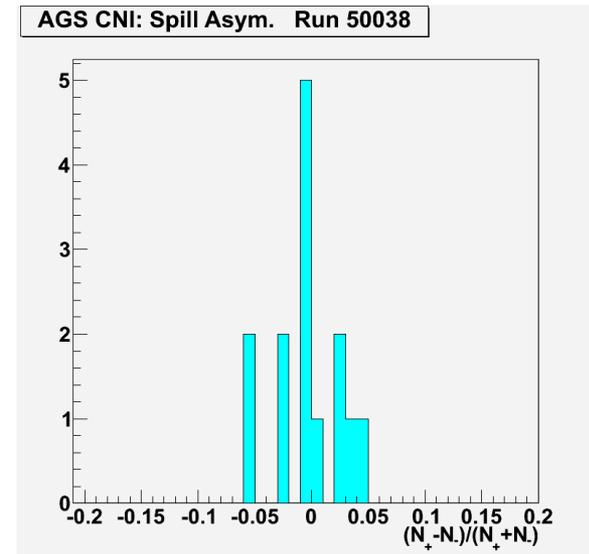
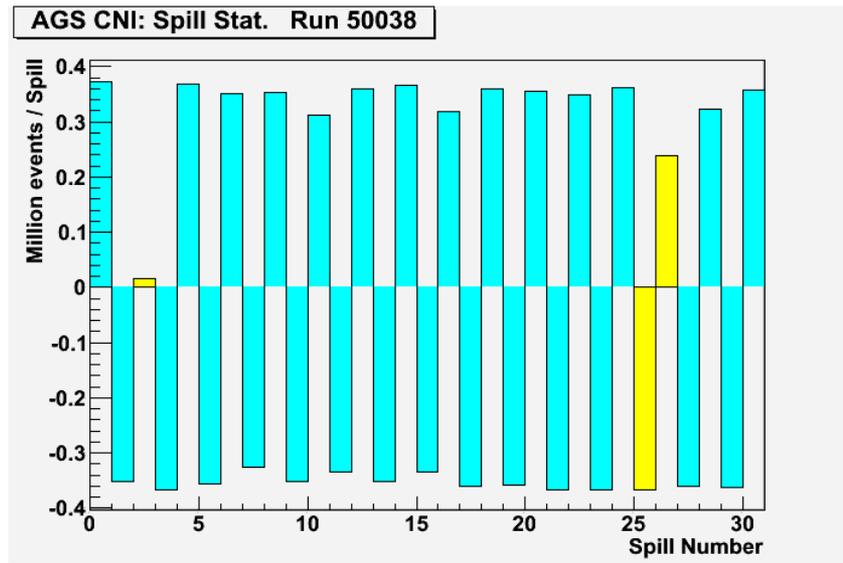
4,5 - Hamamatsu, fast preamplifiers

Run 2009: BNL, slow preamplifiers

Larger length
(50 cm)

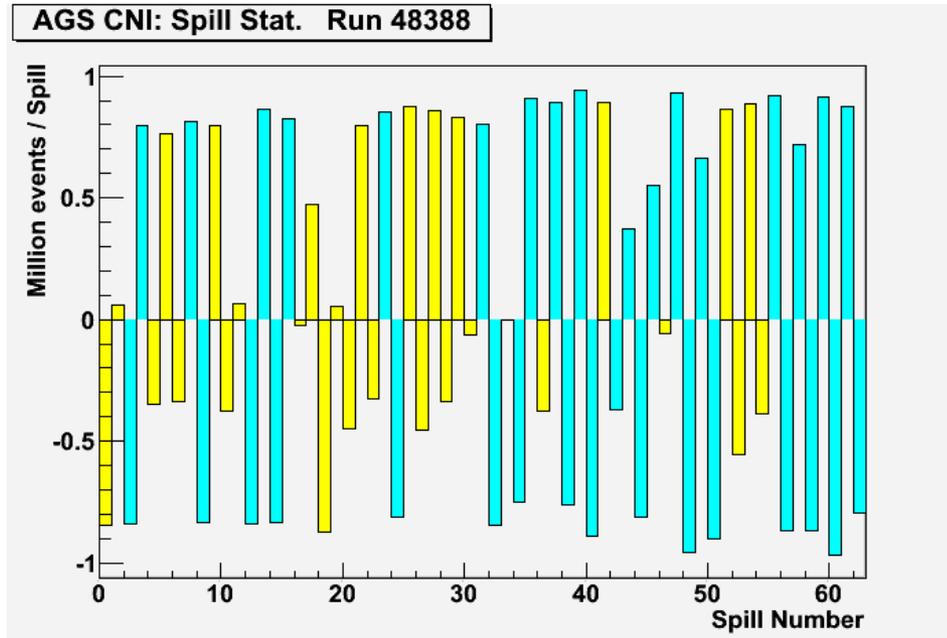
Regular
length (30 cm)

Spill Selection

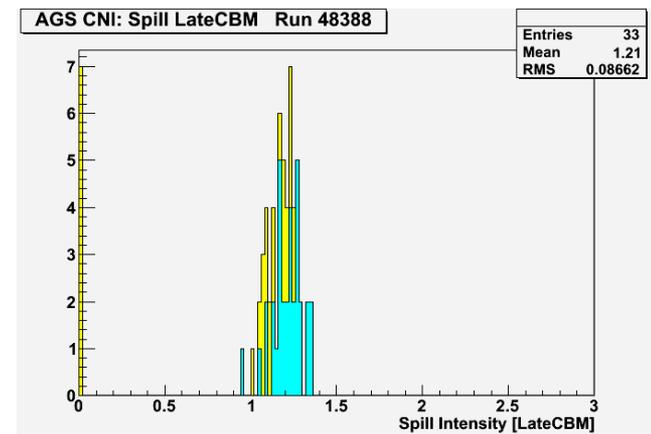
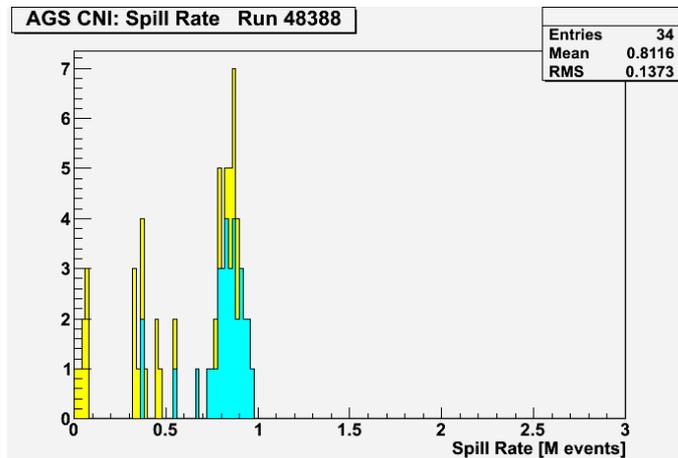


Only pairs of consecutive spills with opposite polarization and approximately equal intensity were selected for analysis.

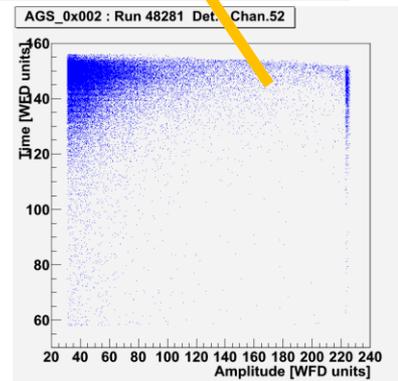
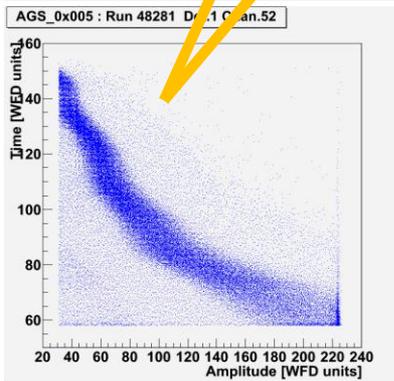
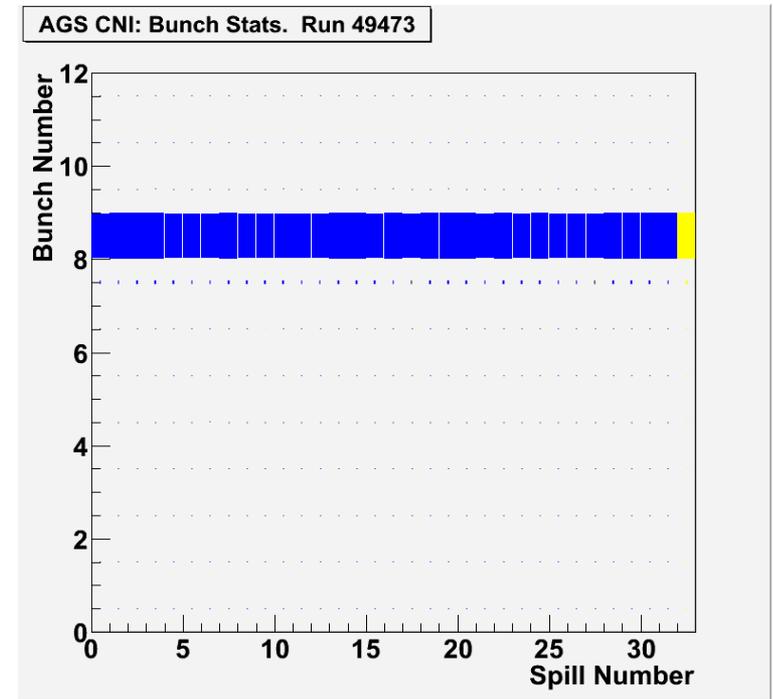
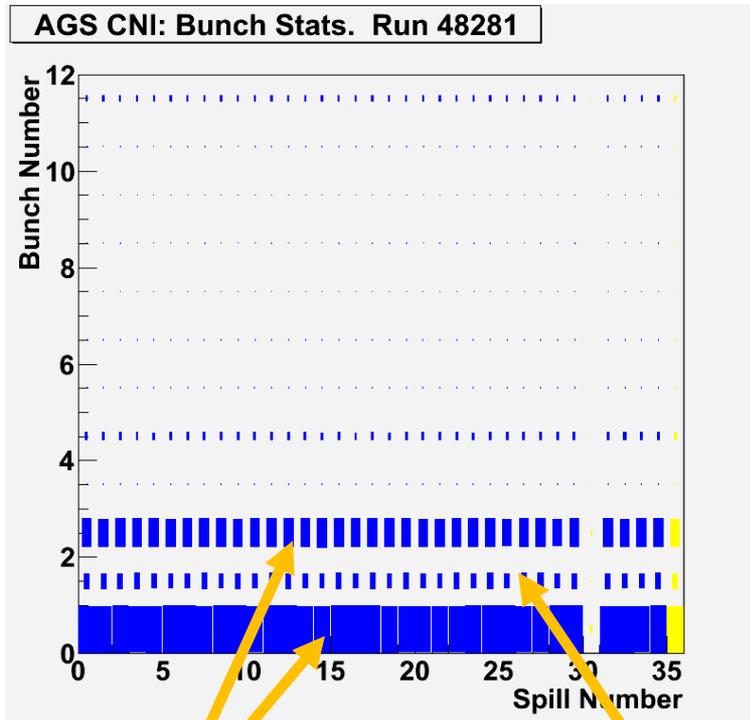
Spill Selection: Bad Run Example



In this run beam intensity was stable but DAQ rate was not



Bunch Selection



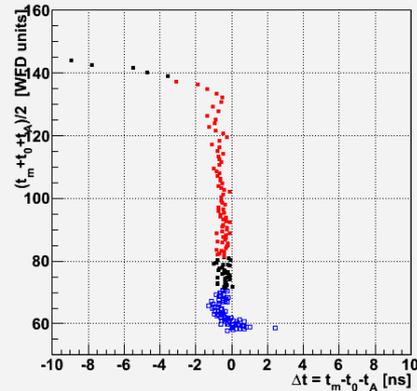
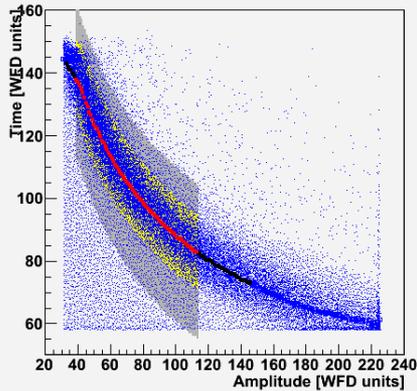
***Wrong Bunch Number identification in the DAQ was caused by noisy rev-tick signal.
(Fixed 02/07/2011, Runs>48494)***

Event Selection

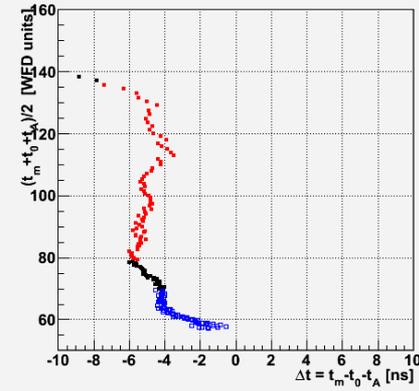
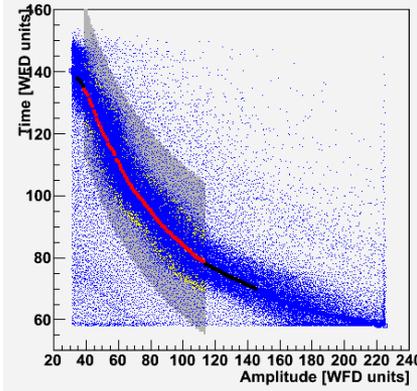
Low Intensity (0.22×10^{11})

High Intensity (1.35×10^{11})

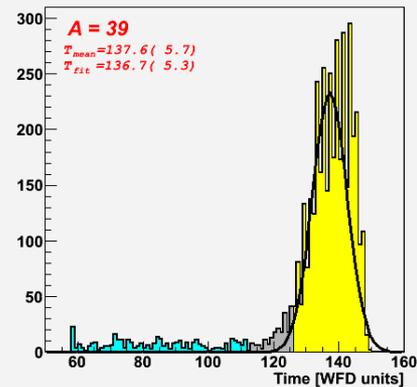
AGS_0x100 : Run 48975 Det.1 Chan.52



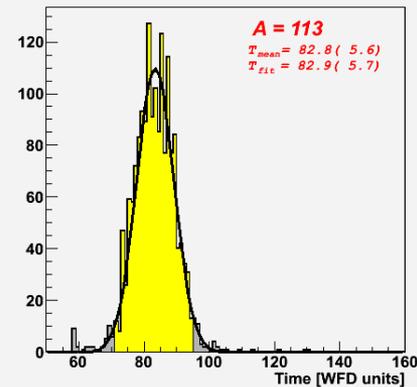
AGS_0x100 : Run 48973 Det.1 Chan.52



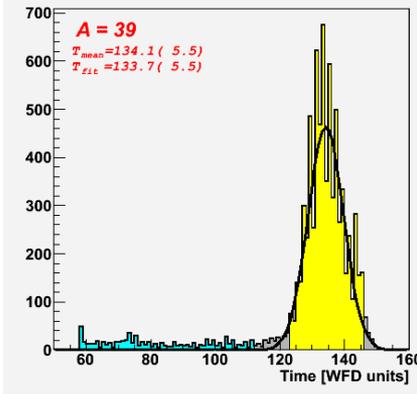
AGS_0x100 : Run 48975 Det.1 Chan.52



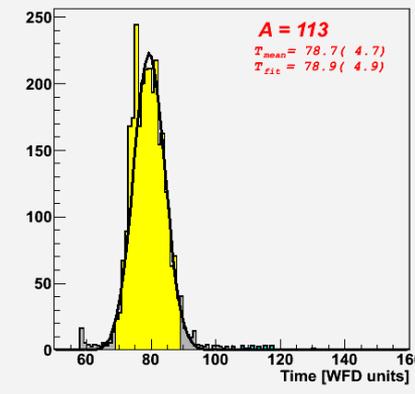
AGS_0x100 : Run 48975 Det.1 Chan.52



AGS_0x100 : Run 48973 Det.1 Chan.52

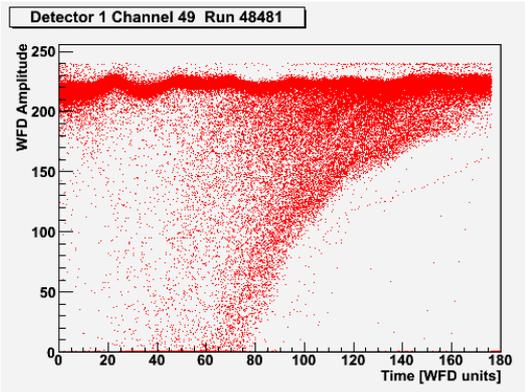


AGS_0x100 : Run 48973 Det.1 Chan.52



- Time measurement is intensity dependent .
- It may result in wrong energy calibration.

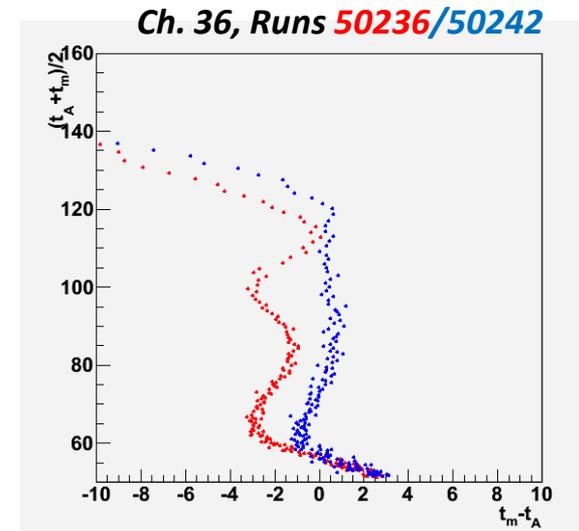
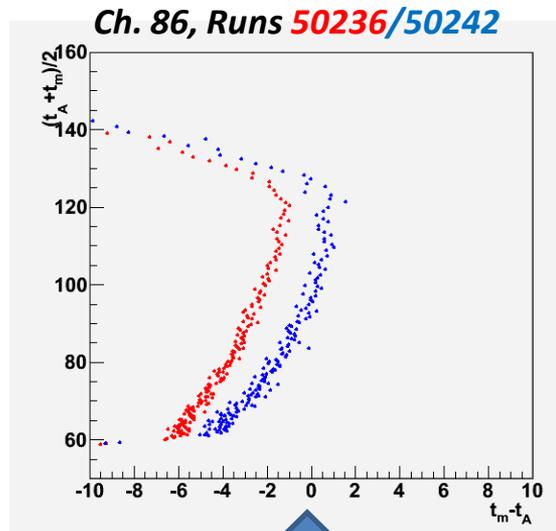
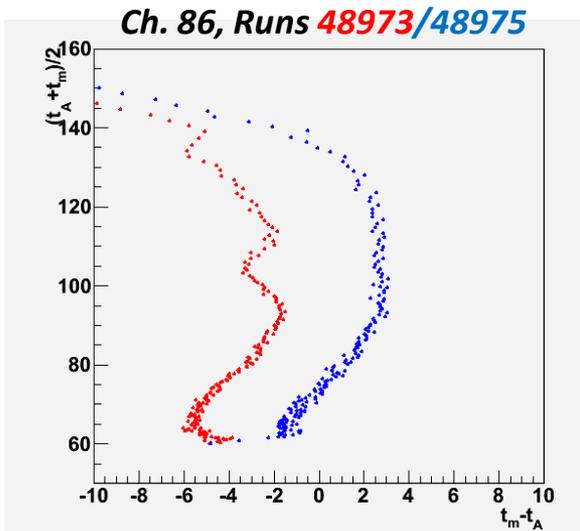
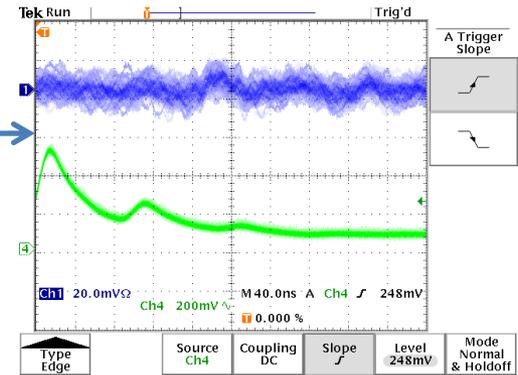
Induced Pulse (correlated with bunches)



WFD view

Oscilloscope

Since signal amplitude and time are strictly correlated such a noise results in systematic time (amplitude) dependent errors of measurements

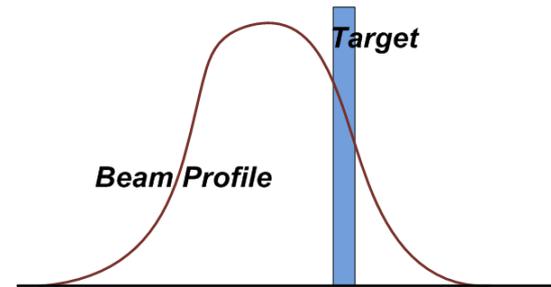


Significant improvement after change of detector grounding

Rate/Intensity ratio

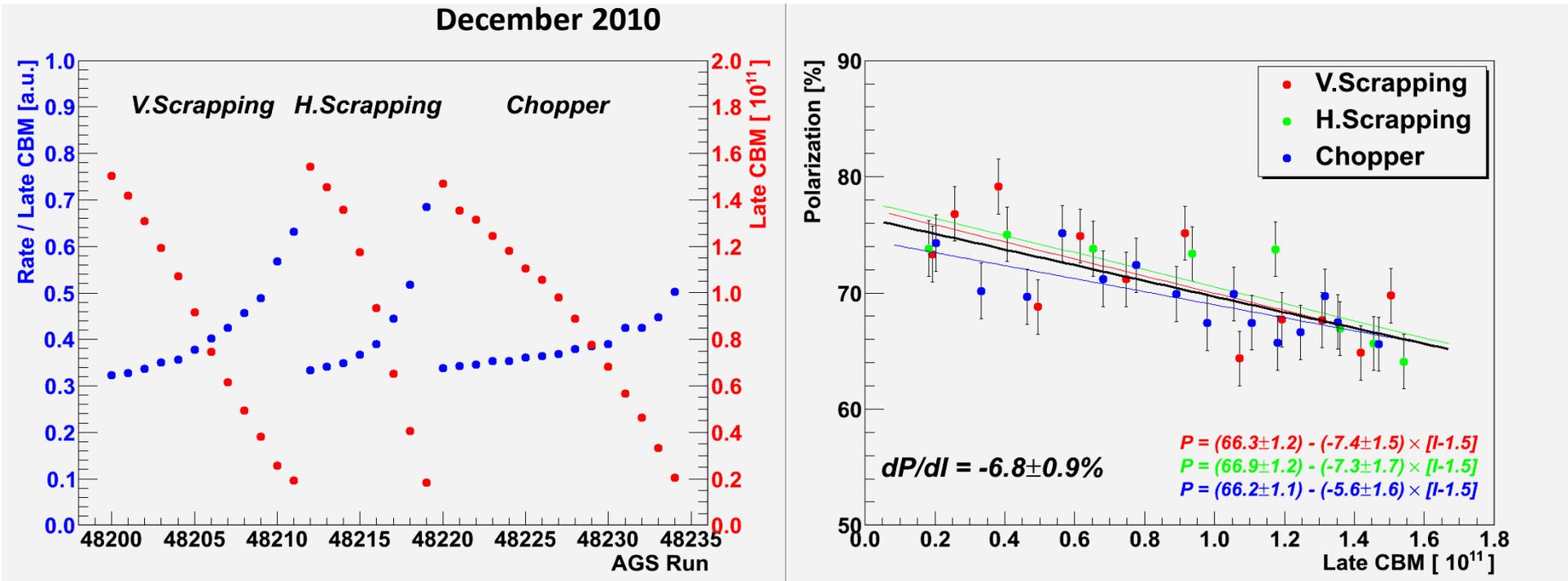
Rate/Intensity ratio depends on

- *Beam Emittance*
- *Target position relative to the beam center*
- *Target dimensions*
- *DAQ (?)*



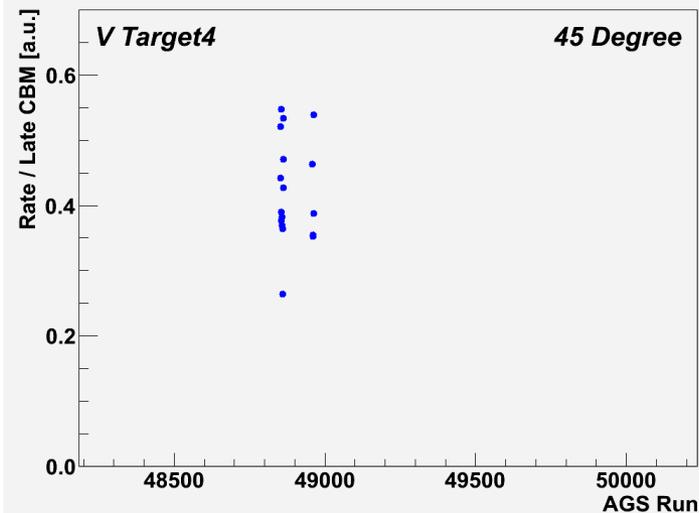
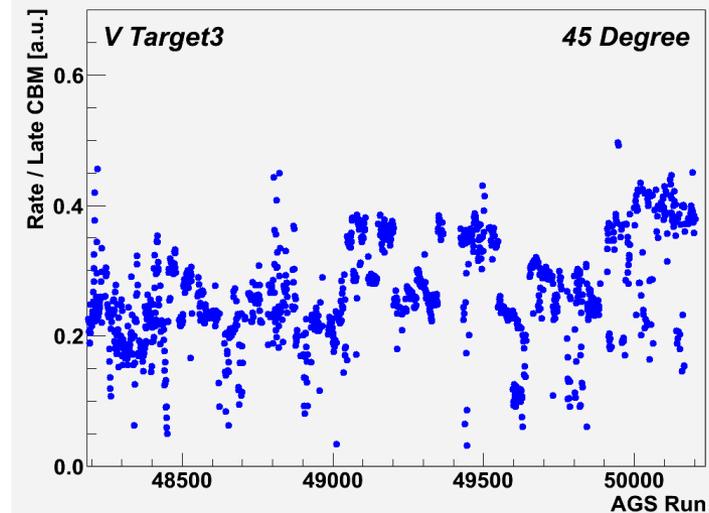
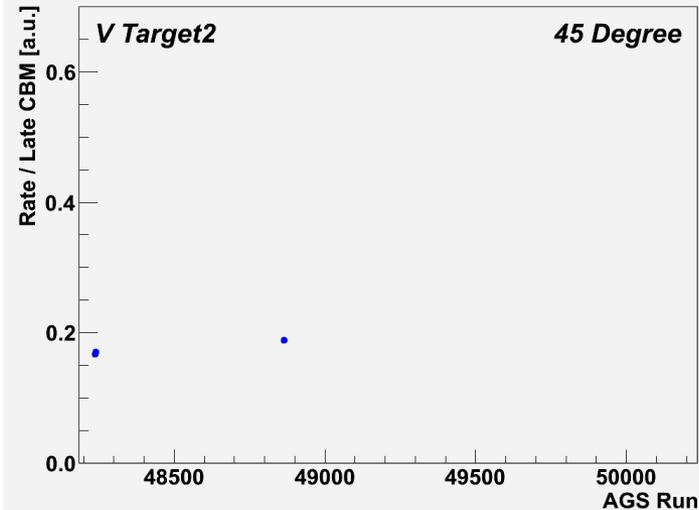
Rate/Intensity ratio may be used as an indicator of changing of measurement conditions

Example of Rate/Intensity dependence on Beam Emittance

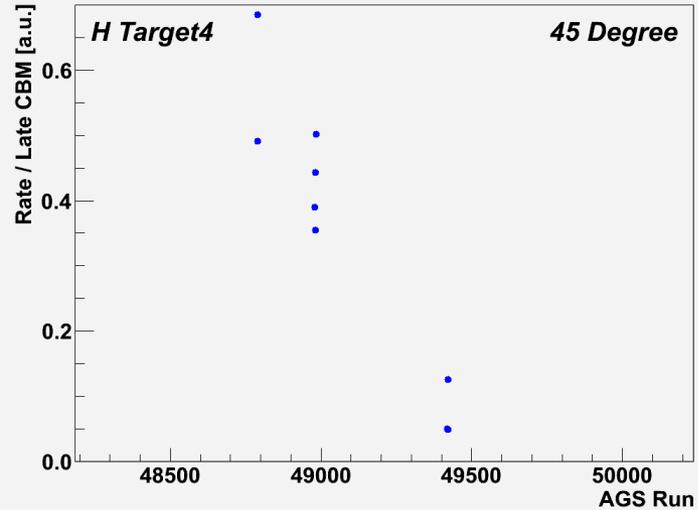
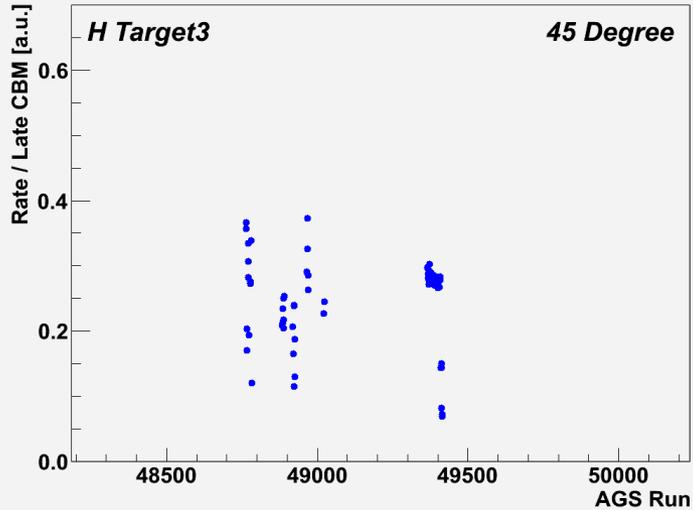
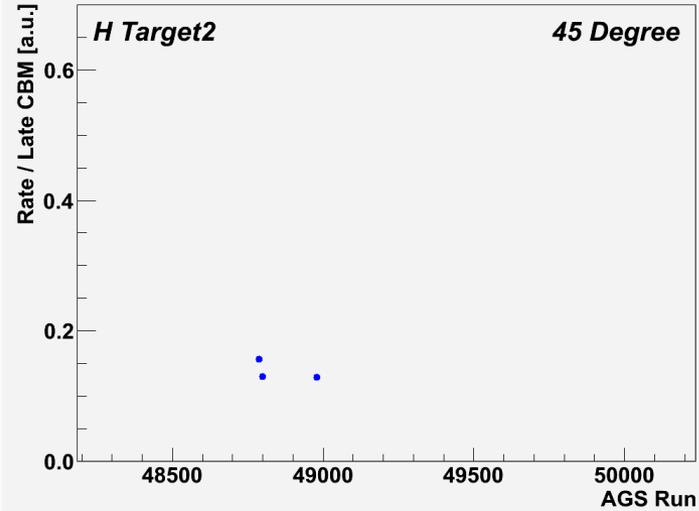
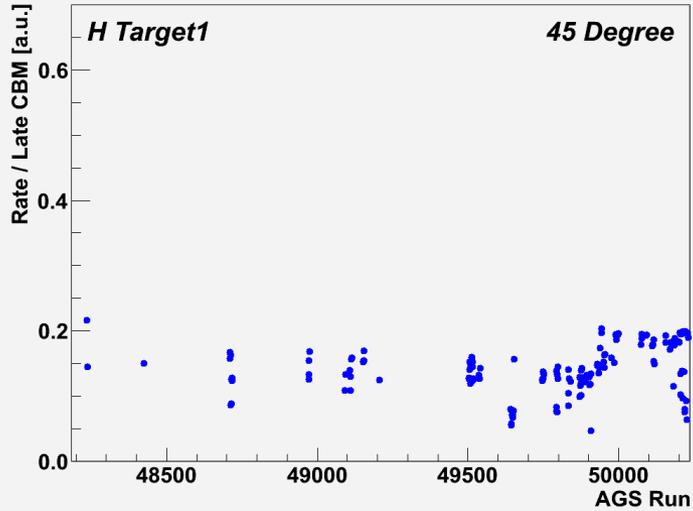


Rate/Intensity for Vertical Targets

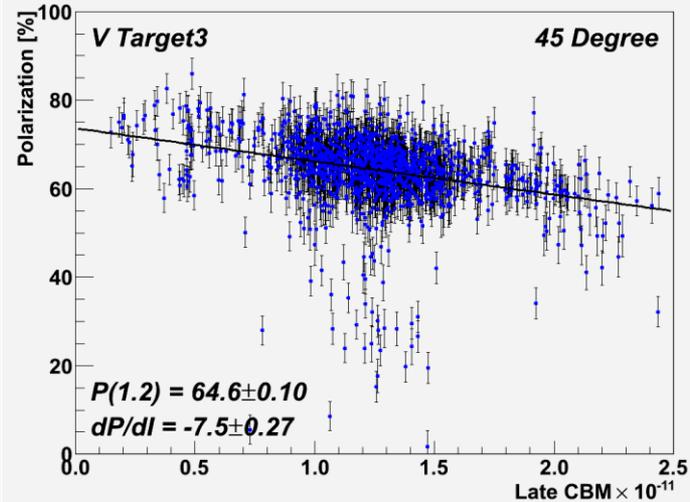
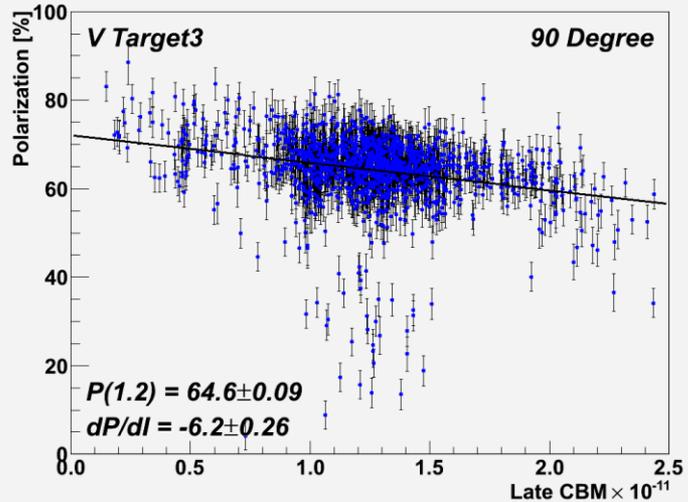
- *Most of measurements were done with V3 target.*
- *(Only) these measurements are suitable for detailed comparison of detectors types performance*



Rate/Intensity for Horizontal Targets

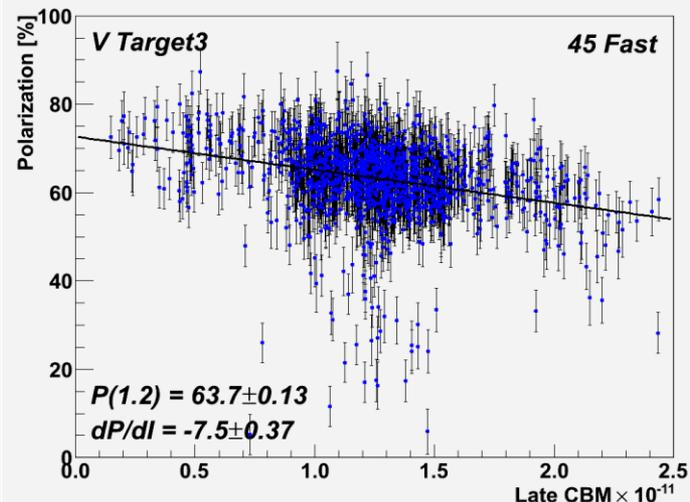
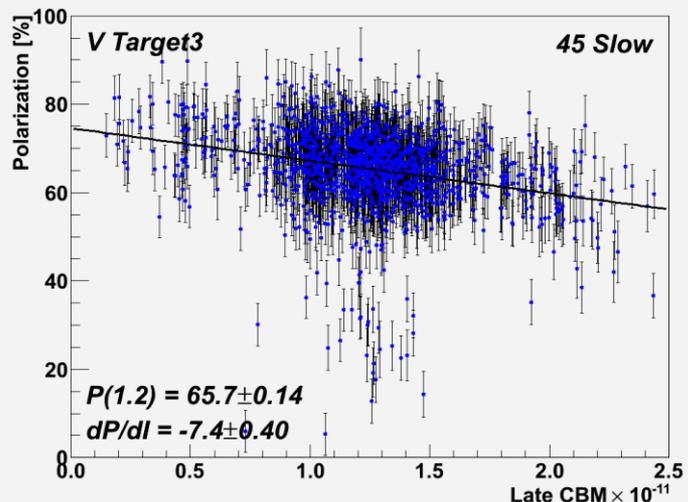


V3, all 2011 runs



Polarization measured by all 3 types of detectors is consistent within 1-2% accuracy!

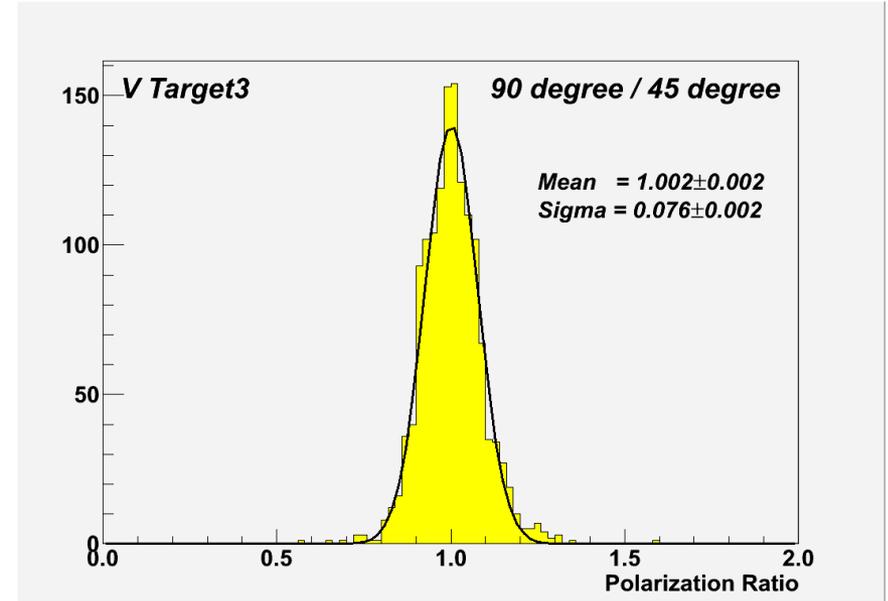
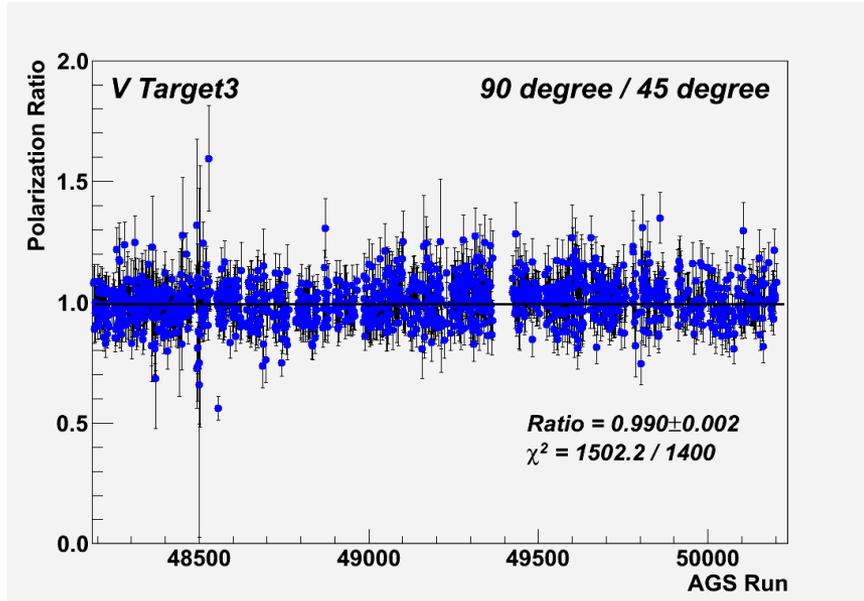
Can we explain slope difference for 90 and 45 degree detectors by rate effect?



All data was included in the fit. Results of the fit should be used for comparison only

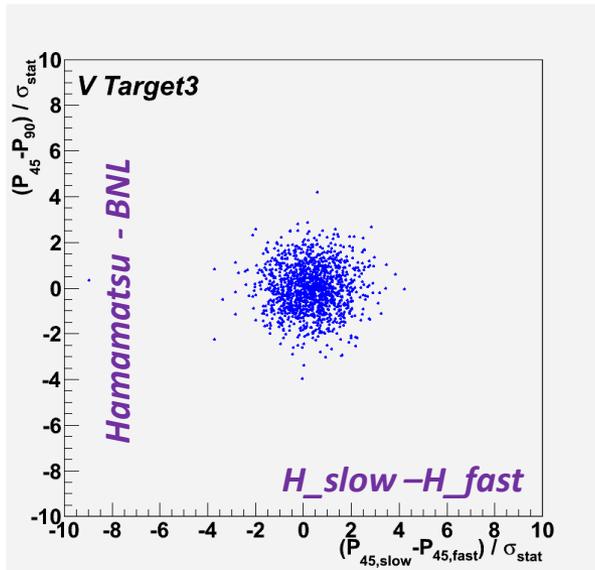
Polarization, $P(1.2)$, is given for intensity 1.2×10^{11}

Hamamatsu (45 degree) vs. BNI (90 degree) detectors

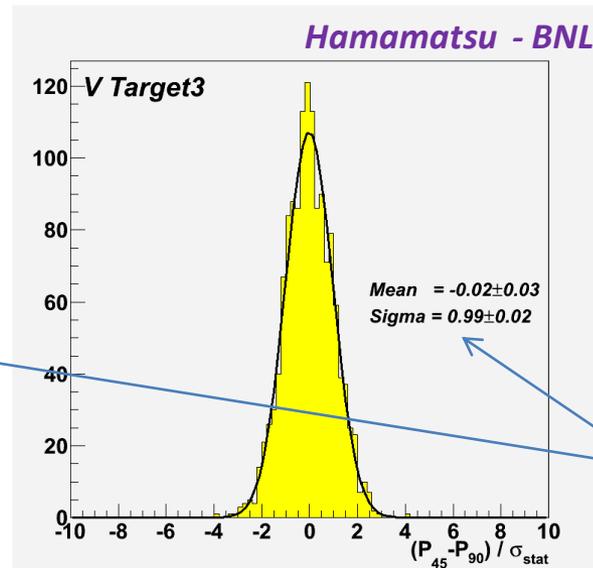
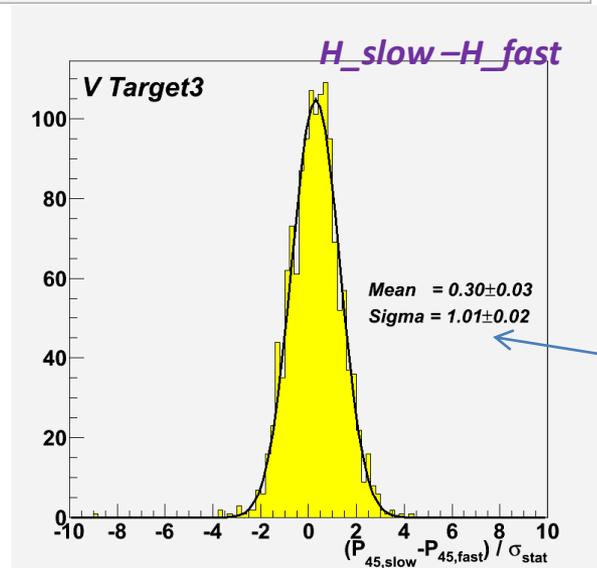


V3, all 2011 runs: Search for instability of measurements

Normalized measured polarization difference



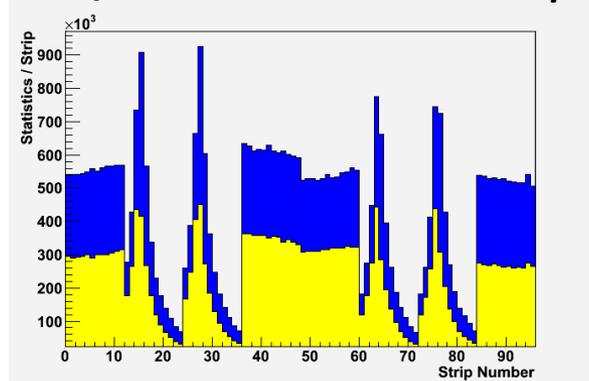
- There is systematic difference in polarization measurements by fast and slow Hamamatsu detectors.
- Systematic difference is much smaller than statistical errors.
- **No fluctuations of the systematic error of measurements were found for all detectors.**



RMS of difference of measured polarisation perfectly agrees with statistical errors

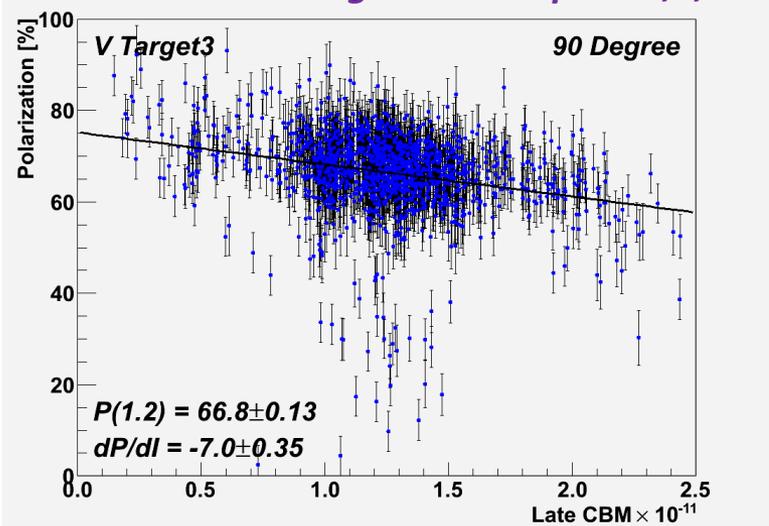
V3, all 2011 runs: Evaluation of the Rate effect

Total/Good statistics in the strips

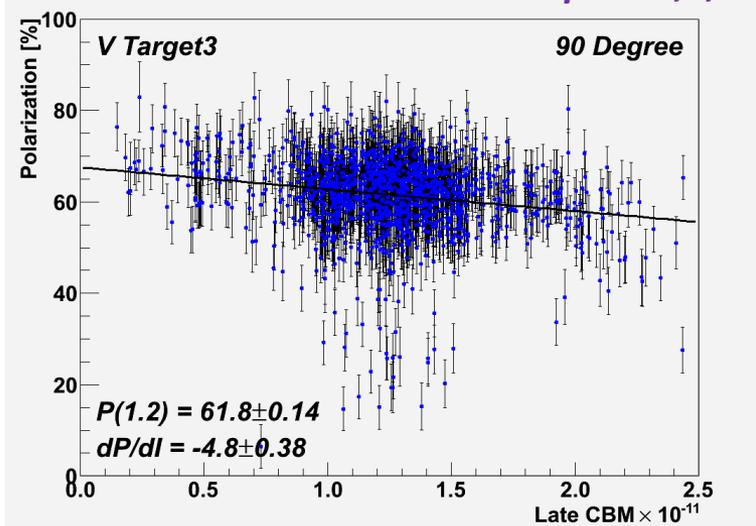


- **The estimate of the rate effect contribution to the slope:**
-(2 – 3)%
(recalculated for V3, 45 degree detectors)
- **Discrepancy for the mean value of polarization (a new problem to be solved)**

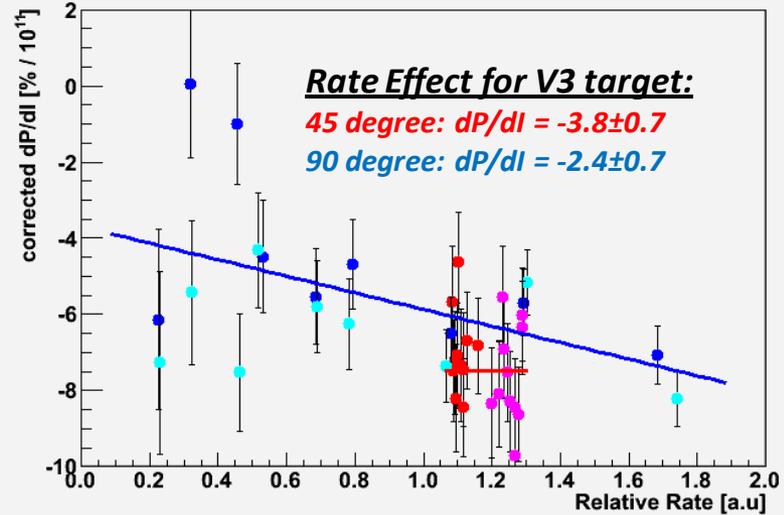
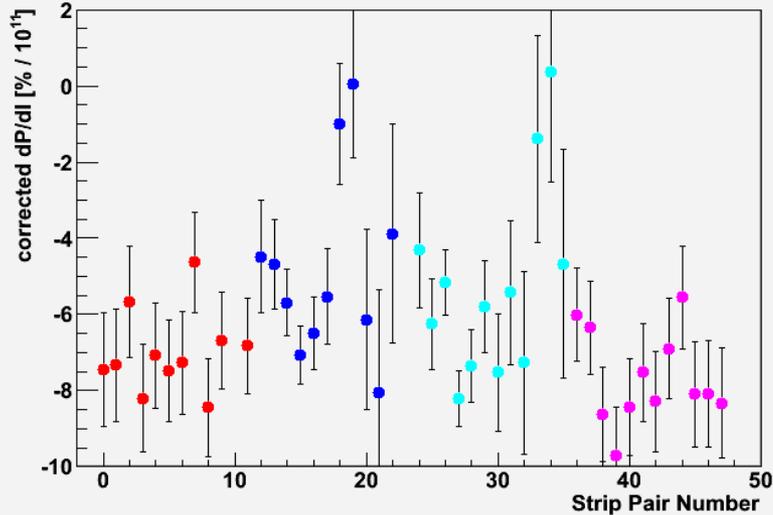
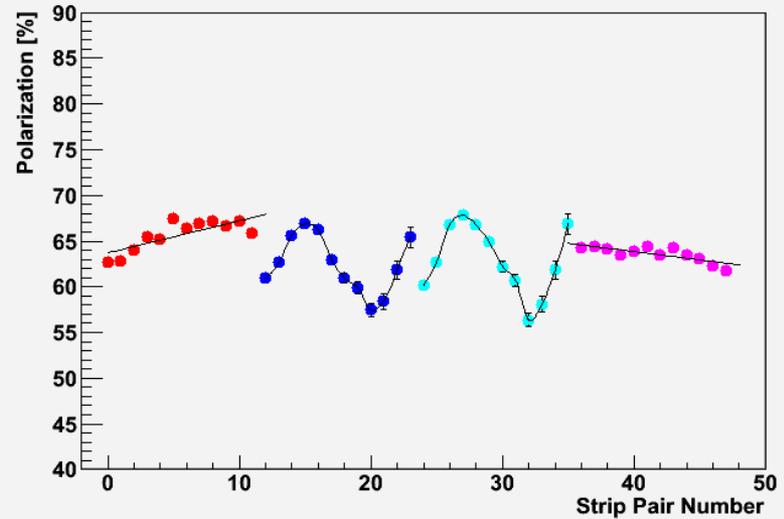
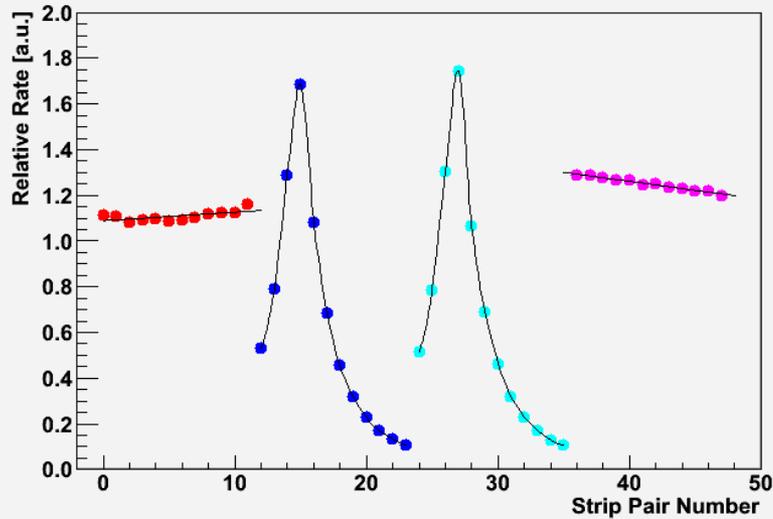
High Rate Strips = 2,3,4



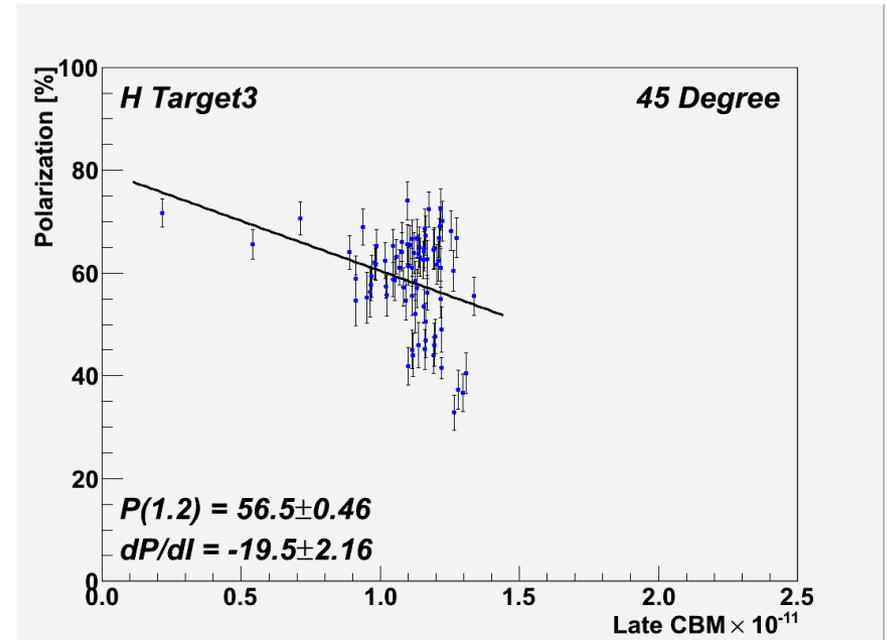
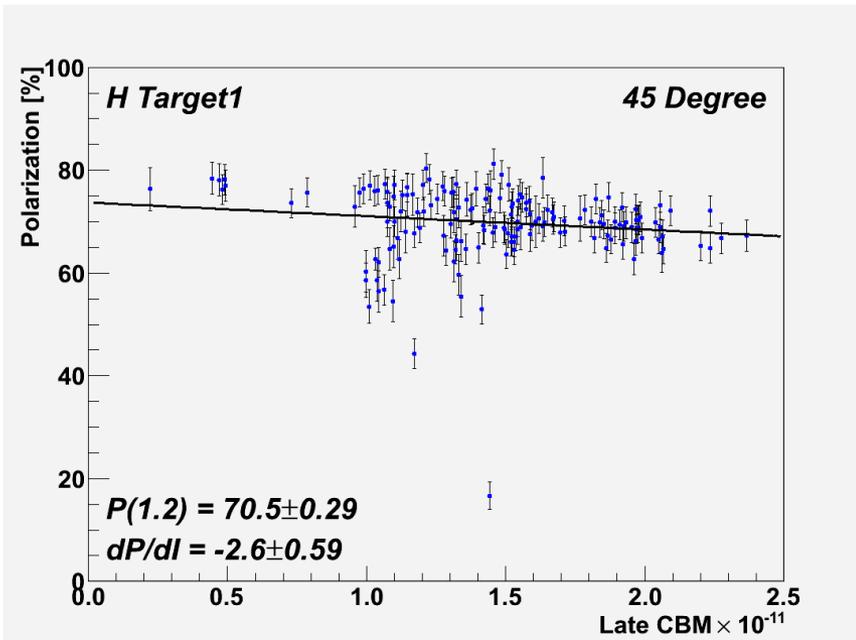
Low Rate Strips \neq 2,3,4



V3, all 2011 runs: Strip Pairs

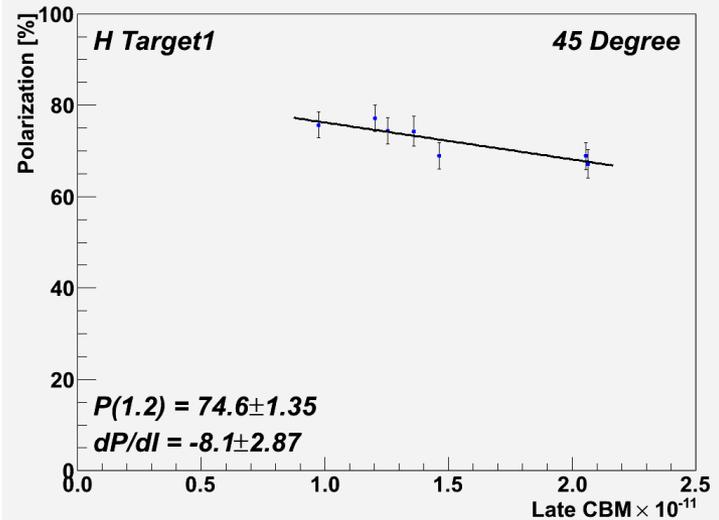
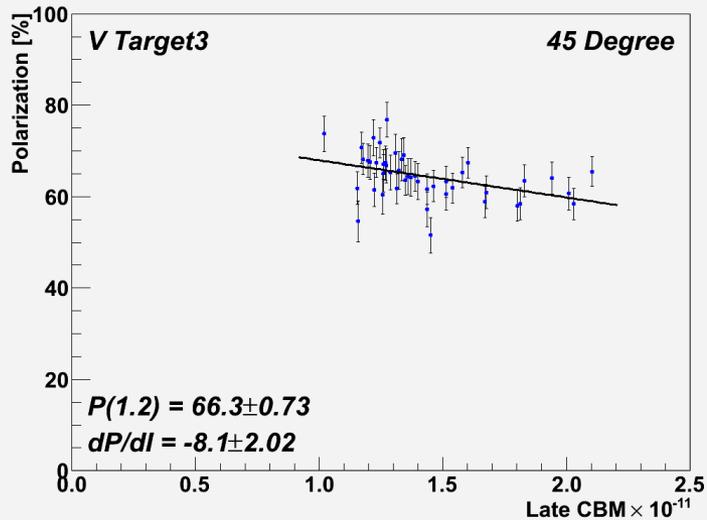
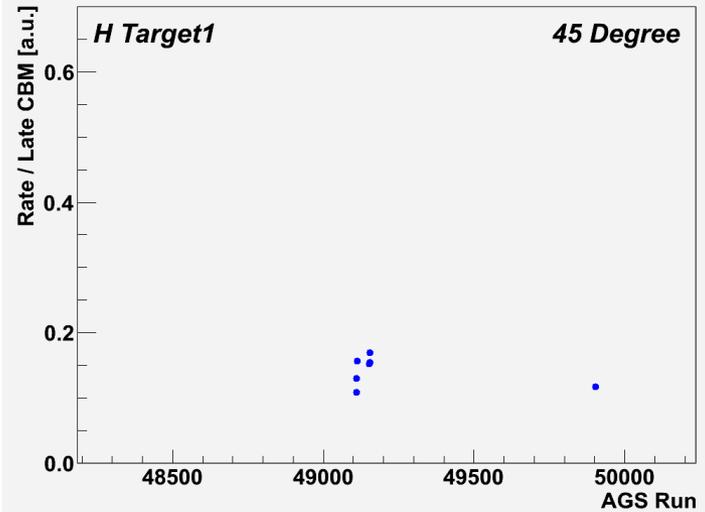
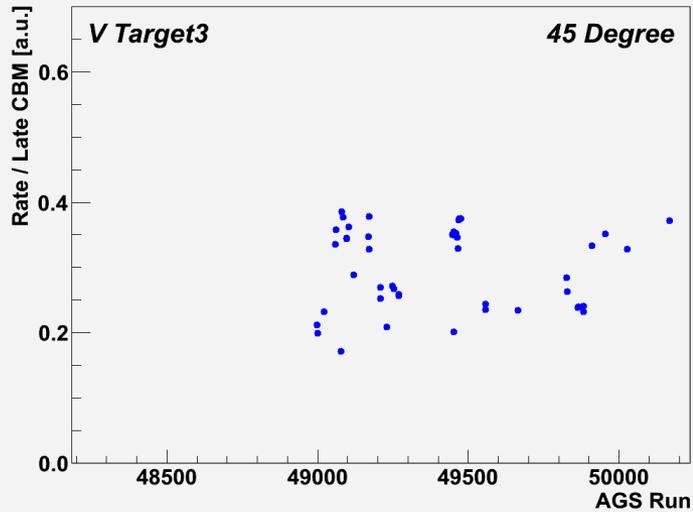


Horizontal targets, all 2011 runs



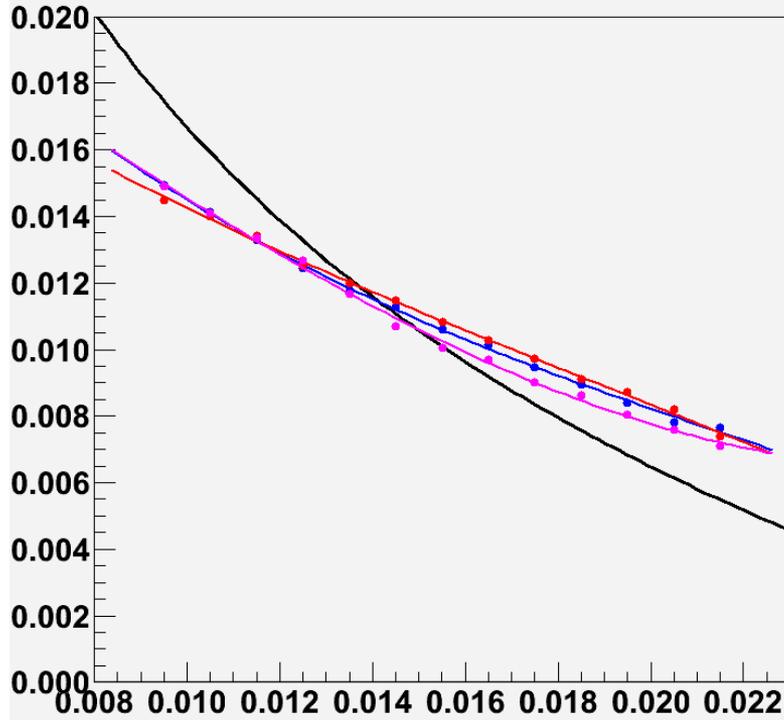
- **Targets V3, H1, and H3 should not be compared in such a way (without preselecting the same beam condition runs)**
- **Nonetheless, we can point out that results of polarization measurements are target dependent.**

"Reference for RHIC fill" runs

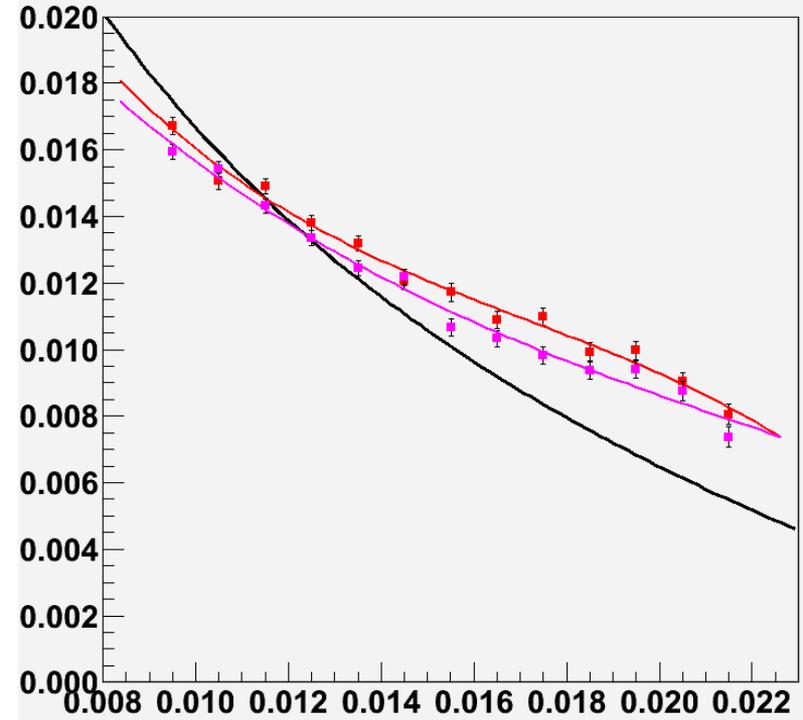


A_N measurement for assumed 65% polarization

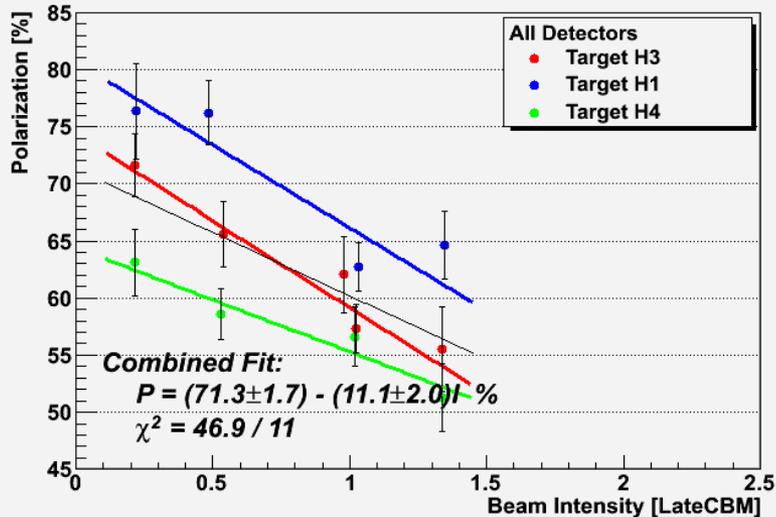
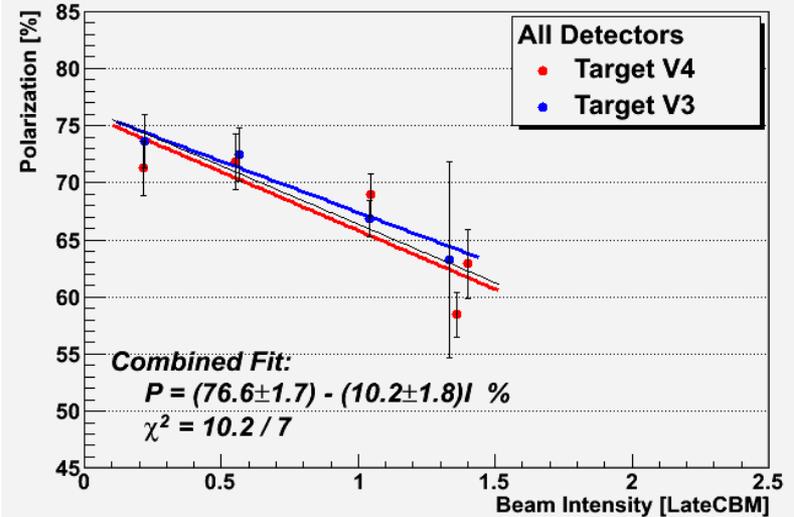
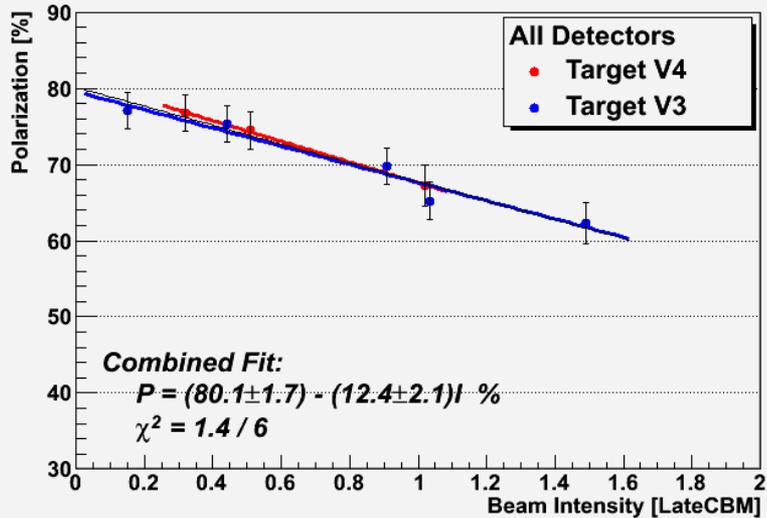
Target V3



Target H1



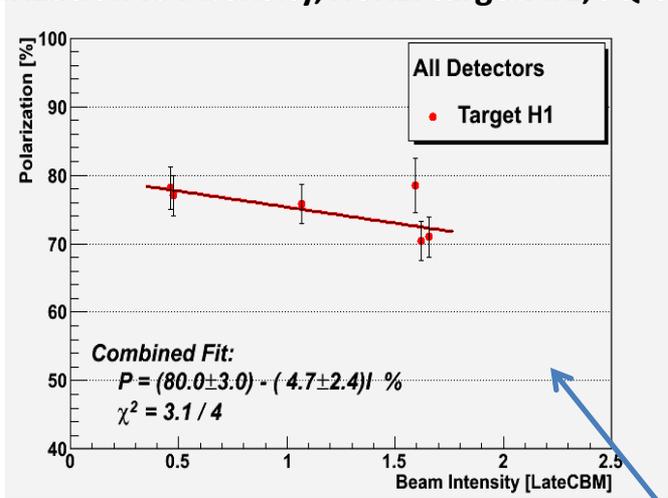
Target dependence of the Polarization measurements



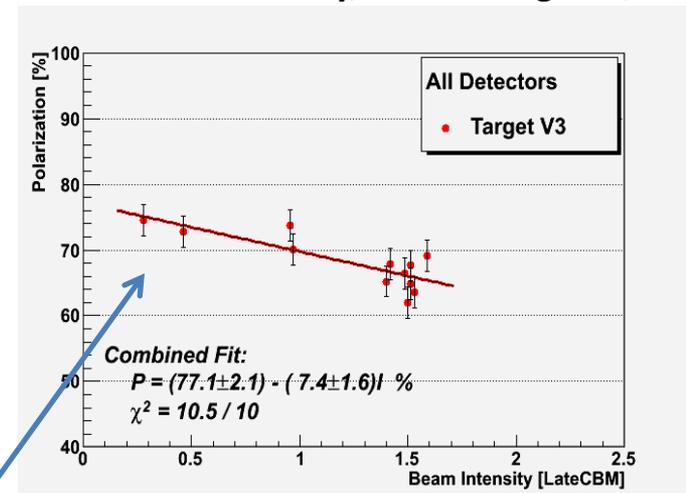
There is about 10% (relative) difference between Polarization measurements with H1 and V3 targets.

Target dependence of the Polarization measurements

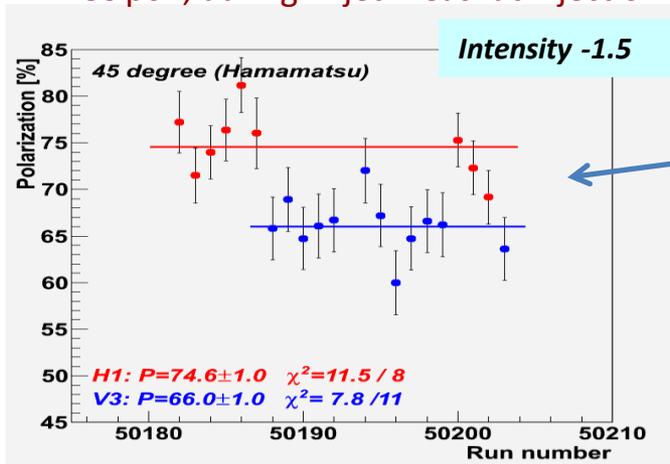
Polarization vs intensity, Horiz. target #1, JQ-on



Polarization vs intensity, Vertical target #3, JQ-on

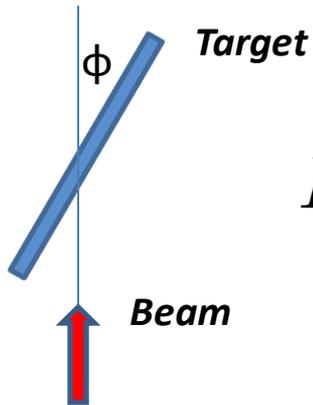


AGS pol., during H-jet meas. at injection

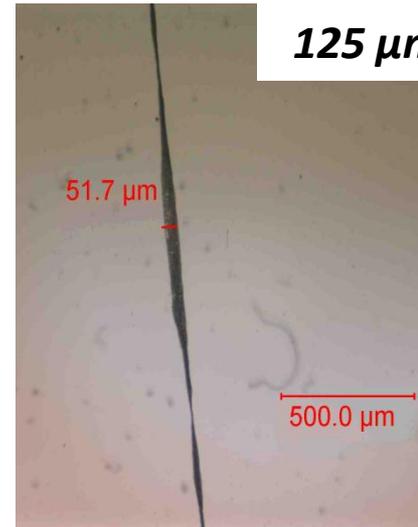


- Slope difference is consistent with our estimates
- We can explain $4 \pm 1 \%$ of polarization difference by rate effect. **Where the rest $4.6 \pm 1.7\%$ come from?**

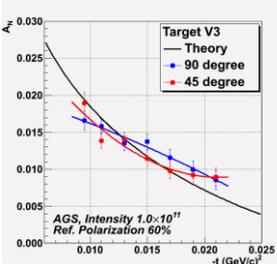
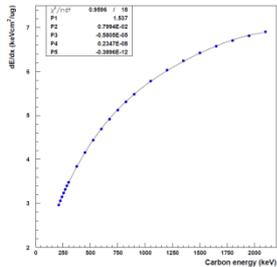
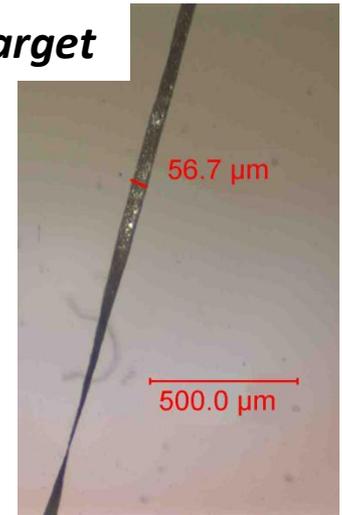
Energy losses in the target



$$L = \frac{\sqrt{2}(d/2)}{\cos \phi}$$



125 μm target



Measured/True Polarization

| Angle | Target Thickness ($\mu\text{g}/\text{cm}^2$) | | |
|---------|--|-------|-------|
| | 4 | 8 | 16 |
| 0 | 0.991 | 0.982 | 0.965 |
| 45 | 0.987 | 0.975 | 0.951 |
| 80 | 0.950 | 0.903 | 0.825 |
| 85 | 0.903 | 0.802 | 0.610 |
| 0 - 360 | 0.970 | 0.948 | 0.911 |

Effect of energy losses in the target

- may be strong
- may be unpredictable

Results are independent on target width !

Energy range 400-900 keV

Summary

- Spill / Bunch selection is needed for data processing
- Strong effect of induced pulse (probably a way for improvement is found)
- **No difference in different type of detectors performance was found (within 1-2% accuracy)**
- Rate effect was estimated for V3 target ($dP/dI \approx -(2-3)\%$)
- Polarization measurement in 90 degree detectors are strip dependent (?!)
- No quantitative explanation for target dependence of the measurements
- Energy losses in the target may be significant.

Plans

- Implement new energy calibration method
 - software is ready and was tested on RHIC data
 - verification of the method is still needed
- More detailed study of the target dependence of the measurements
 - measurement with wide target (to avoid twisting)
 - measurements with very narrow (RHIC) target (to suppress rate effect)
- Fast online analysis