## Purpose of the system

- monitor the quality of LAT science data, to ensure that the detector is performing as expected and to guarantee that data can be used for physics analysis

- hardware related quantities (identify possible anomalies), calibration related quantities (stability of the instrument performance), high-level quantities (physics rates, etc.)

- currently monitoring ~120,000 quantities: duty scientists inspect only a small subset; everything else is monitored through a series of automated alarms

- most quantities orbit dependent, so their behavior is always evaluated towards the detector environment

Implementation

- at each step of the data processing in the Level1 Pipeline, the relevant data quality information is stored in histograms (End-Of-Run quantities) or in a time-ordered database (trending quantities)

- the information is made available via web-based interface (duty scientists take their shifts from anywhere in the world)
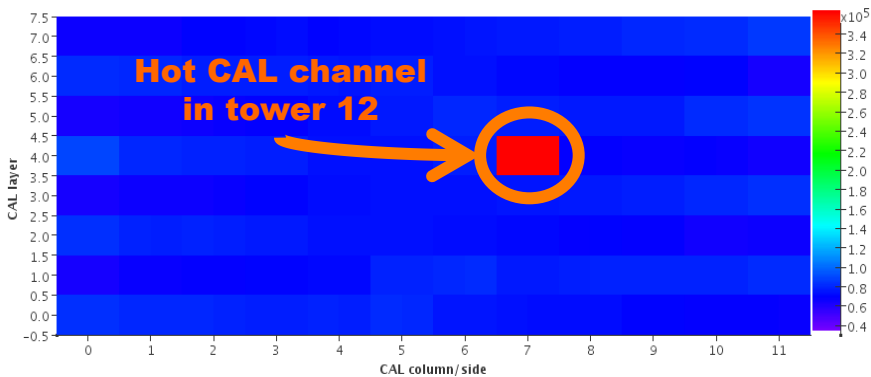

(Diagram by C. Sgrò)

DIFFERENT FLAVORS OF MONITORING
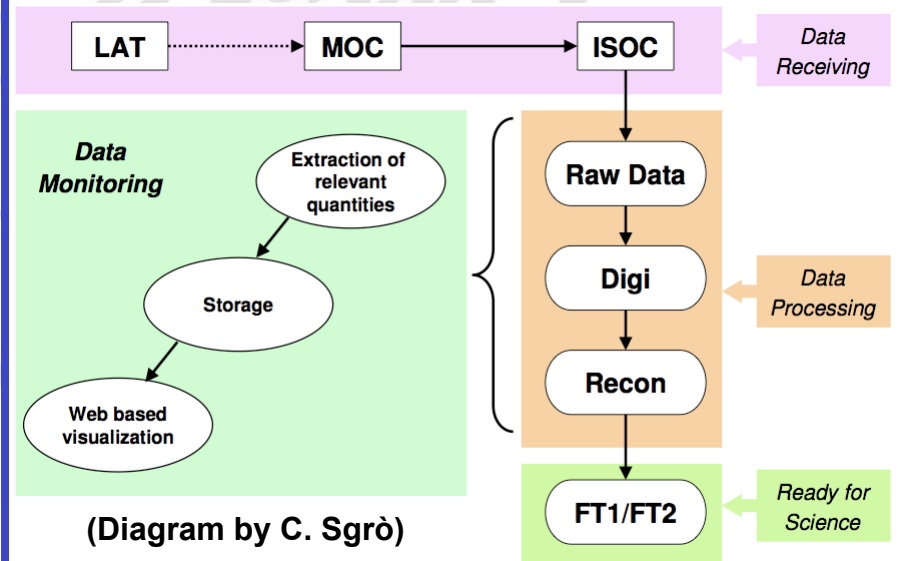
End-Of-Run monitoring

- occupancy plots filled for every subsystem (tower, TKR plane, CAL crystal, ACD tile…)
- identify hardware problems such as dead or noisy channels

Number of hits in each Cal log end for range 0 (LEX8) (tower=12)

Hot CAL channel in tower 12

Overall number of hits vs. Tkr plane and front-end chip (one per tower) (tower=0)

Dead front-end chip in TKR tower 0
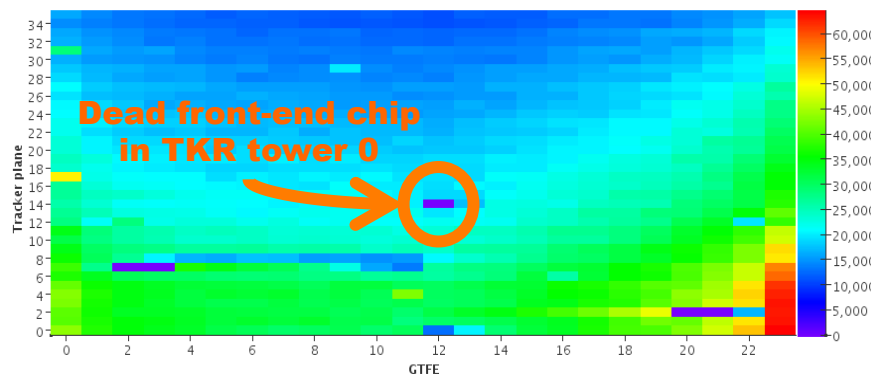
Trending

- particularly sensitive to changes in the detector conditions, on long time scales (pedestal drifts, calibration changes), and on short time scales (errors that manifest suddenly)

Truncated mean (only range [1,249] is used) ToT value per event in con0 (tower, plane) (tower=2,plane=20)

Entries : 1155
Y Mean : 32.924
Y Rms : 34.170

Single Event Upset

Sep 10, 2009   Time (UTC)

Truncated mean (only range [1,249] is used) ToT value per event in con0 (tower, plane) (tower=2,plane=20)

Entries : 1833
Y Mean : 27.746
Y Rms : 33.380

Successful GTRC Reset

Sep 11, 2009   Time (UTC)
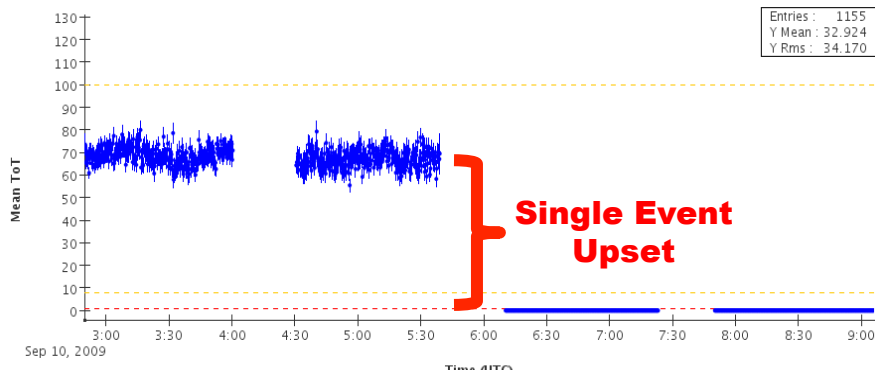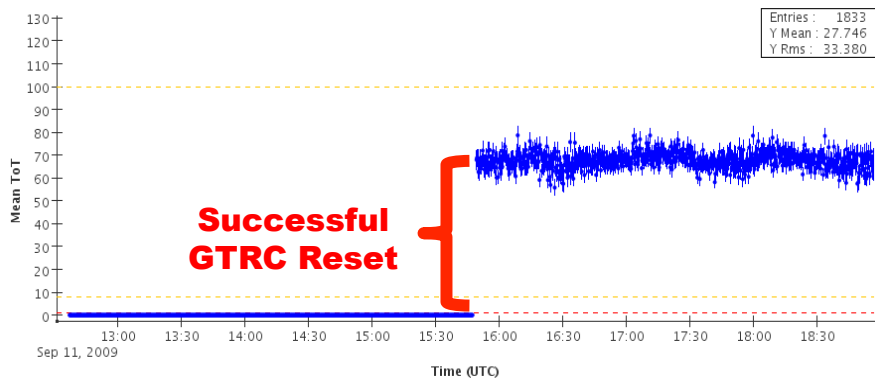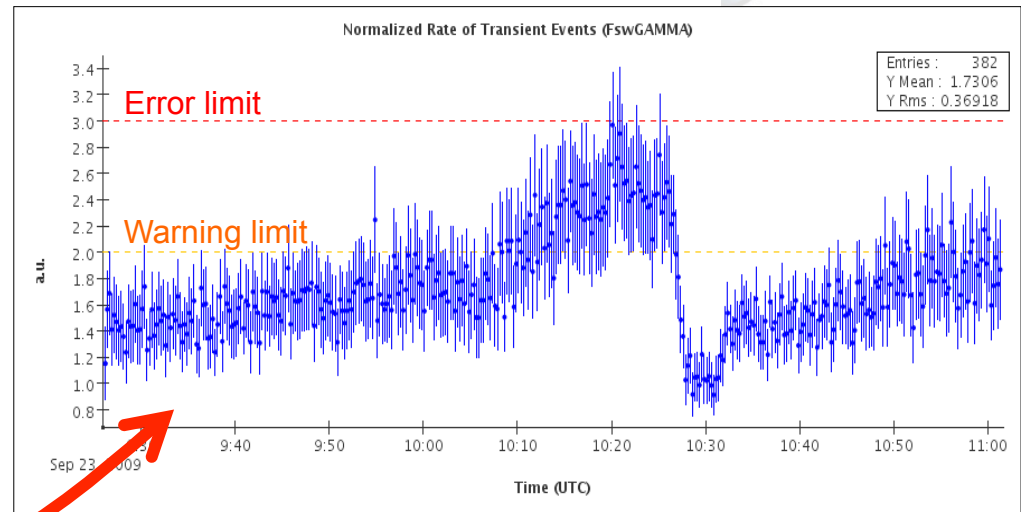
THE AUTOMATED ALARMS

- relevant quantities are automatically checked against limits (or reference histograms), producing a summary report on all the alarms for a given orbit
- whenever an anomaly is detected, a detailed report is generated and the duty scientist is informed via email

Alarms for one orbit of data

Mode	Type	Error	Warning	Undefined	Clean
acdPedsAnalyzer	Hist	0	0	0	14
calGainsAnalyzer	Hist	0	0	0	18
CalPed	Hist	0	0	0	2
calPedsAnalyzer	Hist	0	0	0	33
Digi	Hist	0	0	0	245
Digi	Trend	0	0	0	26
FastMon	Hist	0	0	0	224
FastMon	Trend	0	0	0	3
fastMonError	Trend	0	0	0	26
Merit	Hist	0	0	0	0
Merit	Trend	0	1	0	15
Recon	Hist	0	0	0	3479
Recon	Trend	0	0	0	3
TkrMon	Trend	0	0	0	5
verifyFt2Error	Trend	0	0	0	2
verifyLog	Trend	0	0	0	20

- alarms evaluated on trending and EOR quantities
- we implemented ~20 different alarm algorithms, to check for diverse pathological behaviors

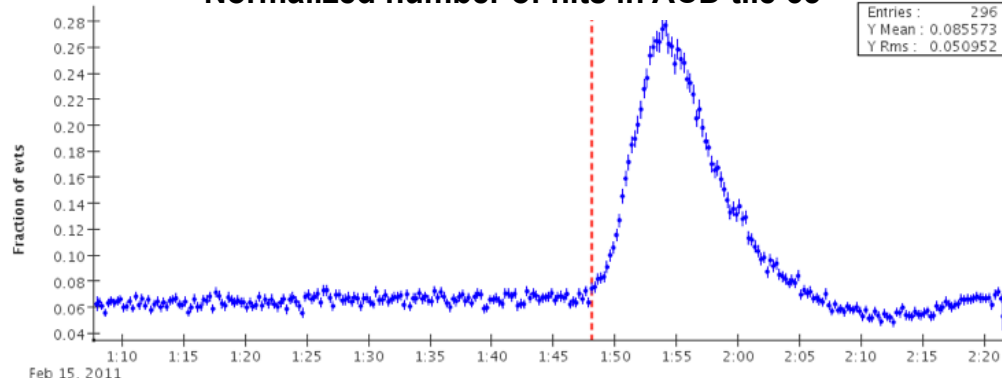Normalized Rate of Transient Events (FswGAMMA)

Entries : 382
Y Mean : 1.7306
Y Rms : 0.36918

Error limit

Warning limit

WARNING Status

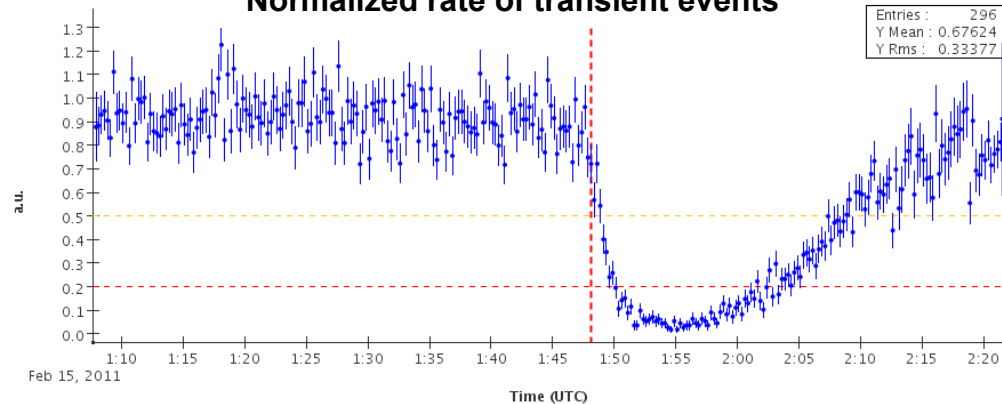| Severity	Mode	Type	Variable Name	Algorithm	Value	Limits	Details
5	Merit	Trend	OutF_NormRateTransientEvts	values	2.97 +- 0.81	[-1.0E10	-1.0E10	---	2.0	3.0]	View

DQM AND SOLAR FLARES

- the Sun is climbing out of its 2008 minimum
- the charged particles emitted during a solar flare trigger all sorts of alarms in the data monitoring
- X class solar flare detected on Feb 15th, 2011

Normalized number of hits in ACD tile 63

Entries : 296
Y Mean : 0.085573
Y Rms : 0.050952

Normalized rate of transient events

Entries : 296
Y Mean : 0.67624
Y Rms : 0.33377

GOES Xray Flux (5 minute data)   Begin: 2011 Feb 13 0000 UTC

Updated 2011 Feb 15 16:30:12 UTC   NOAA/SWPC Boulder, CO USA