# Update on the Status of the RHIC Polarimeter Analysis

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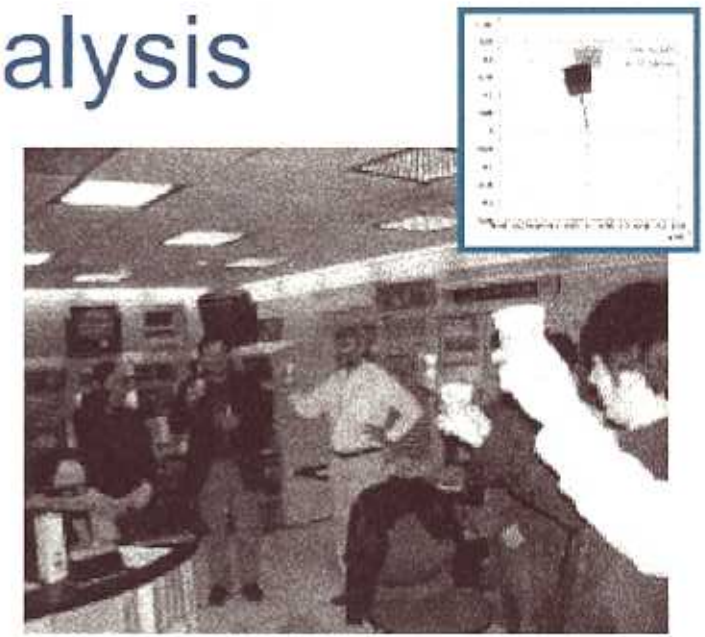
April 12, 2002

for

RHIC Spin Collaboration Meeting VIII

RIKEN BNL Research Center

# Update on the status of the RHIC polarimeter analysis



Contents

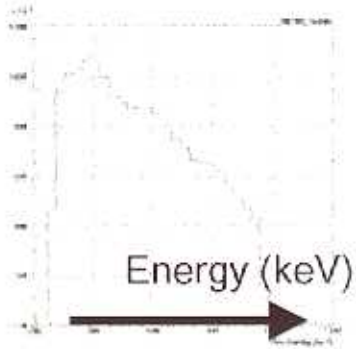
- About offline analysis
- Understanding of the existing systematic
- Stability of the beam polarization

Osamu Jinnouchi (RIKEN)

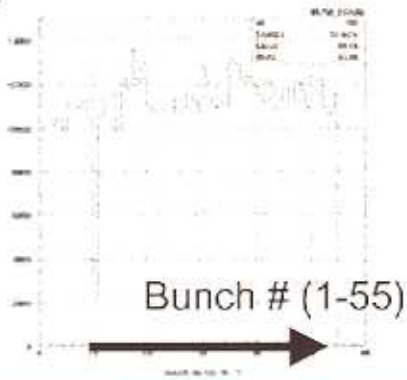
# Our interests and tasks

- Interests
  - Fully understand the systematic of the polarimeter results
  - Confirm if any depolarization during the long store exists
  - -t dependence of the asymmetry
    and cross sections (slope) (←not contained in this talk)
- Tasks
  - Distributions of asymmetry values by version control
    - Including several offline corrections
      - Energy scale, Energy loss correction
      - Excluding bad strips, etc.
  - Systematic study
    - Understanding of the false asymmetries
      - Some measurements have the discrepancy X90 ←→ X45
        Y components in Yellow ring (1/18/02~)
    - Stability of the polarization during the stores

# What is available in our data set for offline analysis




independent




Spin sorted ADC histogram for each strip (1-72)

- Up (+)
- Down (-)
- 0-pol

Bunch dist. histogram for each strip (1-72)
With spin bit pattern from V124

- Energy loss correction (Target & dead layer)
- Energy scale correction
- Strip selection

- Bunch by bunch polarization
- Strip selection
- Bunch selection

# Already distributed asymmetry info

- Several versions of the asymmetry values have been revised and distributed in the form of spread sheets
- The analysis is basically based on the spin sorted energy spectrums, where the re-definition of the energy cut is capable
- Providing many kinds of run conditions
- Assign the flag for validity of the each measurement
- Current situation

  -t range is defined as

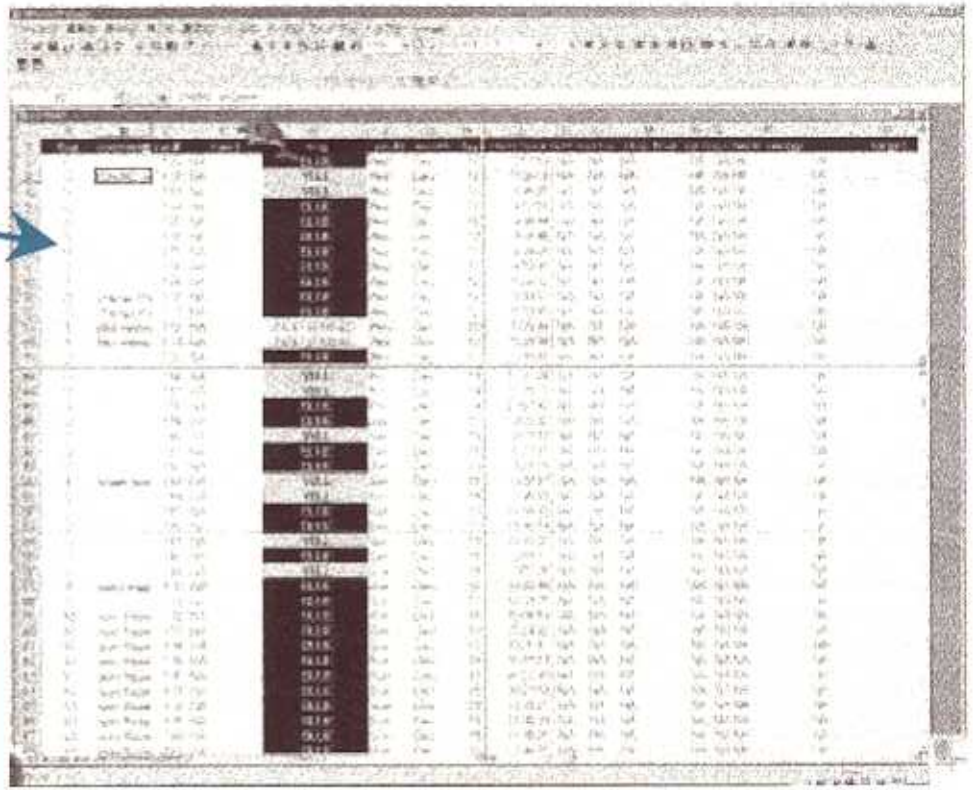
  Analyzing power Ver 2.0 (by J. Tojo)

  Ver 1.0 (distributed)

  target+dead layer correction

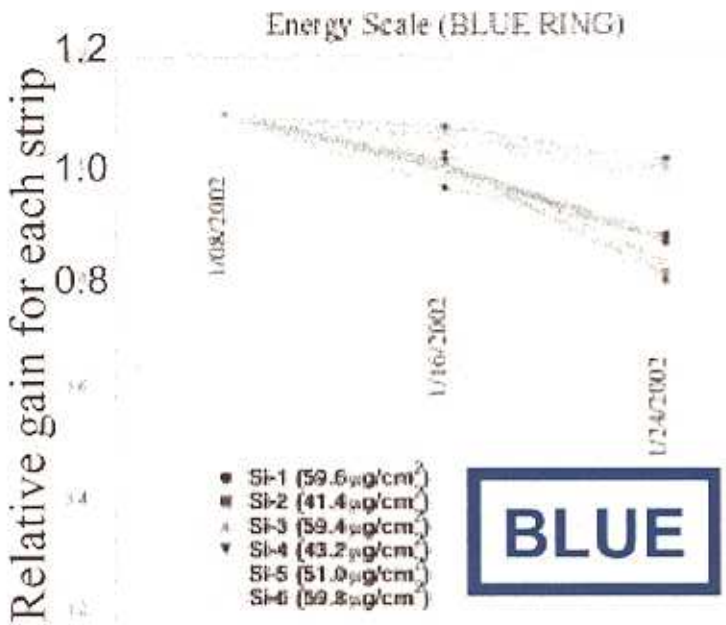
  Ver 1.1 (ready but not announced)

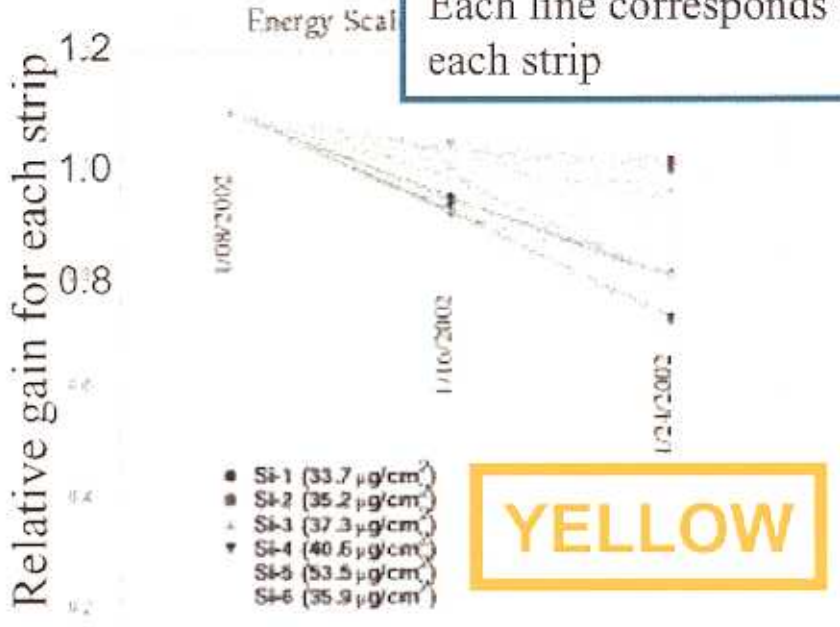
  energy scale correction



http://spin.riken.bnl.gov/exp/pcpol

# Energy scale corrections



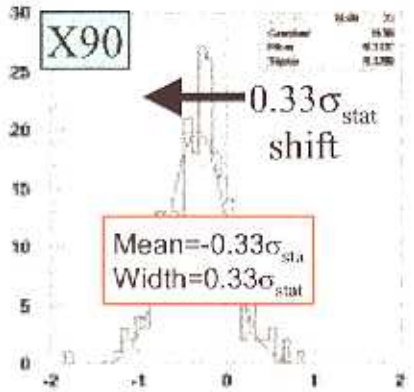



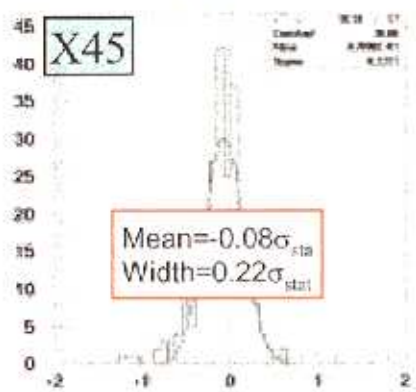

Each line corresponds to each strip

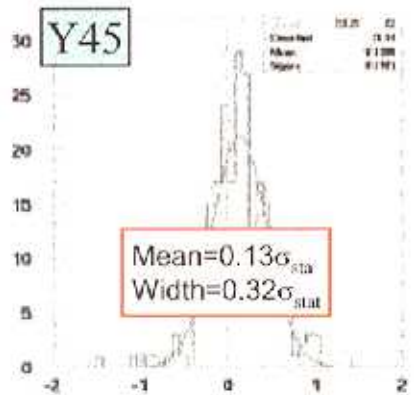
- Re-calibration measurements are performed at 1/8, 1/16 and 1/24(run end)
- Strips from same detector behave in like wise
- No correlation with the dead layer thickness
- The corrections are made with linear interpolation for each strip after the first recalibration

# Results after the corrections

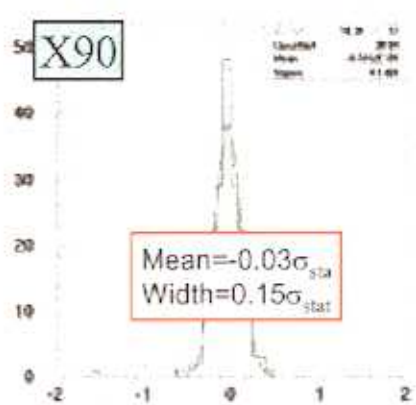
## (energy loss & energy scale)

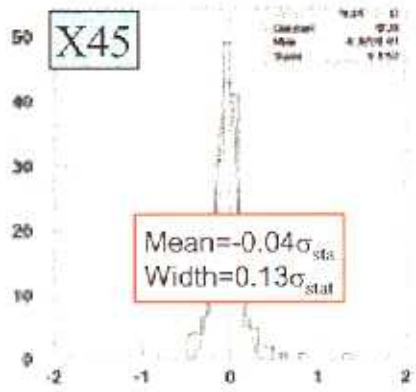


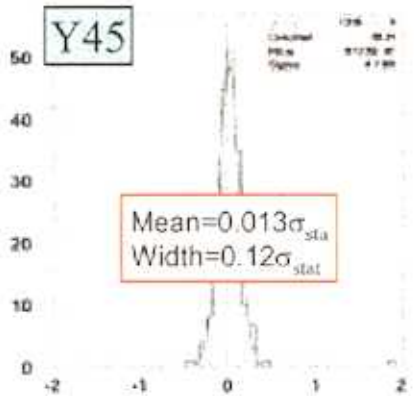




**BLUE**



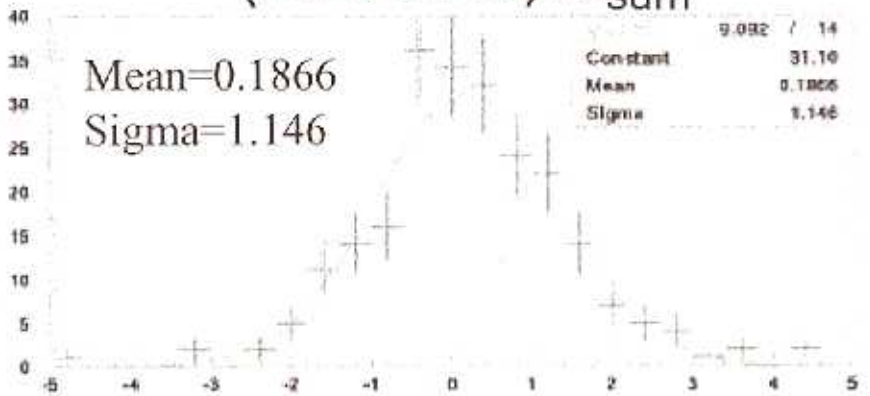

**YELLOW**

**(After-Before)/$\sigma_{stat}$ plots**

- Deviations stemming from the corrections are symmetric and well below the statistical error bars, except blue X90 which has been slightly shifted

# Significance of the X90,X45 separation

$(X90-X45)/\sigma_{sum}$




BLUE

$(X90-X45)/\sigma_{sum}$

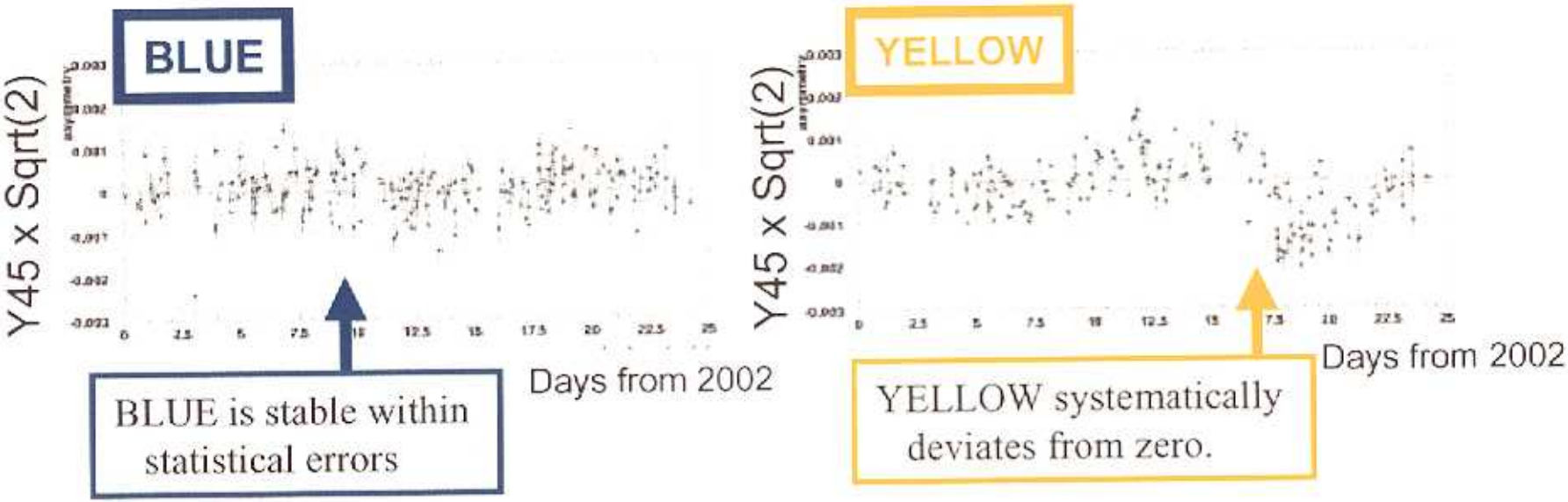
YELLOW

- The degree of separation is in good agreement with the statistical fluctuation of the measurements
- At the level of statistics that we have, the statistical errors still dominate over the systematic
- The average of X90 and X45 (equivalently Xlsq) **can be considered trustworthy**

$$\sigma_{sum} = \sqrt{\sigma^2_{X90stat} + \sigma^2_{X45stat}}$$

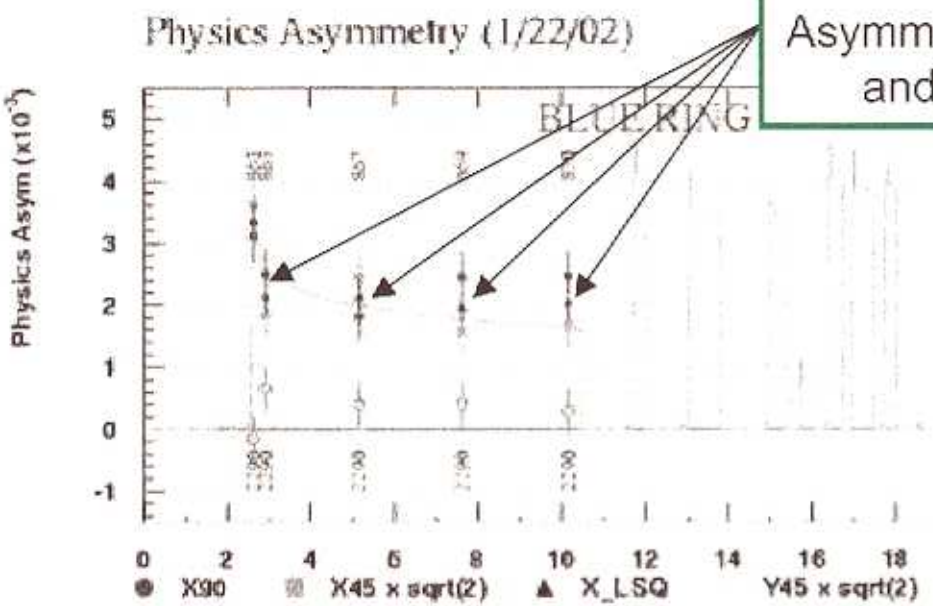
Used data set 1/1-1/24

# Still remaining Y components




- The energy corrections has not improved the Y-components anomalies in yellow
- The study starting from the bunch distribution histograms are on going. Comparison with WCM (wall current monitor) is also shows a quite interesting feature, though no conclusion was delivered so far.

# Polarization stability during the store




Asymmetry A[0],A[1],,,
and beam intensity B[0],B[1],,,

To see the tendency, the values are normalized as A[n] / A[0]

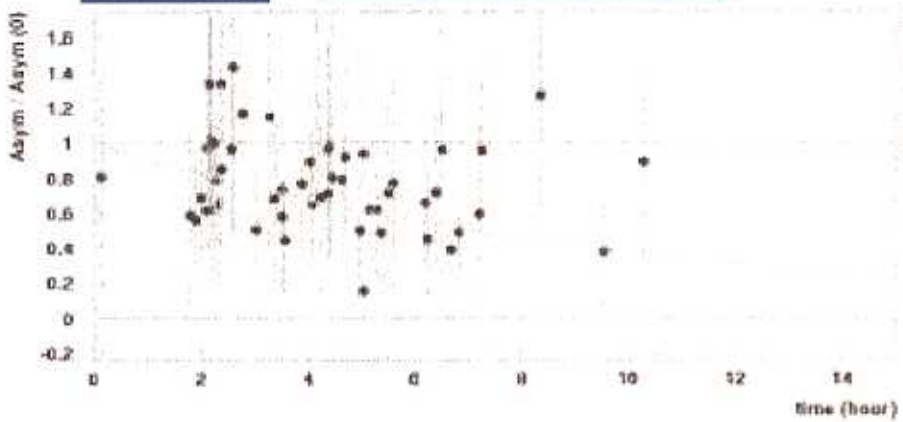
Used fill ID
2147,2153,2161,2162,2173,
2175,2178,2181,2185,2187,
2201,2208,2212,2233,2244,
2246,2251,2258,2266,2269,
2275,2277,2281,2290,2301

- Choose the fill which satisfies following conditions
  - There is a measurement immediately after the ramp
  - Store > 4 hours
  - 1st measurement has asymmetry > $1.0 \times 10^{-3}$
  - The data after Jan. 4th
- Taking the ratio against the 1st measurement
- Is there any correlation with beam intensity ?

# Asymmetry as a function of store time

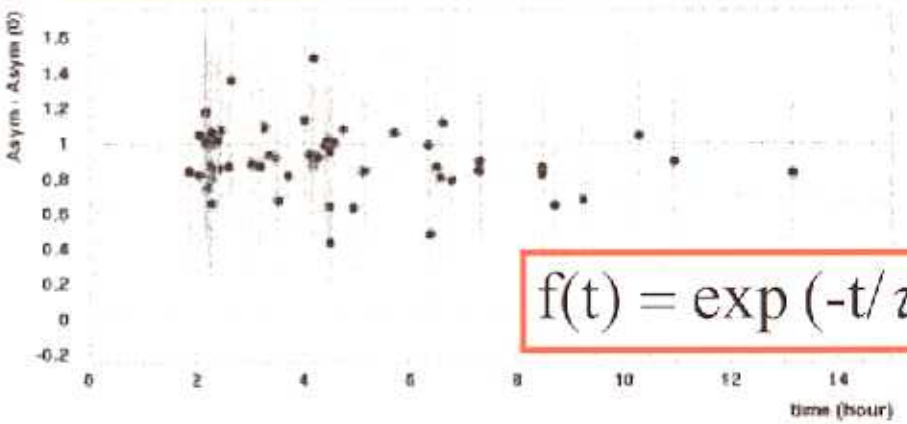
6.9 x $10^{10}$ turns

**BLUE** $\tau = 10.3\ ^{+2.8}_{-2.0}$ hours




2.4 x $10^{11}$ turns

**YELLOW** $\tau = 35.2\ ^{+32.1}_{-12.1}$ hours

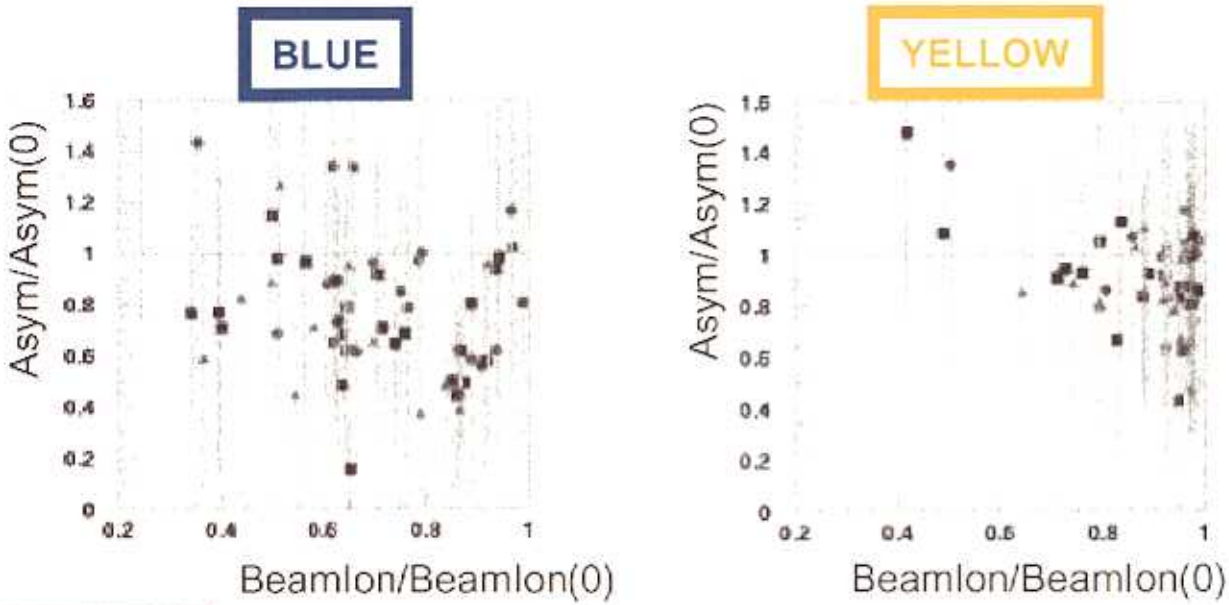



$f(t) = \exp(-t/\tau)$

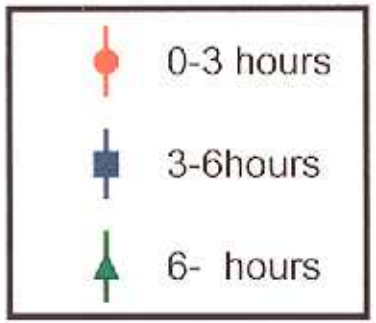
Time starting from the first measurement at flattop (hour)

- We assume the exponential decay function from unit=1 at time=0 although we do not have any particular reason
- Using Xlsq values (asymmetry value calculated with fit)
- Exponential curves fit well, showing long lifetime in yellow, while blue has rather short lifetime
- Statistically, they are depolarizing during the store

# Asymmetry .vs. beam intensity




89

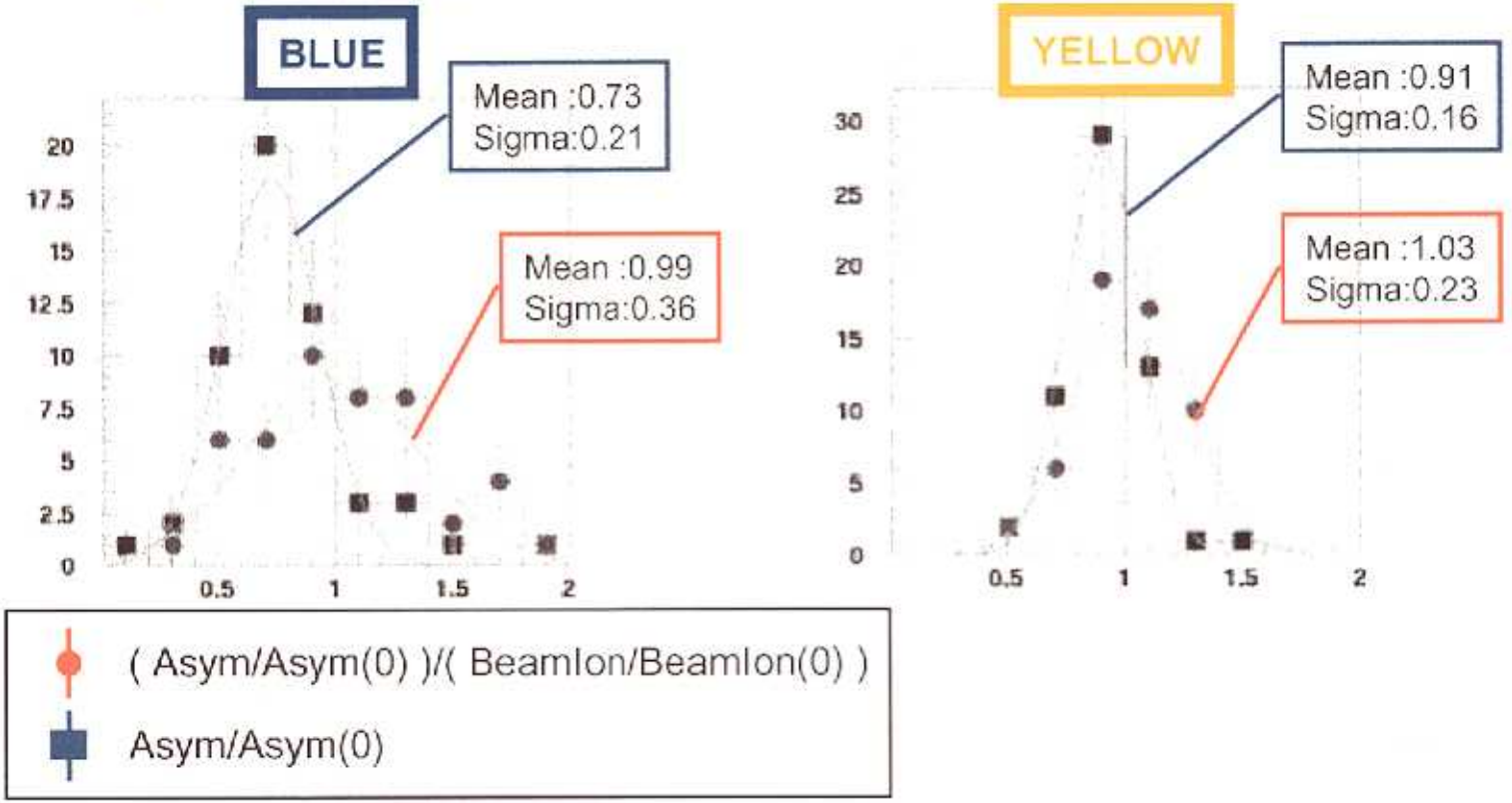



- The correlation between the lifetime of the asymmetry and beam intensity is not clear due to the large statistical error bars
- However by comparing blue and yellow, the correspondence is found, i.e.

  asymmetry decays ←→

  beam intensity decays

# Asymmetry .vs. beam intensity (2)




- By taking the ratio, the distributions show the peak structures around 1 with larger width on both ring
- Statistically, the decay of the asymmetry and the decay of the beam intensity behave in similar way

# Remaining tasks

## Needless to say, there are so many....

- On going study for Y-component anomalies
- Bunch by bunch polarization study
  - Using 10 successive runs (with 0 pol bits) taken at polarimeter dedicated run time
  - The polarizations of the plus and negative spin bit bunches are equal ?
- Estimation of the systematic error originating from the false spin bit pattern
- Polarimeter dedicated run data with WFD AT mode
  - -t dependent asymmetry with x8 good energy resolution
  - Cross section (slope) study
  - Detailed study on the WFD signal shape
- .....

# Summary and Outlook

- Systematic study
  - Separation between X90 and X45 looks reasonable within a statistical error bar
  - Y-component anomalies are still under study
- Stability of the asymmetry during the same fill
  - The asymmetry has the lifetime
    - Blue : 10.3 hour Yellow:35 hour
- Several measurements are needed for more precise determinations?
  - Current statistics (20Mevents) corresponds to about 5% error for 0.004 asymmetry