Update on Realistic Silicon MC

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LBNL

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- Justification
- Framework
- Charge deposition models
- Noise and Killing
- To-Do

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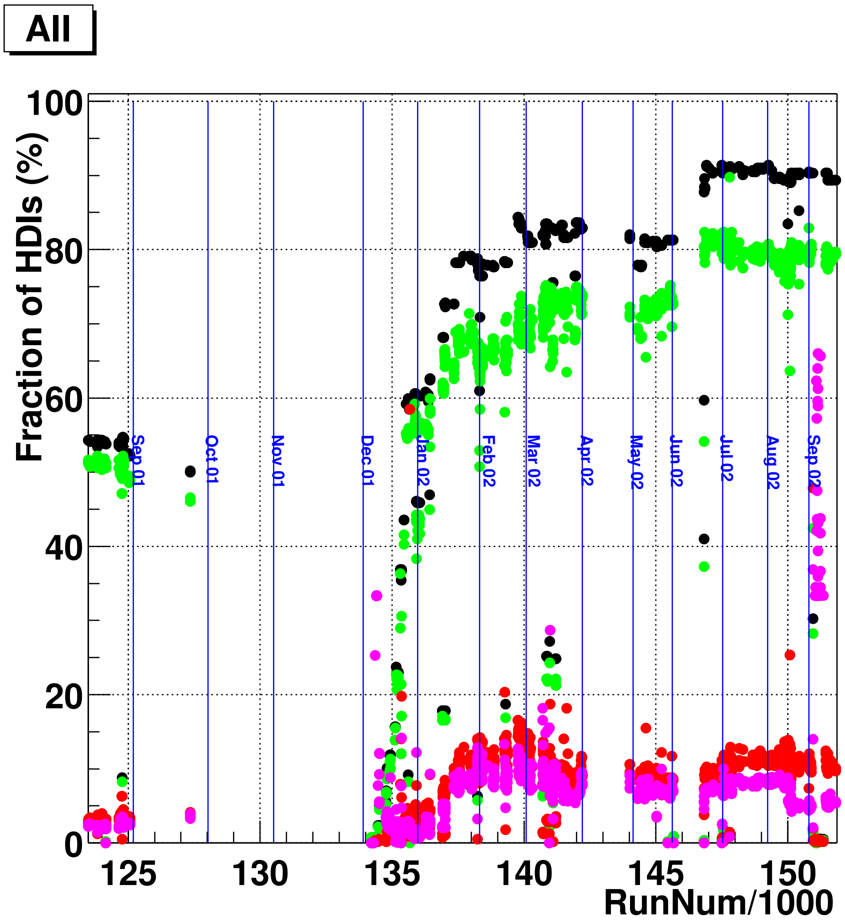
Testers: Saverio d'Auria, Marco Rescigno, Alex Cerri

Justification



- Want to use MC for signal/background eff
  - Need vertex resolution to match data
  - Need b-tag efficiency to match data
  - Need fake rates to match data
  - Pattern reco tends to correlate inefficiencies
- Silicon detector conditions changing as a function of time

Framework

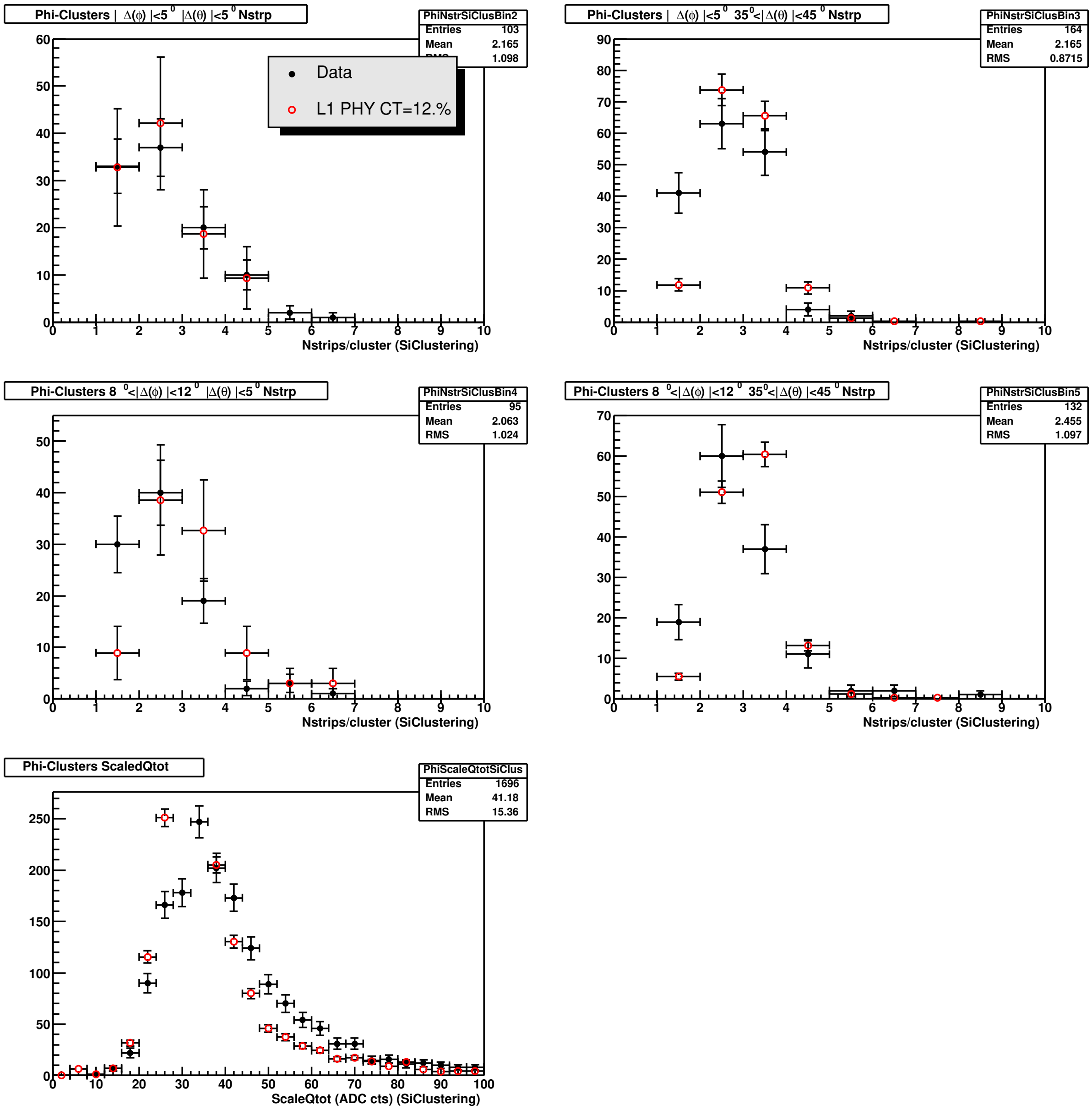
- Almost all changing detector conditions in database
- Take advantage of this by mapping MC events to luminosity weighted runs
- MC will know about this "new" run number (and run section) and can use `CalibrationManager` & `PROD_PHYSICS_CDF` at reconstruction time
  - Run numbers are the KEY to detector database entries
  - Run sections are the KEY to mapping rate of underlying/minbias events or moving beamline
- Generate ~ideal MC and change MC run and (run section numbers) at generation time

Realistic Silicon MC

- Charge deposition model (Padova, Duke, UNM)
  - Should model single-strip landaus & and cluster profiles
  - Matching of intrinsic resolution and efficiency are goals
  - Uses output of Si Studies Group
- Noise
  - Smears real hits
  - Causes fake hits
- Dead regions – inefficiencies
  - Bad strips
  - Ladders which aren't turned on
  - (Ladders which aren't biased but included)
  - Readout errors, data corruption
- Misalignments
  - Causes inefficiencies
  - Smears resolution
  - Causes fake b-tags

Charge Deposition (Susana, Pati)

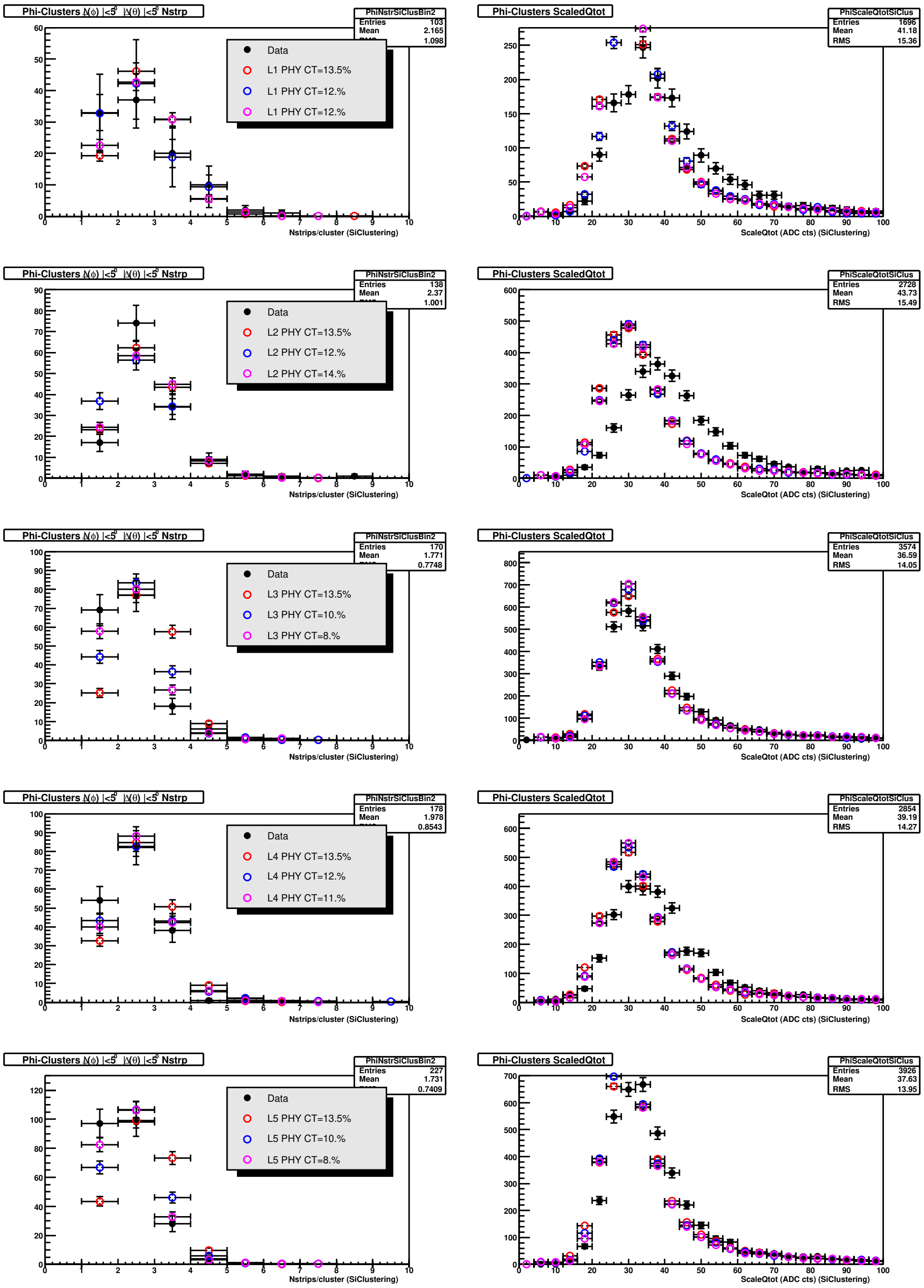
L1: DATA (DPS ON)137416,137484-137485 vs MC 1MU PHYSICAL CDM



Tuned charge sharing w/neighbors

Charge Deposition (Susana, Pati)

L1,L2,L3,L4,L5

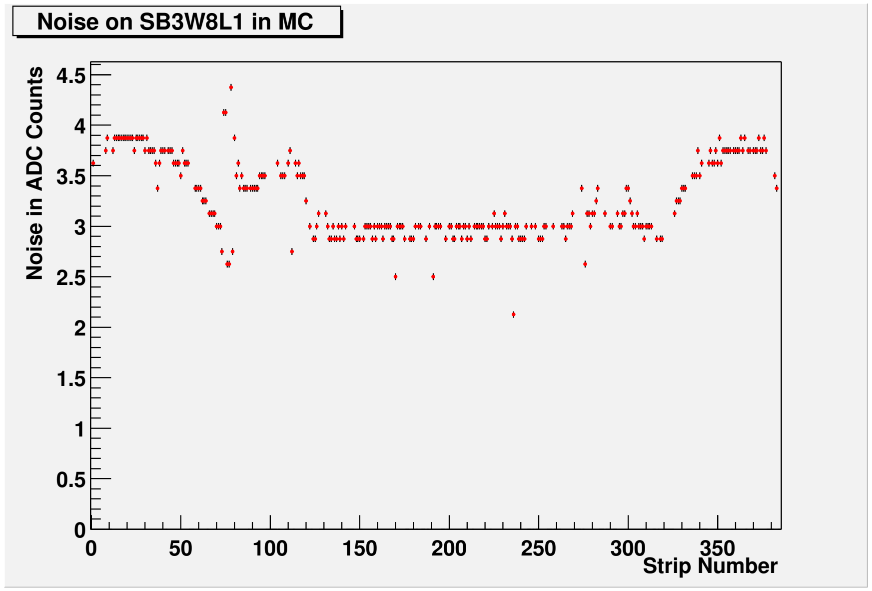


Realistic Silicon MC

- Gain variations
  - $\sim 10\%$ chip-by-chip gain variations measured in real detector
  - Known layer diffs
  - Hook in MC to account for this, not used yet

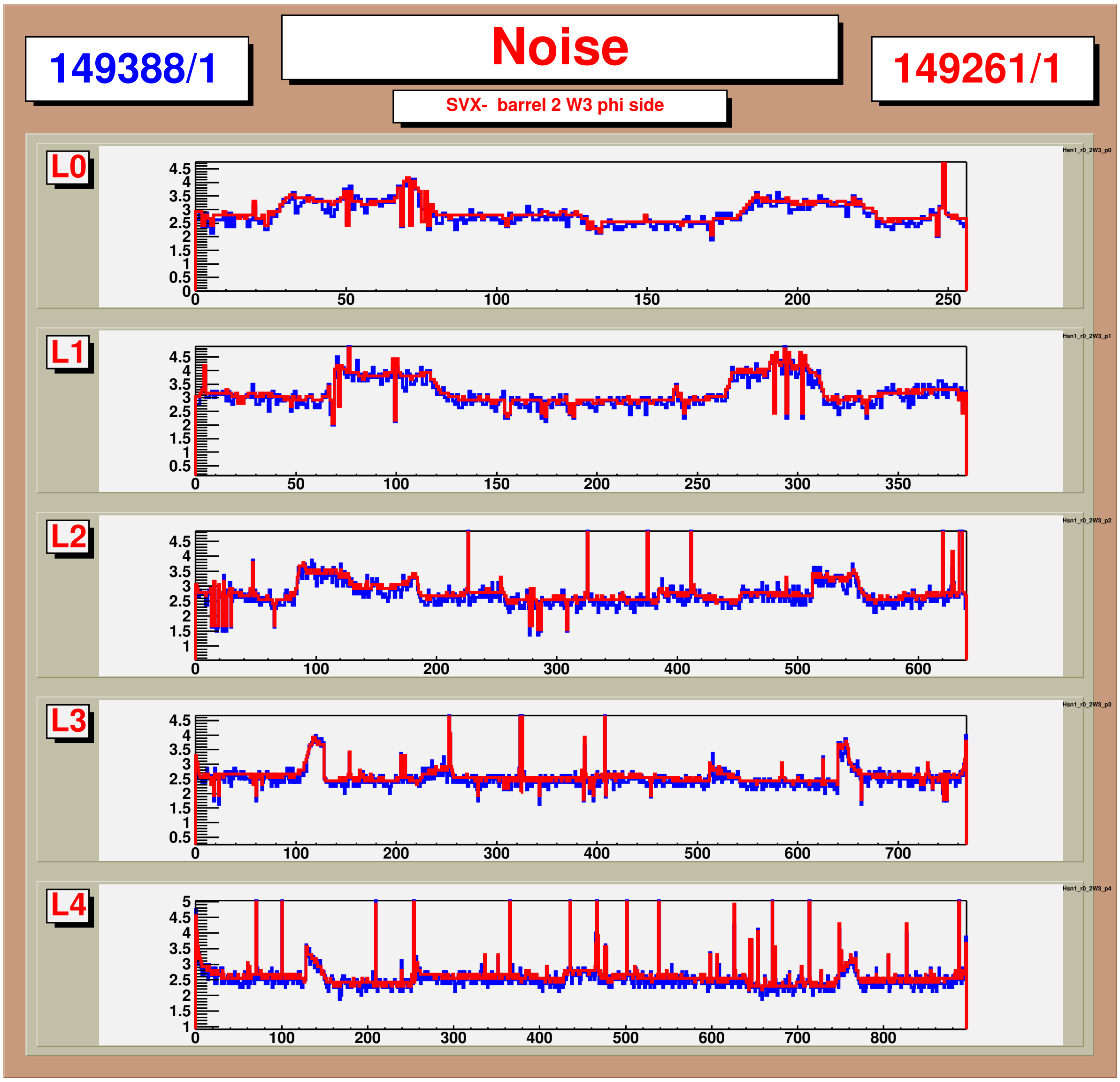
- L00 is a whole 'nother ballgame...
  - Large pickup on majority of ladders neccesitates event-by-event offline pedestal fit
  - Will probably have to do something special for L00 MC

Noise



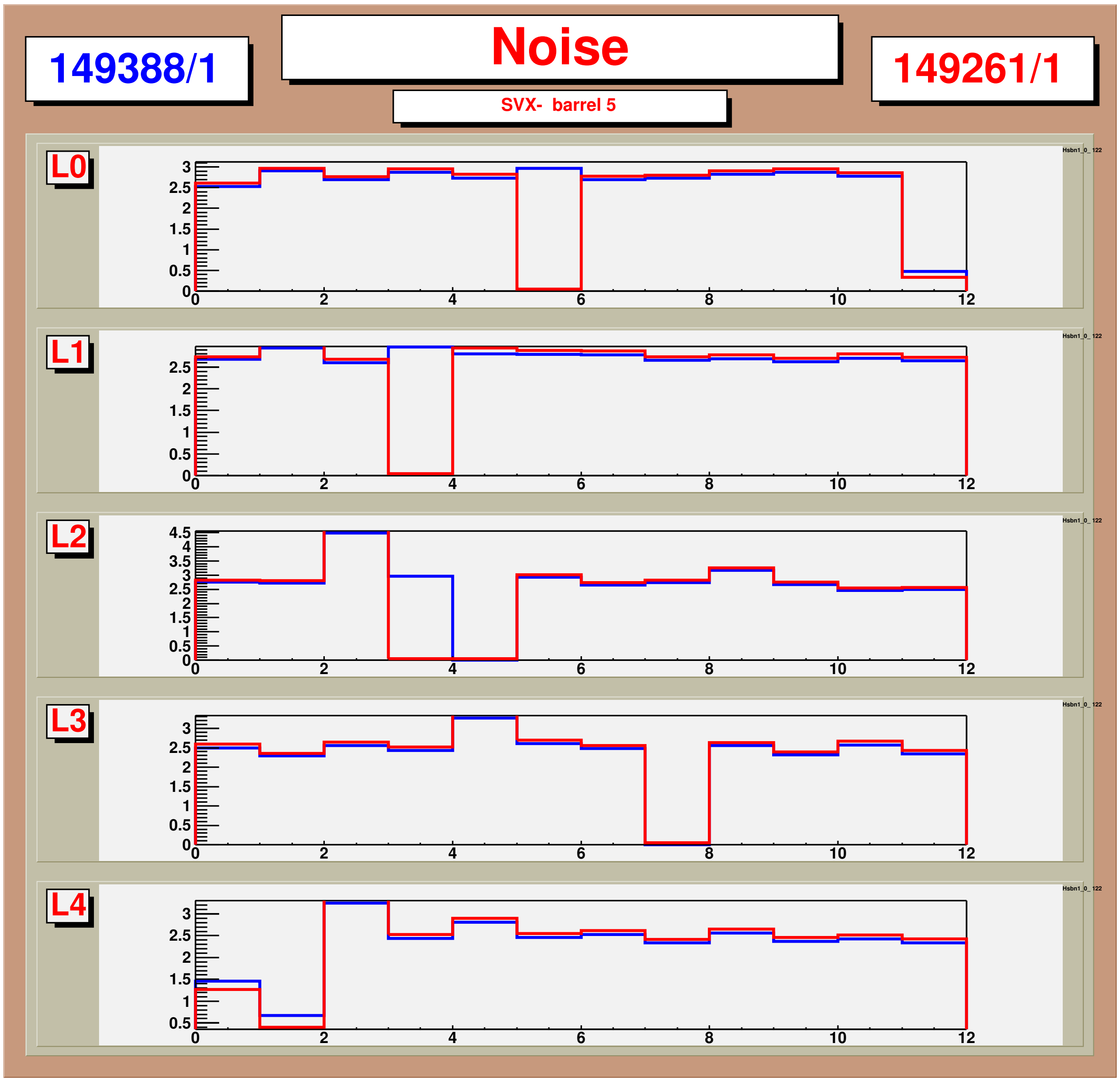
- Noise uneven across halfladder
- Generate fake hits above 2σ based on measured noise strip-by-strip for that run
- Smear physics charge at sim and emulate NN-mode with 2σ fluct on neighbors

Test of Noise (Jason N)



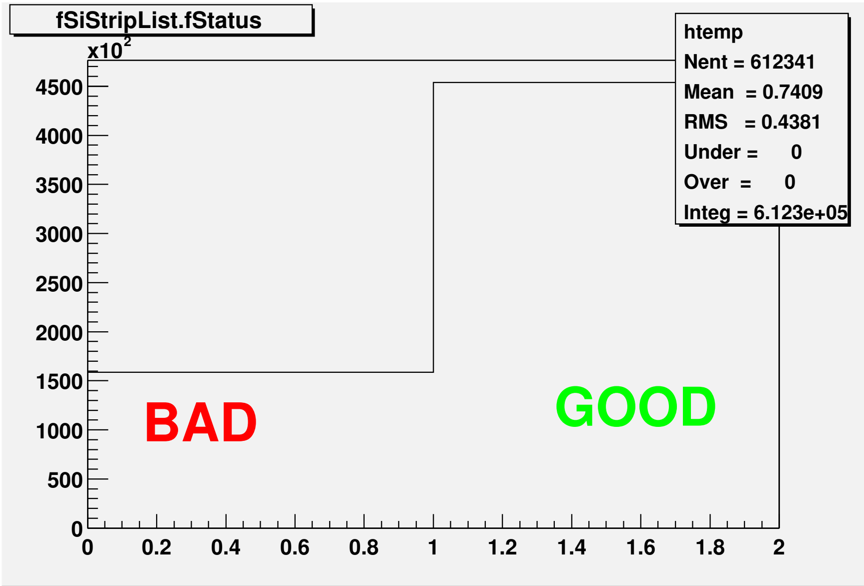
Noise in DB valid for run 149388, Use realistic MC to make fake calibration run as test

Uncalibrateable Channels (Jason N)



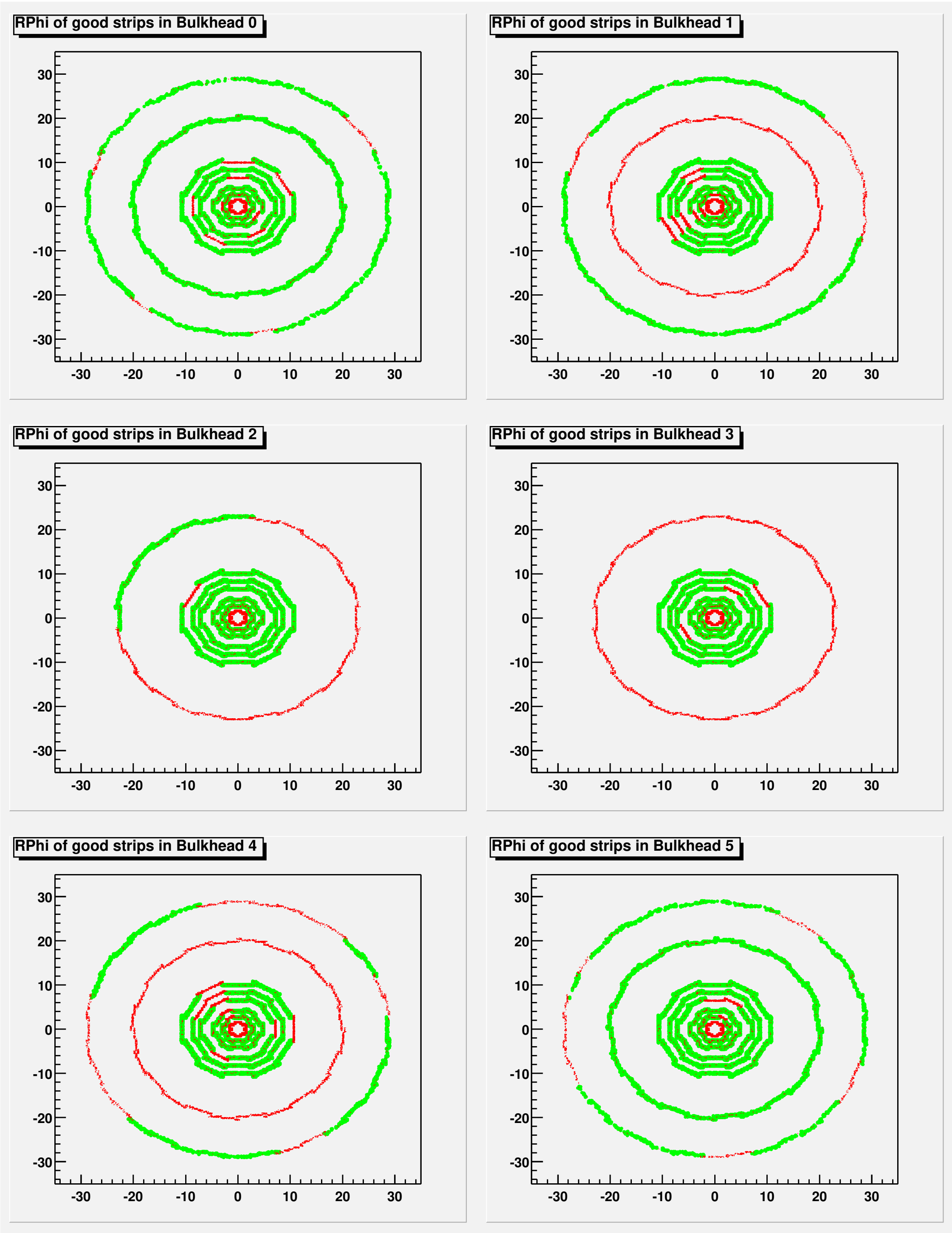
Sometimes ladders are "uncalibrateable" during calib runs, pointed out bug in realistic MC which didn't kill them

Bad & Dead Strips in Run 139900

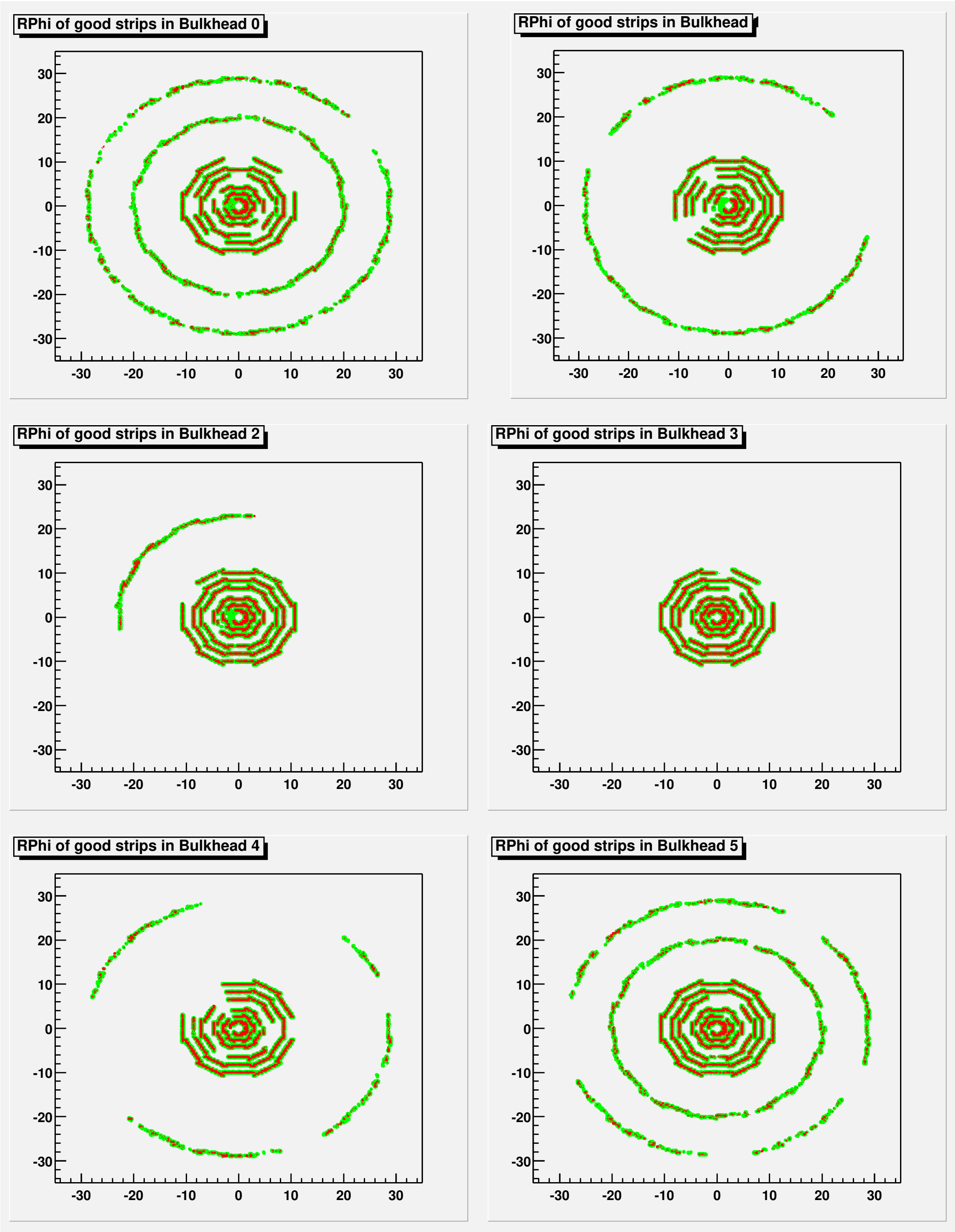


- Changed MC run to 139900 and ran reconstruction
- Read bad strip database according to UsedSet for this run
- Read hardware database for nonintegrated ladders for this run

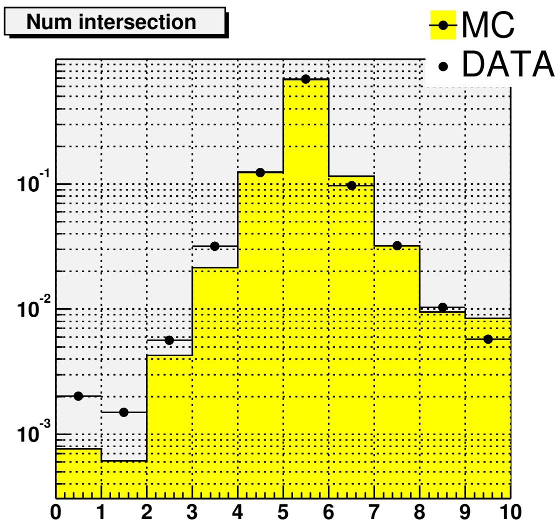
Bad & Dead Strips in MC Run 139900

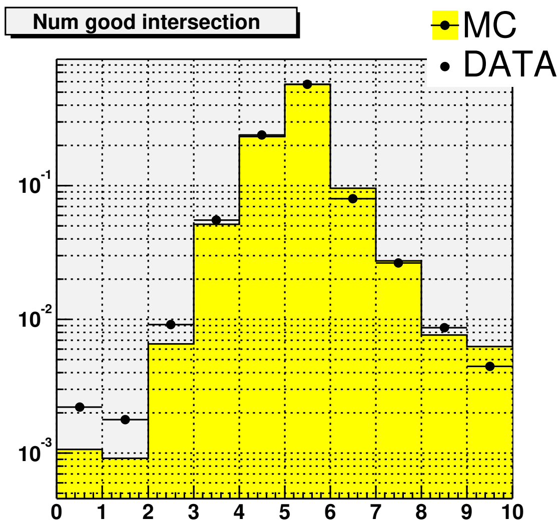


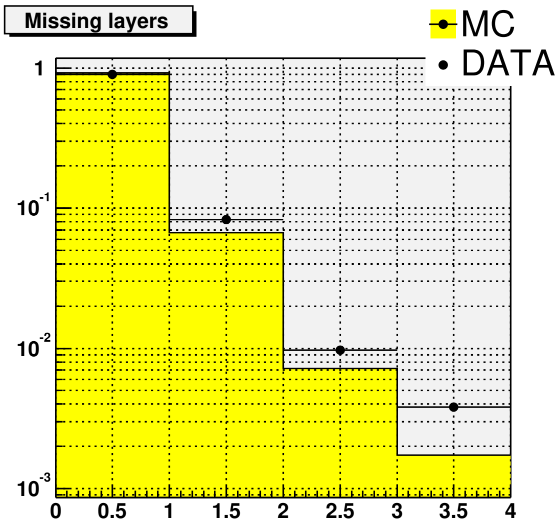
Bad & Dead Strips in DATA Run 139900



Francesco’s Best Attempt







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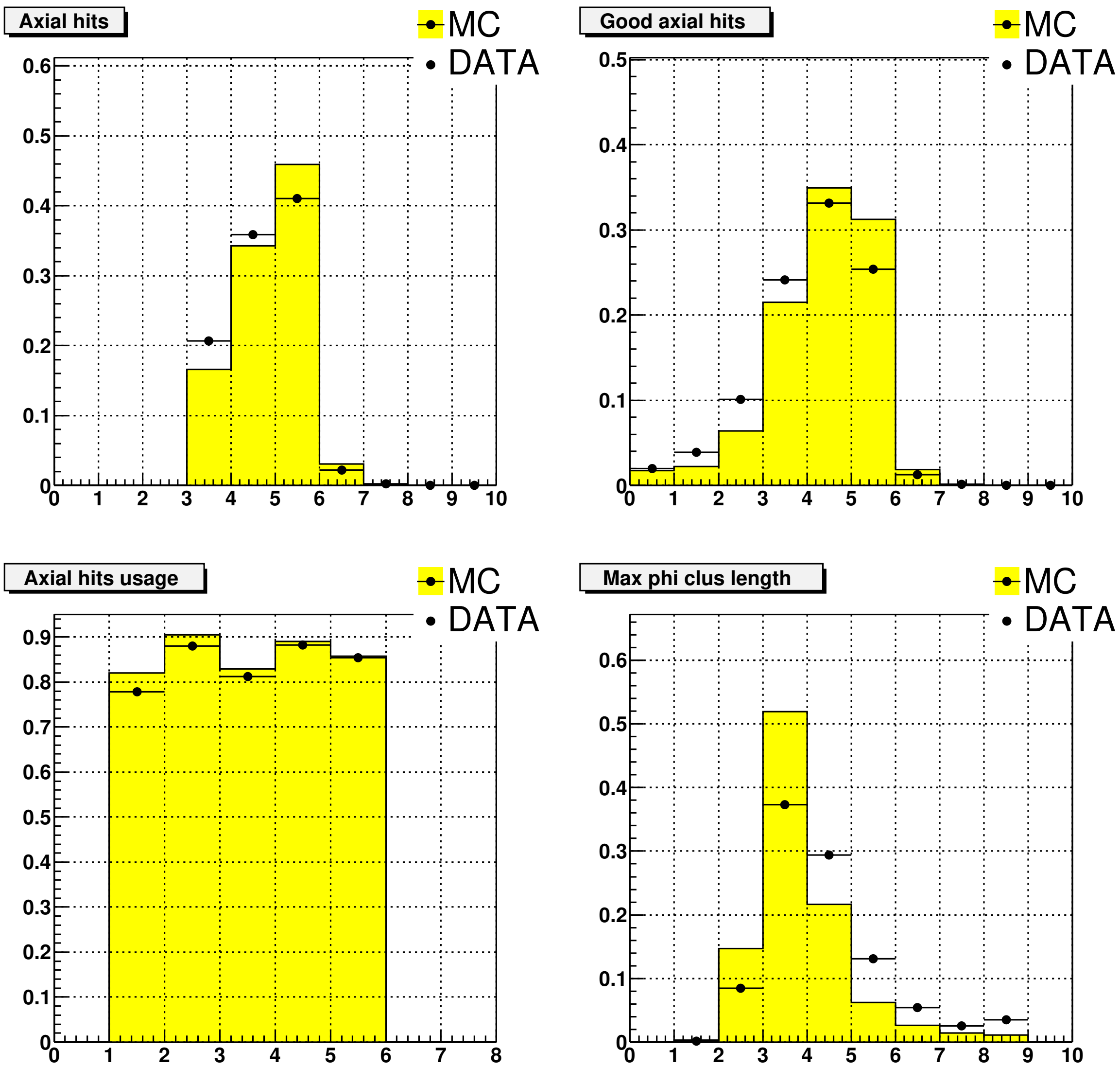

Misalignment

- Nominal positions of detector elements are hardcoded. Same for MC and data
- Alignment tables in database are deltas wrt to these
- Very easy in MC to read a database table with these deltas
- For systematics studies, could run several jobs with different tables
- First user will be SVT people, see Alex's talk

Bugs & Missing Features in `4.7.1`

- Reading of noise, bad chan db not working properly for MC with run numbers > 1
- Non-int ladders and uncal ladders not killed in MC, but were killed in data
- Physical dep model had direction of B-field backwards (again...)
- Noise was added to z-side of L00
- Rounding errors never gave noise on last strip
- Strips from MC physics were double smeared
- No possibility for different gains in different layers/sides
- Default was still geometric model
- Setting run number for lumi weighted runs painful

Lumi Weighted Runs Now Easier

Four use cases for run numbers in MC with $N_{\rm ev}$ taken from `begin -nev`

1. Ideal MC, run number is always 1

2. Pick one run by hand

```
talk GenInputManager
  run_number set 148824
exit
```

3. Use input set of runs with lumi weights in each run set by hand

```
talk GenInputManager
  runNumberAndLumiFile set ./runlist.txt
exit
runlist.txt:  144714 10.0 144715 5.5 144719 25.0 144720
12.0
```

4. Use input set of runs and read DB for lumi weights

```
talk GenInputManager
  runNumberFile set ./runlist.txt
exit
runlist.txt:  144714 144715 144719 144720
```

But Isn't This SLOW?

- Ran side-by-side test of cdfSim with 500 events JET20 QQ on my dual CPU 1GHz linux box

  1. Ideal MC: GeometricModel, no DB access, no noise
  2. Realistic MC: PhysicalModel, 14 runs, full noise

- (2) was 5% only slower in both clock and cpu time

To-Do

- For winter conf, use bug fixes but no more

- Material still not quite right. Resolution different. Alignment not yet applicable to MC.

- Readout errors not accounted for in MC

- Final tune of `PhysicalModel` with gain variations

- Could characterize any left-over relative eff diff b/w data and MC chip-by-chip, or ladder-by-ladder (Peter Bussey, Matt Herndon)

- L00

- Put equivalent of `runlist.txt` in database somehow

- Other detectors can (easily) use same method since framework is in place