

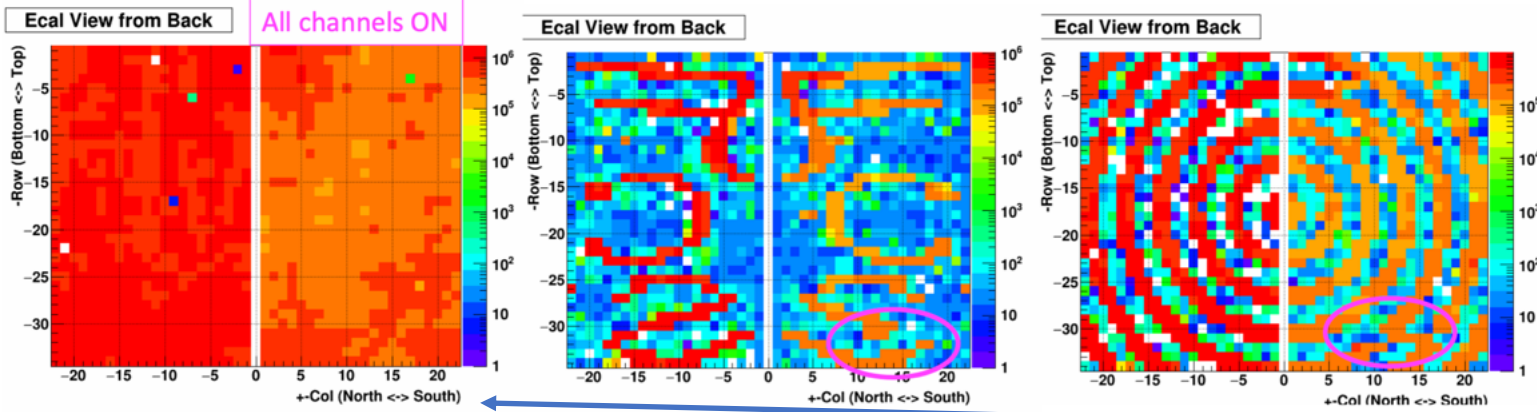
## Needs and plans for built-in calibration systems/tools for fECal

O.Tsai. 01/22/2024

ePIC Calo meeting 12/13/2023 <https://indico.bnl.gov/event/21546/>. Examples of LED monitoring system for STAR FCS and sPHENIX.

- LED monitoring system critical for:
  1. commissioning of the detector
  2. monitoring and correcting unexpected issues during data taking.
- Implementation for fECal will be similar to what was done to sPHENIX and STAR FCS:
  - hardware more like sPHENIX, i.e. LED at SiPM board
  - controls and operation integrated with FEE design, exact specs TBD.
- Software tools similar to what is in use for STAR FCS.

# Mapping Check with Voltage Patterns

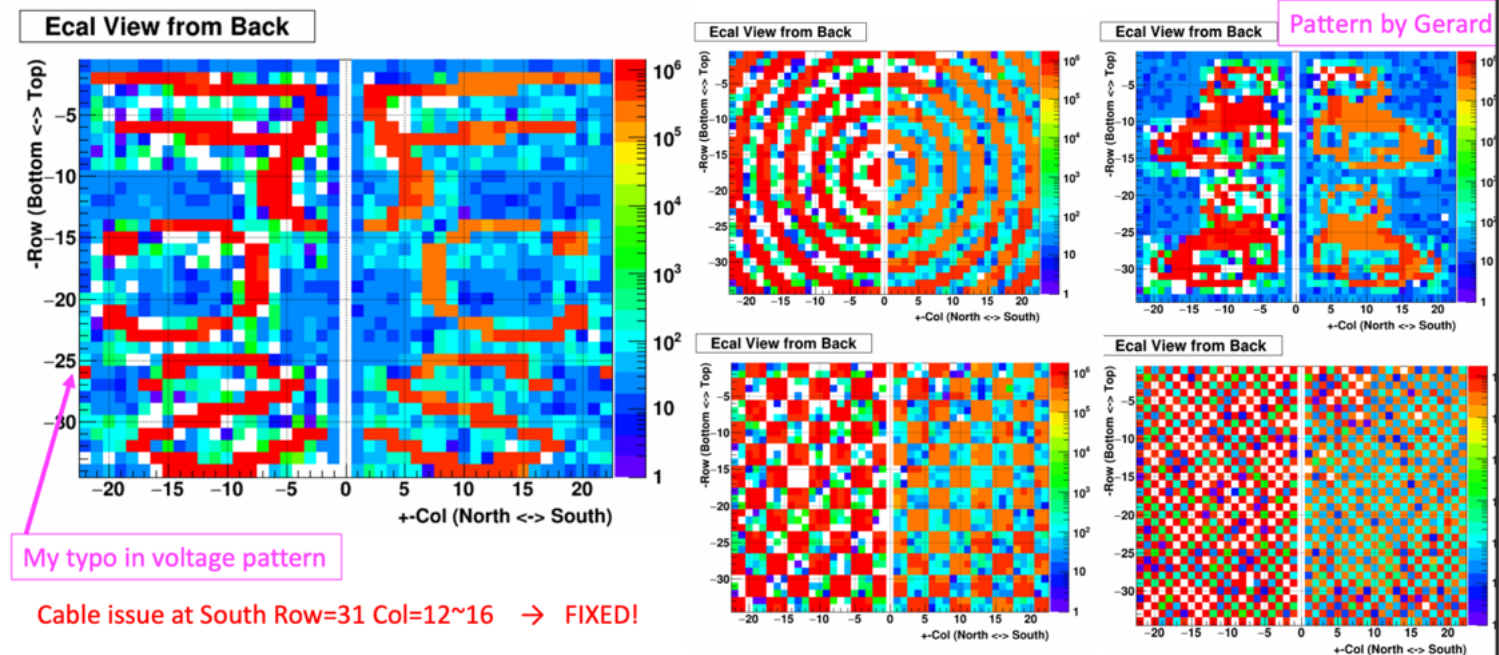


6 bad channels ~ all with DEP problem

Cable issue at South Row=31 Col=12~16

LED system was critical for initial commissioning:

- Well.., sometimes there is no signal !
- Or, signal is nice but it is in a wrong place!



My typo in voltage pattern

Pattern by Gerard

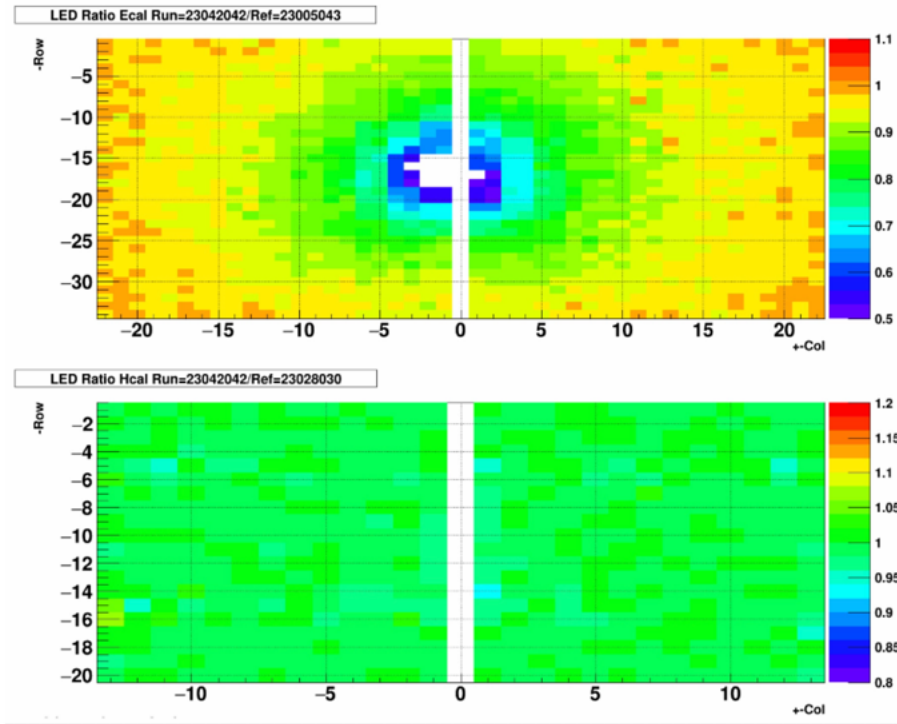
Cable issue at South Row=31 Col=12~16 → FIXED!

2 more cabling mistakes found and fixed with checkered patterns

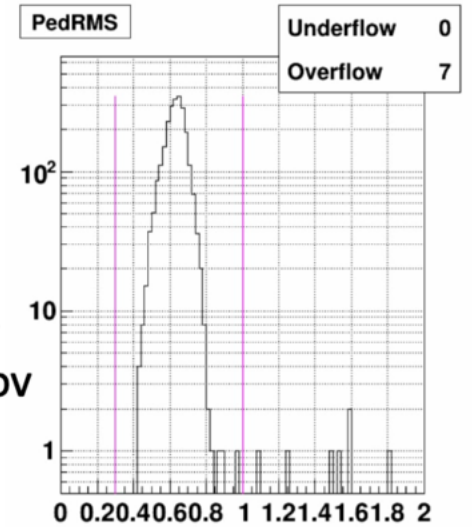
# Online Plots : LED & Pedestal Monitor

<https://online.star.bnl.gov/fcs2022/led/>  
<https://online.star.bnl.gov/fcs2022/led/search.php>

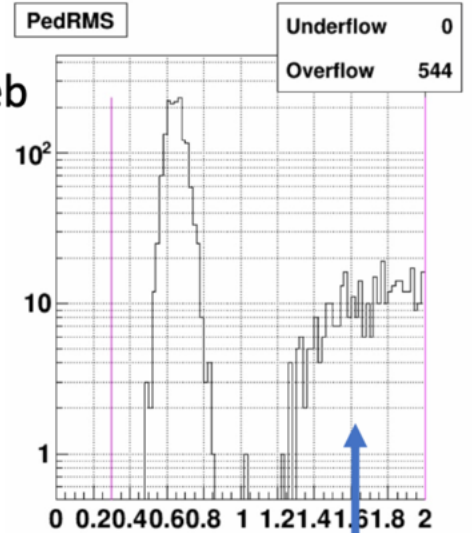
LED Ratio plot 2/11 over 1/05



Pedestal RMS  
2021 Nov



2002 Feb

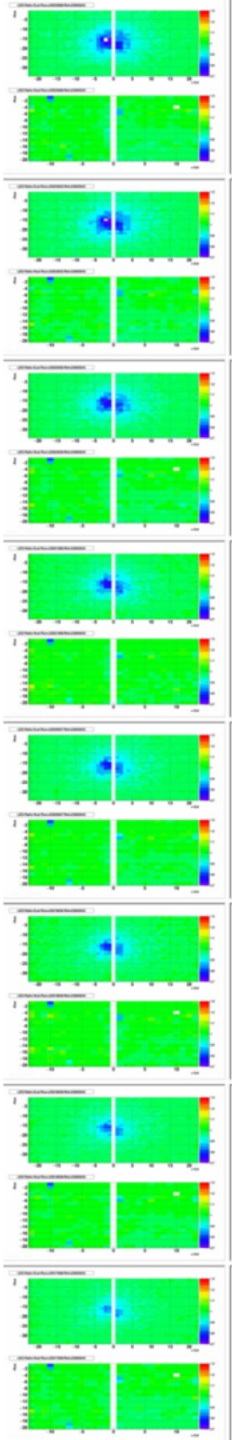


- Ecal losing lights as much as ~50% near beam over a month
- Hcal is stable
- Pedestal RMS is still < 1ch, even near beam

That was very puzzling at that time !

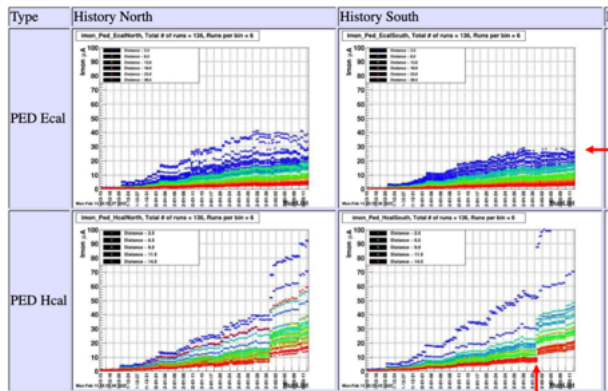
1/23

1/17



## Online Plots : Radiation Monitor (Ananya)

<https://online.star.bnl.gov/fcs2022/radmon/>



Limits are 400uA (Ecal) and 600uA(Hcal)  
At this rate, they will reach 120 (Ecal) and 300 (Hcal) at near beam by end of run22

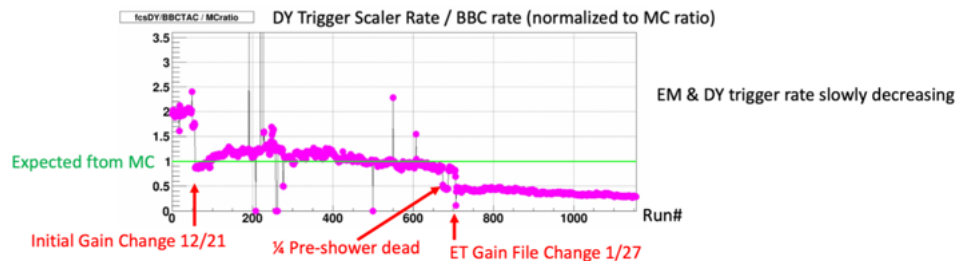
Hcal Voltage Change 2022/01/27

Ecal current flattened?  
(see Oleg's talk)

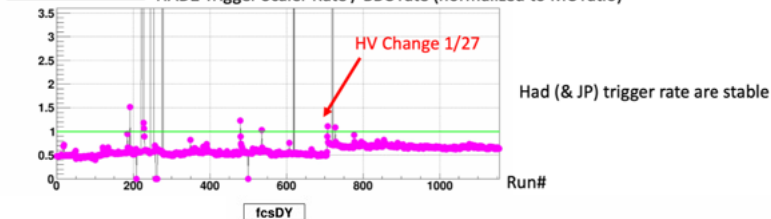
There were other telltale signs something was not right. **Data from LED monitoring system caught the problem immediately!**

## Online Plots : Rate Monitor

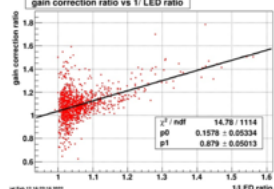
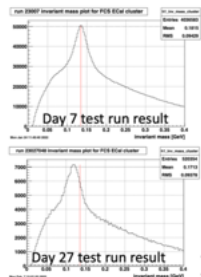
<https://online.star.bnl.gov/fcs2022/trg/rate/>



## HAD2 Trigger Scaler Rate / BBC rate (normalized to MC ratio)

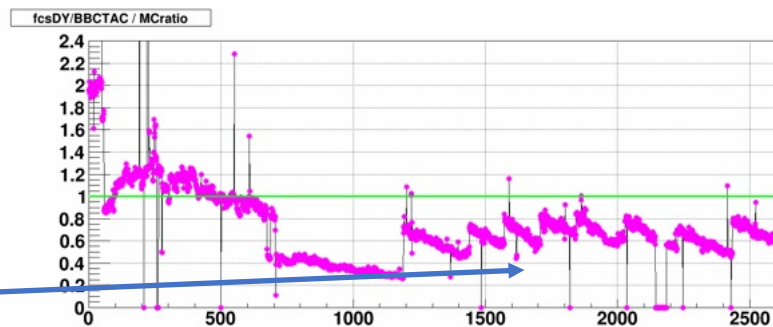
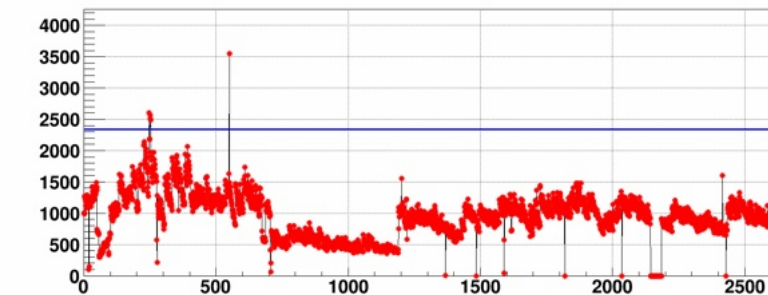


## Future Calibration run needs



Between day7 and day27:  
1/LED ratio  
vs  
GainCorrectoon factor ratio  
(Xilin)

- Light loss seen in LED is also confirmed by Pi0 analysis
- LED and EM shower (pi0) see similar amount of light loss (not trivial)
- But variation is large (cannot use LED ratio for tower by tower gain)
- ASAP, we need to install tower by tower gain (electronics gain file) for DEP (trigger)
- More low-luminosity MB trigger calibration runs?
- Or physics data taking is enough?



Reasonably quickly we figured out that reference voltage chip on FEE board is not rad hard, which was a surprise! Same chip was fine in Run 17 (prototyping for FCS FEEs Run 17, pp 500 GeV)!

N.B. irradiation tests should be done with production components.

**Based on data from LED systems**, new bias settings were calculated and uploaded ~every week. Zig-zag pattern in trigger rate for DY

## Summary:

- At RHIC, STAR and sPHENIX recently build and operated a very simple LED base monitoring systems for EMcals. These are working very well.
- Similar system is planned for ePIC fECal, being designed now (part of FEE/SiPM boards design eRD109).