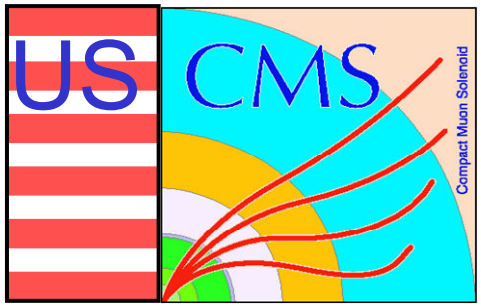
FAST site test results – a global view from ROOT



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Outline

- FAST site CSC test results and ROOT
- Update on the ROOT analysis package
- Examples of global distributions of test results
- Conclusions

FAST site test results and ROOT

- **Goals**
  - Get distributions of the test results for all chambers and FAST sites (plus ISR and SX5)
  - Compare results for each chamber, wire,strip (ISR vs FAST sites, SX5 vs ISR)
  - Prepare data for the database at CERN
  - Monitor CSC stability on disks at SX5
  - Web based interface for analysis by user?

FAST site test results and ROOT

- **What, Where and How To**
  - CSC test results available by March 16, 2004 for UF(74 CSC), UCLA(71), IHEP(66), PNPI(65), ISR(193) and SX5(55)
  - Stored at FAST site and CERN Web
    http://www.phys.ufl.edu/cms/emu/fast, http://cmsdoc.cern.ch/CSC/CERN
  - Test results are in pictures (Postscript files) and tables (text files) for each chamber and test
  - Download (automatically) only the tables and make a ROOT tree for further analysis in ROOT
  - Analyze in ROOT, results are on CMU Web

    http://www-hep.phys.cmu.edu/cms/FAST/test.html

FAST site test results and ROOT

- **List of tests**
  - On Web ~ 28 tests (~ 90 tables) per CSC
  - Selected for ROOT tree – 17 tests (87 parameters)
  - Event (CSC) Header – FAST site ID (+ ISR and SX5), CSC type and ID, SX5 station and location
  - Total 524 CSC in current ROOT tree file (19.6 MB)

FAST site test results and ROOT

- **Anode Front-End in ROOT Tree**
  - Rate, hit probability, crosstalk, noise, threshold, threshold slope for each CSC wire group and layer
  - Threshold, threshold slope for each AFEB on CSC
  - ALCT delay intercept, slope and equalized delay for each AFEB on CSC
  - On AFEB test stand certified parameters for each AFEB on CSC

FAST site test results and ROOT

- **Cathode Front-End in ROOT tree**
  - Cathode strip pedestals, RMS, SCA RMS, timing, amplitude, crosstalk, calibration slope and intercept etc.
  - Strip comparator rate, occupancy, threshold, noise, slope, timing, offset
  - CFEB comparator thresholds and slopes
  - CLCT and ALCT cosmic rates
  - CSC Gas gain Landau fit parameters for layer, HV segment and CFEB

FAST site test results and ROOT

- **Others**
  - Slow Control LVMB, ALCT and CFEB
    - Voltages, currents, temperatures
  - Gas leak rate on arrival and prior shipment to CERN
  - Date of the test (from test 13-01)
- **Results posted on CMU Web**

  (www-hep.phys.cmu.edu/cms/FAST/test.html)
  - 18 parameters for anode front-end
  - 20 – cathode front-end
  - 1 – LVMB
  - 2 – CSC gas leak rate

Update on ROOT analysis

- **Code for Making the ROOT Tree**
  - Original test results – large variety of formats and meanings
  - Consolidate all results to form 16 classes (tree branches) having up to 20 data members (parameters)
  - Abandon traditional channel/detector relating naming convention for class and data members, like

    BranchAnodeWire class, fParNoise data member etc.
  - Instead number as Branch1, Branch2, fPar1, fPar2 etc.

    (the meaning is always known and described in document)

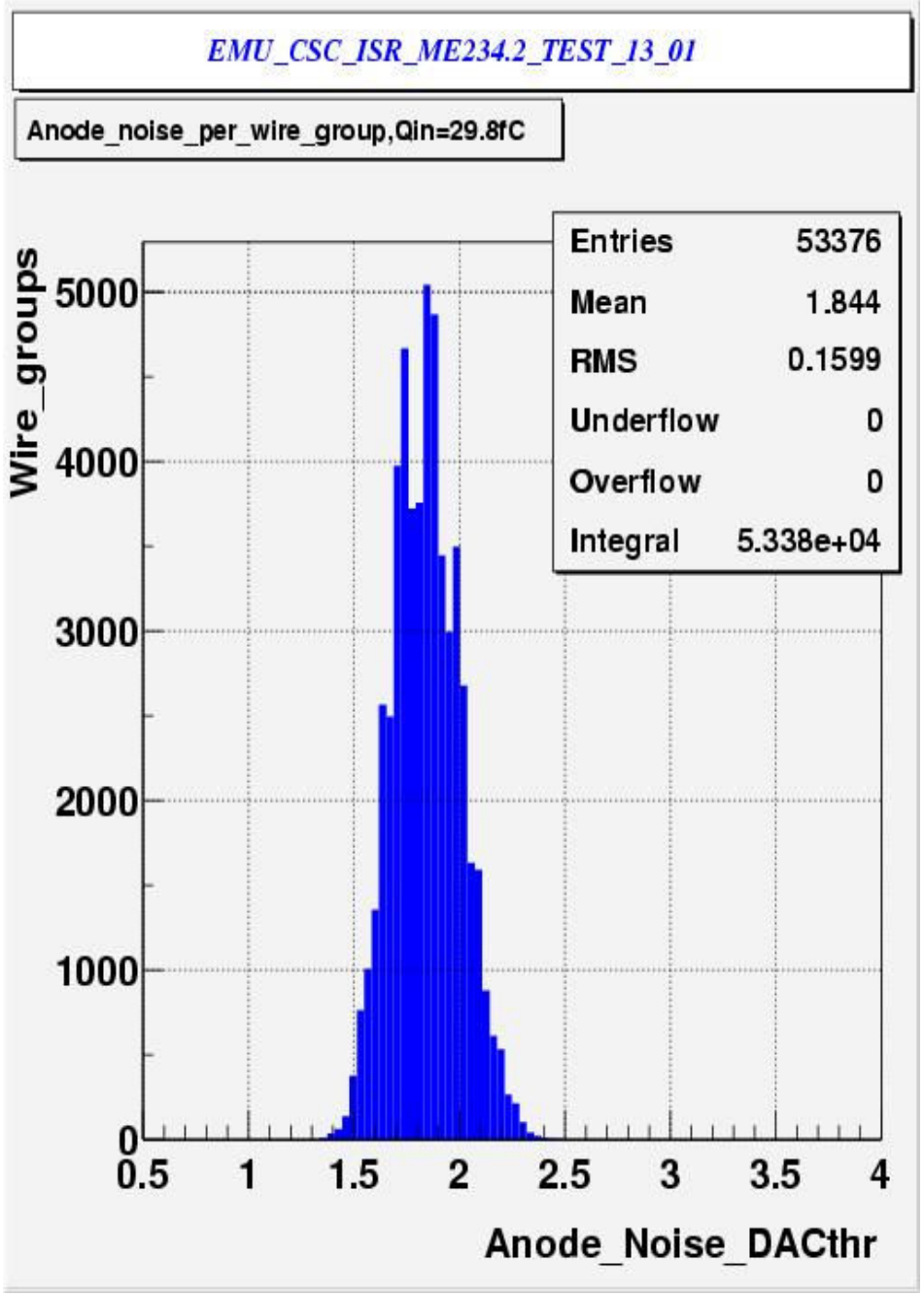
Update on ROOT analysis

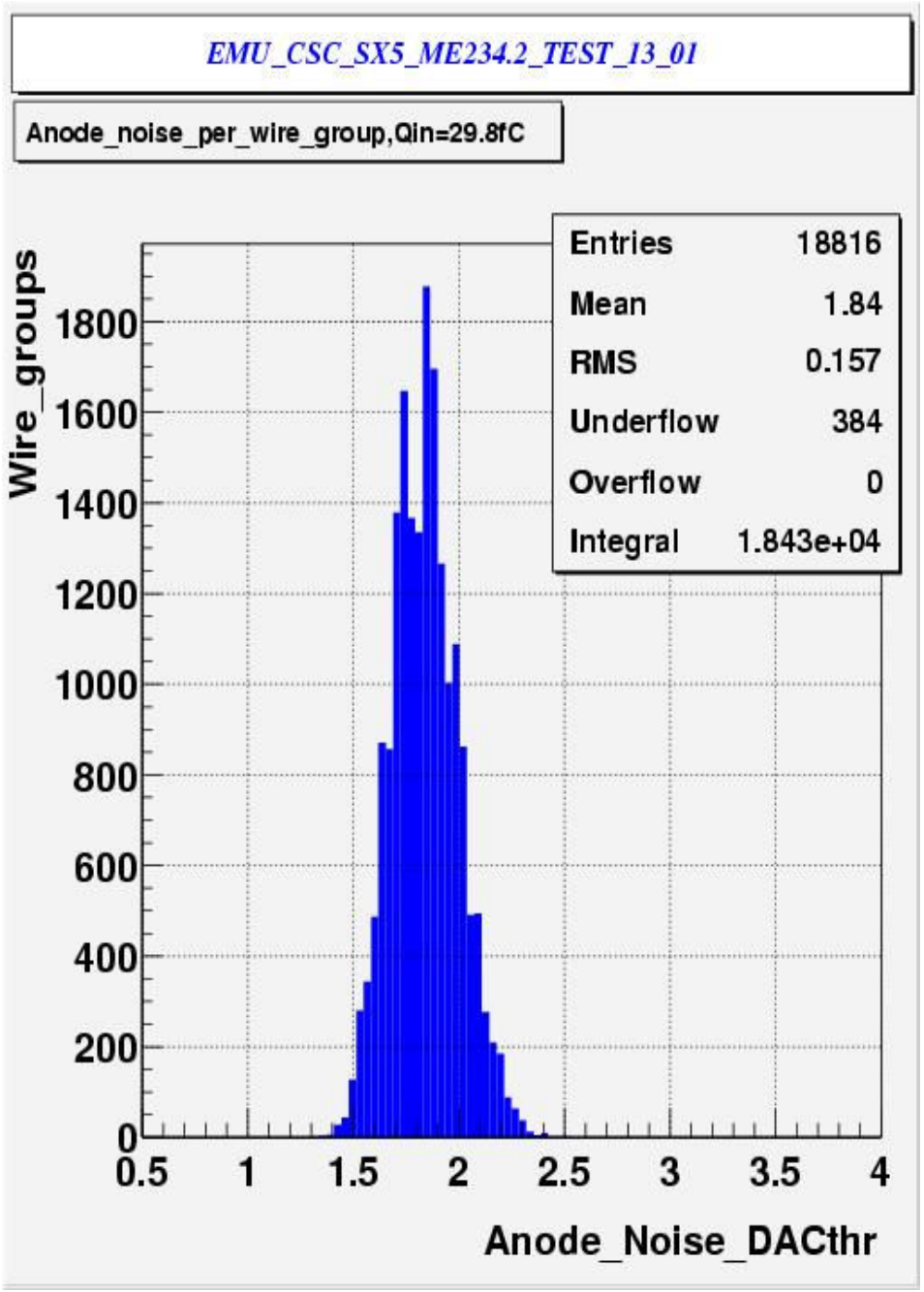
- **Code for Making the ROOT tree (cont'd)**
  - Automate quick code modifications and adding new class with the script having as inputs only Branch # and # of data members (or their names if still needed)
  - All class related input info specifics is coded manually in user's interface – methods of FileReaderEvent class
  - Can be useful in upcoming beam tests when the RPC and HCAL data will be added to CSC data (the main code is not detector specific)
- **The ROOT tree analysis code**
  - Automated as well in script to plot distributions for selected parameter (if needed internal links to detector/channel names to be provided)

Examples of the test result distributions

- **Anode analog noise at FAST sites, ISR and SX5**
  - Test 13_01
  - Per AFEB channel ("wire group ") at ~30 fC of ALCT test pulse
  - Measured as RMS of the integrated threshold curve, in threshold DAC units. Goes up with capacitance.
  - Look at ME234.2 as largest CSC
  - Form single peak, MEAN = 1.8 - 1.9 DAC (1.5 - 1.6 fC, if 0.8 fC/DAC) in tests at all locations, UF+UCLA(144 CSC),ISR(139),SX5(49)
  - ISR agrees well with FAST sites (134)
  - SX5 agrees well with ISR (49) (ME234.2.044 mismeasured at SX5 ?)
  - The same true for available ME1.2, ME2.1

Examples of the test result distributions





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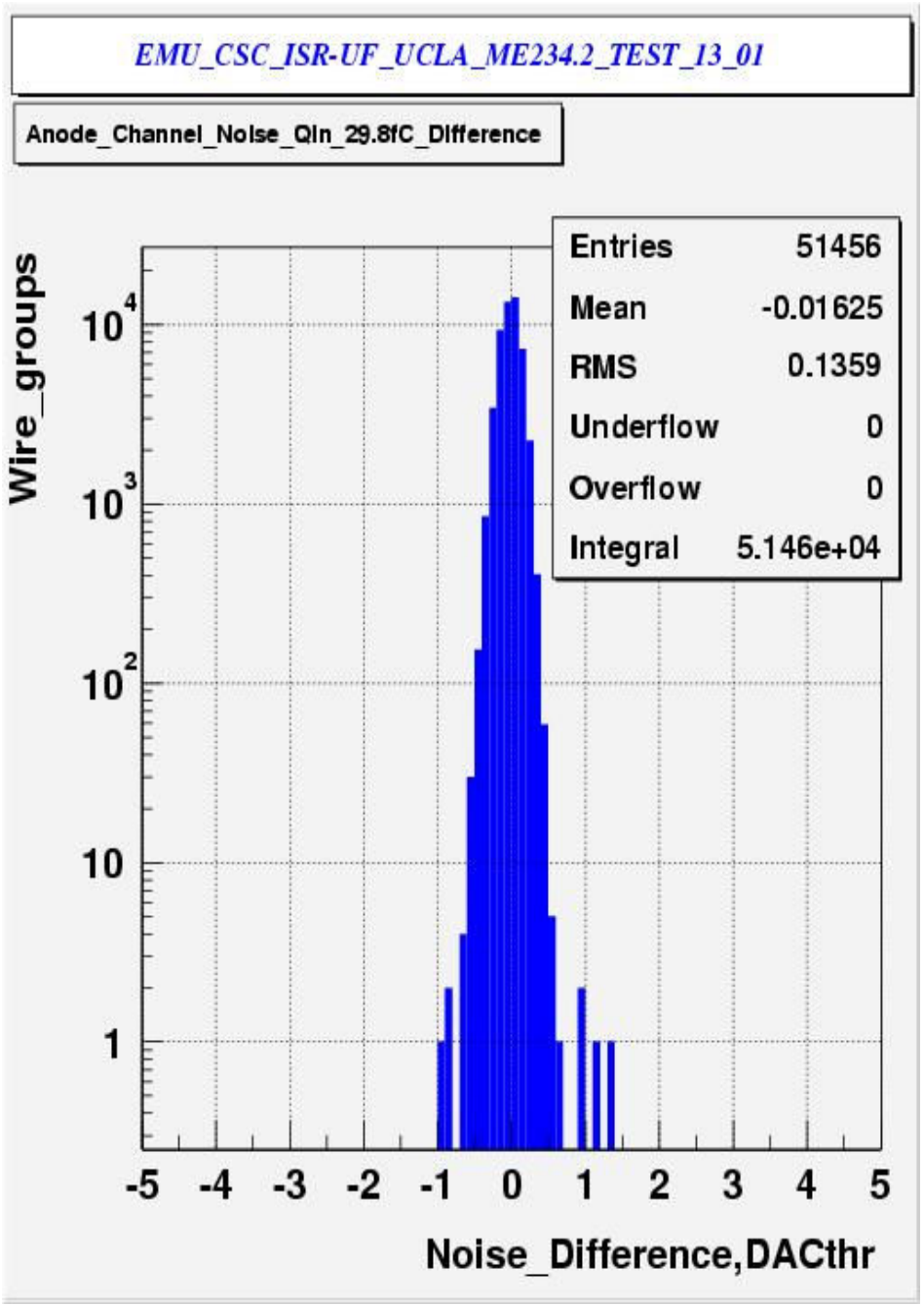
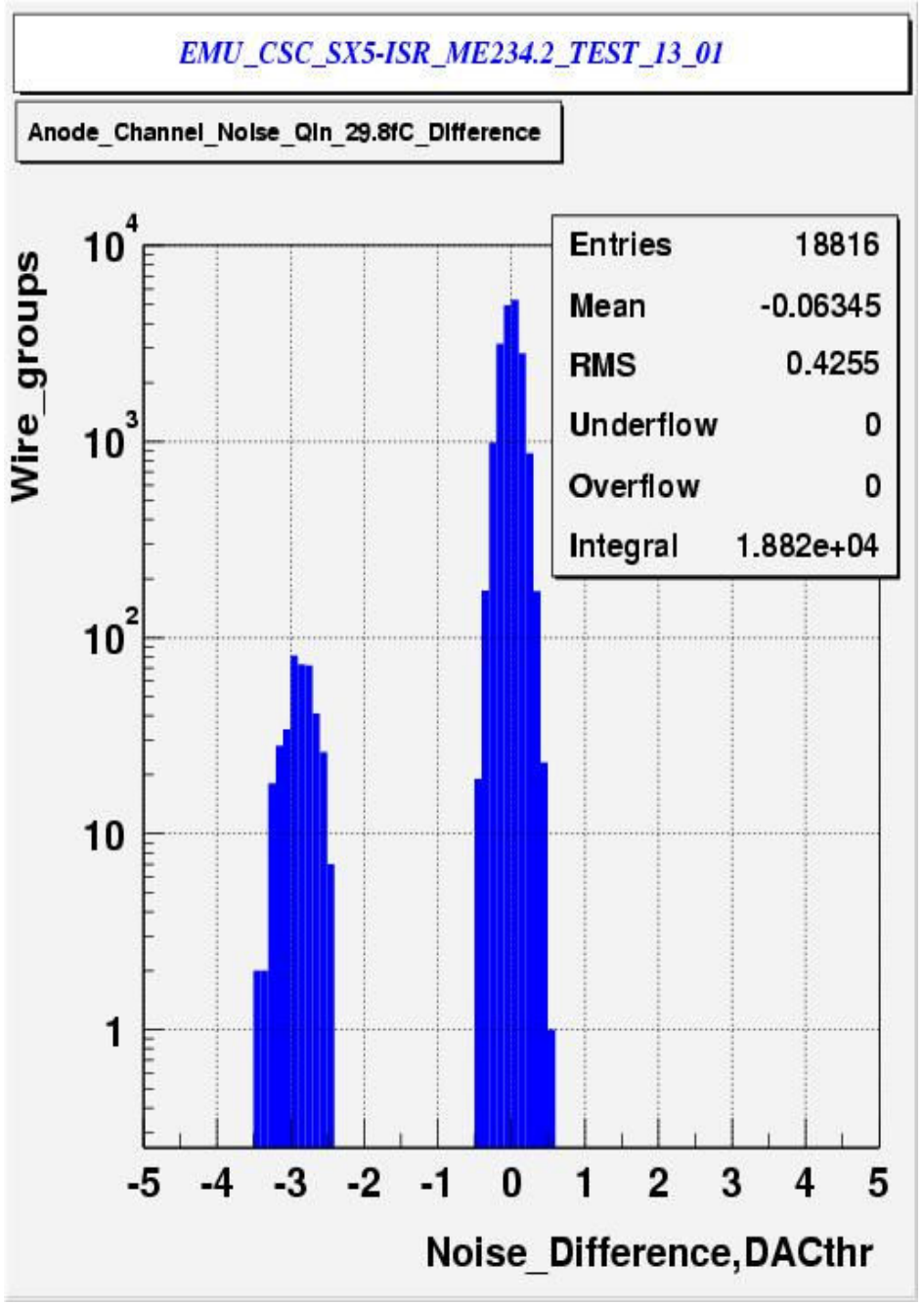
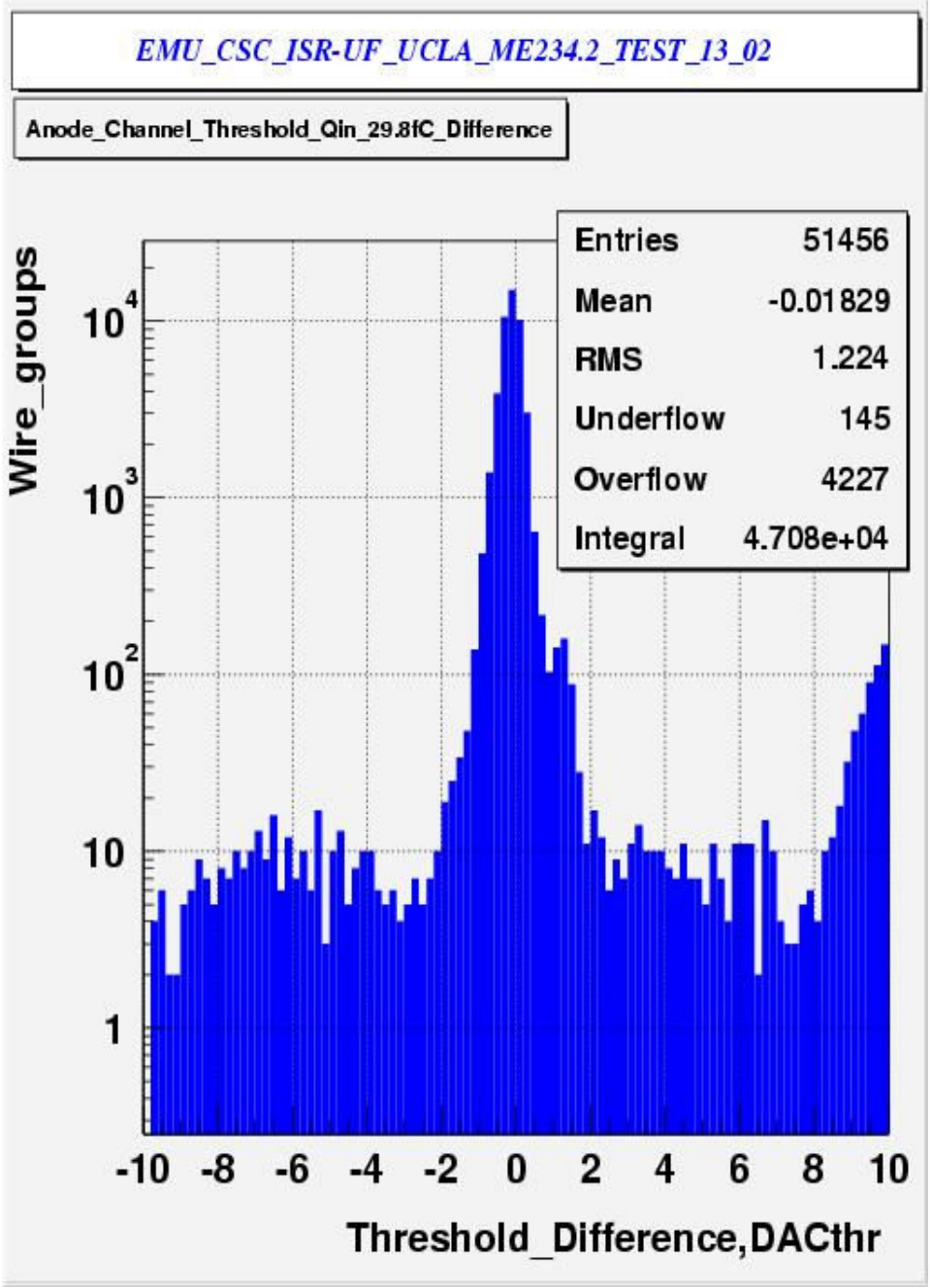


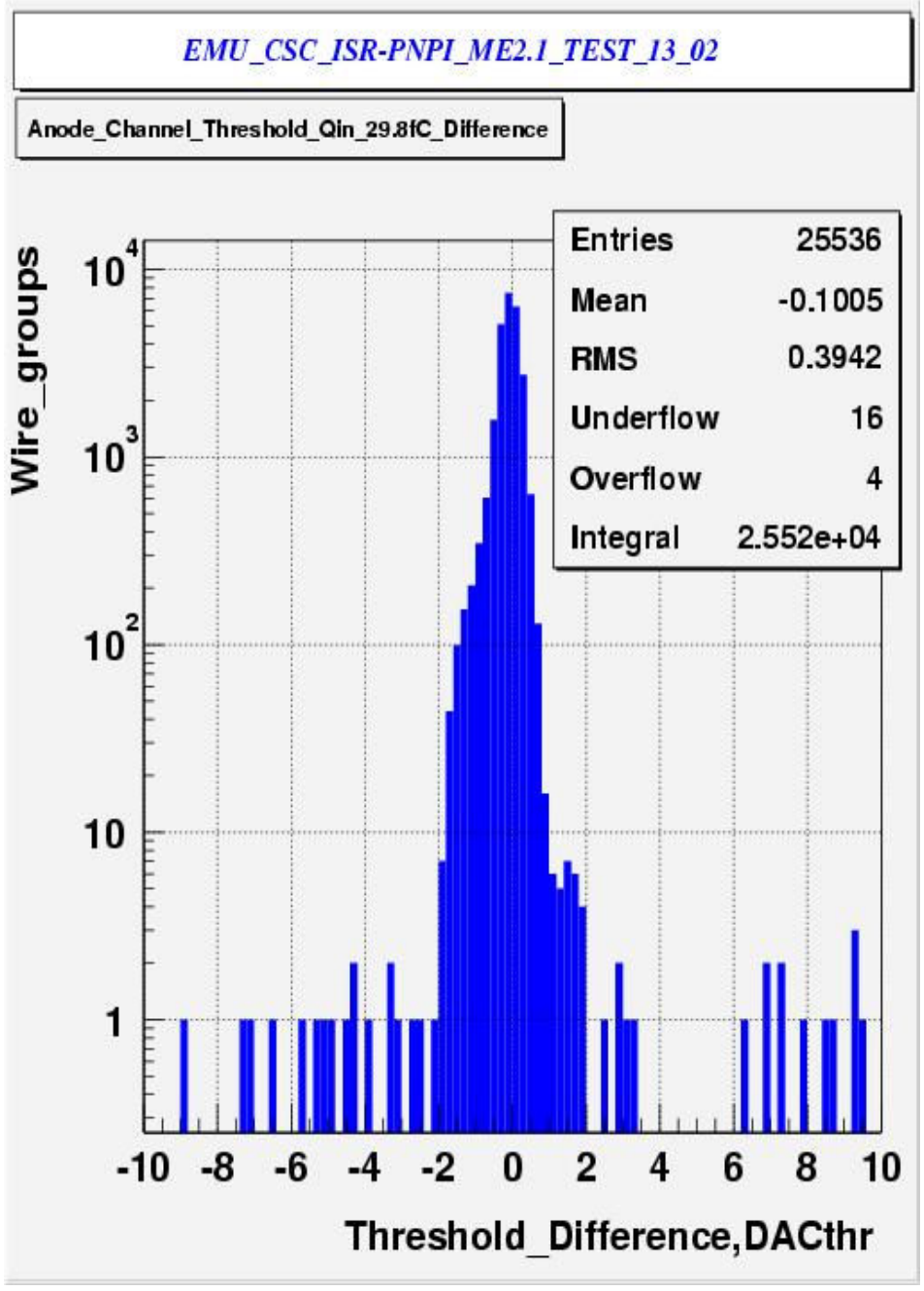


Examples of the test result distributions

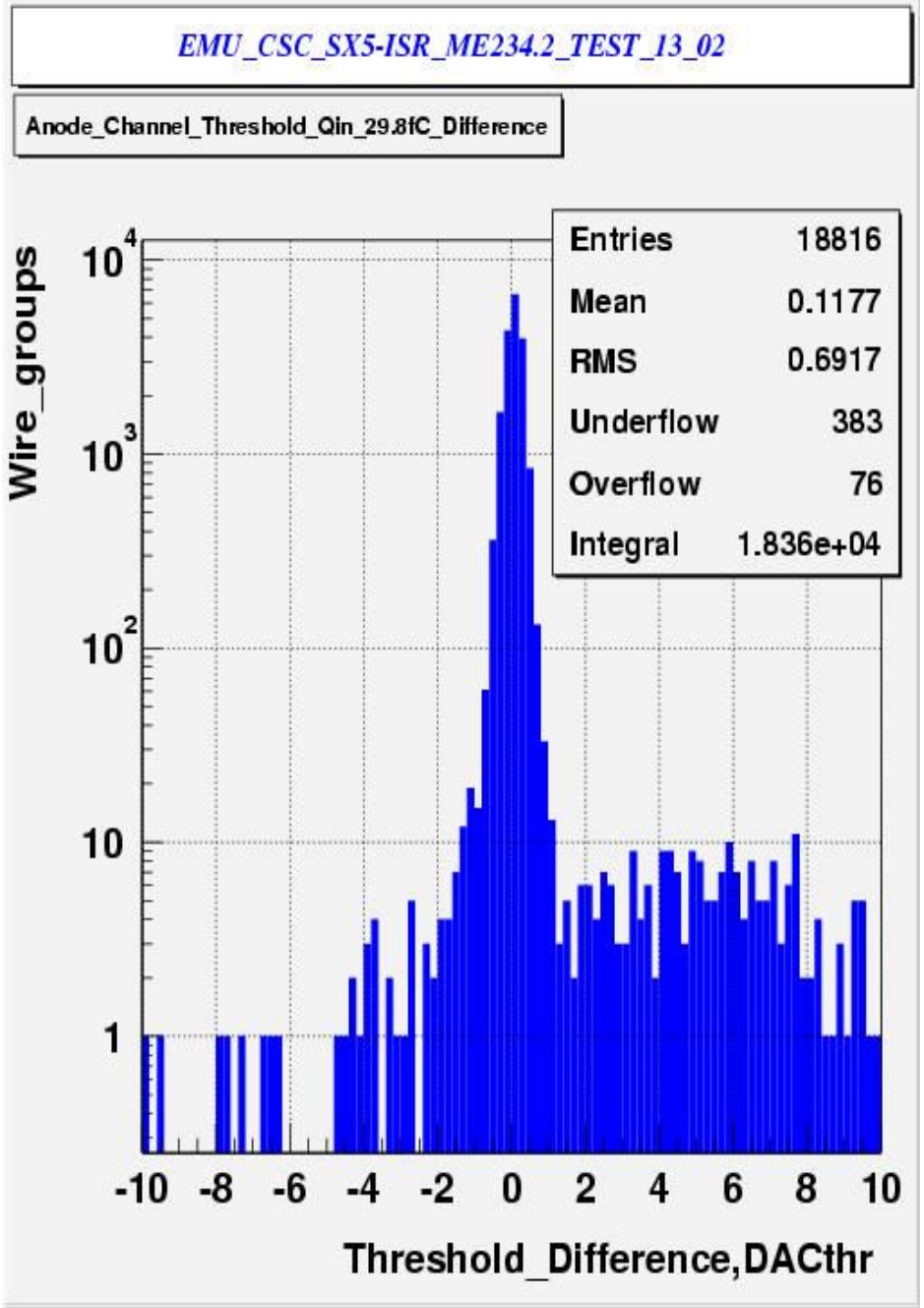
- **Anode thresholds (ISR - FAST sites, SX5 – ISR)**
  - Test 13_02
  - Per AFEB channel (“wire group ”) at ~30 fC of ALCT test pulse
  - ISR – (UF+UCLA), ME234.2 (134 CSC)
    - RMS ~ 1 fC; Outside of +- 2 fC ~ 1-2% of channels;
    - Overflow at DAC>8 due to approximate calibration in first tests
  - ISR – PNPI, ME2.1 (38 CSC)
    - RMS ~ 0.3 fC; Outside of +- 2 fC ~ 0.2% of channels
  - SX5 – ISR, ME234.2 (49 CSC)
    - RMS ~ 0.6 fC; Outside of +- 2 fC ~ 0.2% of channels;
    - At SX5 CSC #44 mismeasured (?), CSC #59 has wrong file in data
  - SX5 – ISR, ME2.1 (6 CSC)
    - RMS ~ 0.2 fC
  - FAST sites, ISR and SX5 tests give the same results

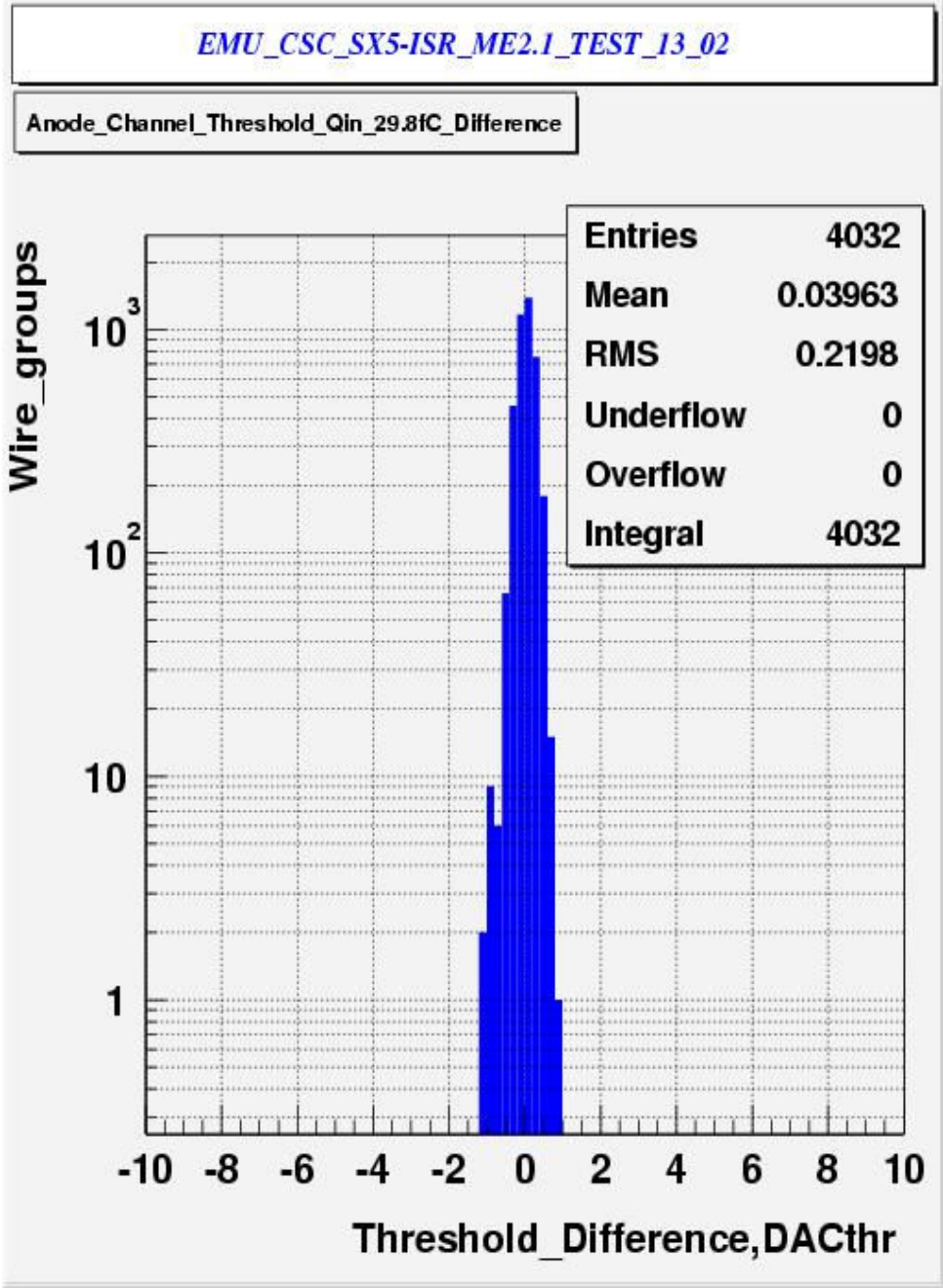
Examples of the test result distributions





Examples of the test result distributions





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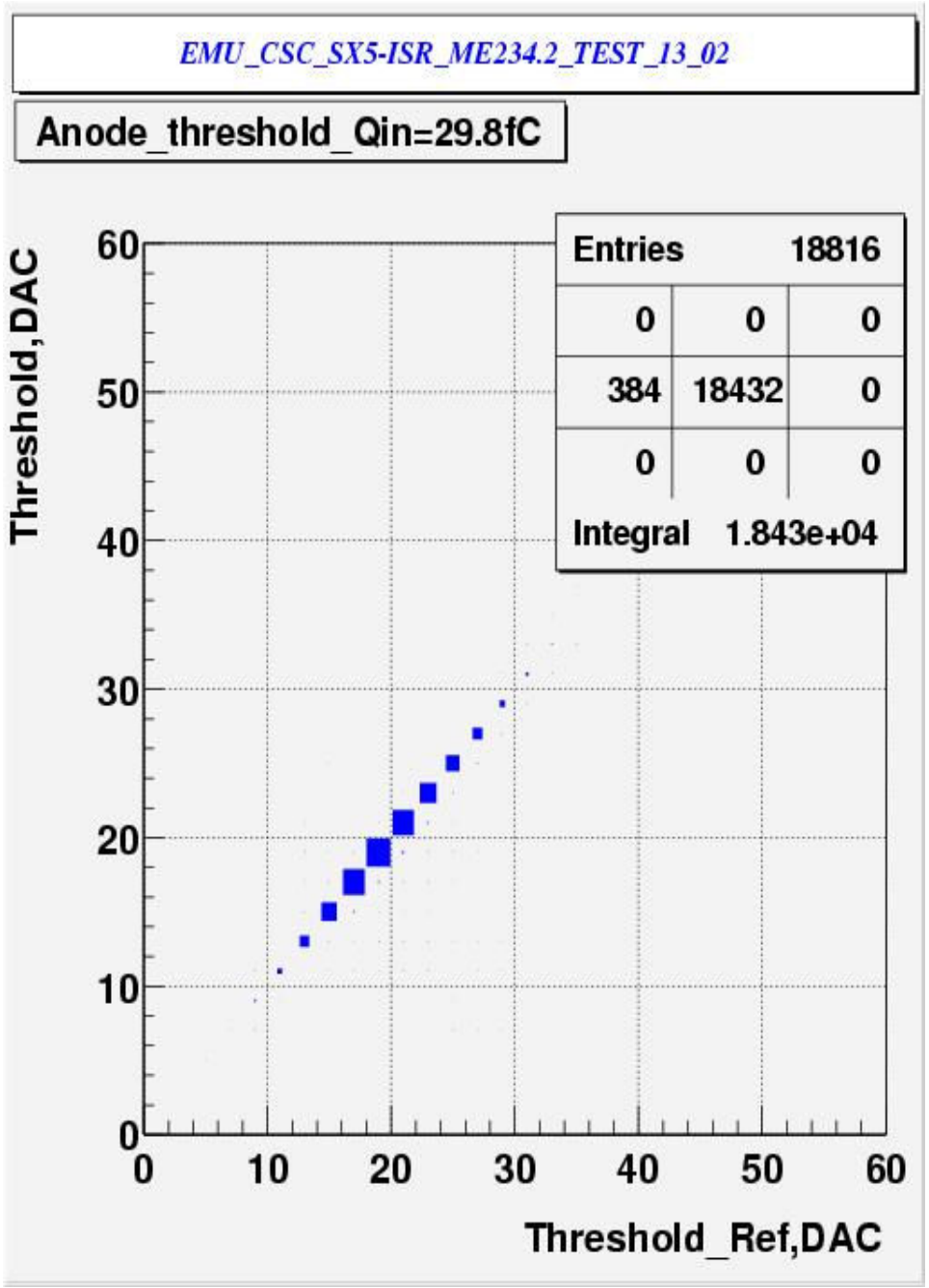
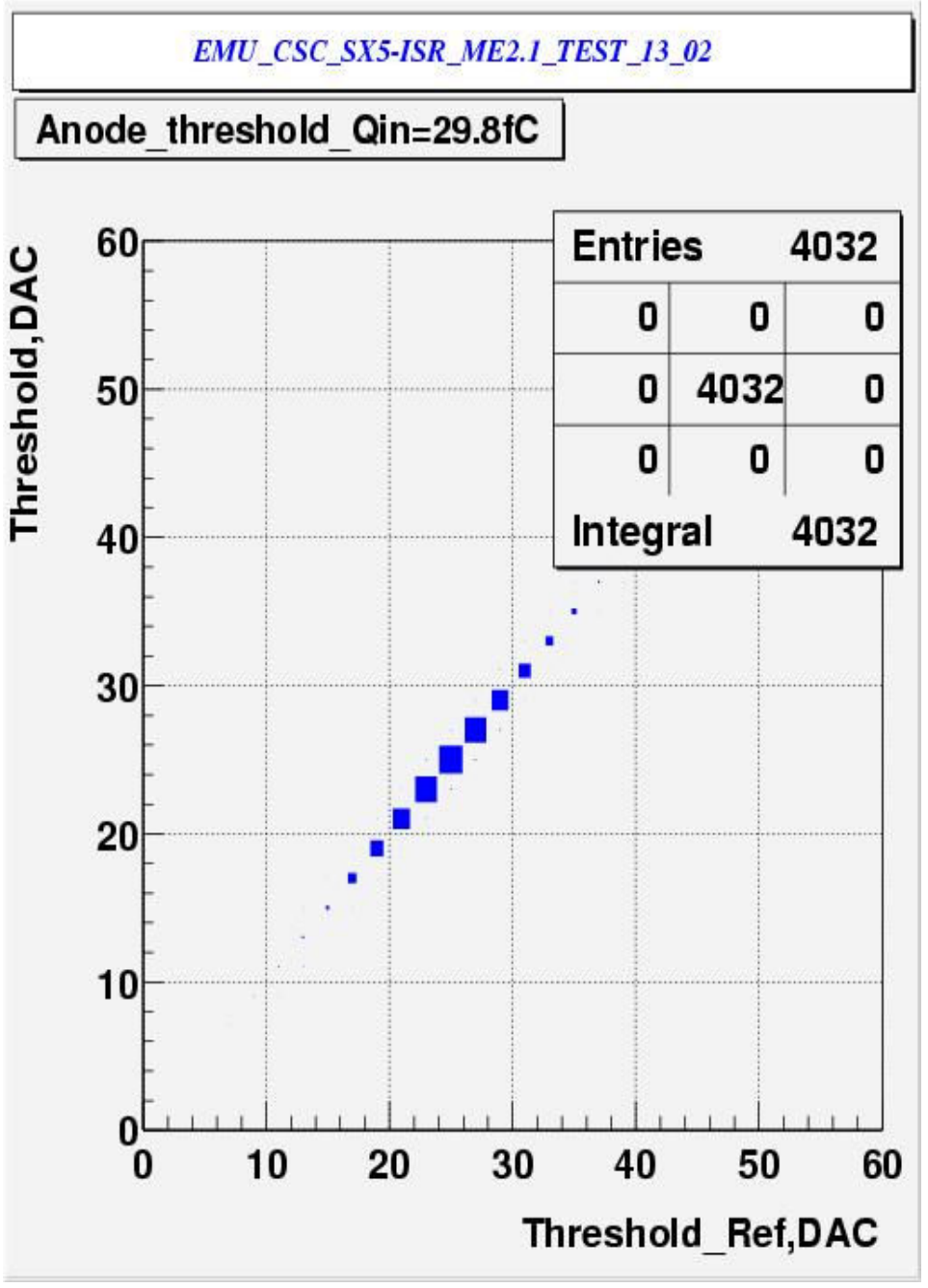
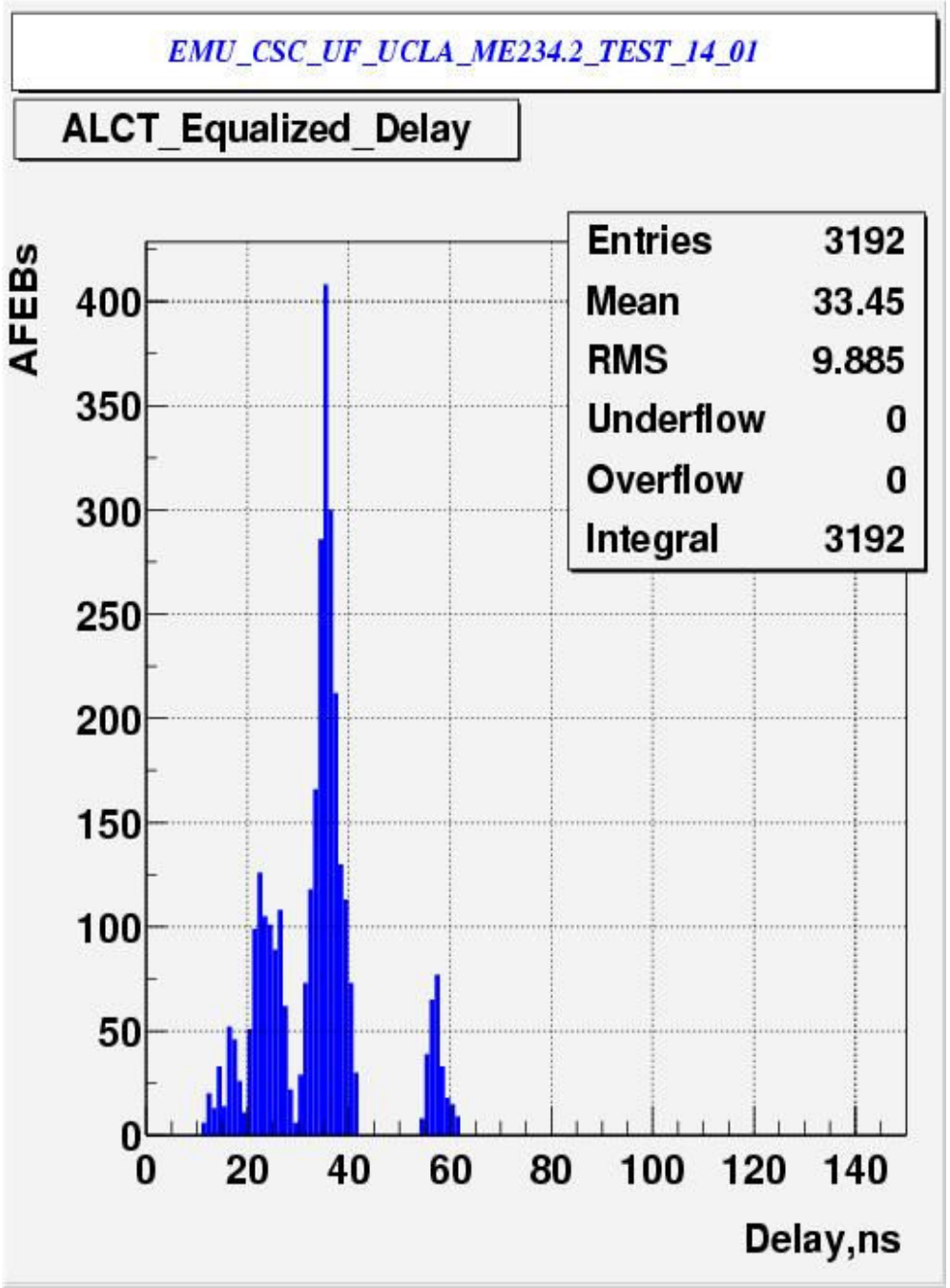




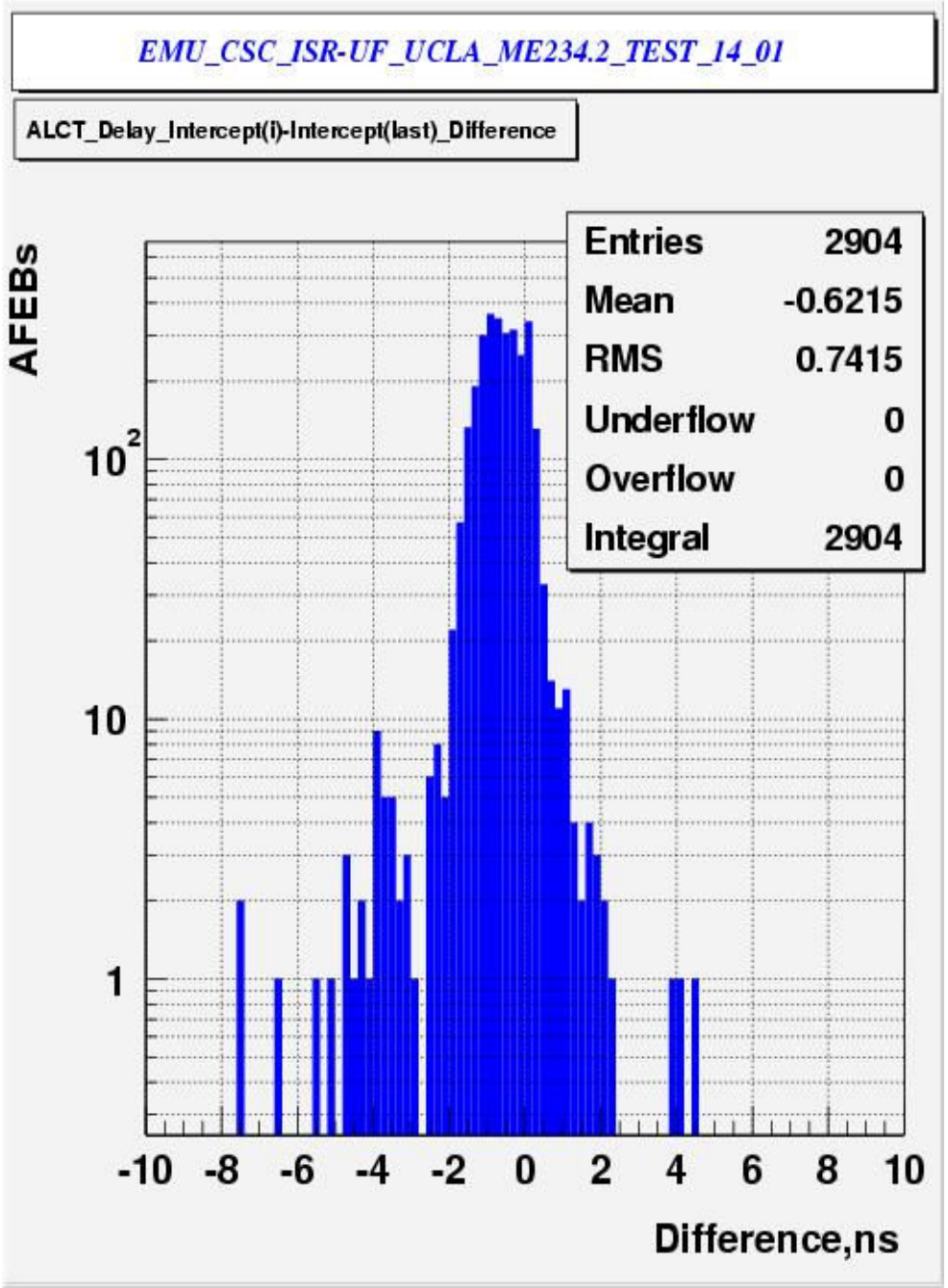
Examples of the test result distributions

- **ALCT equalized delays**
  - Test 14_01
  - Tune delays in ALCT delay chips to equalize hit arrival times from AFEBs
  - All FAST sites - many peaks for CSCs of one and the same type (not an issue, DAQ setup changes…)
  - ISR:
    - ME234.2 - two peaks (~13 ns apart, DAQ setup changes…)
    - ME1.2 and ME2.1 – one peak (at ~ 60 ns, RMS ~ 1.8 ns)
  - SX5 – test optional (?)



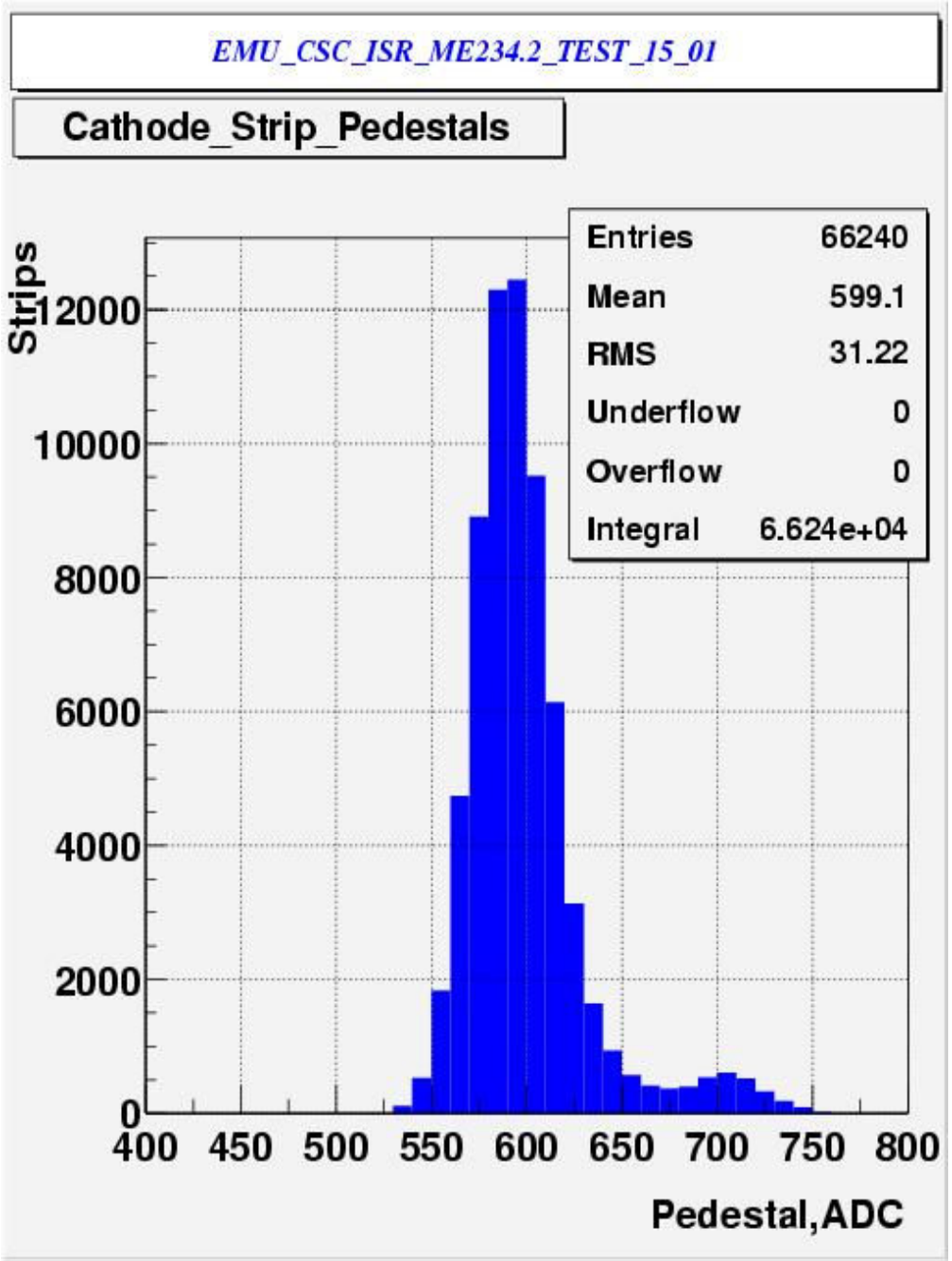
Examples of the test result distributions

- **ALCT delays in ISR-FAST difference**
  - Test 14_01
  - Calculate Delay(i) – Delay(last) for each AFEB on CSC to cancel DAQ setup changes
  - Compare ISR and FAST sites:
    - ME234.2 – about 2% outside of (-2,2) ns interval
    - ME1.2 and ME2.1 – about 1%



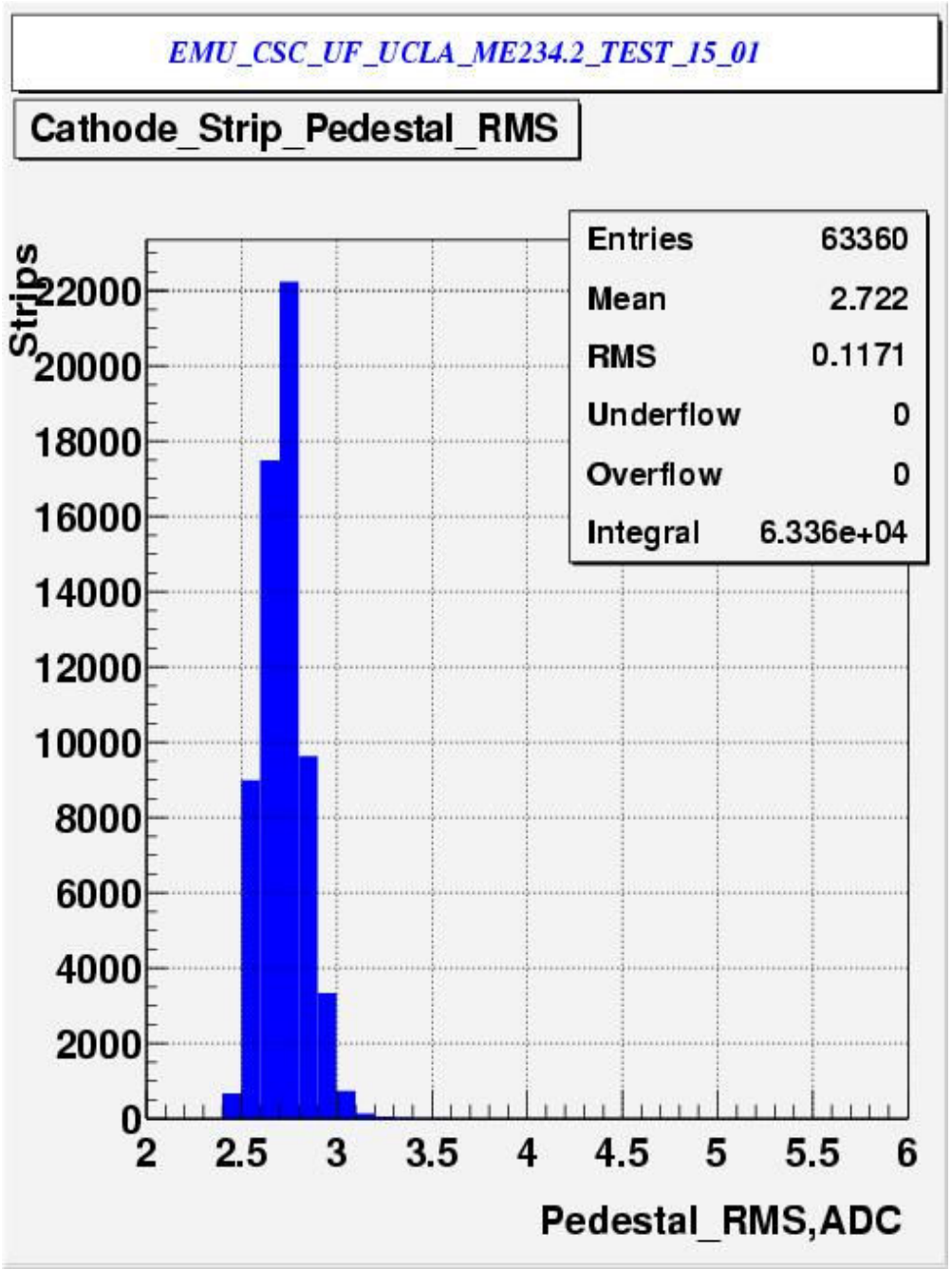
Examples of the test result distributions

- **Cathode strip pedestals**
  - Test 15_01
  - One and the same at FAST sites, ISR and SX5
  - Pedestals at ~700 are from one-two CFEB chips/CSC
  - ISR – FAST and SX5 – ISR pedestal differences have MEAN = 0-2 , RMS=1-3 and < 1-2% outside +- 5 ADC
  - FAST, ISR and SX5 strip pedestals agree



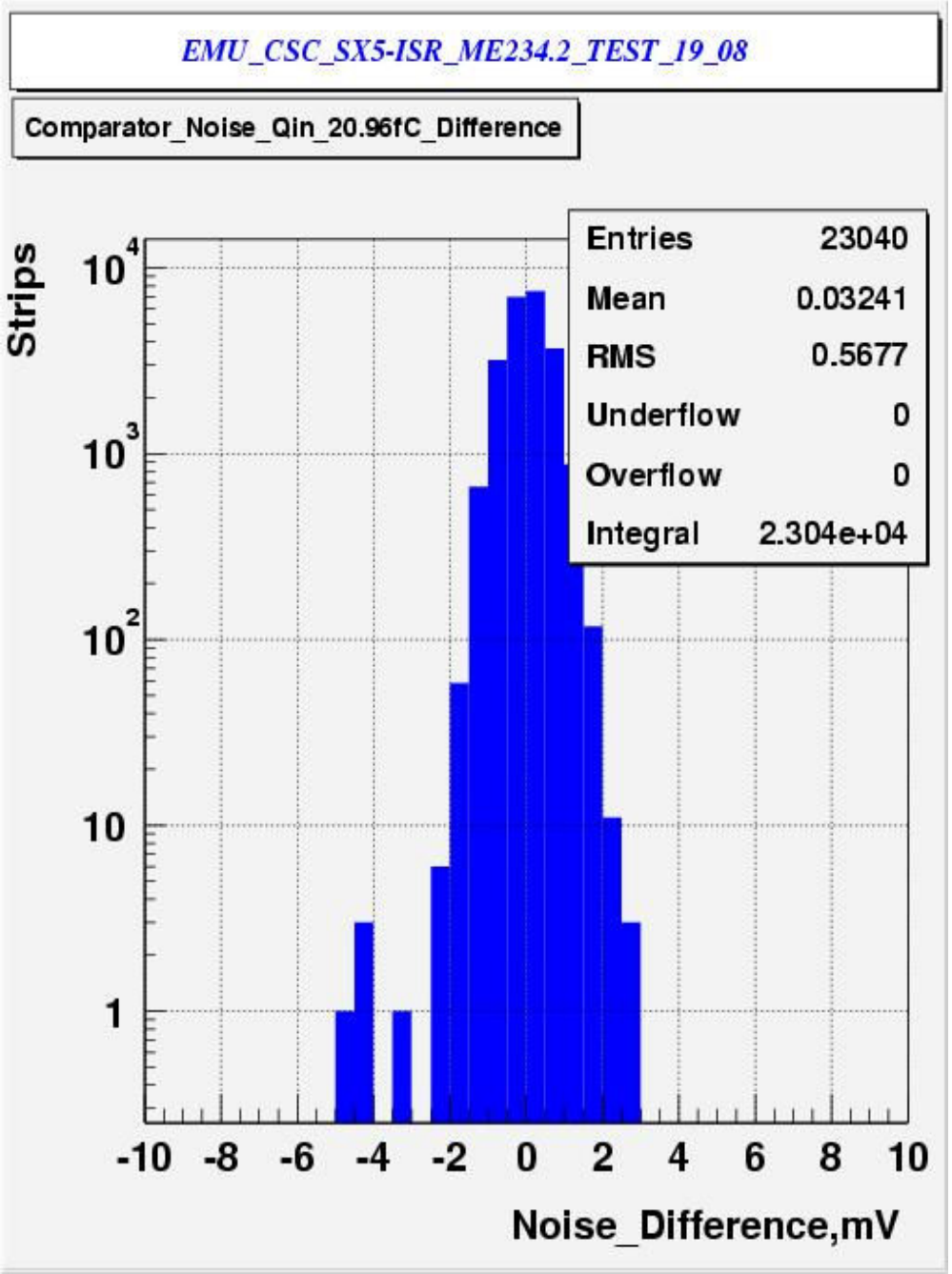
Examples of the test result distributions

- **Cathode strip pedestal RMS**
  - **Test 15_01**
  - **One-peak distributions at FAST sites, ISR and SX5**
  - **MEAN = 2.3-2.7, RMS=0.1**



Examples of the test result distributions

- **Cathode strip comparator noise**
  - Test 19_08
  - One-peak distributions at FAST sites, ISR and SX5
  - MEAN = 3.1-3.6, RMS=0.3-0.4
  - ISR vs FAST sites – no high noise tail at ISR
  - SX5 - ISR difference
    - MEAN=0, RMS=0.5-0.6 mV



Conclusions

- The list of tests and tables for the ROOT tree was finalized, the needed software was developed, analysis is in progress.
- Presented FAST site , ISR and SX5 results (noise, pedestals, thresholds, delays) are largely consistent.
- Future data will be included in the ROOT tree and monitored.