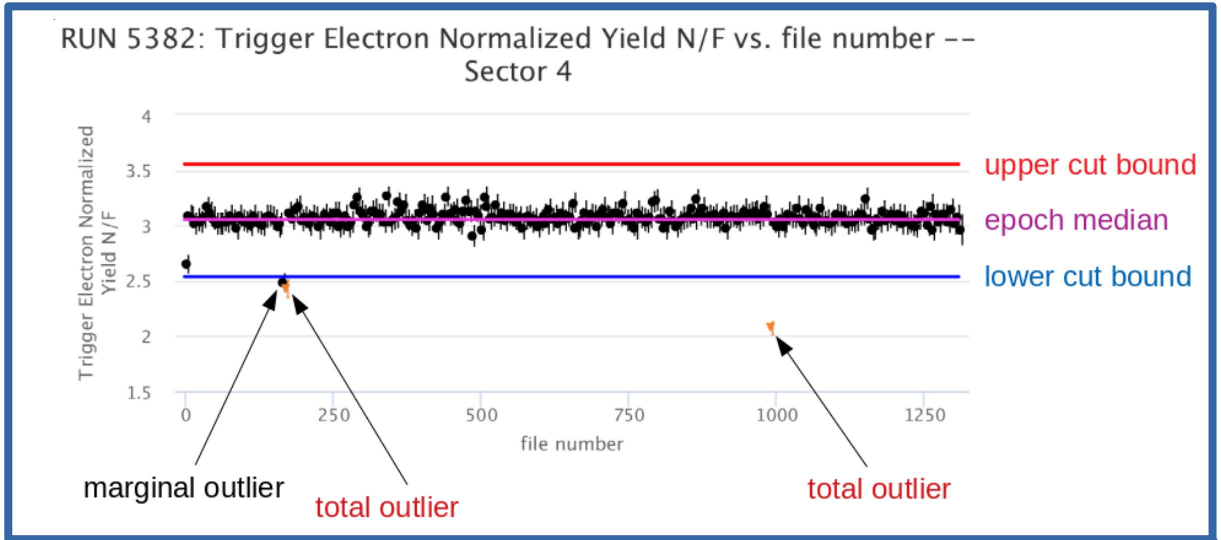
CLAS12 Quality Assurance

Christopher Dilks
CLAS Collaboration Meeting
4 June 2021

Quality Assurance Timelines

Monitor helicity sign

Identify outliers of # trigger electrons, normalized to FC charge



upper cut bound

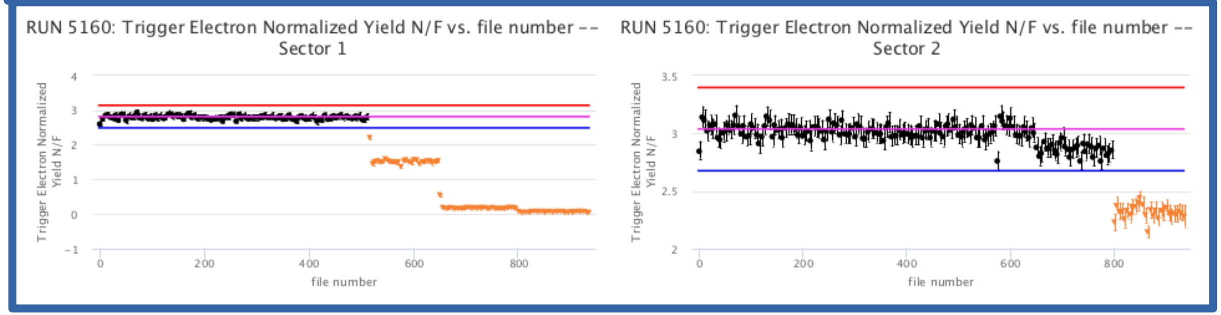
epoch median

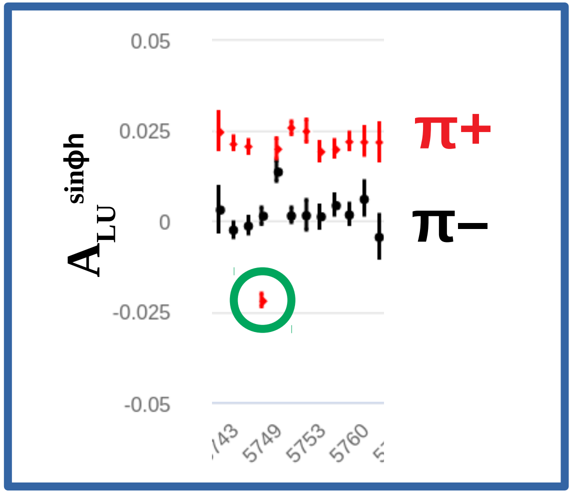
lower cut bound

marginal outlier

total outlier

total outlier



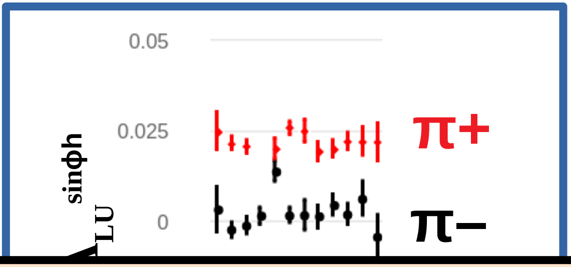


Document other miscellaneous cases:

- special runs, e.g., low lumi
- junk runs
- anything else noteworthy

Quality Assurance Timelines

Monitor helicity sign



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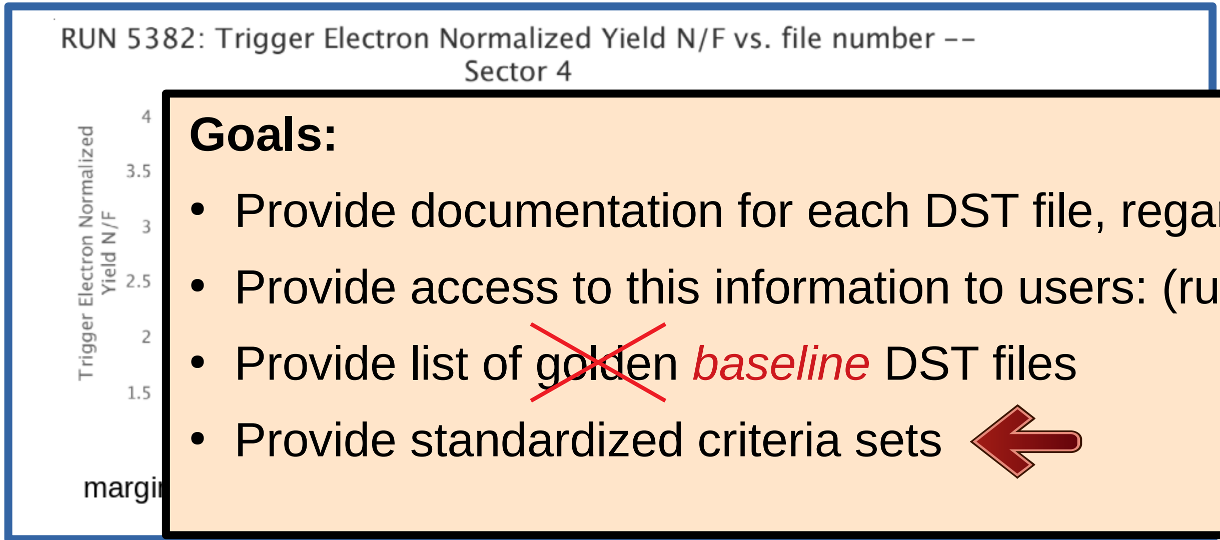
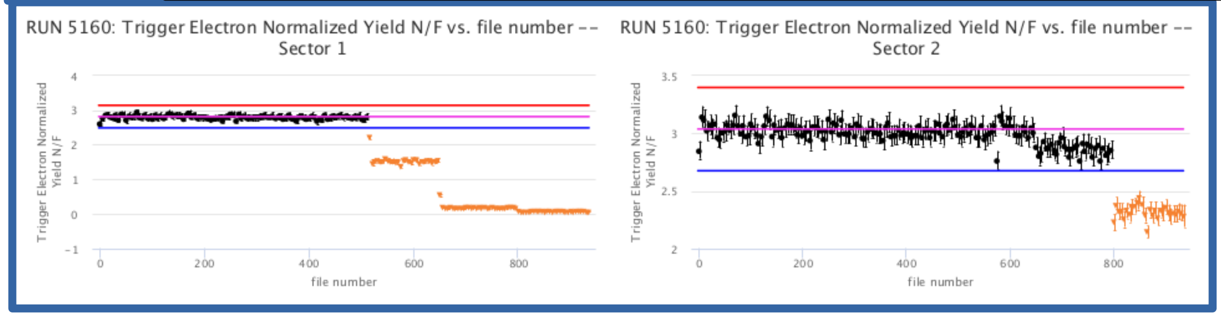


Goals:

- Provide documentation for each DST file, regarding QA status
- Provide access to this information to users: (runNum, eventNum) → QA status
- Provide list of ~~golden~~ *baseline* DST files
- Provide standardized criteria sets



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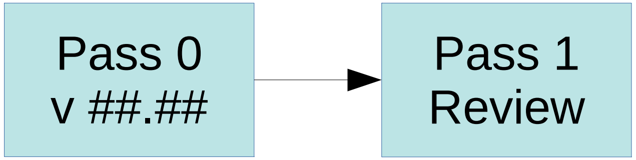
The Procedure



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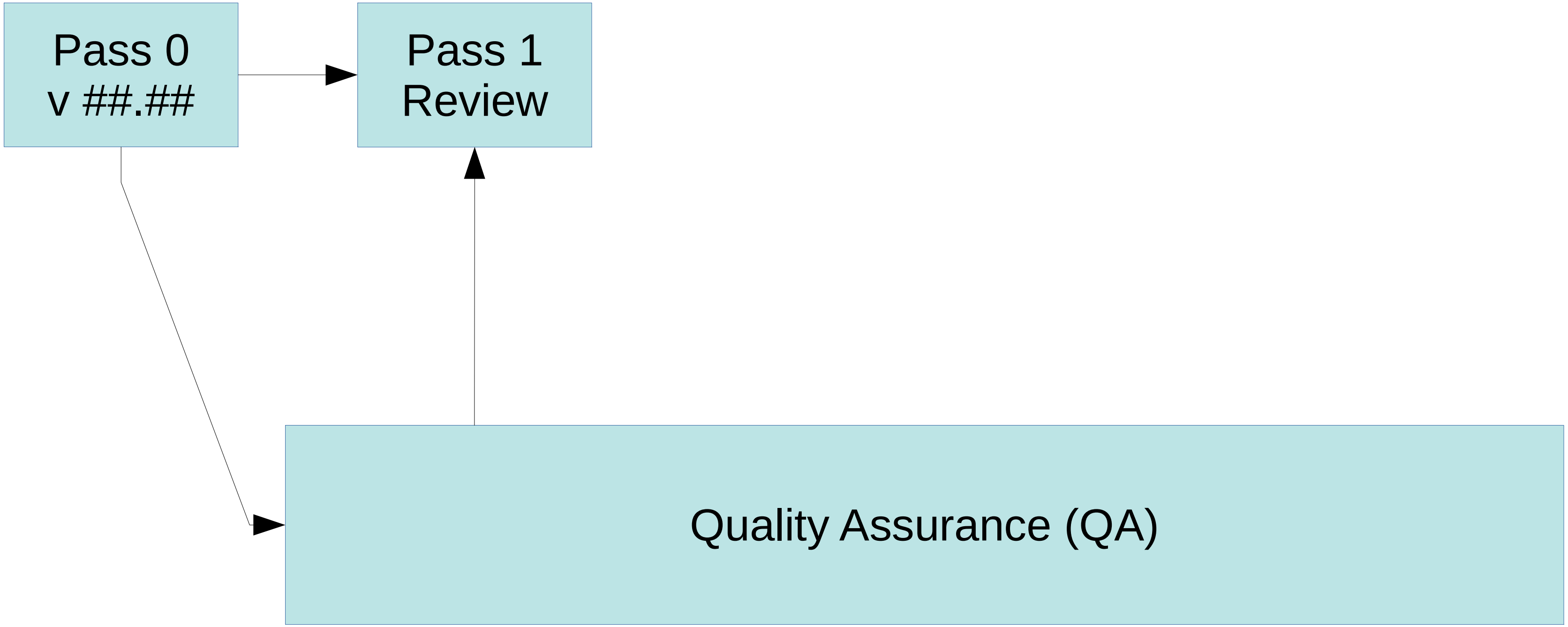

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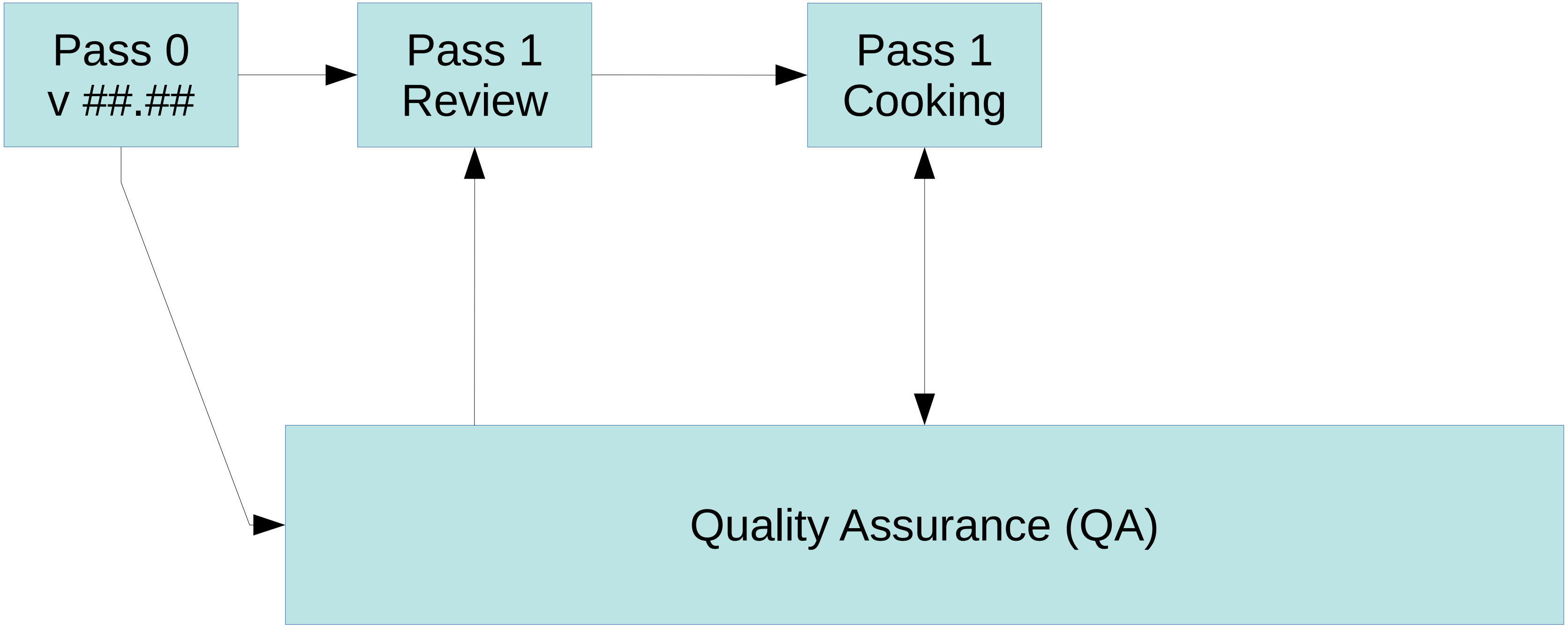

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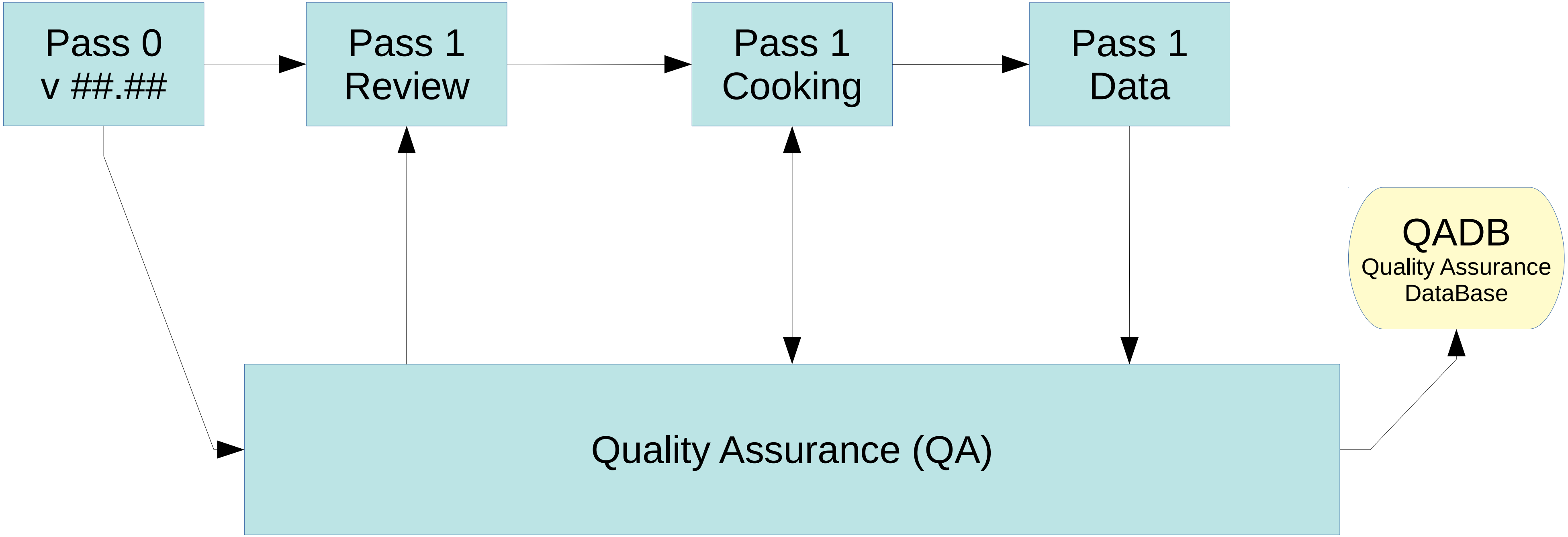

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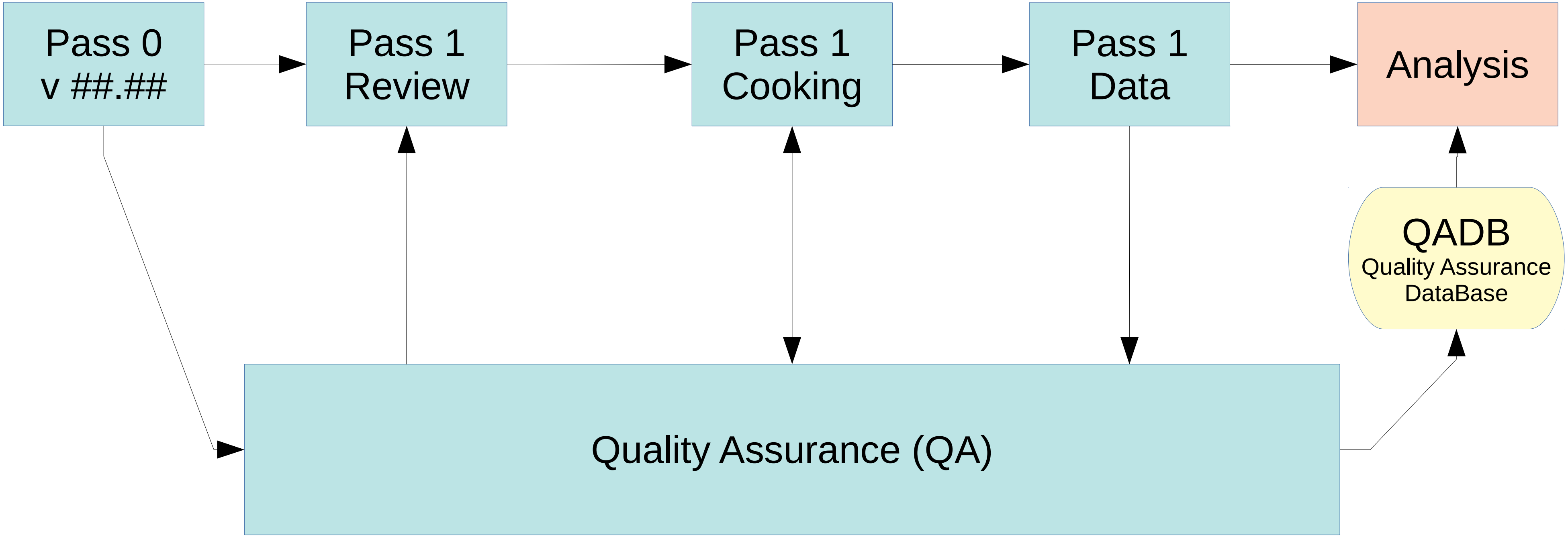


People Power

Development

Chris Dilks

Lucilla Lanza

Matthew McEneaney

Support

Andrey Kim

Nick Markov

Latifa Elouadrhiri

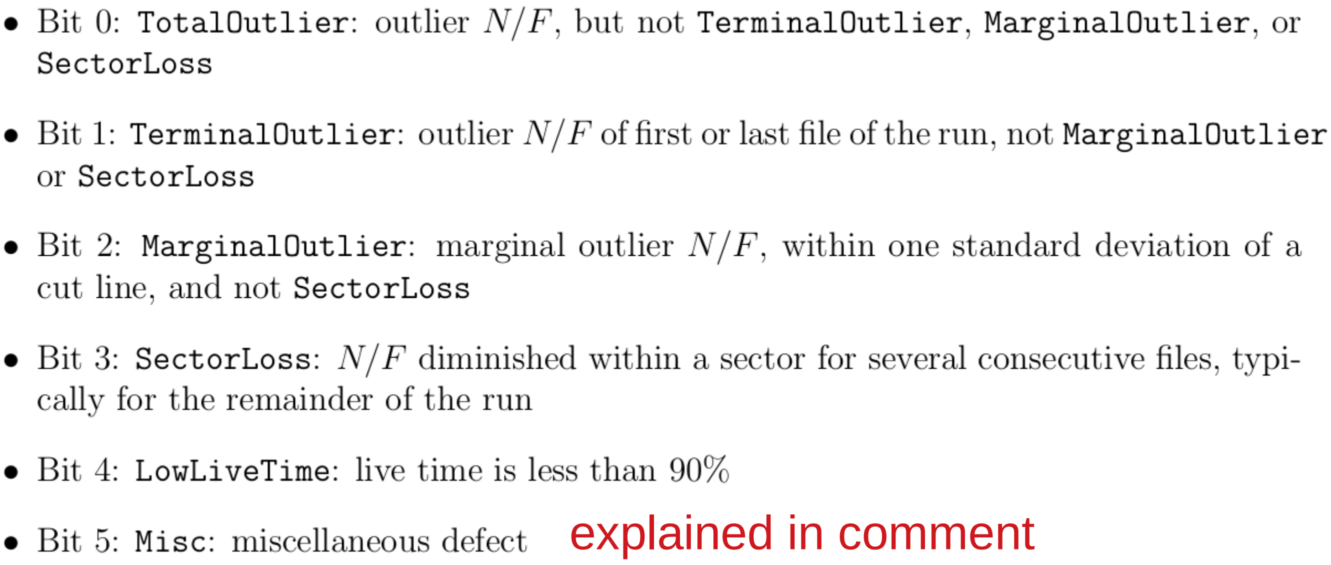
Collaboration feedback and advice

Documenting QA Status: the QADB

Each DST file can be assigned ***defect bits***, along with an optional comment

Defect Bits:

FD electron outliers



- Bit 0: `TotalOutlier`: outlier N/F, but not `TerminalOutlier`, `MarginalOutlier`, or `SectorLoss`
- Bit 1: `TerminalOutlier`: outlier N/F of first or last file of the run, not `MarginalOutlier` or `SectorLoss`
- Bit 2: `MarginalOutlier`: marginal outlier N/F, within one standard deviation of a cut line, and not `SectorLoss`
- Bit 3: `SectorLoss`: N/F diminished within a sector for several consecutive files, typically for the remainder of the run
- Bit 4: `LowLiveTime`: live time is less than 90%
- Bit 5: `Misc`: miscellaneous defect

explained in comment

Under construction:

- FT defect bits → Lucilla Lanza
- Pion outlier bits / generalization → Matthew McEneaney
- CD outlier bits

QADB for the Users

https://github.com/JeffersonLab/clasqaDB

Included Data Sets

- RG-A
- RG-B
- RG-K
- started RG-F

- Online Timelines → visual access
- Human-readable Tables → quick lookup for browsing
- Software access for analysis
  - C++ (directly, or via *clas12root*)
  - Groovy
  - To do: Fortran (help!)

QADB also provides:
Faraday Cup charge, filtered by the QA
cross-checked between Chris & Lucilla

To use the software, user only needs **run number** and **event number**; QADB software will find the associated DST file and return corresponding QA information

QADB for the Users

Principle of Least Action

$$\frac{\delta S}{\delta \mathbf{q}(t)} = 0$$

QADB Information Provided

Outlier FD electron

Low Live Time

Misc

Comments

Simplified Booleans

OkForAsymmetry

Used for RGA 1st publications of beam spin asyms

Golden

“Golden” = NO defects, perfect DST files

N.B.: Most “good” runs are ~98% golden, *very few* are 100% golden

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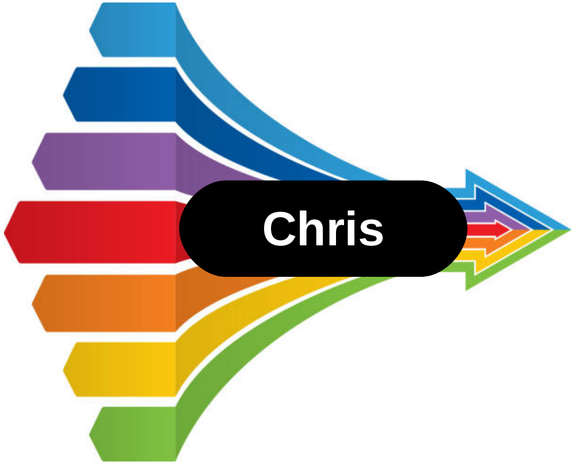

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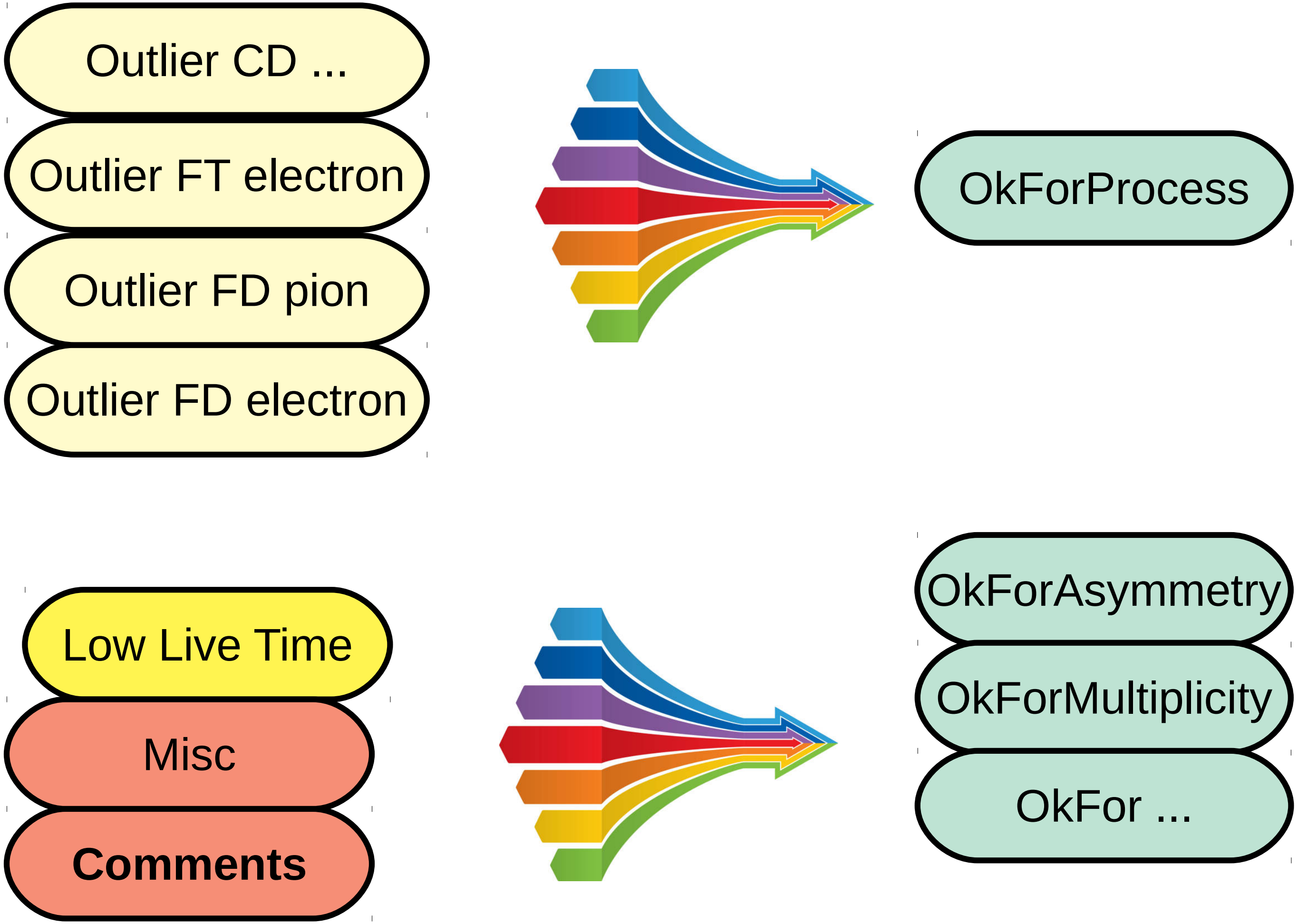
QADB Upgrades

Simplified Booleans



Outlier CD ...

Outlier FT electron

Outlier FD pion

Outlier FD electron

OkForProcess

Low Live Time

Misc

Comments

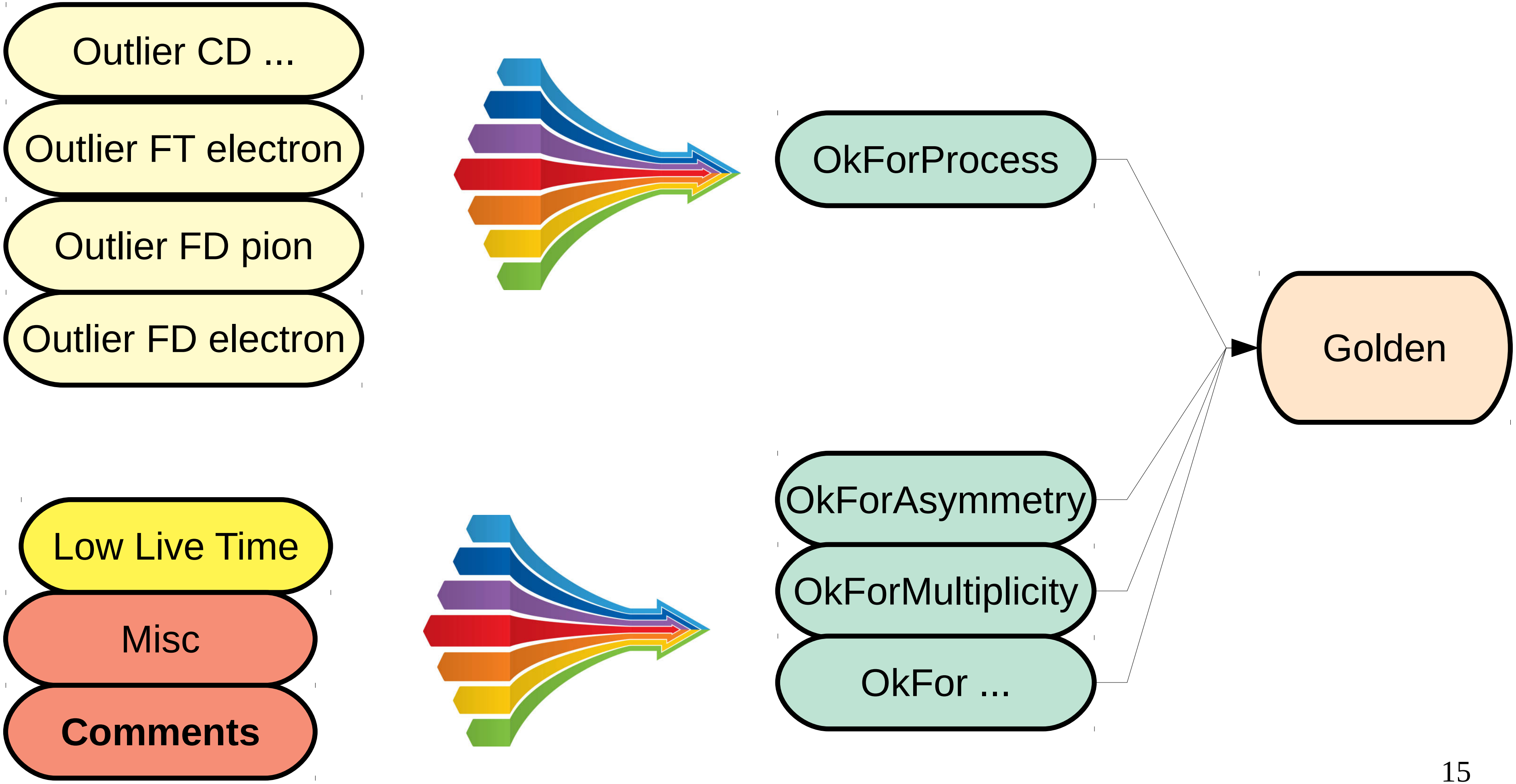
OkForAsymmetry

OkForMultiplicity

OkFor ...

QADB Upgrades

Simplified Booleans



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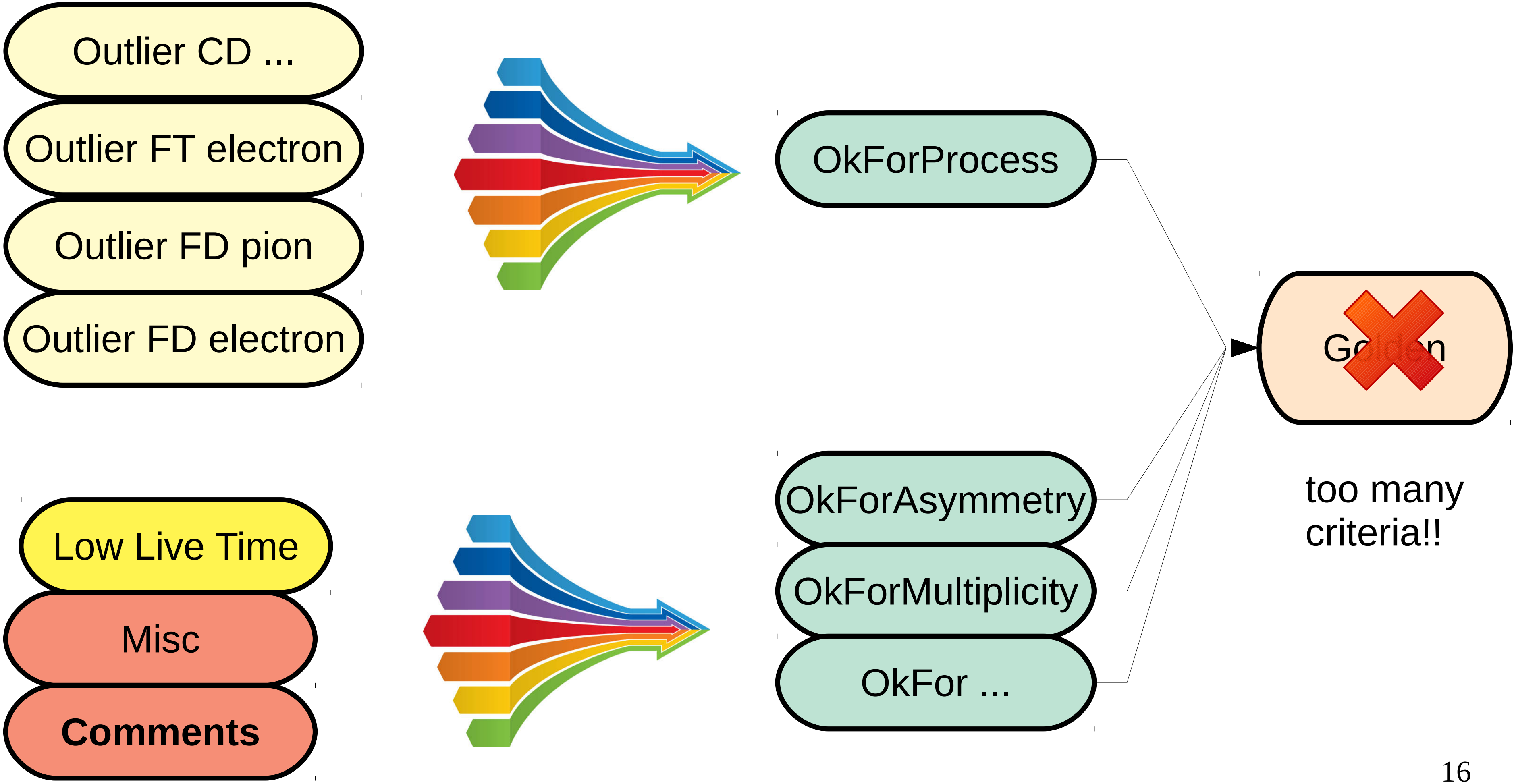

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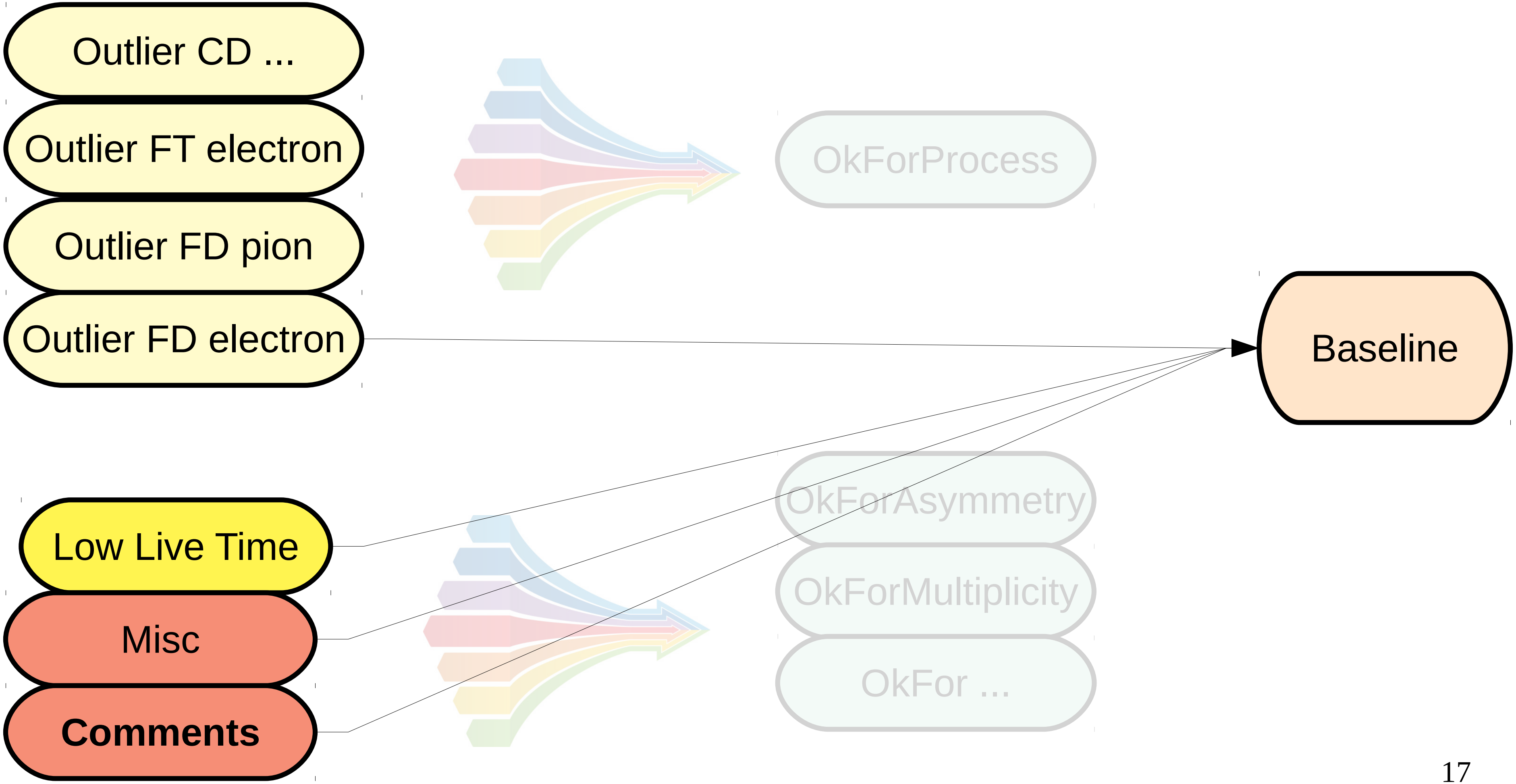
OkFor ...

~~Golden~~

too many
criteria!!

QADB Upgrades

Simplified Booleans



Outlier CD ...

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Low Live Time

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Baseline

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Outlier CD ...

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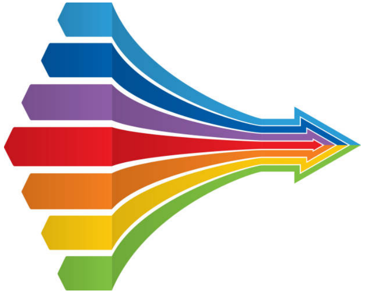


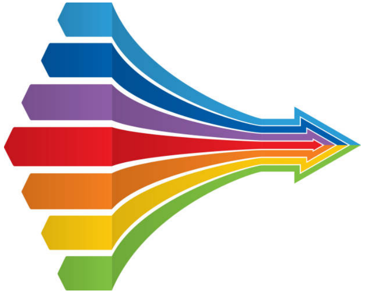
OkForProcess

Decision-Making Responsibility

Low Live Time

Misc

Comments



OkForAsymmetry

OkForMultiplicity

OkFor ...

note: not all OkFor_____ files will be “baseline”

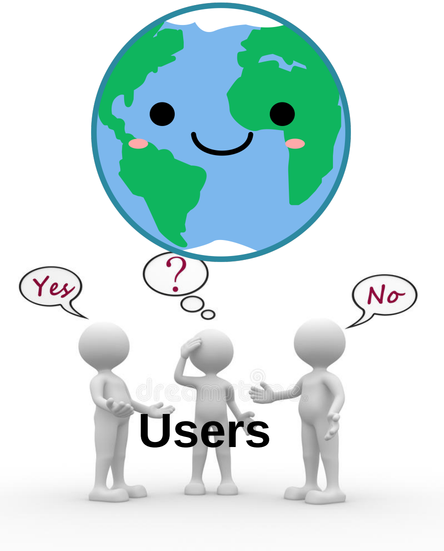
Example Comments in the QADB, for Misc Defect Bit

- all ROC rates at zero; ended run
- beam current ramping
- **beam current was drifting; sporadic livetime issues**
- DAQ test, omit this run
- DC trips
- **empty target**
- FC charge offset problem
- **fluctuation in pion pT and theta**
- fraction of events with defined helicity is low
- hardly any beam
- **helicity sign is wrong**
- junk run
- livetime issues; logbook mentions zig-zag problems in the current
- **low lumi run**
- N/F abnormally high
- N/F is high for the whole run
- no connection to ECAL sector 2, but N/F looks normal
- no helicity info
- RGK trigger test
- ROC problems near the end of this run
- sector 1 was lower than normal, but not by much; marked as sectorLoss anyway
- short and trippy run
- **used different trigger file, rgb_v9_1.cnf; N/F lower than usual; Beam current changed to 50nA**
- zero-field alignment run
- …

Who judges whether “Misc” = bad or good?

Bearing the QA Burden

More Data
More Users
More Analyses



Users

Experts

Decision-making Responsibilities

- Determine analysis **categories**, which group analyses together with common goals
- For each category/observable, define a **QA criteria set**, which can be applied to each analysis of the category
- Facilitate **communication** between QA developers and the needs of the collaboration
- Long term responsibility, but not a time-consuming effort
- Need input from **diverse** group of experts
- QA Procedure and usage of QADB is **optional** for any Run Group and/or analysis, but recommended

The Way Forward…

- Committee?
- Task Force?
- Subgroup within existing Committee or Task Force?
- Expand responsibility of QA developers, bringing in expert help for decision-making?
- Do not provide “simple” booleans, forcing users to make decisions?
- Do nothing, leaving all as is?

bad ideas...

backup

Example Criteria Set: OkForAsymmetry

Current QA Implementation

Defect Bits:

FD electron outliers

Reject
- Bit 0: `TotalOutlier`: outlier N/F, but not `TerminalOutlier`, `MarginalOutlier`, or `SectorLoss`

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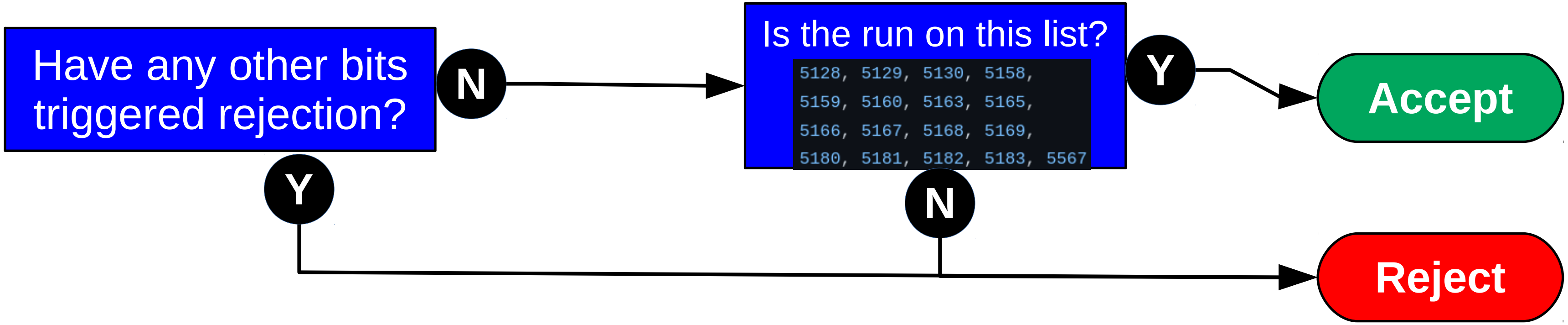
Reject
- Bit 3: `SectorLoss`: N/F diminished within a sector for several consecutive files, typically for the remainder of the run

Accept
- Bit 4: `LowLiveTime`: live time is less than 90%

Conditional
- Bit 5: `Misc`: miscellaneous defect



```
5128, 5129, 5130, 5158,
5159, 5160, 5163, 5165,
5166, 5167, 5168, 5169,
5180, 5181, 5182, 5183, 5567
```

QA Decision-Making Plan

- Define list of analysis categories (observables)
  - Need input from:
    - Run group chairs
    - Physics working group chairs
    - Process chairs (e.g. Harut for SIDIS)
- Decide whom to invite to the group
- Kick-off meeting
  - Introduce goals, what we are doing, and why
- Develop spreadsheet of defect bits & misc cases vs. analysis category
  - This spreadsheet will be the basis of the subsequent QA Criteria Review Meeting
  - Group together common misc. cases
- QA Criteria Review meeting
  - Each run group category will individually decide:
    - Yea/Nay for each defect bit
    - Yea/Nay for each misc. case run
- Implement in QADB, and release to the collaboration!

Long Term Support Commitment

- Future data and analysis can bring:
  - New defect bits
  - New misc. cases
  - New passes (e.g., pass2) could also raise new QA concerns

- Responsibility for decision-making should new questions arise
  - After the QA Criteria Review meeting, QA developers will have a much clearer idea of the expectations of quality
  - Utilize past QA requirements to make decisions on future data
  - … but there could always be new unforeseen cases which will require input from experts (likely solvable over an email / shorter meetings)