

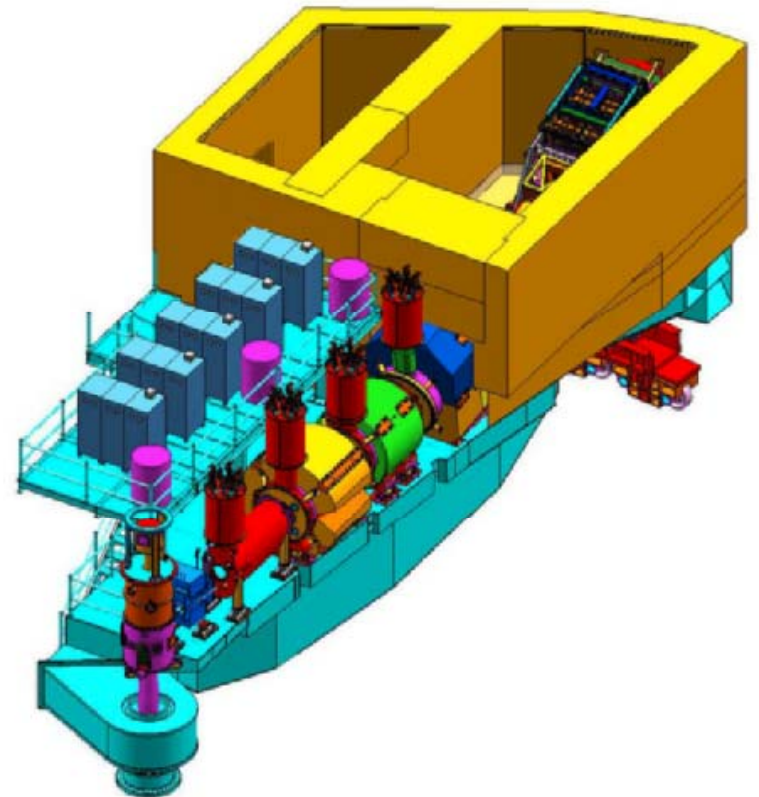


Halls A and C Deep Dive

*(Software Maturity and associated labor,
User Experiences,
Discussion of how to go from production beam to publication,
examination of remaining risks)*

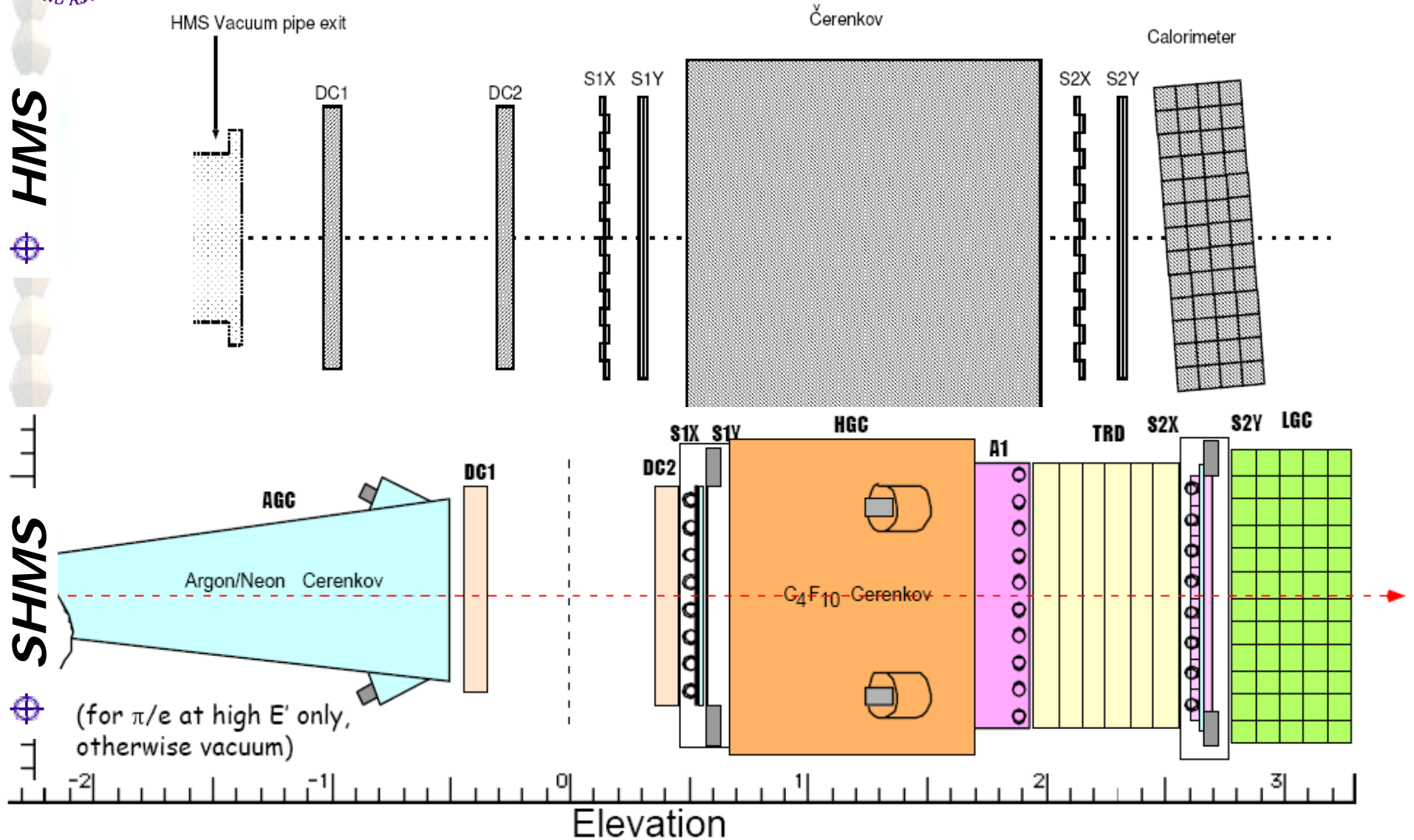
*Gabriel Niculescu
James Madison University*

- ⊕ *Introduction*
- ⊕ *Software Maturity*
- ⊕ *User experiences*
- ⊕ *beam-to-PRL journey*
- ⊕ *Conclusions*





Reminder





Reminder

HMS
⊕

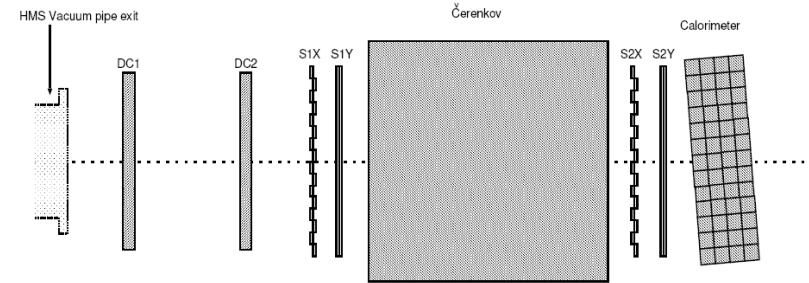
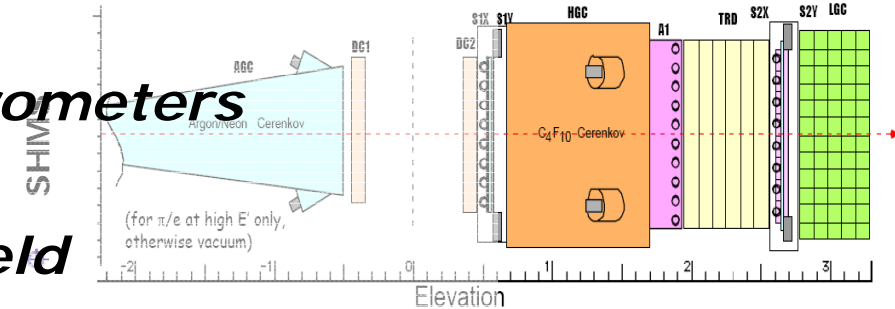


Figure 3.9: Schematic side view of the HMS detector package.



⊕ Hall C:

- ⊕ *Dual small aperture spectrometers*
- ⊕ *Low # of channels*
- ⊕ *No tracking in magnetic field*
- ⊕ *High precision (p , angles, PID)*

⊕ Tasks:

- ⊕ *Complete rewrite of the Hall C analysis code (ROOT/C++) – [hcana](#)*
- ⊕ *Built on top of Hall A's [podd](#)*
- ⊕ *Keep all* algorithms from [engine](#)*
- ⊕ *[Document](#) analysis algorithms*



Software Maturity (& Labor)

hcana:

- ⊕ *Reconstruct single arm (HMS) events – 100% agreement with **engine** results* (N.B.: this subsumes a number of steps/milestones...)
- ⊕ *Handle (HMS) scalars (read, process, report)*
- ⊕ *Process coincidence events (HMS-SOS). NEW*
- ⊕ *Do single arm “physics analysis” (Q2,W2,x...). Coinc. reconstruction underway.*
- ⊕ *...while tightly integrated with Hall A’s **PODD***
- ⊕ *... and with a minimum of personnel*

- ⊕ *JLab (Steve, Mark, Brad...)*
- ⊕ *Regina (Ahmed), Yerevan (Simon, Vardan)*
- ⊕ *CNU (Ed), FIU (Pete), Miss. SU (DD), JMU (GN)*

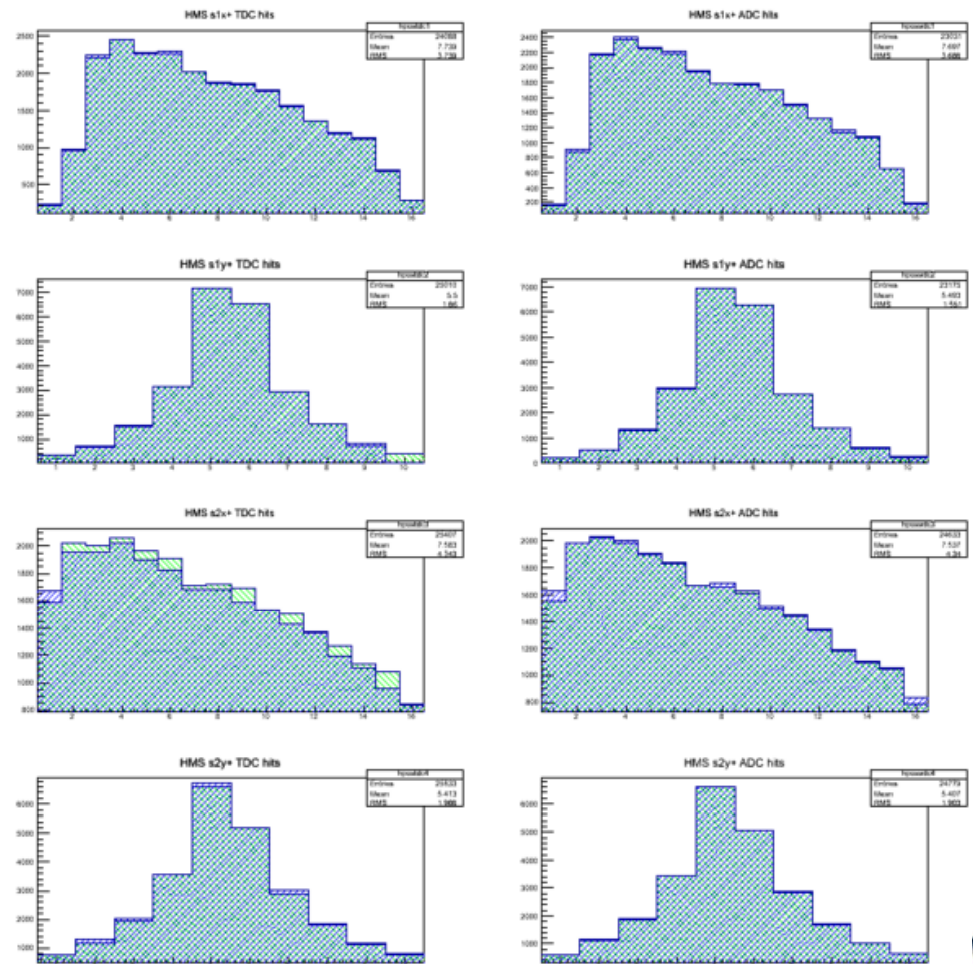
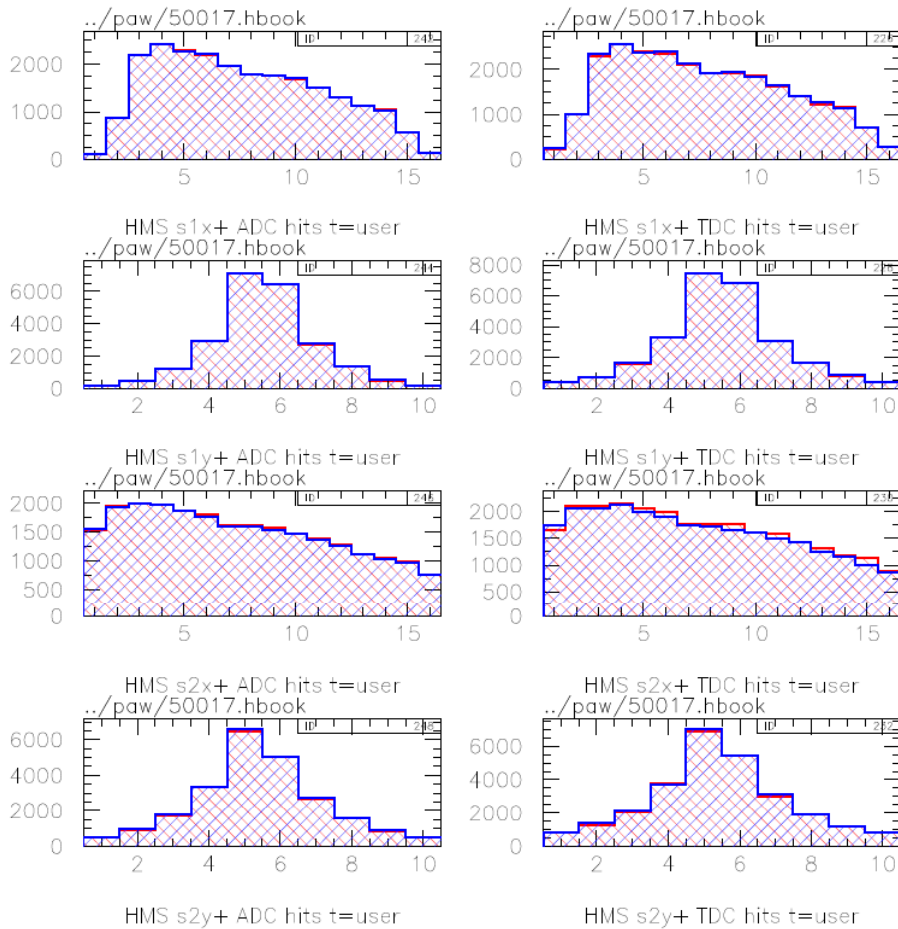
- ⊕ *Excellent value as most people listed have (many) other duties.*



Drift Chambers (early testing)

- ⊕ HMS hodoscope ADCs & TDC
- ⊕ In the engine

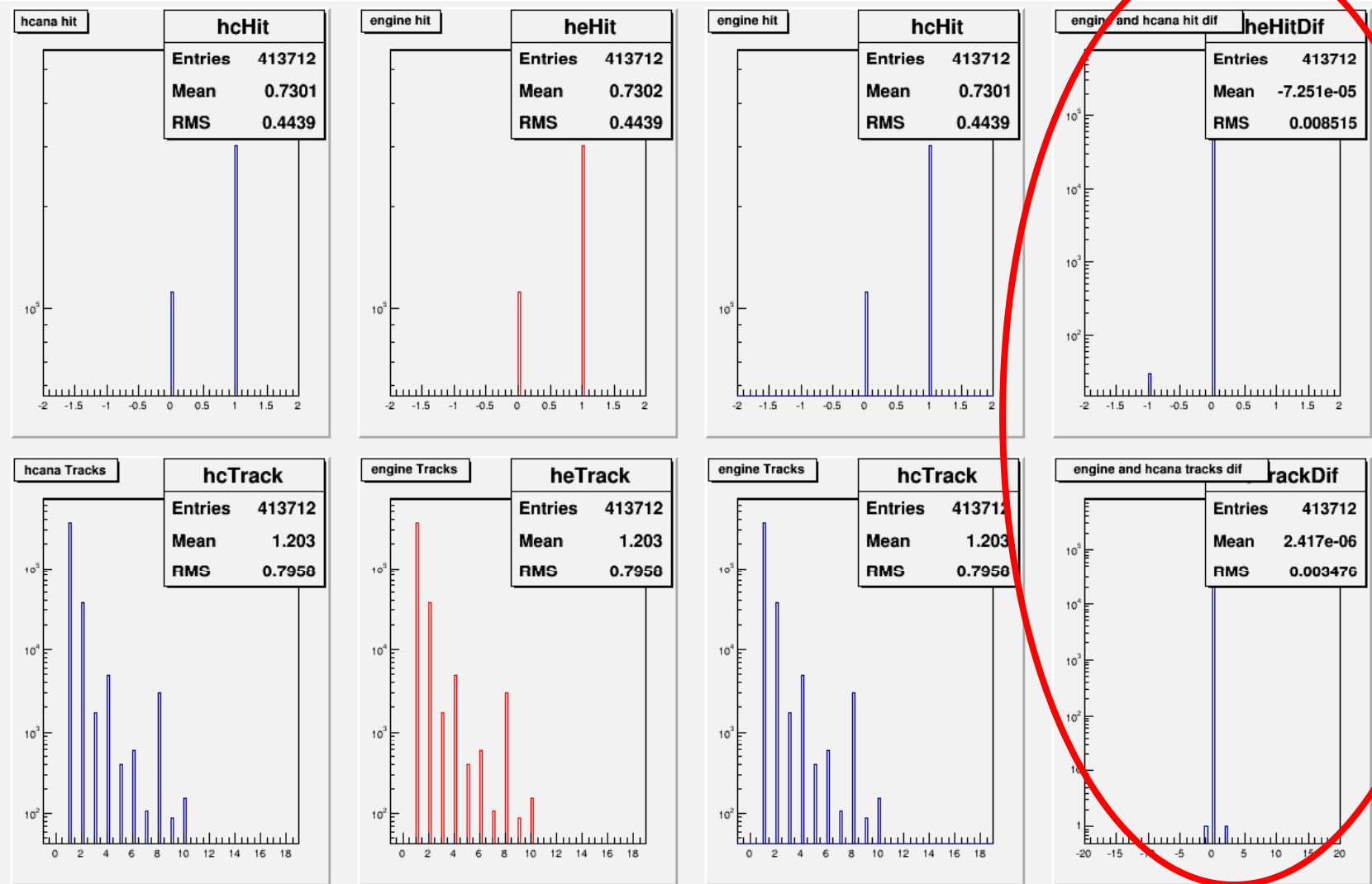
- ⊕ Same HMS hodoscope raw ADC & TDC hits
- ⊕ Done in *hcana*!





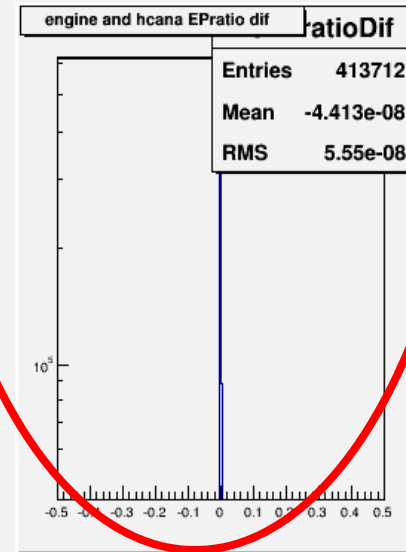
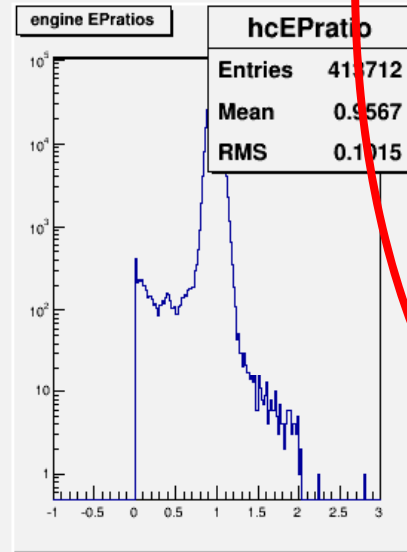
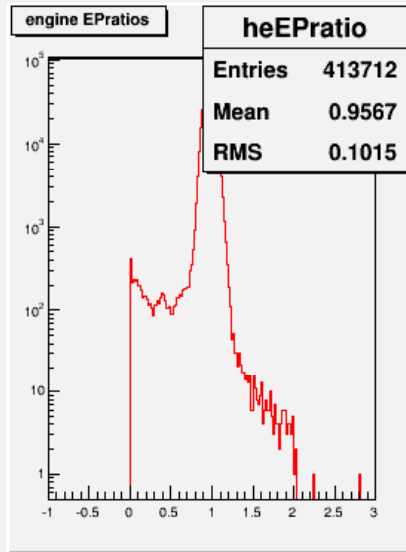
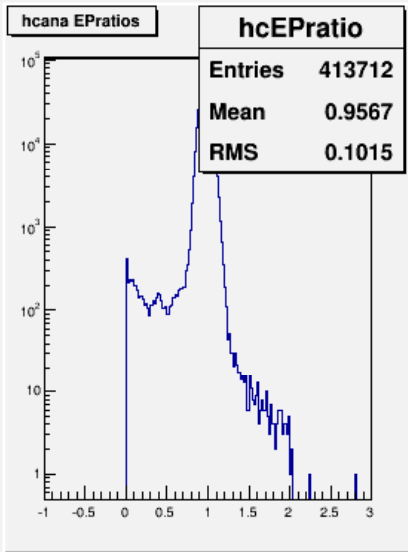
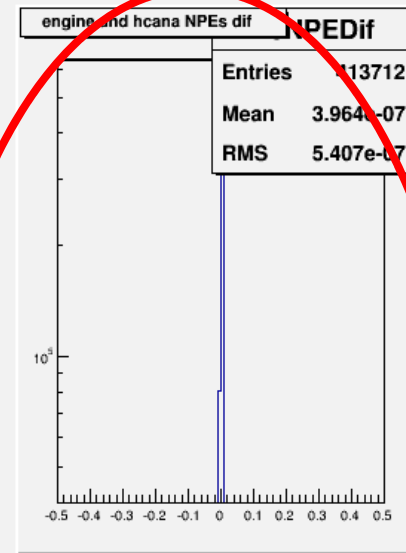
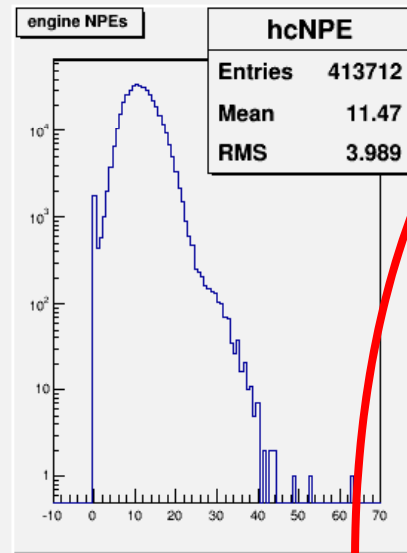
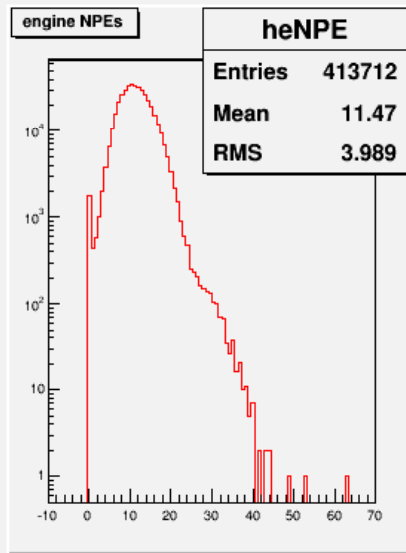
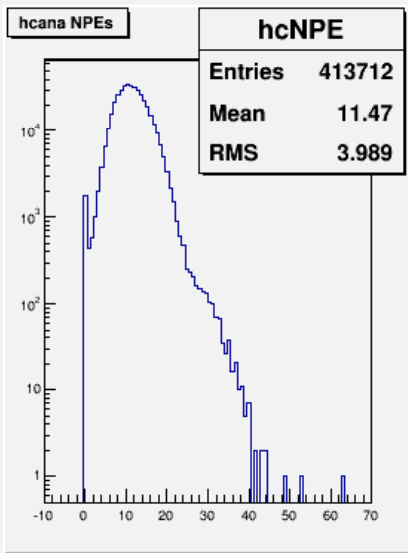
Tracking Efficiency (Ahmed)

✦ 4 quantities of interest: GoodScintHit, # of tracks, ecal, Cer npe



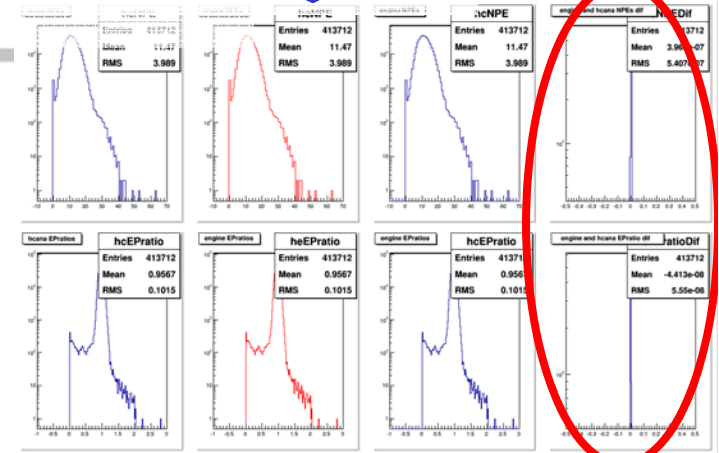


Tracking Efficiency (Ahmed)





Tracking Efficiency (Ahmed)



- ✦ **hcana**
- ✦ **hdid: 299928**
- ✦ **hscinshould: 318101**
- ✦ **SING FID TRACK EFFIC: 0.9429 +- 0.0004**

✦ **engine**
 ✦ *****

✦ **HMS TRACKING EFFICIENCIES ***
 ✦ *****

- ✦ **hdid : 299947**
- ✦ **hscinshould : 318123**
- ✦ **SING FID TRACK EFFIC : 0.9429 +- 0.0004**

✦ **It works!**





*Online * Monitoring (Pete, FIU students)*

- ⊕ *"Based" on Hall A's onlineGUI (Bryan Moffit, MIT LNS)*
- ⊕ *Display (save, print) useful information detector information*
- ⊕ *ROOT-based (highly portable, customizable)*
- ⊕ *Allows for direct comparison with a "Golden" standard (useful for longer exp. – less kinematics changes)*




Online * Monitoring (Pete, FIU students)

Radio Buttons

Canvas Title

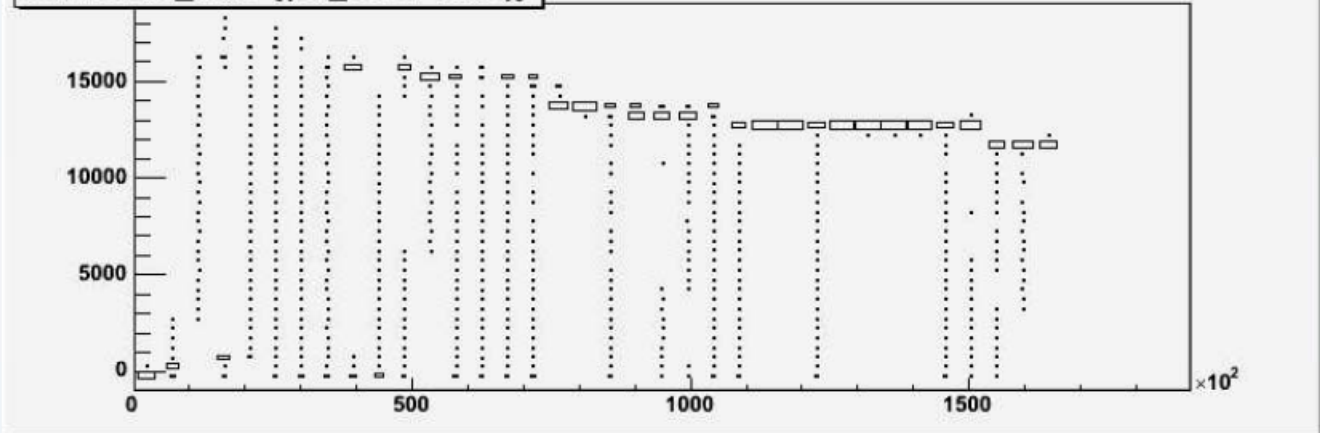
- Blumi vs event number
- Norm Asym: Flumi
- Norm Asym: Flumi corr
- Asym: Flumi vs BCM1



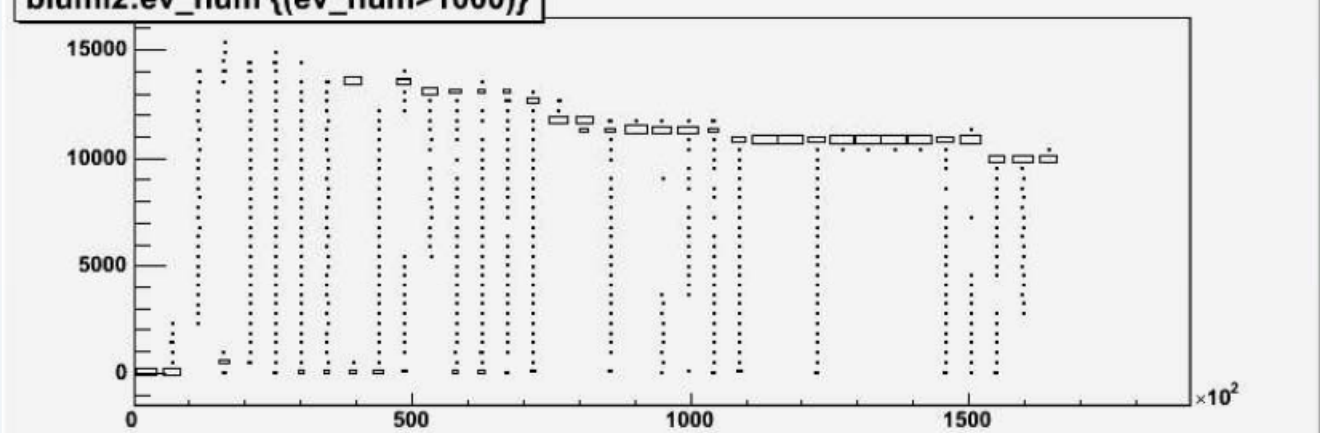
Update Button

Current Canvas

blumi1:ev_num {(ev_num>1000)}



blumi2:ev_num {(ev_num>1000)}



Navigation Buttons

EXIT Button

Run Number

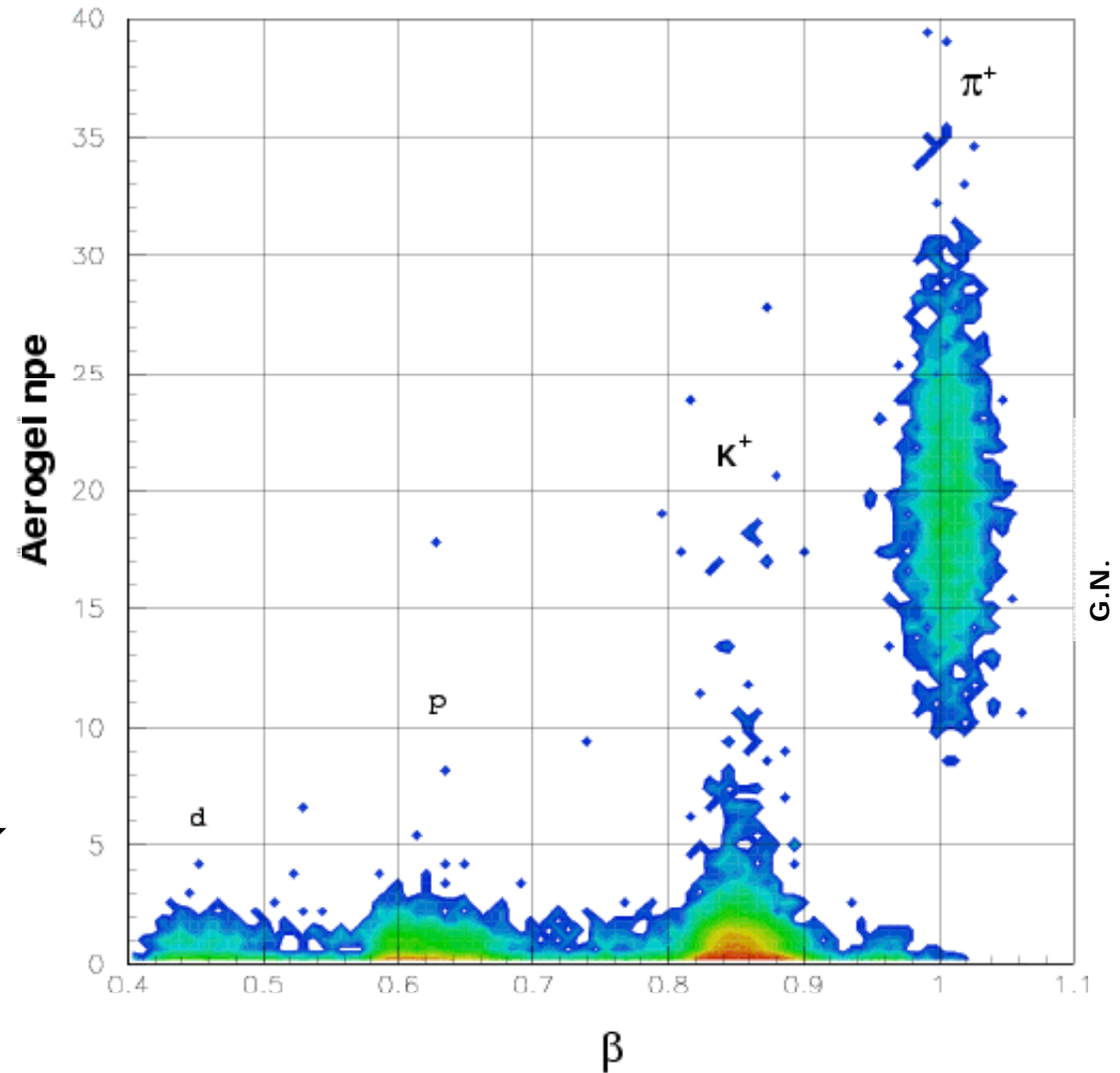
Print Button





Coincidence-related calibrations

- ⊕ **Aerogel**
- ⊕ *Gain match PMTs*
- ⊕ **Velocity vs. Aerogel**
- ⊕ *Separate pions (and e^+) from heavier*
- ⊕ **e -h coincidence time**
- ⊕ *Separate $\pi/K/p$...*
- ⊕ **Velocity vs. dE/dx**
- ⊕ *Separate $\pi/p/d$ at lower momentum*

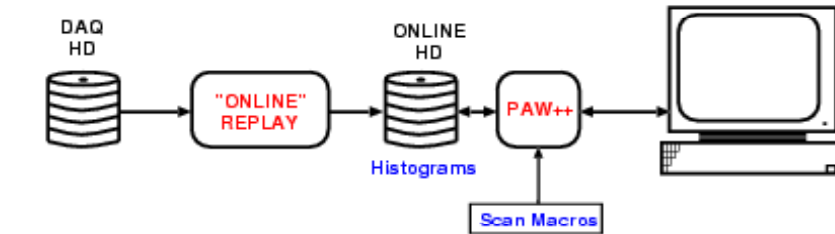


Beyond single event reconstruction

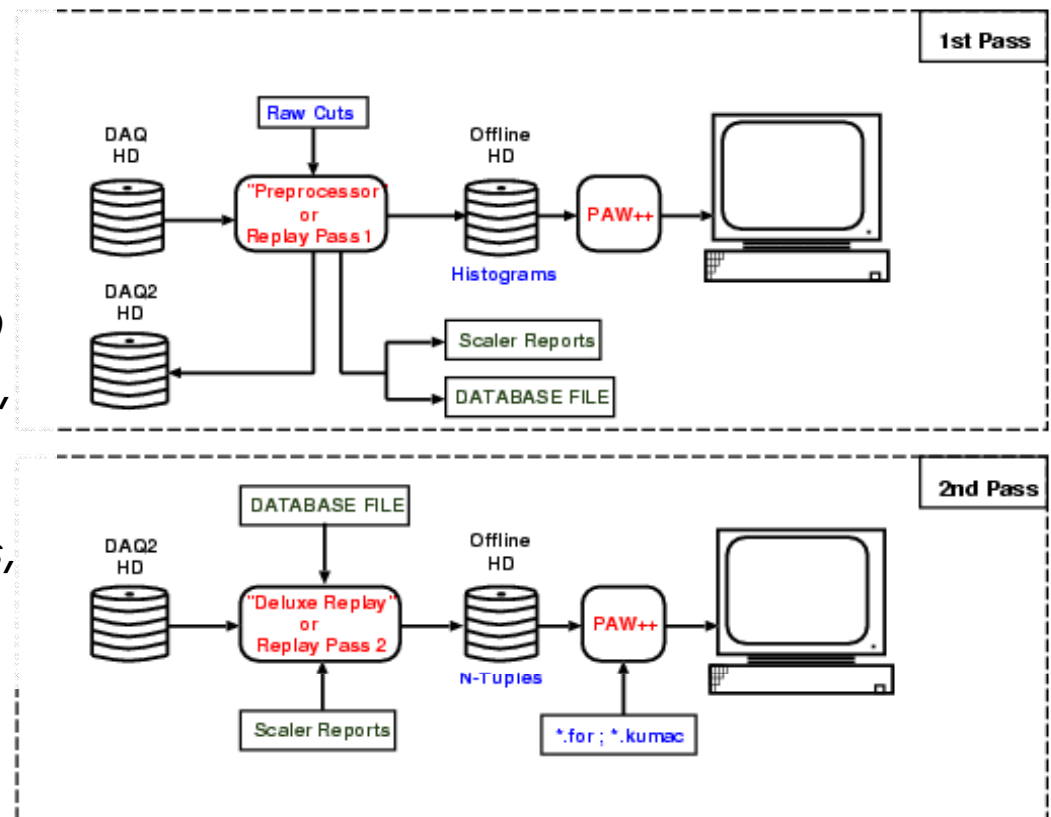
(beam-to-prl...)

- ⊕ Sample workflow for a typical Hall C experiment (engine)
- ⊕ Programs & (customizable) scripts available to the user
- ⊕ 3 Step process:
 - ⊕ Acquisition (Data Integrity)
 - ⊕ Processing (Reconstruction, Validation)
 - ⊕ Post-Processing (Normalization, Corrections, binning, etc.)

"Online" Analysis



"Offline" Analysis





Beyond single event reconstruction (II)

(beam-to-prl...)

⊕ *Retooling for the 12 GeV Hall C era (hcana):*

- ⊕ *Workflow remains (largely) the same as the fundamentals of small angle spectrometers have not changed. However...*

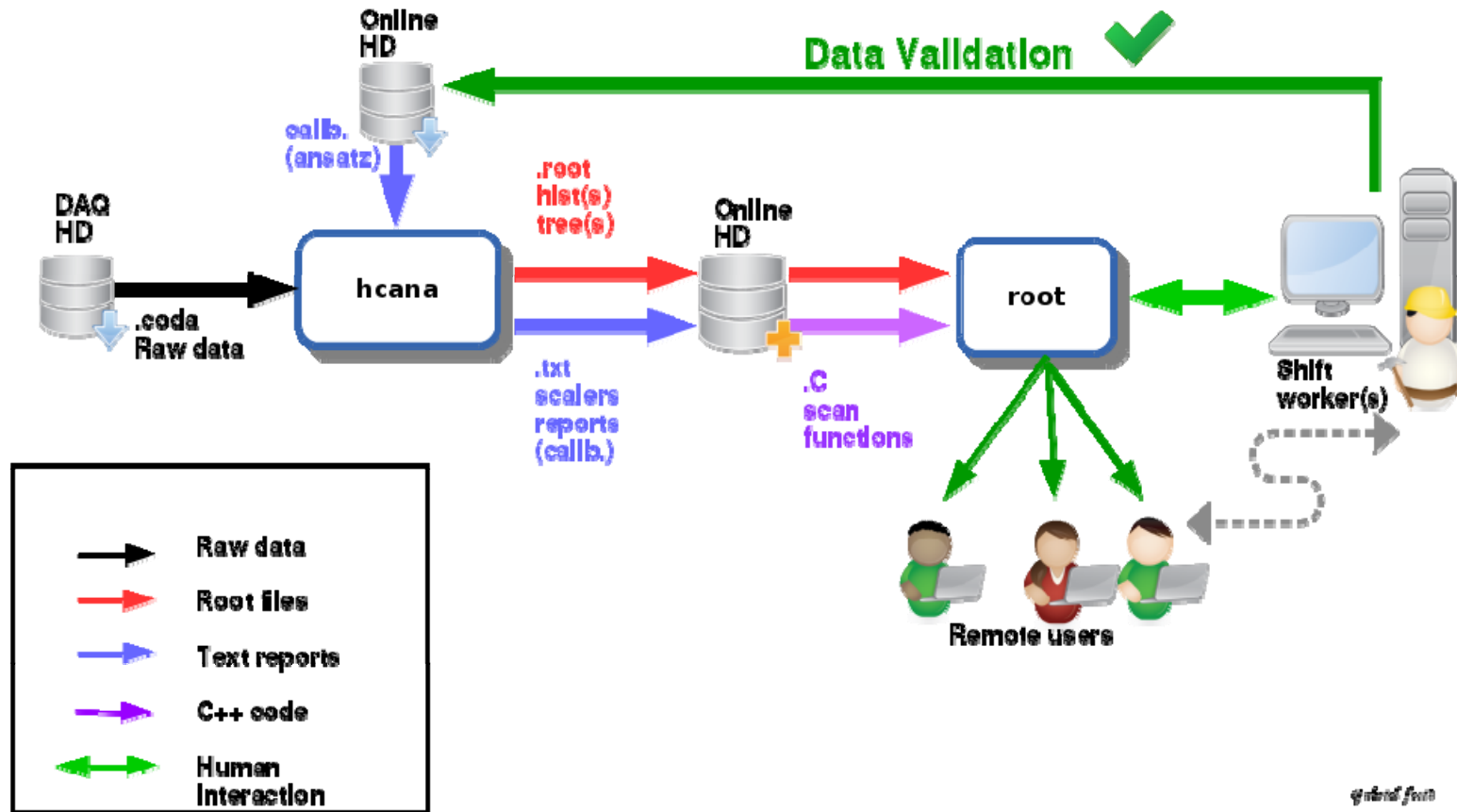
⊕ *Substantial “toolkit” upgrade:*

- ⊕ *C++/ROOT used throughout*
- ⊕ *Integration of calibration procedures into hcana (using podd’s plug-and-play capabilities)*
- ⊕ *Improved documentation, access to code (GIT/GITHUB, doxygen, wiki, nightly builds)*
- ⊕ *Tight, mutually beneficial cooperation with Hall A*



Hall C "From beam to PRL"

Step 0: "Online" ("just offline") Analysis

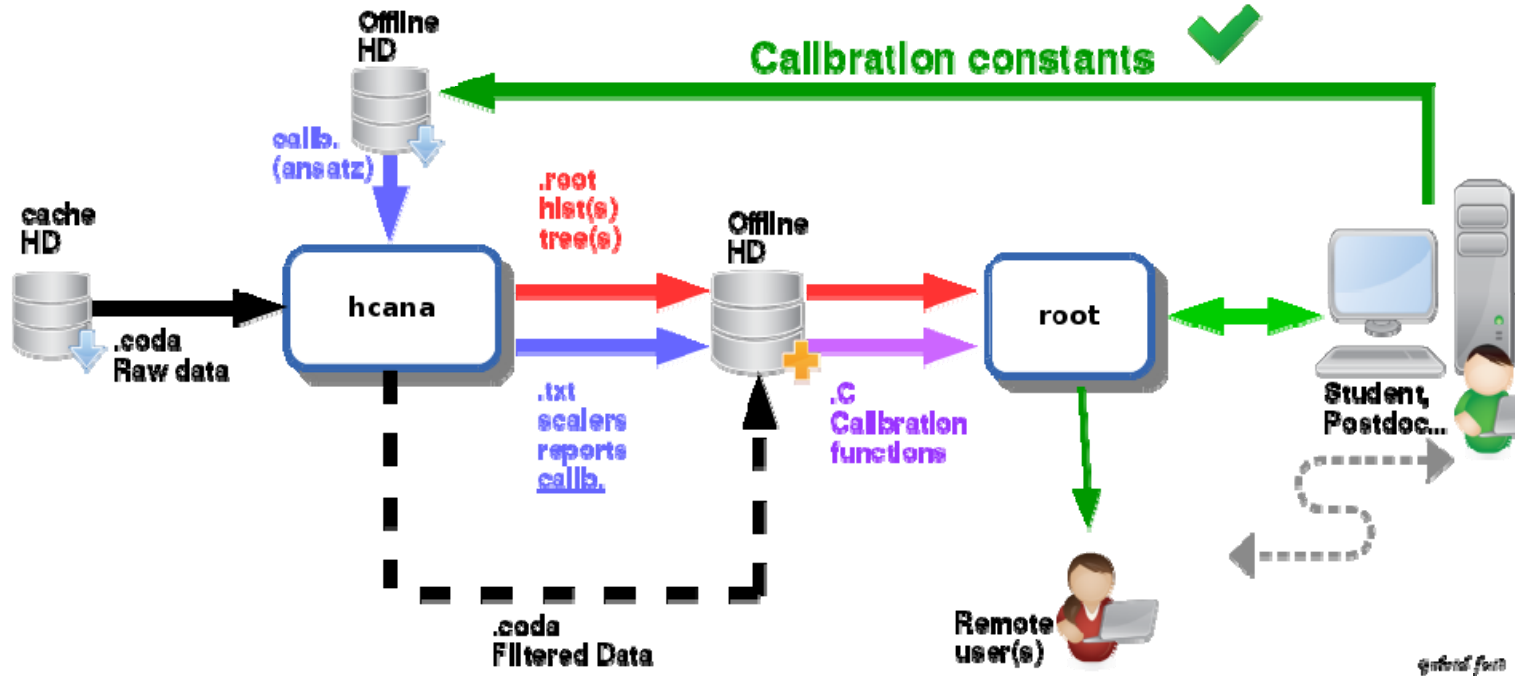


gabriel niculescu



Hall C "From beam to PRL"

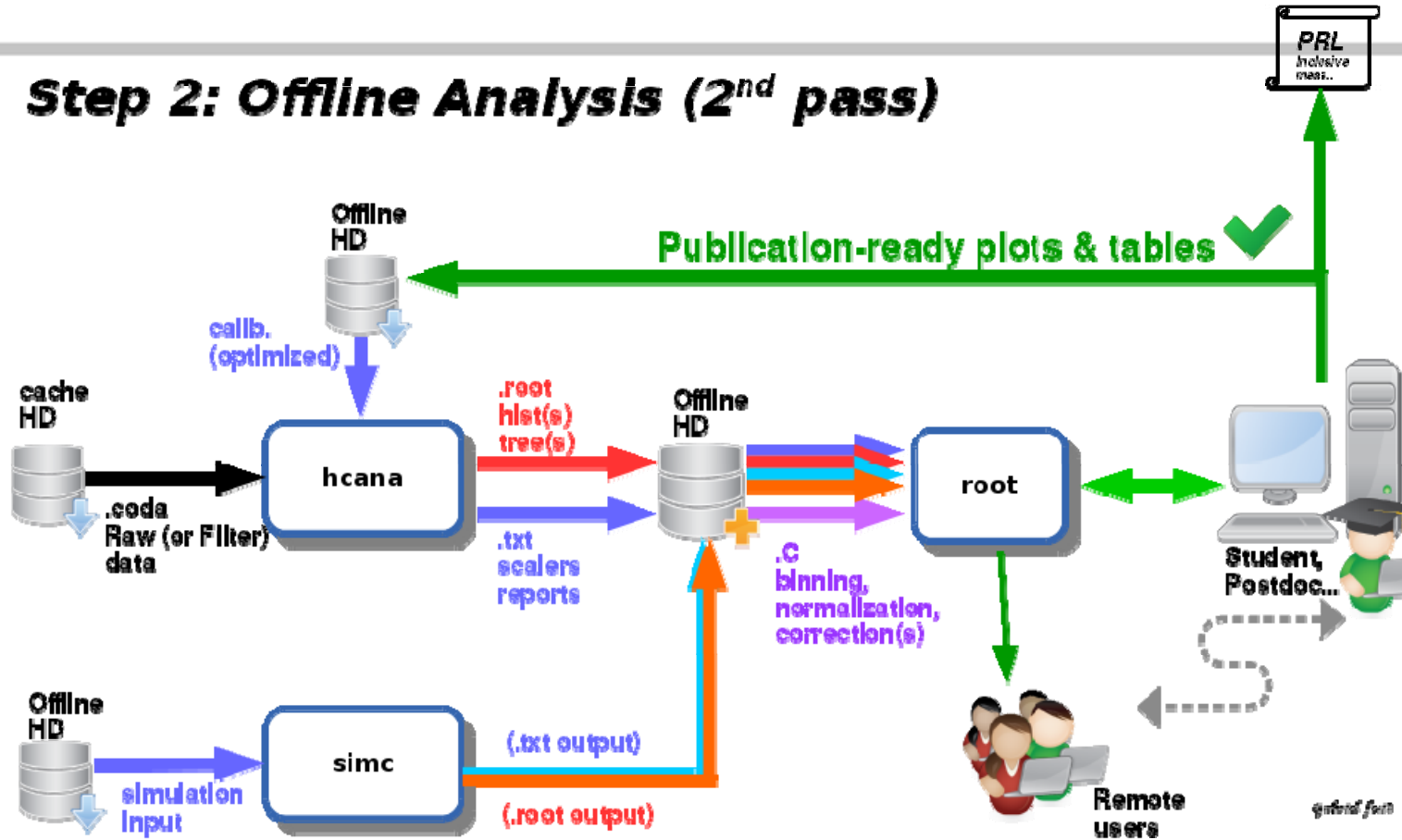
Step 1: Offline Analysis (1st pass)





Hall C "From beam to PRL"

Step 2: Offline Analysis (2nd pass)





Summary

⊕ **Code:**

- ⊕ ***Fully reconstructed hcana tracks match their engine counterparts.***
- ⊕ ***Substantial progress on calibration & scalers***
- ⊕ ***Can do double arm, will test with HMS-SOS coinc.***

⊕ **User Experience:**

- ⊕ ***Documentation – continuously updating (wiki, github)***
- ⊕ ***Excellent JLab staff support & communication.***
- ⊕ ***Intensify effort to attract/educate more collaborators on hcana usage (tutorials, workshops?...)***