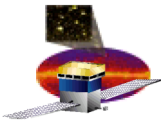**Gamma-ray Large Area Space Telescope**

GLAST Large Area Telescope:

TKR Data Processing Overview

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TKR

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Introduction

- **We cannot trend parameters for each TKR elements (800K strips, 14K GTFEs, 576 layers).**
  - **Trend tower (or layer) average of ratio of parameters for individual elements with respect to the references.**
  - **Requires offline processing.**
- **Parameters for TKR data processing and trending.**
  - **Calibrations (see Mizuno's talk for trending results).**
    - **GTFE threshold DAC.**
    - **GTFE calibration DAC (charge scale).**
    - **TOT gain parameters.**
    - **Channel thresholds.**
    - **Bad channels (dead, hot and disconnected).**
  - **Performance monitoring.**
    - **Hot strips.**
    - **Noise flare.**
    - **Efficiency.**
    - **Layer displacement.**
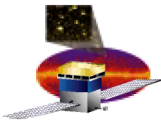   - **Tower displacement.**
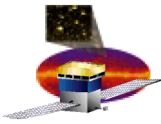
GTFE Threshold DAC Calibrations

- **Type of Data processing**
  - **Online script (TkrThresholdCal.py).**
- **Perquisites**
  - **GTFE charge scale.**
- **Output**
  - **LATTE type schema xml file.**
    - **Manually included as LATTE schema ancillary file.**
    - **LATTE schema file is converted to LATc to be used in LICOS.**
- **Trending**
  - **Offline python script to read the online test reports.**
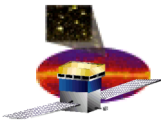 - **Manual handling of valid run number list.**
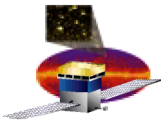
GTFE Charge Scale Calibrations

- **Type of Data processing**
  - **Offline muon data analysis (calibGenTKR/totCalib).**
- **Perquisites**
  - **Calibrated GTFE threshold DAC for muon data taking.**
  - **TOT gain parameters for each channel.**
- **Output**
  - **Special xml file.**
    - **Manually included as LATTE schema ancillary file for online scripts.**
      - **LATTE does not understand the contents**
      - **Only TKR online script parse the contents.**
      - **Not sure how LICOS handles this file.**
    - **Converted to a special ROOT file to be put into offline analysis database.**
- **Trending**
  - **Offline python script to read output xml file.**
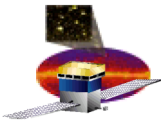 - **Manual handling of valid run number list.**

TOT Gain Parameters Calibrations

- **Type of Data processing**
  - **Online script (TkrTotGain.py).**
- **Perquisites**
  - **Calibrated GTFE threshold DAC.**
- **Output**
  - **Special xml file.**
    - **Converted to ROOT file and put into offline analysis database.**
    - **Direct access to the xml file from charge scale calibration job via job option.**
- **Trending**
  - **Offline python script to read online test reports.**
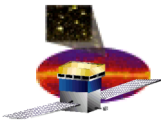 - **Manual handling of valid run number list.**

Channel Thresholds Calibrations

- **Type of Data processing**
  - **Online script (TkrThrDispersion.py).**
- **Perquisites**
  - **Calibrated GTFE threshold DAC.**
  - **GTFE charge scale.**
- **Output**
  - **Special xml file.**
    - **Converted to ROOT file and put into offline analysis database for MC generation.**
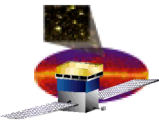- **Trending**
  - **N/A.**

Dead/Disconnected Channels Calibrations

- **Type of Data processing**
  - **Online script (TkrNoiseAndGain.py).**
  - **Offline data analysis (svac/EngineeringRoot/TkrHits).**
  - **Offline history analysis (calibGenTKR/totCalib).**
- **Perquisites**
  - **NONE.**
- **Output**
  - **Dead strip xml file.**
    - **Manually included as LATTE schema ancillary file.**
      - **LATTE schema file is converted to LATc to be used in LICOS.**
    - **Put into offline analysis database.**
- **Trending**
  - **Offline python script to read output xml file.**
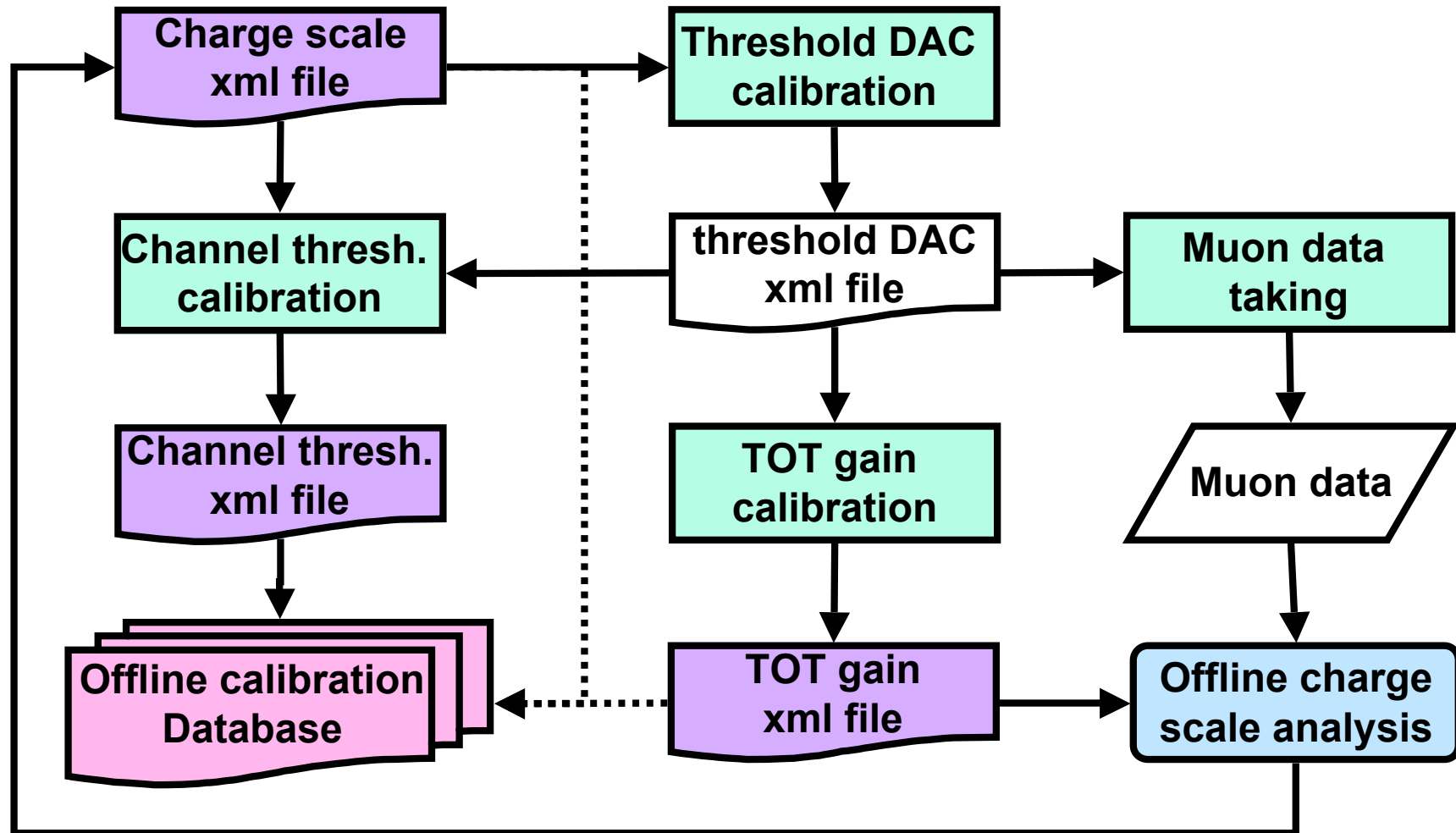 - **Manual handling of valid run number list.**
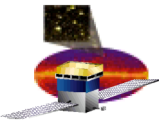
Hot Strips Calibrations

- **Type of Data processing**
  - **Online script (TkrNoiseOccupancy).**
  - **Offline data analysis (svac/EngineeringRoot/TkrNoiseOcc).**
  - **Offline history analysis (in development).**
    - **Offline data to mask new hot strips.**
    - **Online data to put cured strips into probation.**
- **Perquisites**
  - **NONE.**
- **Output**
  - **Hot strip xml file.**
    - **Manually included as LATTE schema ancillary file.**
      - **LATTE schema file is converted to LATc to be used in LICOS.**
    - **Put into offline analysis database**
- **Trending**
  - **Offline python script to read output xml file.**
  - **Manual handling of valid run number list.**
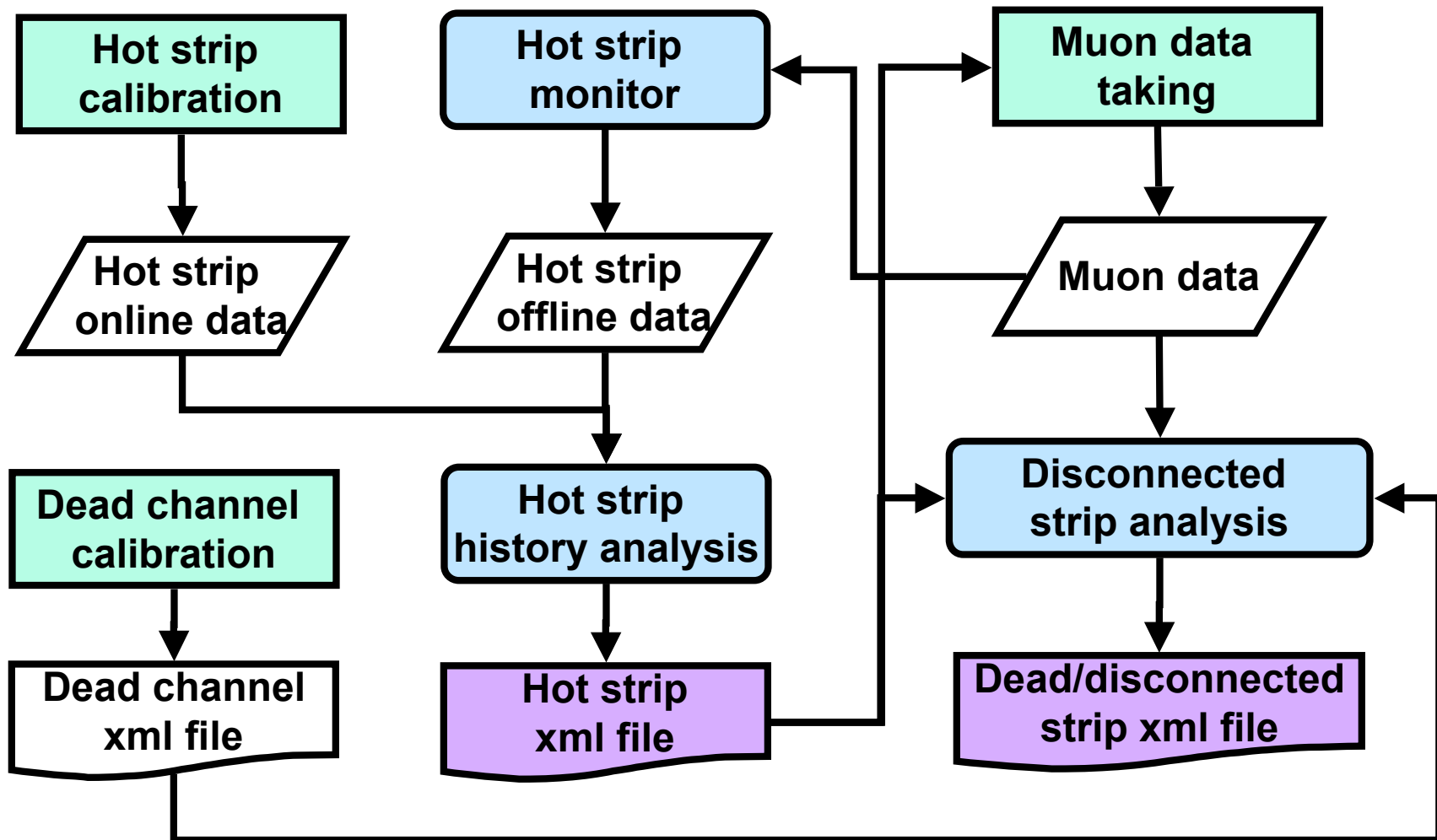
Calibration Data Processing Flow (1)

- **Data processing flow for threshold, charge scale, TOT gain.**

Charge scale xml file	**Threshold DAC calibration**	
Channel thresh. calibration	**threshold DAC xml file**	**Muon data taking**
Channel thresh. xml file	**TOT gain calibration**	**Muon data**
Offline calibration Database	**TOT gain xml file**	**Offline charge scale analysis**

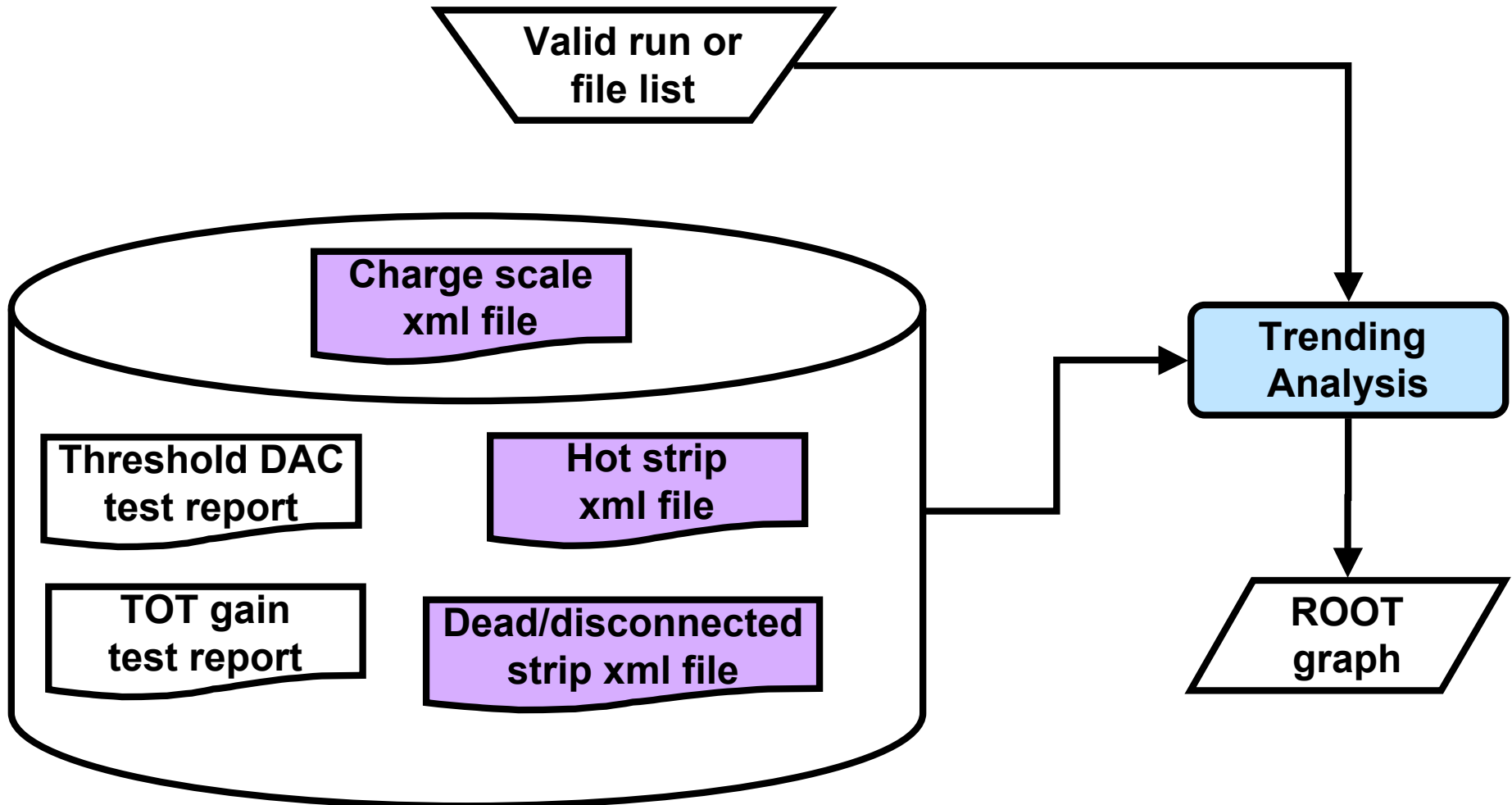# Calibration Data Processing Flow (2)

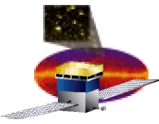- **Data processing flow for bad strips.**
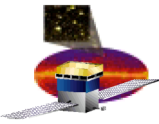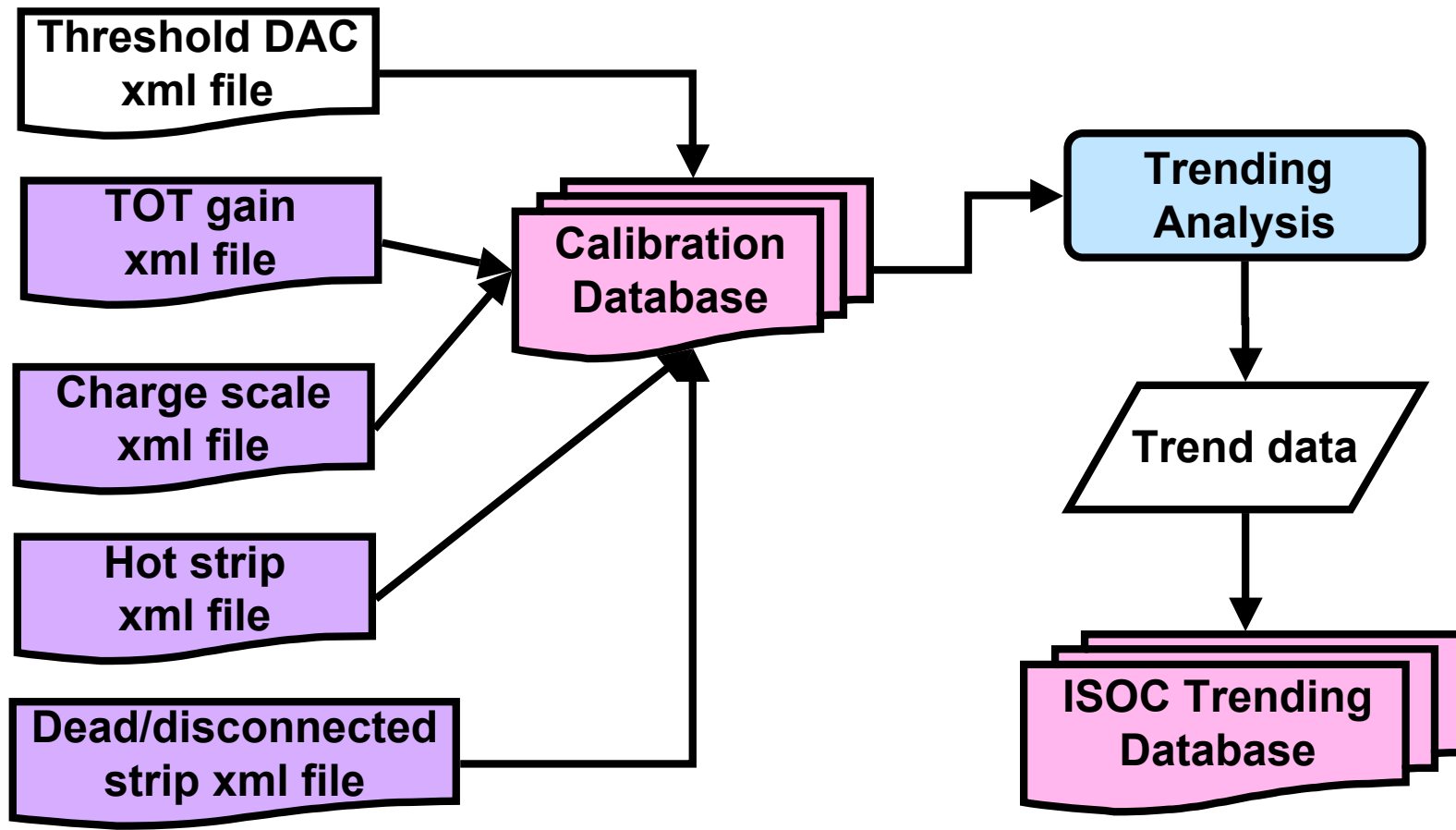
Current Calibration Data Trending Flow

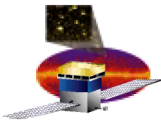- Currently there are too much manual processing.

Desired Calibration Data Trending Flow

- **Use database to keep track of parameters to be trended.**
 - **Should be common to the database for online schema files and offline calibration file.**

TKR Performance Monitor

- **Monitored Parameters**
  - **Hot strips, noise flare (see Sugizaki's talk).**
  - **Disconnected strips (see Mizuno's talk).**
  - **Efficiency, layer and tower displacements.**
- **Type of Data processing**
  - **Muon offline data analysis.**
    - **Built into SVAC ntuple processing.**
- **Perquisites**
  - **Calibrated TKR.**
- **Output**
  - **NONE defined so far.**
    - **Exist as ROOT histograms.**
- **Trending**
  - **Manual analysis of ROOT histograms.**
  - **Manual handling of valid run number list.**
    - **Some parameters require multiple runs.**
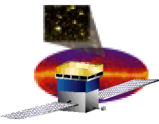
TKR Performance Trending Flow

- **Multiple runs need to be combined to get sufficient statistics.**
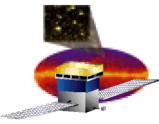 - **This part should be automated somehow.**
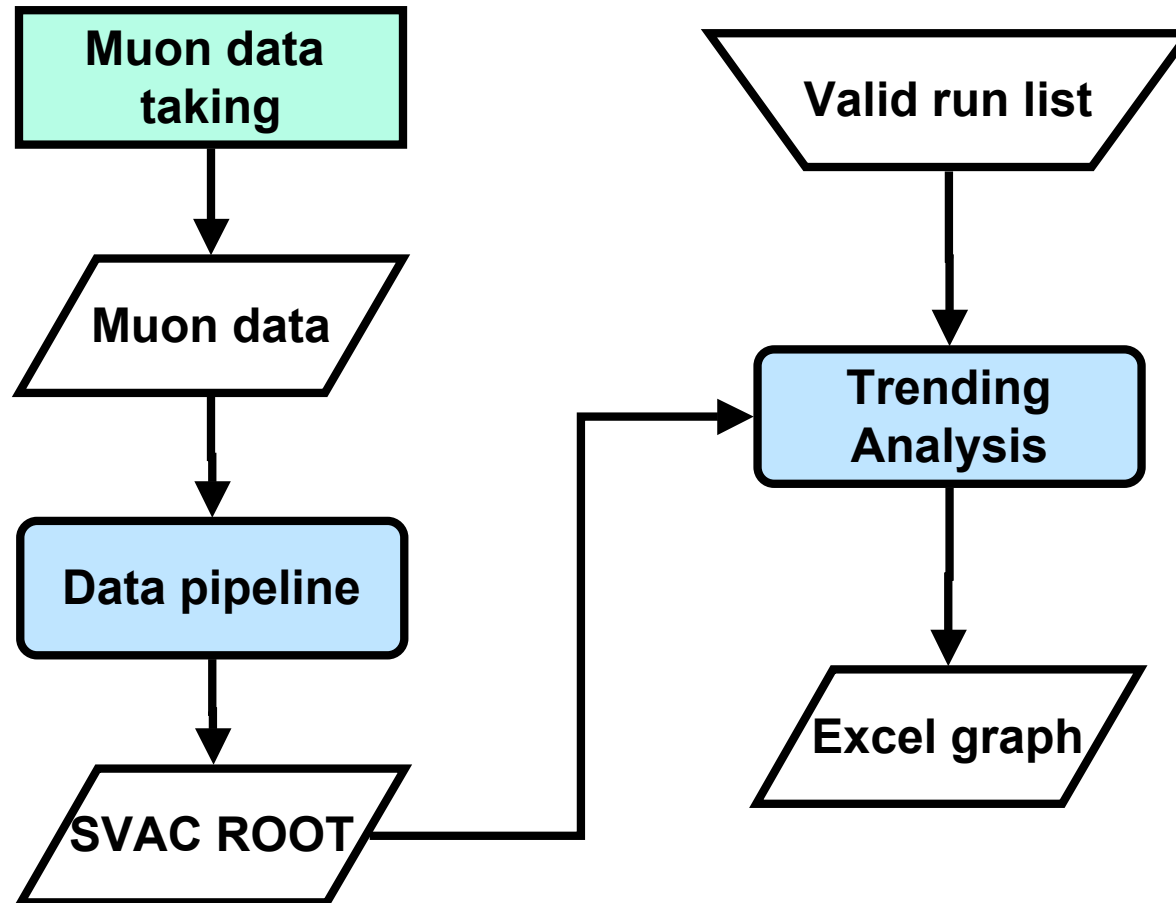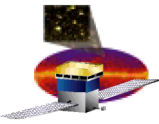
# Efficiency Trending Result

- **Consistent downward trend.**
  - **Inconsistent with stable bad strips.**
  - **Probably due to LAT configuration change.**
    - **Efficiency values depend on track quality and other factors.**
    - **Further improvement on track selections required to make it more stable.**
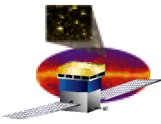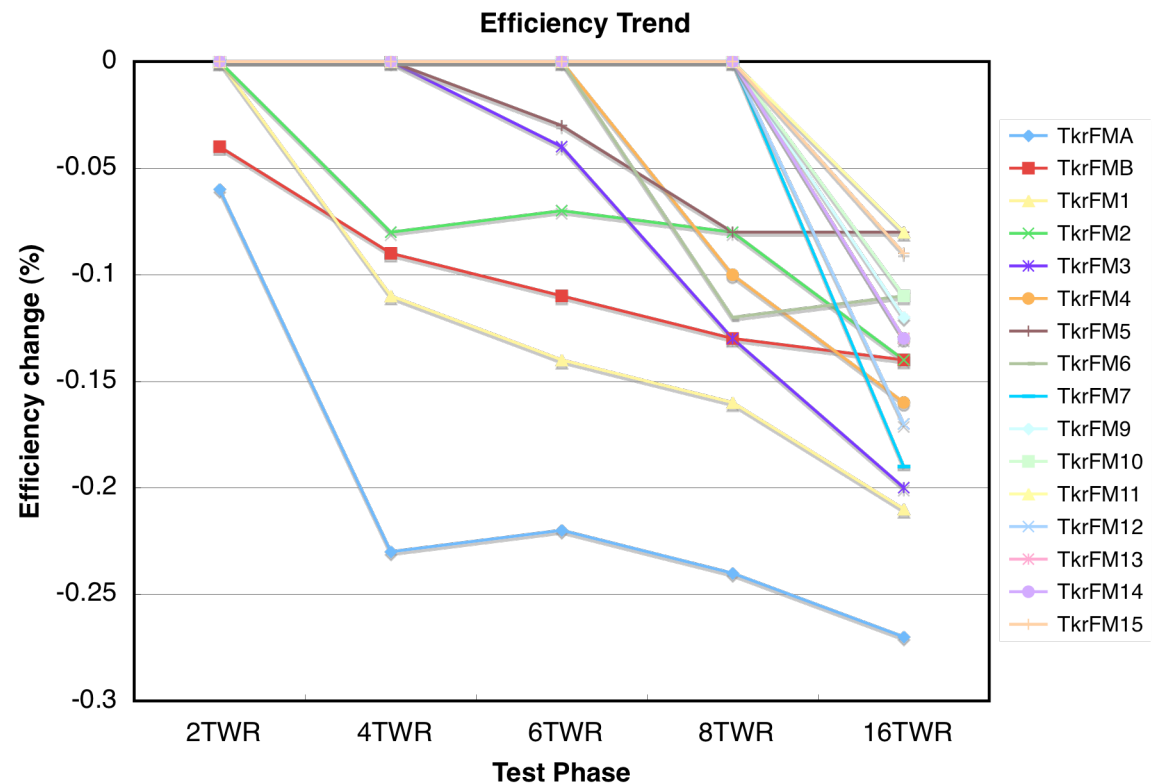
Layer Displacement Monitoring

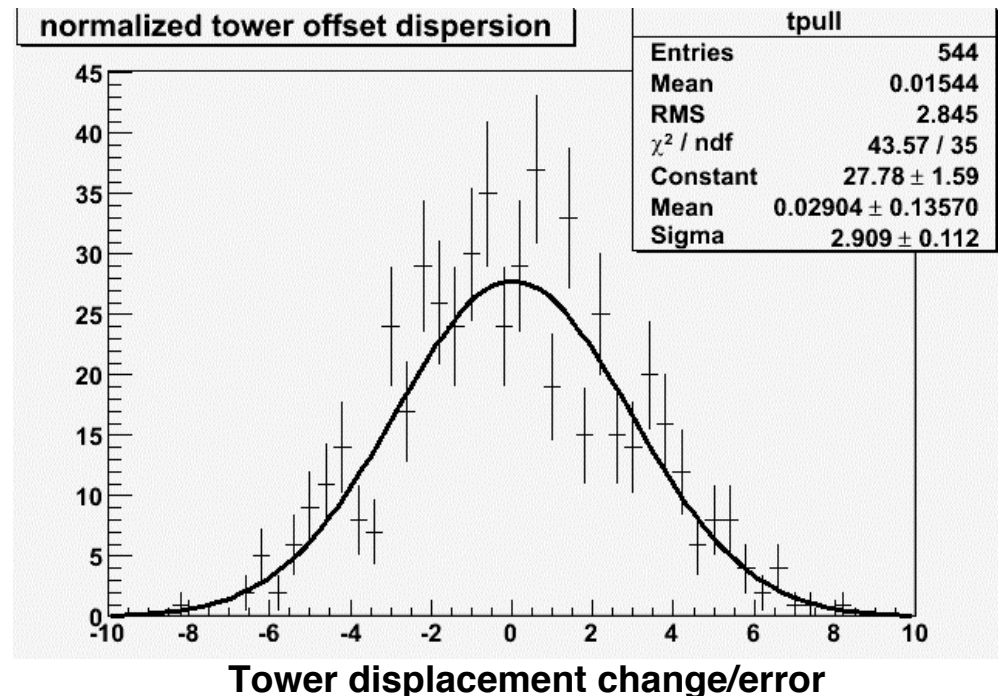- **Monitor average of residual from straight line fit within the tower.**
    - **The value depends on track angle distribution and other factors.**
    - **The result is consistent with Pisa alignment results.**
    - **Variation of the layer displacement from reference is consistent with statistical error.**
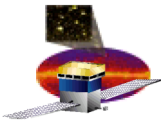   - **Issue warning if layer displacement is varied from the reference by more than 4σ.**
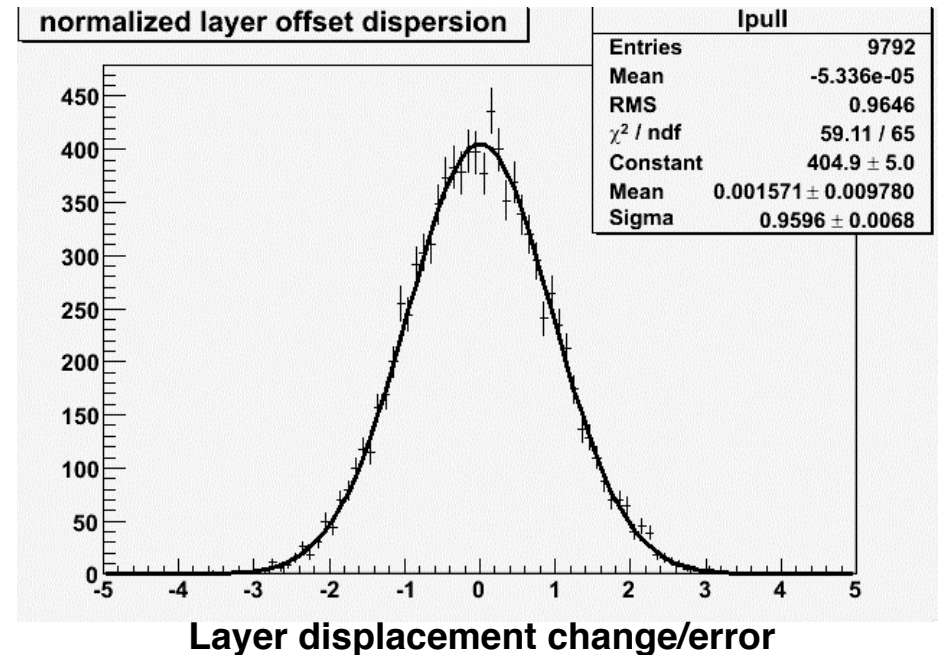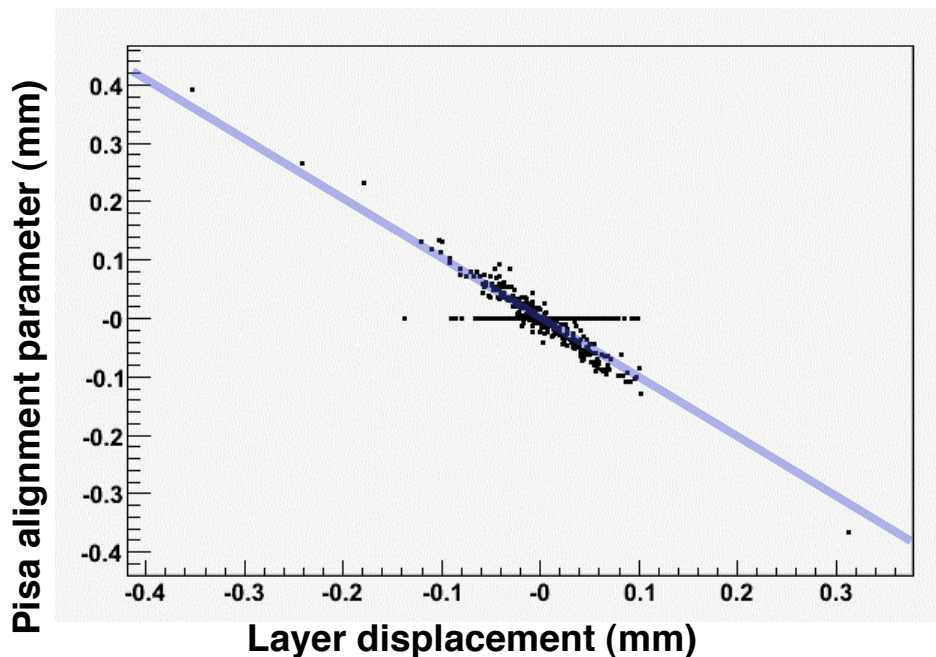
Tower Displacement Monitoring

- **Monitor average of residual from track extrapolated from adjacent towers.**
  - **The value depends on track angle distributions and tower configuration.**
    - **Comparison between different LAT configuration is not very meaningful.**
  - **Variation of the tower displacement from reference is NOT consistent with statistical error.**

normalized tower offset dispersion

tpull	
Entries	544
Mean	0.01544
RMS	2.845
χ^2 / ndf	43.57 / 35
Constant	27.78 ± 1.59
Mean	0.02904 ± 0.13570
Sigma	2.909 ± 0.112

Tower displacement change/error

Conclusions

- **Trending of TKR calibration data requires some offline analysis due to large number of elements involved.**
- **Calibration data trending requires much manual processing.**
  - **We would like to have database to store all valid (online/offline) calibration data to automate.**
  - **We would like to utilize ISOC trending tool for UI.**
- **TKR performance monitor is being implemented.**
  - **Basic data processing implemented in data pipeline.**
    - **Systematic effects on tower efficiency and displacement need to be addressed.**
  - **Automation required to combine multiple runs.**
  - **Interface to ISCO trending tool.**