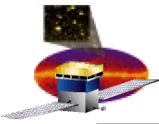


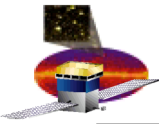
Ingredients

- **The hardware trigger rate depends on a number of factors, including:**
 - **background fluxes**
 - **orbit position, attitude (observatory)**
 - **hardware trigger configuration**



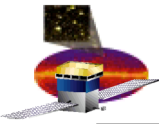
Backgrounds

- Background fluxes always seem to be increasing! Long story.
- Review convened. (Bill Atwood, Toby Burnett, Eric Grove, Francesco Longo, Julie McEnery, Tsunefumi Mizuno, Steve Ritz and Jonathan Ormes (Chair)).
 - see <http://confluence.slac.stanford.edu/display/SCIGRPS/Background+Flux+Review>
- Questions from the Charge:
 - * Are all the components identified? If not, what is missing and what are the likely quantitative impacts?
 - * For each component, are the spectra, orbit position variation, altitude extrapolation and other relevant parameters implemented correctly? Are other important data or reasonably reliable calculations not included?
 - * approximately how does each component change with altitude (over a change of +35 km and -150 km) and inclination (a change of -5 degrees)?
 - * **What is the precision of knowledge for each component? How much higher or lower might the background rate be for each component? What are the dominant contributions to the uncertainties and why?**
 - * **SAA: is the size and location of the SAA approximately correct? Are the background fluxes in the neighborhood of the SAA appropriately modeled?**
 - note: we don't operate in the SAA



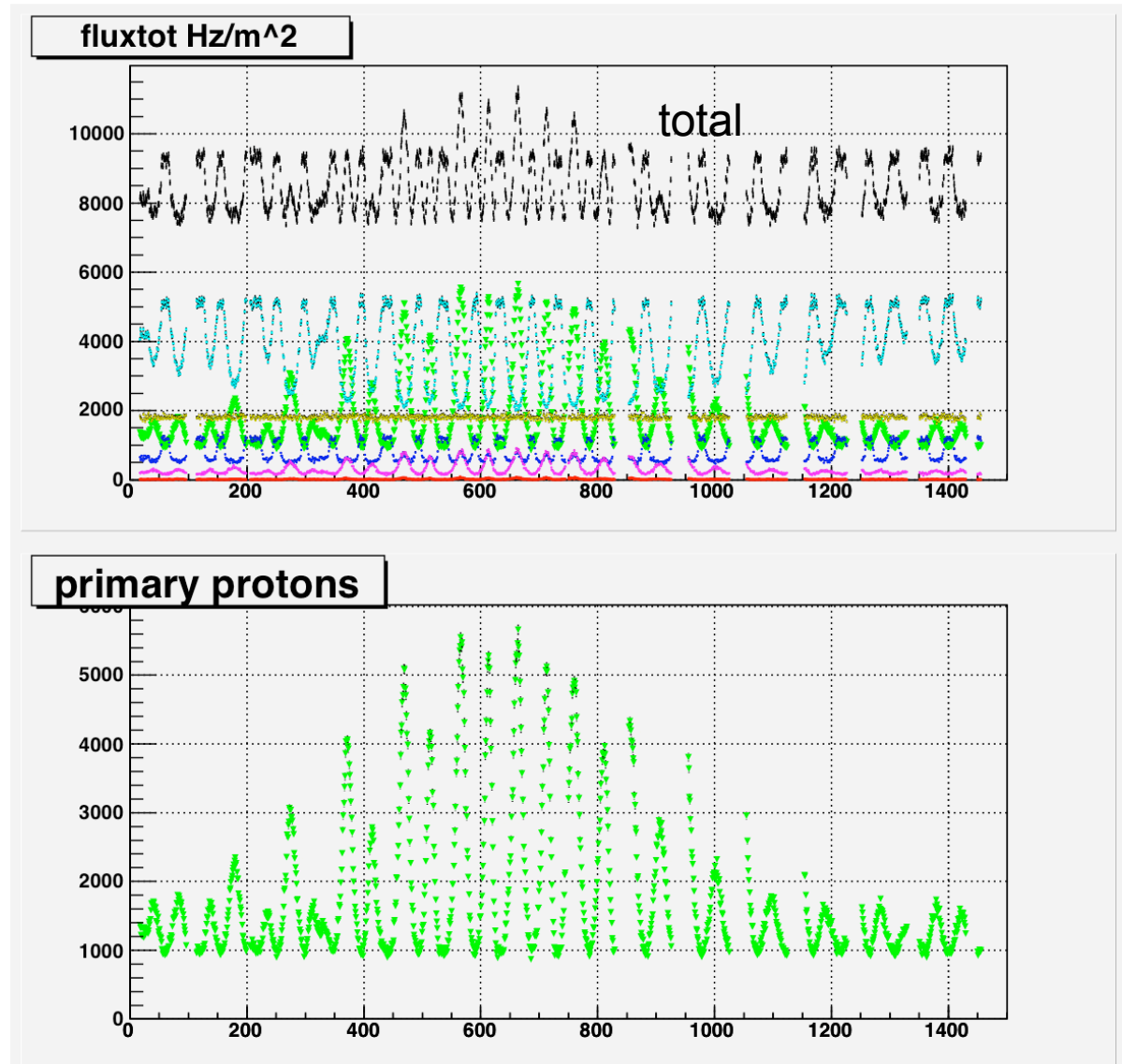
DC2 Background Model

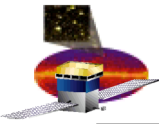
- **Bottom line for now: flux in the DC2 background model is about right, to the best of our knowledge**
 - **see <http://confluence.slac.stanford.edu/display/SCIGRPS/Background+Fluxes>**
- **Strong variation of components with orbit position, plus SAA.**
 - **lesson: a single-orbit average can be misleading. There are better ways to characterize the rates than avg and max (see later slides).**
- **To study background, did special runs (linked to above pages) (thanks, Richard&co!):**
 - **Full day all-sky survey orbit**
 - **Sample for 0.1 seconds every minute. The total livetime is thus 124 seconds (1440 minutes total, of which 201 minutes were in the SAA.)**
 - **Keep all events (including those that miss the observatory) for this study**



Integral Flux ($E > 10$ MeV) Variations

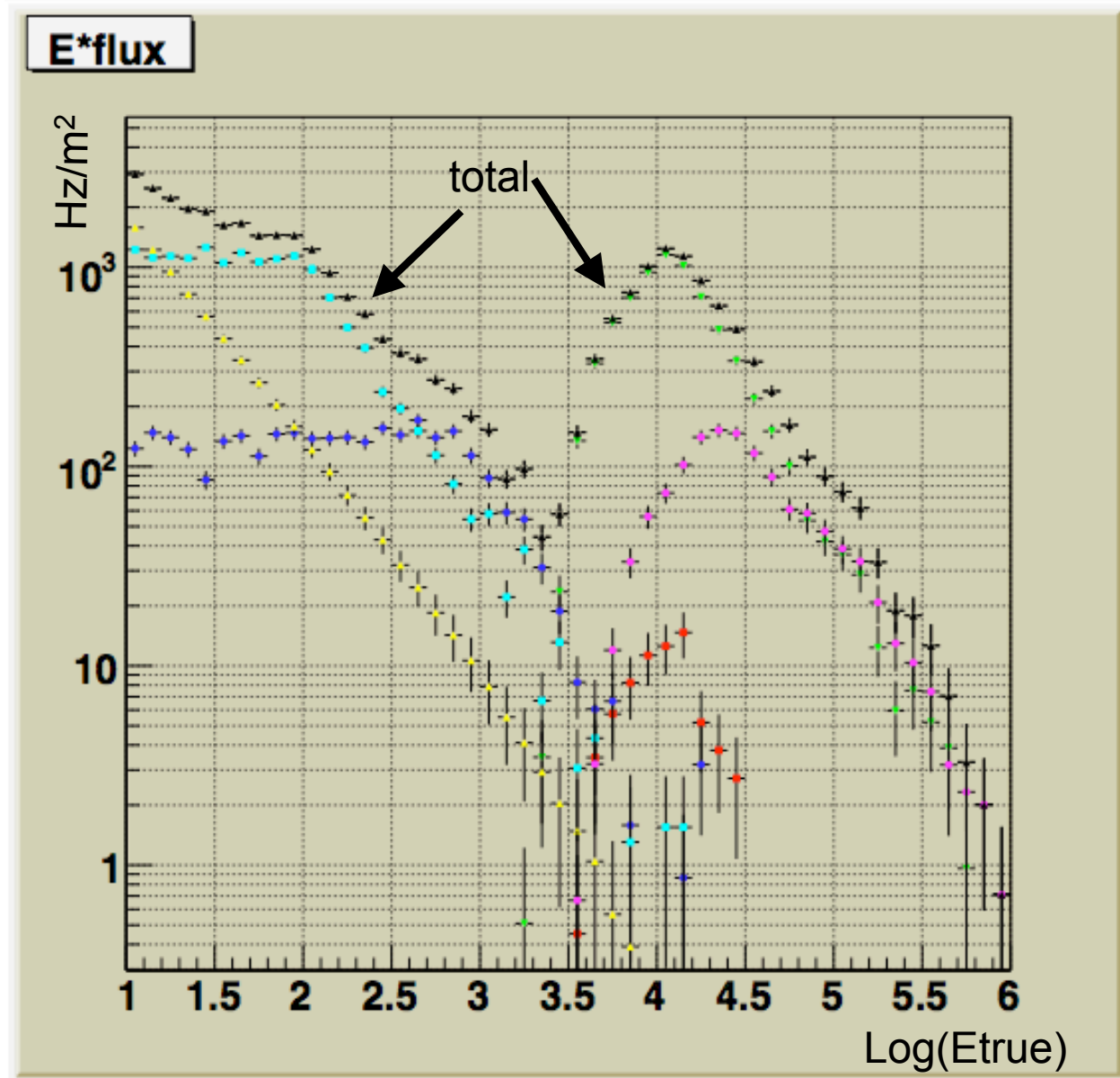
- **Components:**
 - Albedo e^+e^-
 - Primary (GCR) protons
 - Albedo gammas
 - Albedo $p+pbar$
 - Heavy ions
 - Galactic Cosmic Ray electrons
- **Note the different variations with orbit position!**
- [tuple and macros attached to confluence page, previous slide]

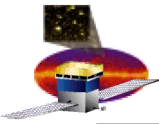





Flux Spectra (one-day average)

- **Components:**
 - Albedo e^+e^-
 - Primary (GCR) protons
 - Albedo gammas
 - Albedo $p+pbar$
 - Heavy ions
 - Galactic Cosmic Ray electrons





Hardware Trigger Configuration

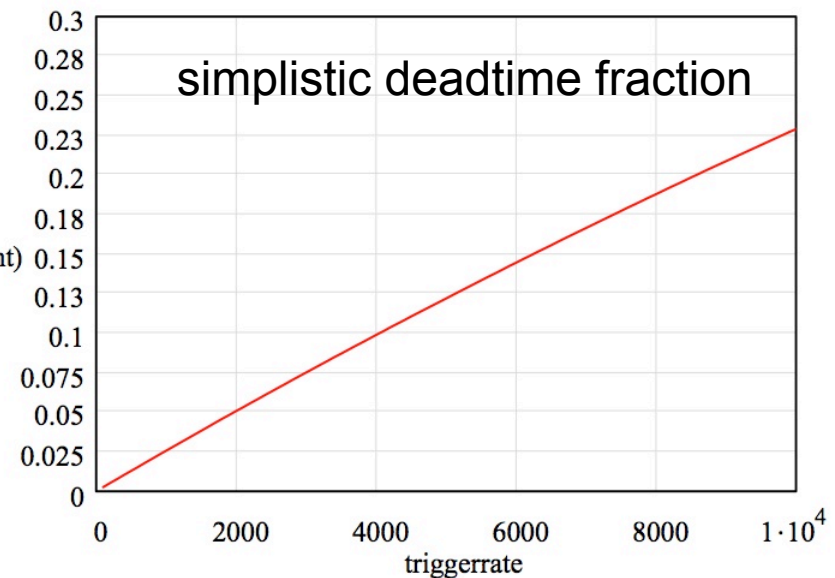
- Elements are TKR, CAL-LO ($E_{\text{xtal}} > 100$ MeV), CAL-HI ($E_{\text{xtal}} > 1$ GeV), and VETO (see below).
- Studied combinations (see <https://confluence.slac.stanford.edu/display/SCIGRPS/Resulting+Trigger+and+Filter+Rates>)
 - plot day history and histogram of rate sampled every minute over the day (better than simple “average” and “max”) 
- Keep an eye on the deadtime! If the background rates are really as high as the DC2 model, it is certain that we will use the ACD veto in the hardware trigger:

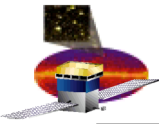
Associate list of ACD tiles with each TKR tower.

If any such ROI tile fires, veto the event.

[does not include bottom two rows of tiles!]

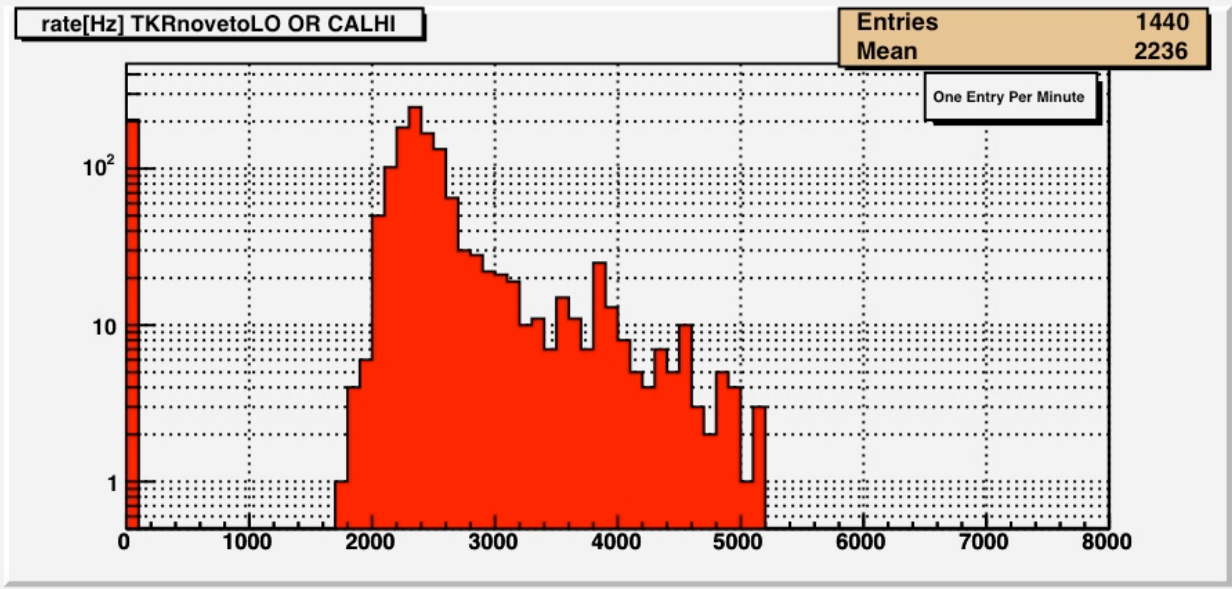
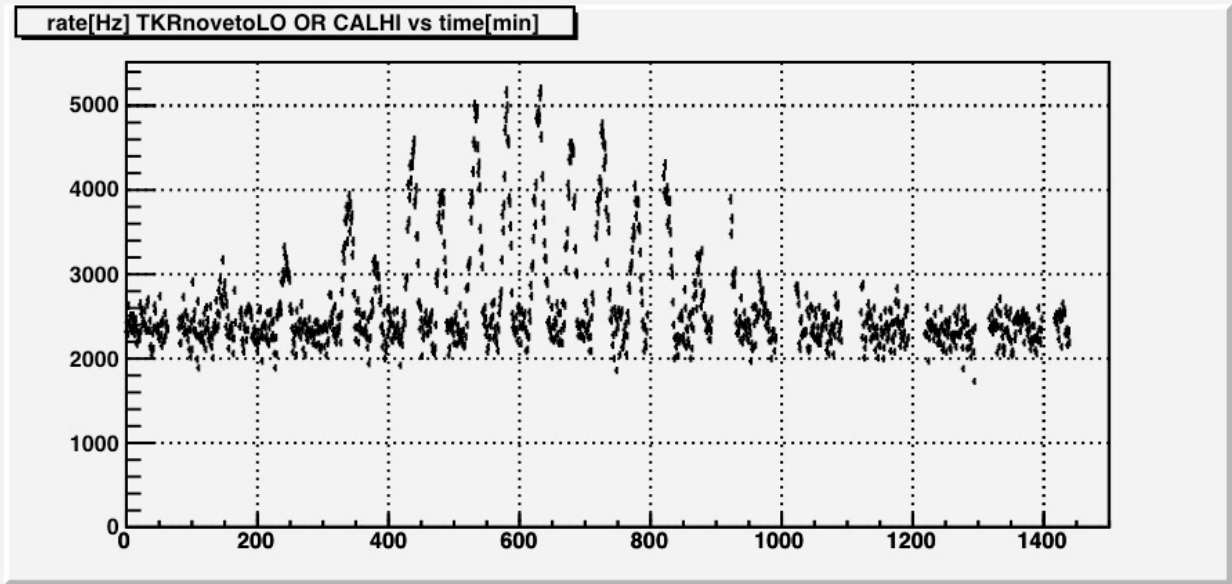
$$1 - \text{dpois}(0, \text{triggerrate} \cdot \text{perevent})$$



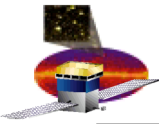


(TKR&&(!VETO||CAL-LO))||CAL-HI

- **Daily-average operating rate (outside SAA): 2.6 kHz**

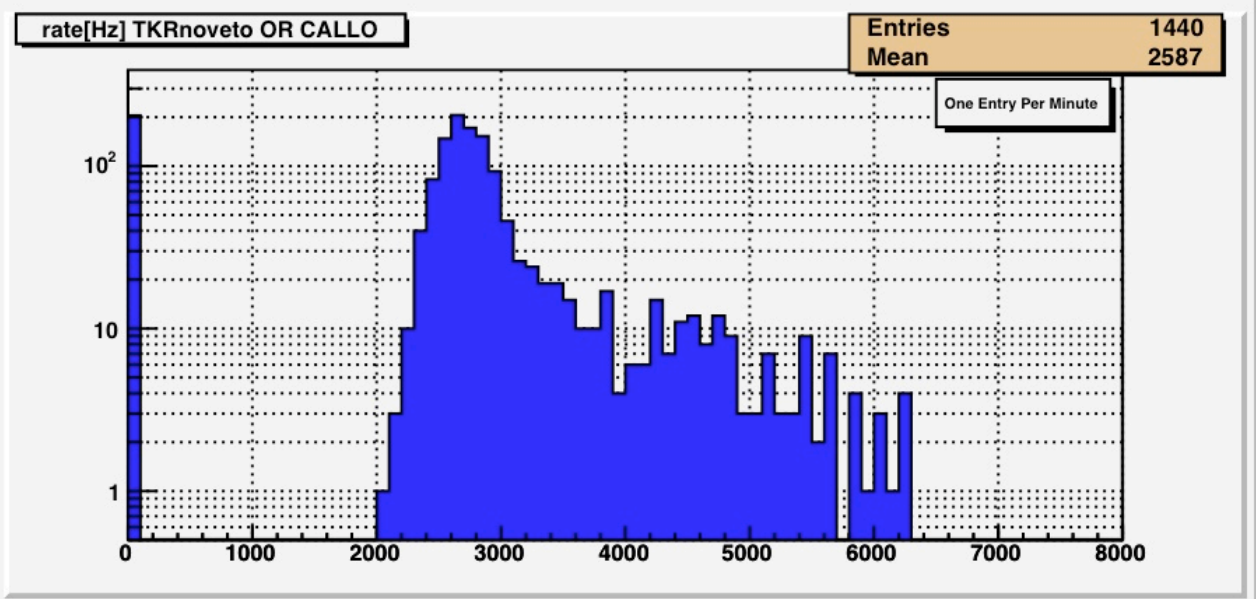
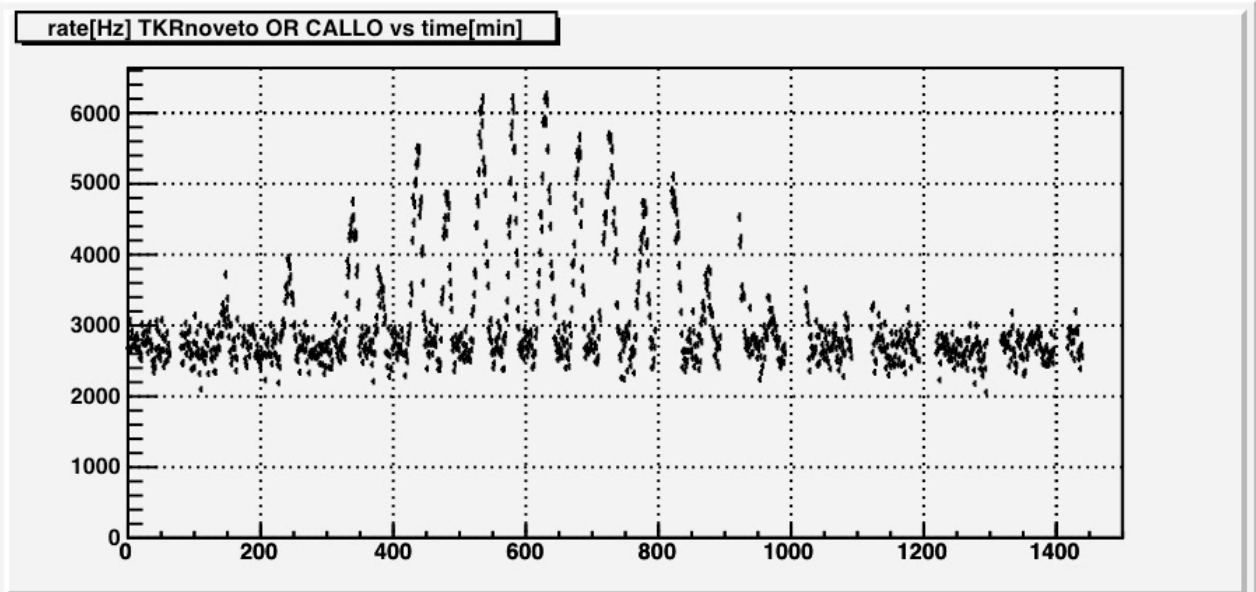


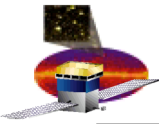
Note: tuple and macros attached to confluence page, previous slide



(TKR&&!VETO)||CAL-LO

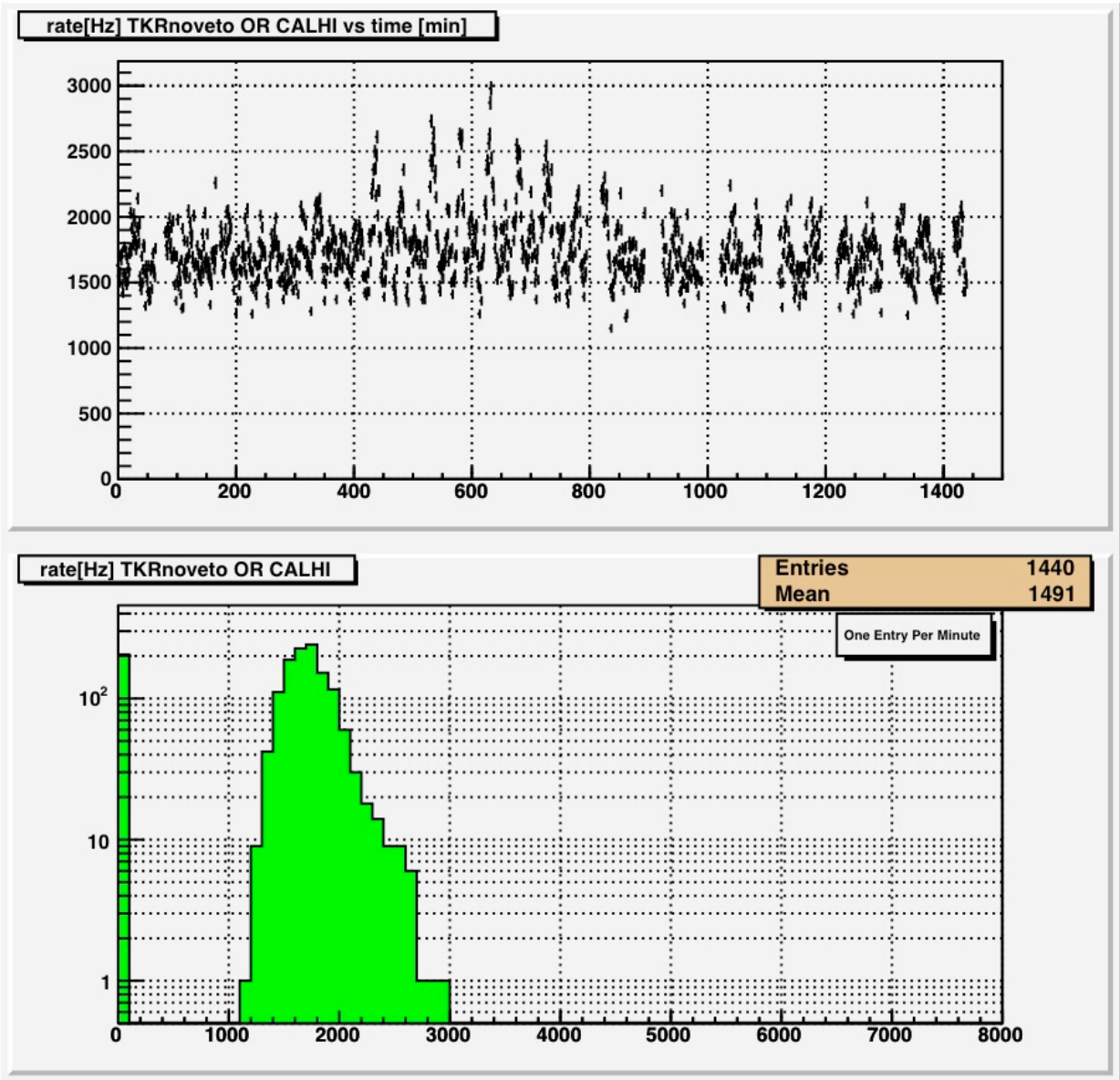
- **Daily-average operating rate (outside SAA): 3 kHz**
- **Choose whether or not to prescale CAL-LO ONLY events (see slide 11)**

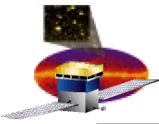




(TKR&&VETO)||CAL-HI

- **Daily-average operating rate (outside SAA): 1.7 kHz**
- **NOT A RECOMMENDED CONFIGURATION, since we want to turn off VETO at lower energy. See next slide**
- **[Note the smaller orbit variation.]**





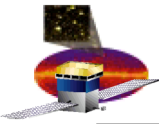
Real Trigger Engines

- See work by Eric Grove and David Smith: <http://www-glast.slac.stanford.edu/software/AnaGroup/2006-feb6-TriggerEngines.pdf>

Engine number	Condition Summary								Trigger Context				<Rate> (Hz)	Purpose
	external	solicited	periodic	CNO	CAL-HI	CAL-LO	TKR	ROI	Zero supp	Ranges	Prescale	Marker		
3	0	0	0	1	0	1	1	1	yes	4-mg	0	5	200	GCR calibration
	0	0	0	1	1	1	1	1						
4	0	0	0	1	0	0	0	0	yes	1-mg	255	7	5	Other "CNO" triggers
	0	0	0	1	0	0	1	0						
	0	0	0	1	0	0	1	1						
	0	0	0	1	0	1	0	0						
	0	0	0	1	0	1	1	0						
	0	0	0	1	1	0	0	0						
	0	0	0	1	1	0	1	1						
	0	0	0	1	1	1	0	0						
	0	0	0	1	1	1	1	0						
	0	0	0	1	1	1	1	0						
5	0	0	0	0	1	0	0	0	yes	1-mg	0	2	100	HE gammas
	0	0	0	0	1	0	1	0						
	0	0	0	0	1	0	1	1						
	0	0	0	0	1	1	0	0						
	0	0	0	0	1	1	1	0						
	0	0	0	0	1	1	1	1						
6	0	0	0	0	0	0	1	0	yes	1-mg	0	1	1500	Gammas
	0	0	0	0	0	1	1	0						
7	0	0	0	0	0	1	0	0	yes	1-mg	0	4	400	CAL-only gammas
8	0	0	0	0	0	1	1	1	yes	1-mg	0	3	700	Self-vetoed gammas
9	0	0	0	0	0	0	1	1	yes	1-mg	255	6	20	Leakage of protons

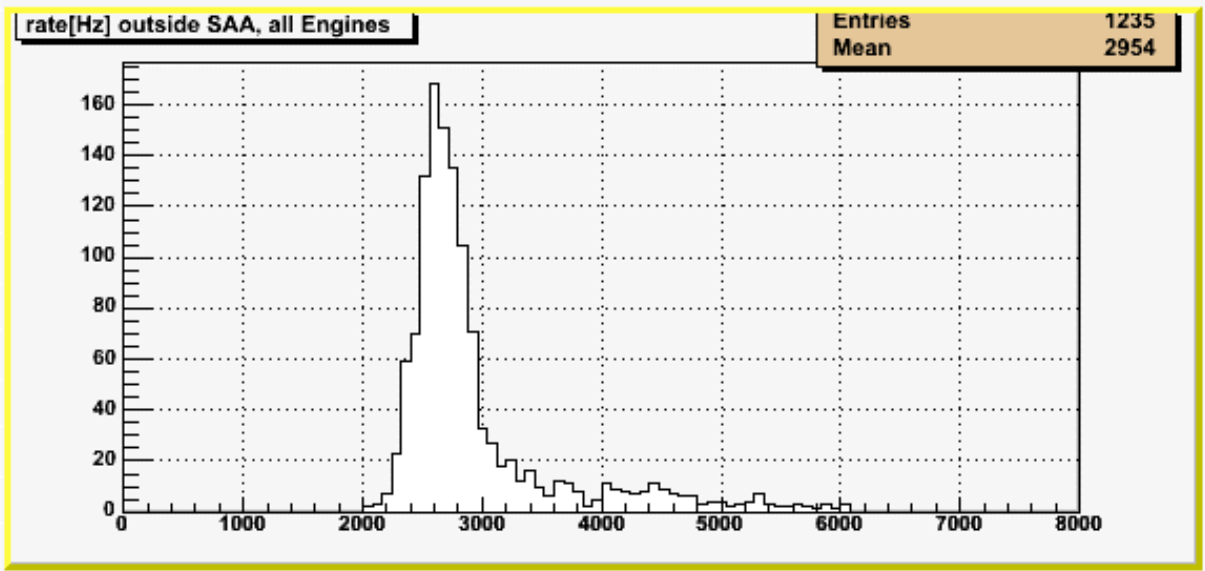
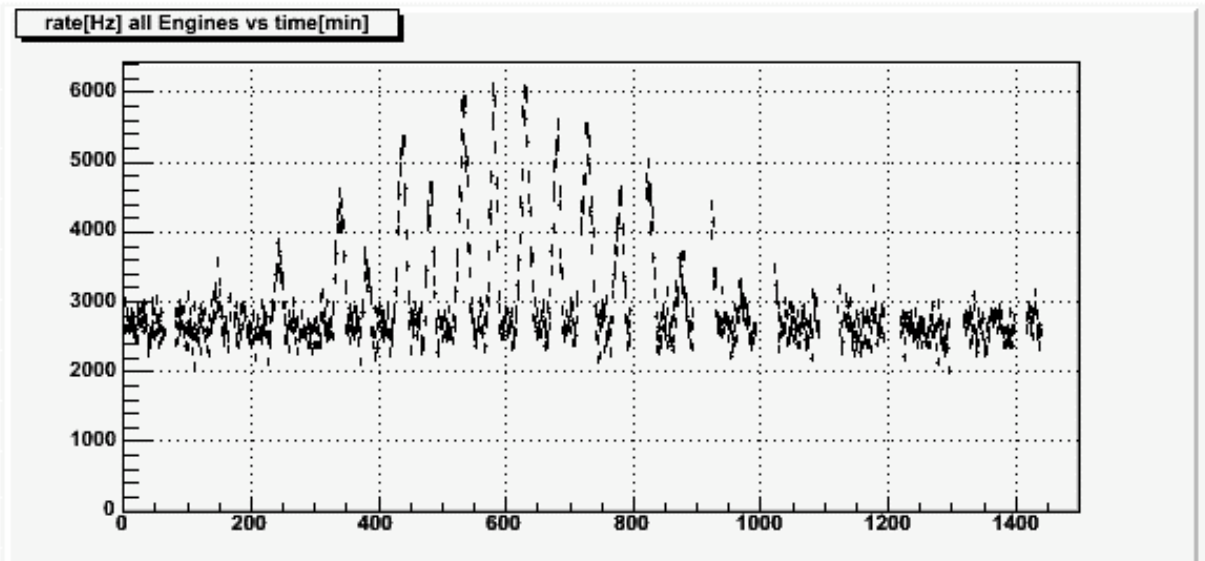
Notes:

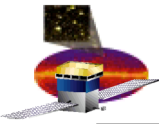
- CAL-LO-ONLY un-prescaled adds 400 Hz (and accompanying deadtime)
- With CAL-LO-ONLY not prescaled, the yellow box reduces to (TKR AND !VETO)||CAL-LO||CAL-HI. Of course, expect CAL-LO with every CAL-HI.



Total rate for all Engines (Eric's talk)

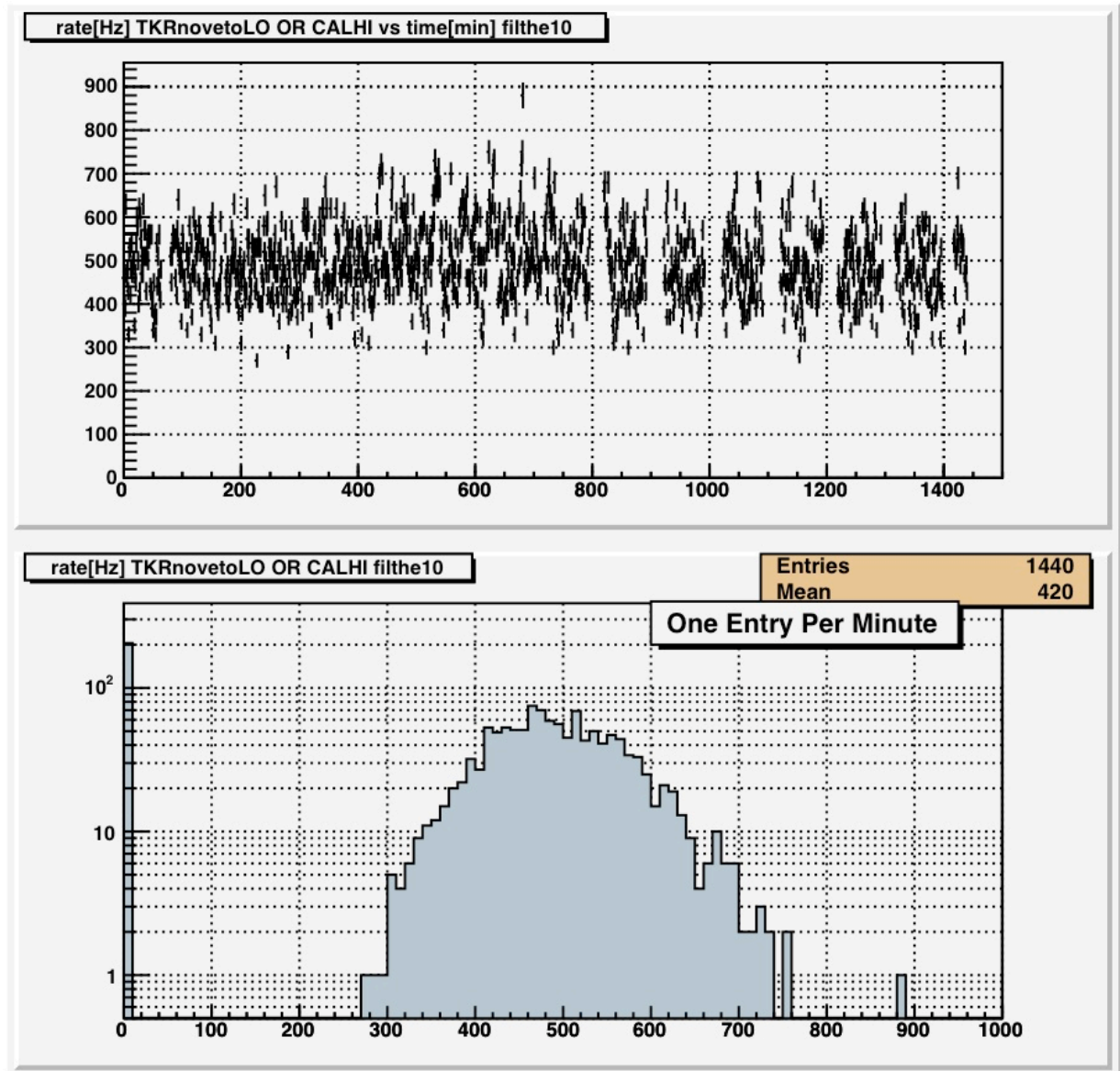
- Sum of rate from all Engines
 - Note
 - Dropouts in SAA, where triggering is disabled
 - Peak rates occur away from SAA
 - Histogram includes only time outside SAA
 - Mean ~ 3 kHz
 - Peak ~ 6 kHz

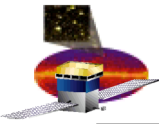




Next: Rates Out of the Filter (to the ground)

- depends on the hardware trigger configuration.
Example:
(TKR&&(!VETO||CAL-LO))||CAL-HI
- Standard filter PLUS keep any event with raw cal energy >10 GeV
- Daily-average event rate is 420 Hz (a bit high).
[Reduces to 390 Hz when raise auto-accept to 20 GeV.] What matters is data rate.
- See confluence page for other configurations and details.
- See R. Hughes talk.





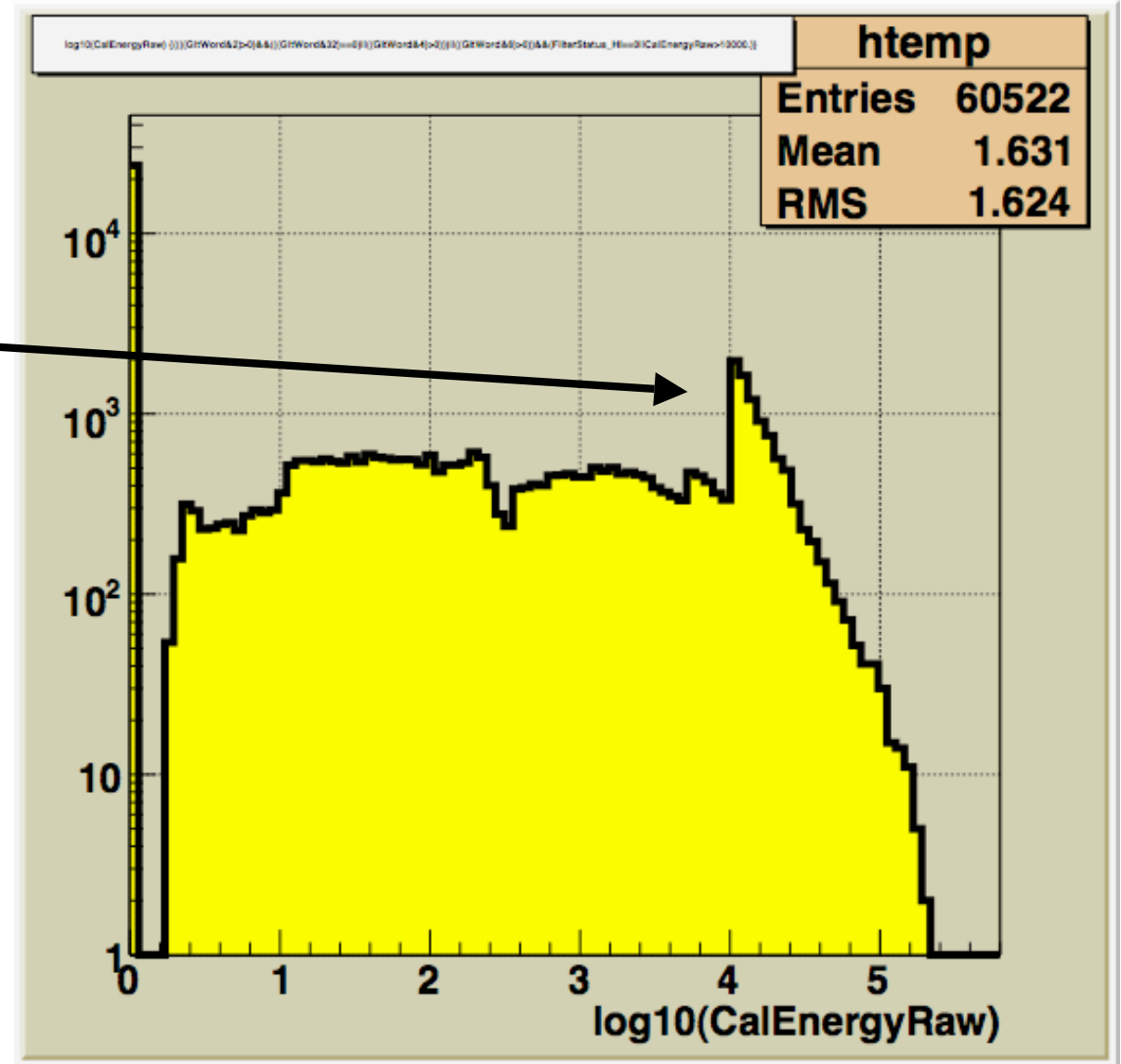
Raw CAL Energy of Events Passing the Filter

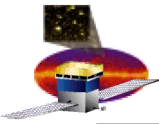
- Same config as previous slide:

- (TKR&&(!VETO||CAL-LO))||CAL-HI
- Standard filter PLUS keep any event $E > 10$ GeV

- Notes:

- ~half the events at zero (NOT due to the SAA)!
- ~flat in $\log(E)$ up to 10 GeV
- recall livetime is 144.4 sec, so this corresponds to 420 Hz





More work...

- **Another background model update**
- **Pending changes to the filter**
 - **check let through the prescaled monitoring/calibration triggers, CNOs.**
 - **additional use of total CAL energy: keep event if $E > E_{min}$ no matter what; also enable possibility to cut events with zero CAL energy deposition (as a contingency measure -- NOT currently part of baseline).**
 - **alternative filter approaches for future implementations under discussion.**
- **Study implications of additional rate reduction measures for both trigger and filter (be prepared!).**
- **Studies to design early observations and analyses to tune the background model!**
- **Join the fun! This is a frequent topic at the Monday Calibration and Analysis Methods Monday VRVS meeting.**