Spinfest 2016

Introduction to Spin analysis and Spin Database

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Outline

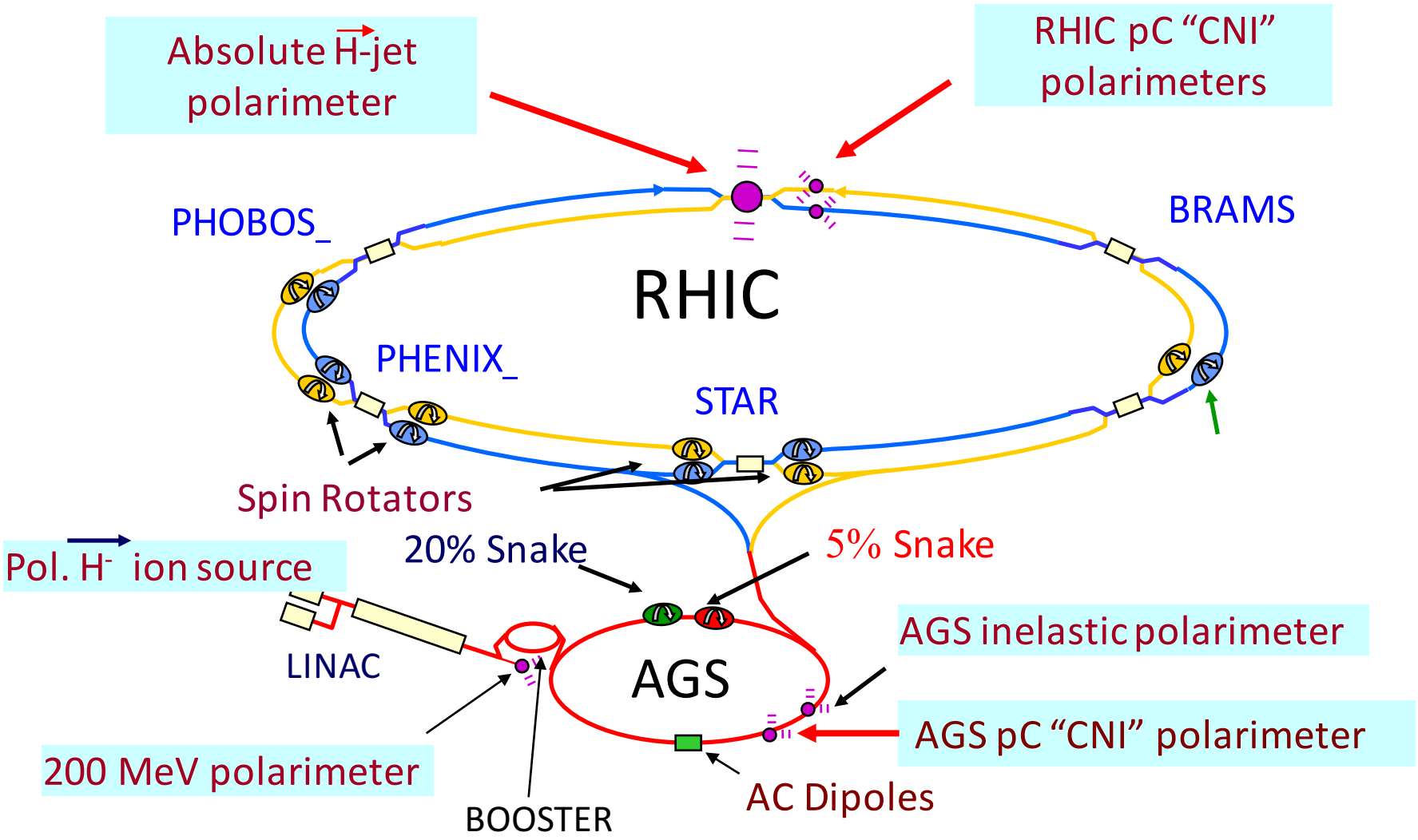
- Simple introduction to Spin analysis.
- Extract Spin information from database.
  - PostgreSQL command line.
  - uspin.
- Spin DB QA

Spin Analysis

Polarization facilities at RHIC.

Anatoli Zelinsky's PolarizedSource Talk

70% Polarization $L_{max} = 1.6 \times 10^{32}\ s^{-1}cm^{-2}$ $50 < \sqrt{s} < 500$ GeV

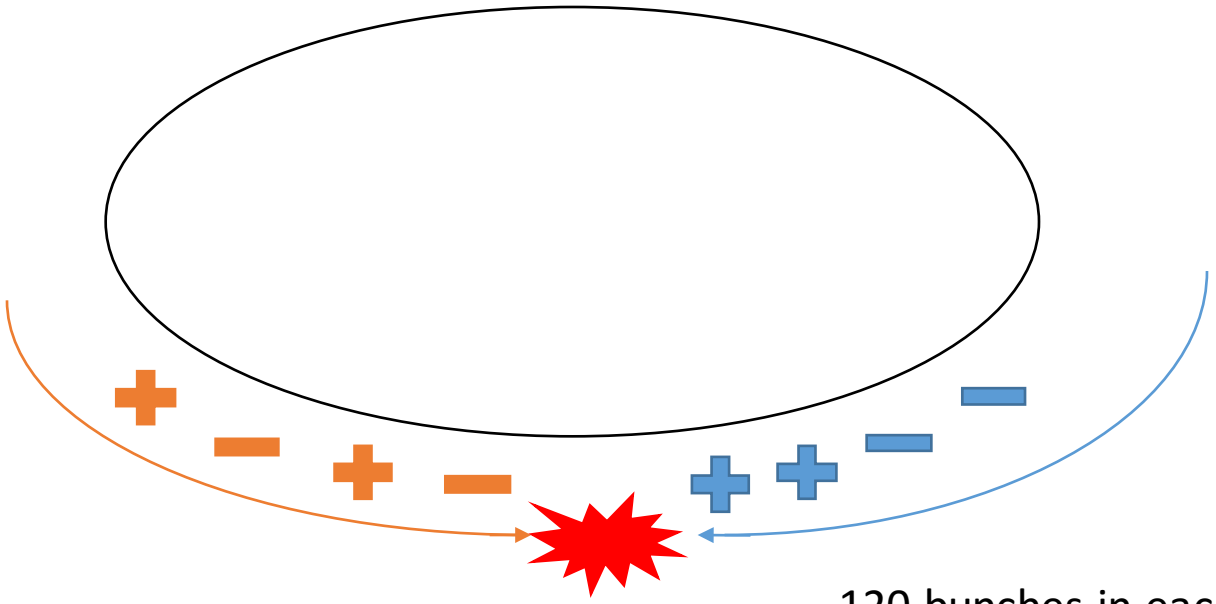


What is a "bunch"

A bunch of protons:

- ~10^11 protons
- ~200 micron wide (500 GeV)
- ~1m long
- ~109 ns / 30m between bunches
- Can be identified with a run # and a bunch #

Vernier scan, Covered by Mike on Friday

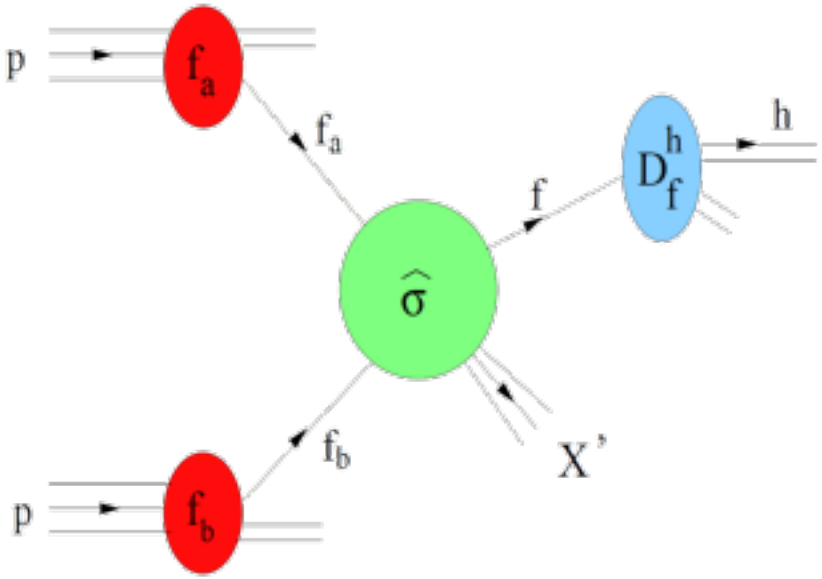


120 bunches in each ring

Spin Analysis: Took Double Helicity Asymmetries (A_{LL}) as example

Theoretically:

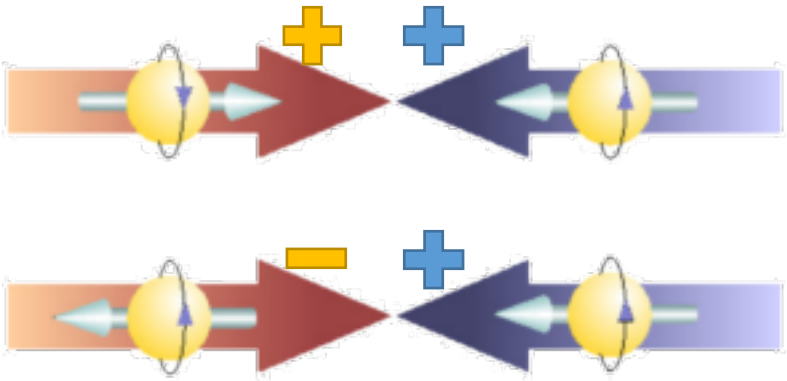
$$A_{LL} = \frac{\sigma^{++} - \sigma^{+-}}{\sigma^{++} + \sigma^{+-}} = \frac{\sum_{a,b,c=q,\bar{q},g} \Delta f_a \otimes \Delta f_b \otimes \Delta\hat{\sigma} \otimes D_{h/c}}{\sum_{a,b,c=q,\bar{q},g} f_a \otimes f_b \otimes \hat{\sigma} \otimes D_{h/c}}$$



Experimentally:

$$A_{LL} = \frac{1}{P_B P_Y} \frac{N^{++} - R\, N^{+-}}{N^{++} + R N^{+-}}$$

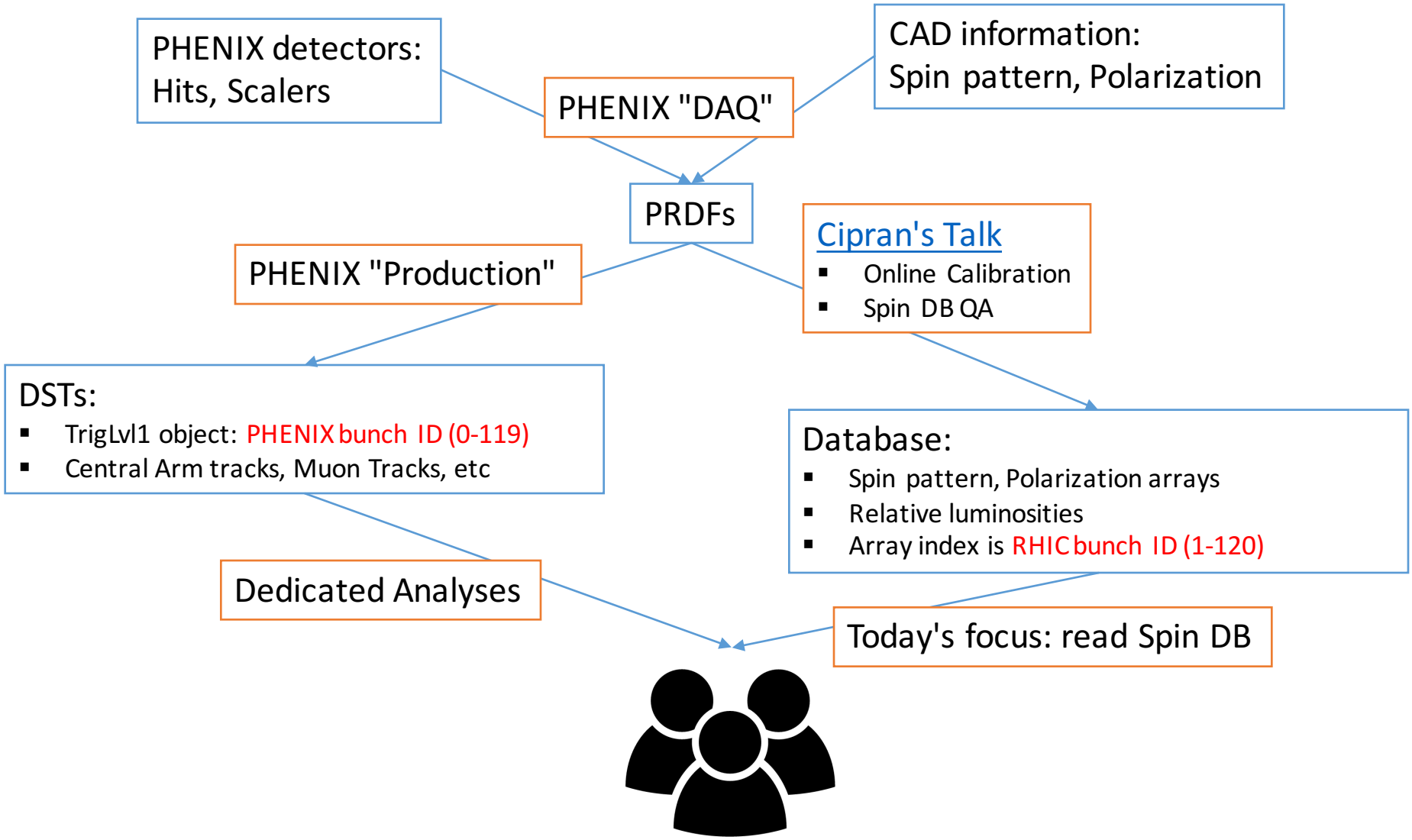
Where $P_{B,Y}$ is the polarization of Blue (Yellow) beam.
And R is the relative luminosity:



$$R = \frac{L^{++}}{L^{+-}}$$

Covered by Sanghwa on Wednesday

Spin Analysis



Definition of Xing_Shift: BunchID_RHIC = (BunchID_PHENIX + Xing_Shift)%120

Spin Database

What is database

- A database
  - is a organized dataset. Basically bunches of tables, like the Microsoft excel spreadsheet.
  - is managed by a DB Management System, DBMS. PHENIX mainly used PostgreSQL, (psql).

- Ways to interact (insert, update, read) with DB at PHENIX:
  - PostgreSQL scripts, interactive command lines.
  - PHENIX utilities based on ODBC (Open DB Connectivity) APIs
  - etc.

- Advantages of database comparing with data files, e.g., text files:
  - Easy to trace history.
  - Better accessibility for retrieving small amount of data by multiple users.
  - Common APIs.
- Disadvantages:
  - Performance is not good when serially accessing large amount of data.

PostgreSQL command line

```
[yuhw@rcas2065 ~]$ psql -h phnxdbmirror3.rcf.bnl.gov -d spin
psql (9.1.12)
Type "help" for help.

spin=> \d
           List of relations
 Schema |     Name      | Type  | Owner
--------+---------------+-------+--------
 public | spin          | table | phnxrc
 public | spin_daq      | table | phnxrc
 public | spin_default  | table | phnxrc
 public | spin_oncal    | table | phnxrc
(4 rows)
```

PSQL command line, cont'd

```
spin=> \d spin
                    Table "public.spin"
      Column        |            Type             |     Modifiers
--------------------+-----------------------------+--------------------
 runnumber          | integer                     | not null
 fillnumber         | integer                     |
 badrunqa           | integer                     |
 crossingshift      | integer                     |
 polarblue          | real[]                      |
 polarblueerror     | real[]                      |
 polaryellow        | real[]                      |
 polaryellowerror   | real[]                      |
 spinpatternblue    | integer[]                   |
 spinpatternyellow  | integer[]                   |
 bbcvertexcut       | bigint[]                    |
 bbcwithoutcut      | bigint[]                    |
 zdcnarrow          | bigint[]                    |
 zdcwide            | bigint[]                    |
 badbunchqa         | integer[]                   |
 transversxblue     | real                        |
 transversxblueerr  | real                        |
 transversyblue     | real                        |
 transversyblueerr  | real                        |
 transversxyellow   | real                        |
 transversxyellowerr | real                       |
 transversyyellow   | real                        |
 transversyyellowerr | real                       |
 qa_level           | integer                     | not null default 0
 timestamp          | timestamp without time zone |
 polarblueerrorsys  | real[]                      |
 polaryellowerrorsys | real[]                     |
```

SQL basics:

```
spin=> SELECT fillnumber, runnumber, qa_level, polaryellow[1], spinpatternblue[1], bbcvertexcut[1] FROM spin WHERE fillnumber = 18672 ORDER BY qa_level, runnumber;
 fillnumber | runnumber | qa_level | polaryellow | spinpatternblue | bbcvertexcut
------------+-----------+----------+-------------+-----------------+--------------
      18672 |    422064 |        1 |      0.7187 |              -1 |     10027970
      18672 |    422066 |        1 |      0.7187 |              -1 |       668994
      18672 |    422067 |        1 |      0.7187 |              -1 |      8412663
      18672 |    422068 |        1 |      0.7187 |              -1 |      1967211
      18672 |    422070 |        1 |      0.7187 |              -1 |      5850413
      18672 |    422074 |        1 |      0.7187 |              -1 |       335996
      18672 |    422075 |        1 |      0.7187 |              -1 |      1436572
      18672 |    422084 |        1 |      0.7187 |              -1 |       215425
      18672 |    422085 |        1 |      0.7187 |              -1 |      2328927
      18672 |    422064 |        2 |    0.697515 |              -1 |     10027970
      18672 |    422066 |        2 |    0.700553 |              -1 |       668994
      18672 |    422067 |        2 |     0.70336 |              -1 |      8412663
      18672 |    422068 |        2 |    0.706621 |              -1 |      1967211
      18672 |    422070 |        2 |    0.710671 |              -1 |      5850413
      18672 |    422074 |        2 |    0.719539 |              -1 |       335996
      18672 |    422075 |        2 |    0.721056 |              -1 |      1436572
      18672 |    422084 |        2 |    0.724773 |              -1 |       215425
      18672 |    422085 |        2 |    0.727181 |              -1 |      2328927
(18 rows)
```

PHENIX Utilities based on ODBC

Online Calibration

- online/calibration/onlcal/subsystems/xingshift
- offline/packages/xingshift/

Update DB,

- SpinDBUpdater: offline/analysis/SpinDBUpdater

Read DB:

- uspin: offline/packages/uspin/

Use uspin to extract spin DB content

Wiki page :
https://www.phenix.bnl.gov/WWW/offline/wikioff/index.php/Get_Data_From_Database_(using_root)

```
[user@rcas ~]$ root -l -b
root [0] gSystem->Load("libuspin.so");
root [1] SpinDBContent spin_cont;
root [2] SpinDBOutput spin_out("phnxrc");
root [3] spin_out.StoreDBContent(170332,170332);
root [4] spin_out.GetDBContentStore(spin_cont,170332);
root [5] cout<<spin_cont.GetFillNumber()<< endl;
```

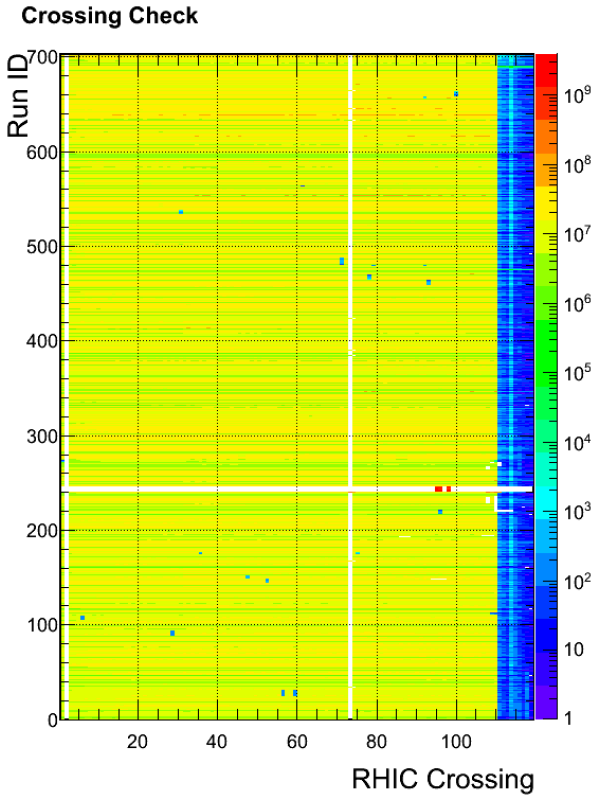
SpinDBContent doxygen page:
http://www.phenix.bnl.gov/WWW/offline/doxygen/html/d8/d38/classSpinDBContent.html

Be careful about the Crossing Shift!

From Chen Xu's talk

One way to check that you applied the xing shift correctly is

- making a 2D histogram (Run# vs RHIC Crossing#)
- Fill it with reconstructed event counts, e.g. number of Jpsi.
- Fill it with luminosity scalers.
- There should be a 9 BCO wide gap at the end.



Spin Database QA

Spin Analysis

PHENIX detectors:
Hits, Scalers

PHENIX "DAQ"

CAD information:
Spin pattern, Polarization

PRDFs

Cipran's Talk
- Online Calibration
- Spin DB QA

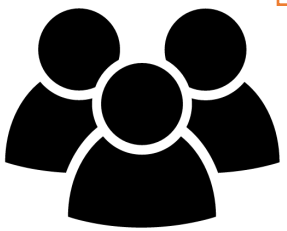
PHENIX "Production"

DSTs:
- TrigLvl1 object: PHENIX bunch ID (0-119)
- Central Arm tracks, Muon Tracks, etc

Database:
- Spin pattern, Polarization arrays
- Relative luminosities
- Array index is RHIC bunch ID (1-120)

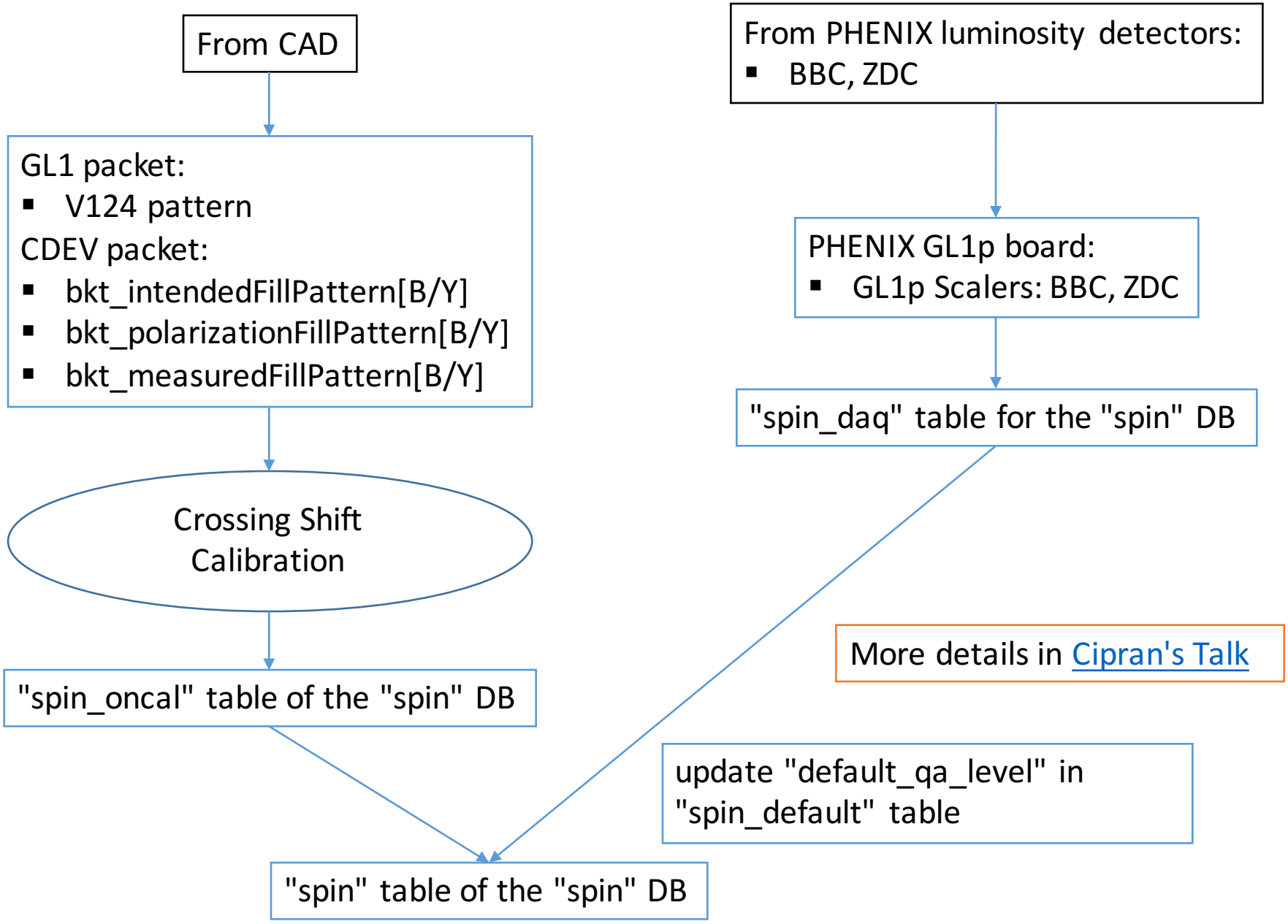
Dedicated Analyses

Today's focus: read Spin DB



Definition of Xing_Shift: BunchID_RHIC = (BunchID_PHENIX + Xing_Shift)%120

From PRDF packets to DB



Merge "spin_oncal" and "spin_daq" to "spin"

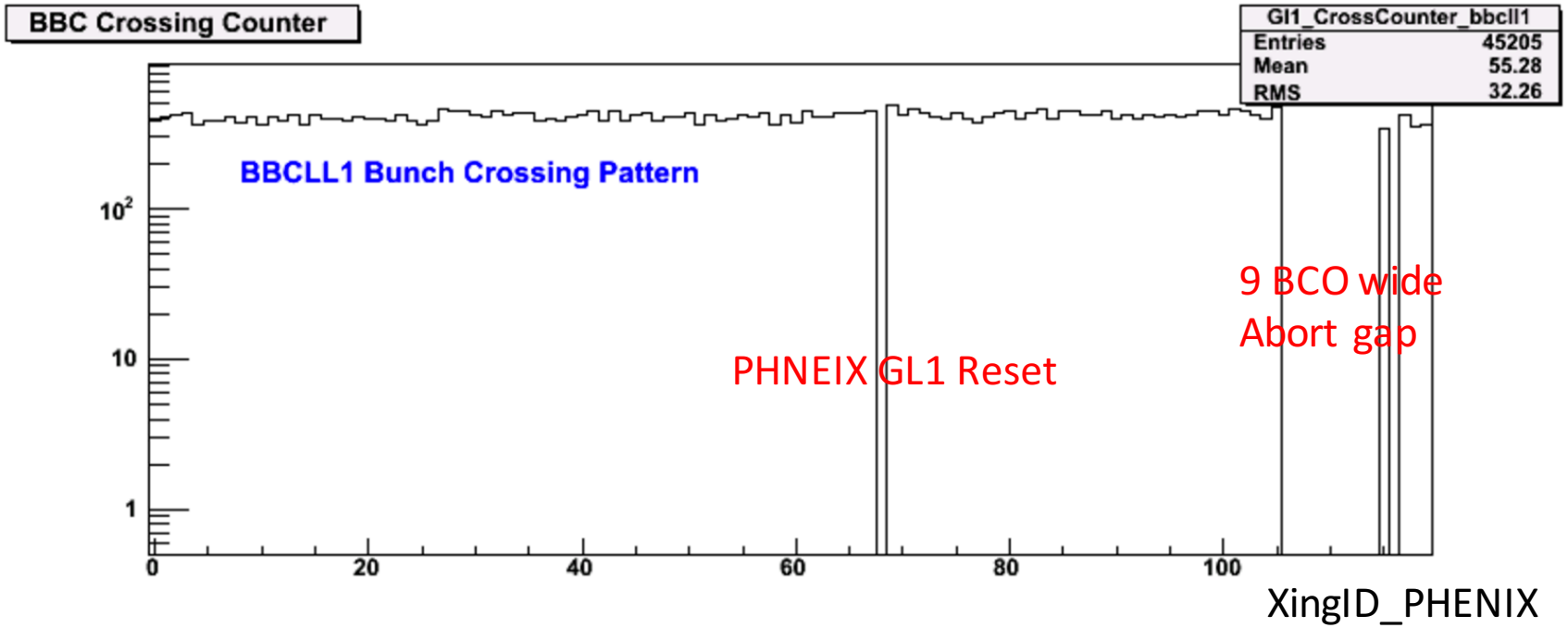
spin_oncal

- runnumber
- fillnumber
- crossingshift
- spinpattern
- Polarization (online values)

spin_daq

- runnumber
- fillnumber
- bbcvertexcut
- bbcwithoutcut
- zdcnarrow
- zdcwide

Crossing Shift Online Calibration



Spin DB QA

- Data availability: try to recover some spin DB information.
- Check online calibration crossing shift values.
- Cross check data consistency with CNI, CDEV, etc.
- Update polarization values after CNI group finalized their numbers.
  - Run-by-run polarization.
- Stacy Karthas' Run15 QA work:
  - AN1255
  - Almost finalized

Summary

- By flipping spin patters very fast (~100ns), a lot of the detector efficiency systematic uncertainties got canceled out.
- Use uspin to get Spin information from Spin DB is easy and structural.
- Careful about the Crossing shift!
- Jin's SpinAnalyzer:
  - Fast and reliable way to do spin analysis.