Analysis of four Flight Software Runs

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(with the help of Eduardo)

SLAC April 21 2006

Summary

- FSW Runs 077002163 – 077002164 – 077002165 – 077002166
  - Total time: 3126 s
  - Total counts: 1283691 events
- Engine Rate
  - No solicited and periodic trigger
- Study of the Tracker trigger rate
- Study of ROI trigger rate
  - understanding GemRoiVector, GemTkrVector and GemConditionsWord
  - as the structure of the ACD and the ROI definition affect the data
- Study of the trigger rate with different cuts
  - TkrNumTracks>0
  - TkrNumTracks==1
  - TkrNumTracks==2

Shadow ROI trigger conditions

ACD map

Shadow ROI conditions

roi0 = 000, 001, 010, 011, 100, 101, 110, 111,200, 201, 210, 211

roi1 = 001, 002, 011, 012, 201, 202, 211, 212

roi2 = 002, 003, 012, 013, 202, 203, 212, 213

roi3 = 003, 004, 013, 014, 203, 204, 213, 214, 300, 301, 310, 311

roi4 = 010, 011, 020, 021, 101, 102, 111, 112

roi5 = 011, 012, 021, 022

roi6 = 012, 013, 022, 023

roi7 = 013, 014, 023, 024, 301, 302, 311, 312

roi8 = 020, 021, 030, 031, 102, 103, 112, 113

roi9 = 021, 022, 031, 032

roiA = 022, 023, 032, 033

roiB = 023, 024, 033, 034, 302, 303, 312, 313

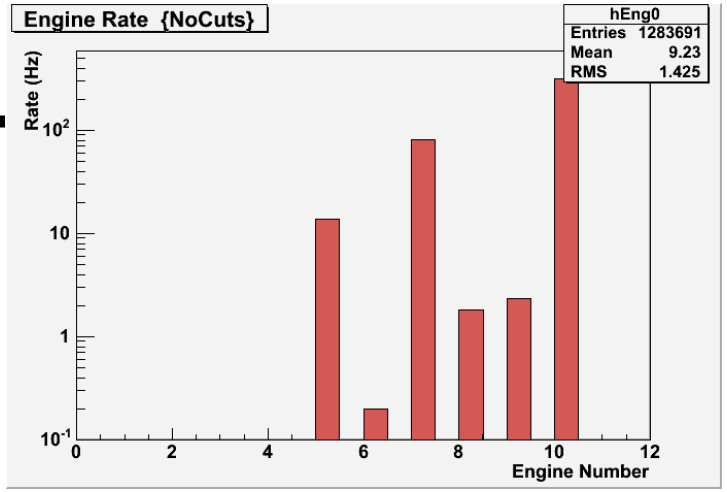
roiC = 030, 031, 040, 041, 103, 104, 113, 114, 400, 401, 410, 411

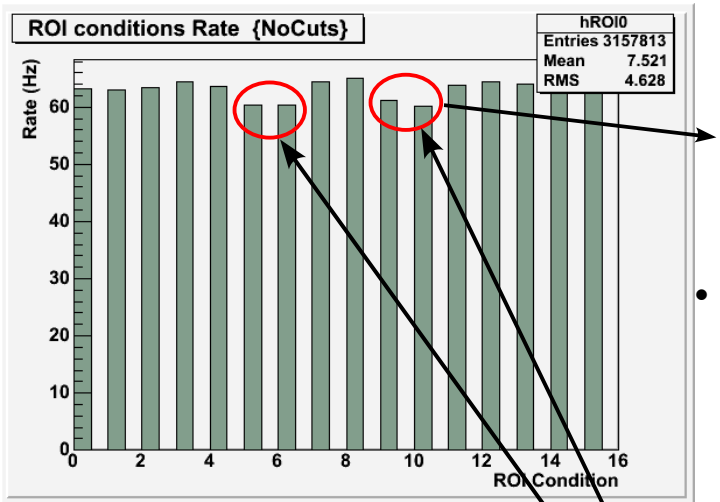
roiD = 031, 032, 041, 042, 401, 402, 411, 412

roiE = 032, 033, 042, 043, 402, 403, 412, 413

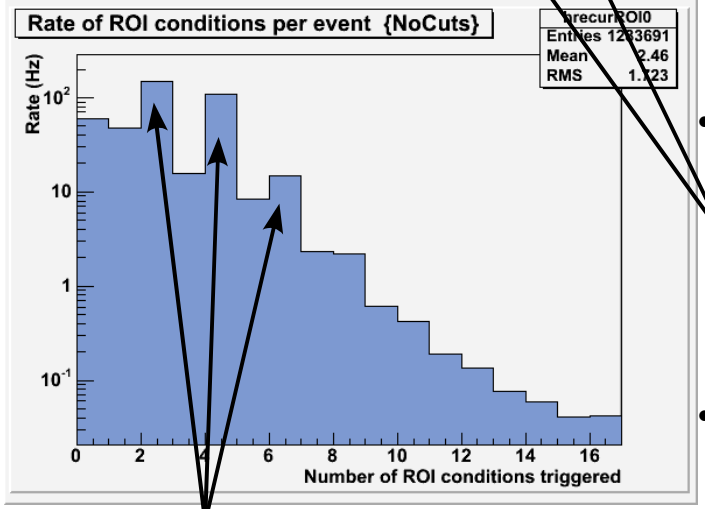
roiF = 033, 034, 043, 044, 303, 304, 313, 314, 403, 404, 413, 414

No cuts





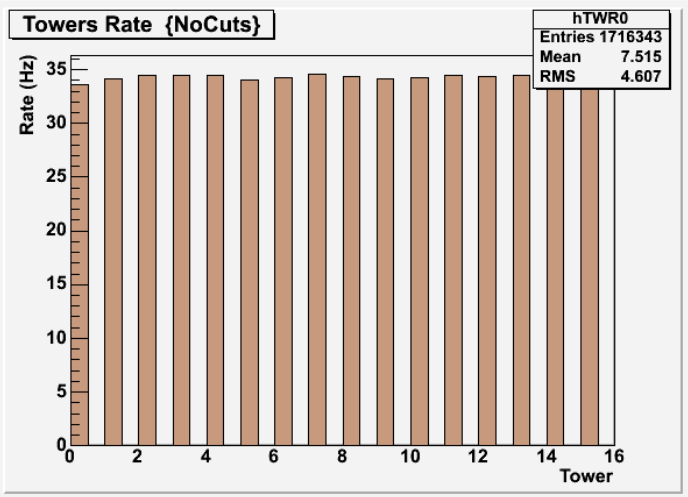
statistical Poisson fluctuations are here of ~0.14Hz

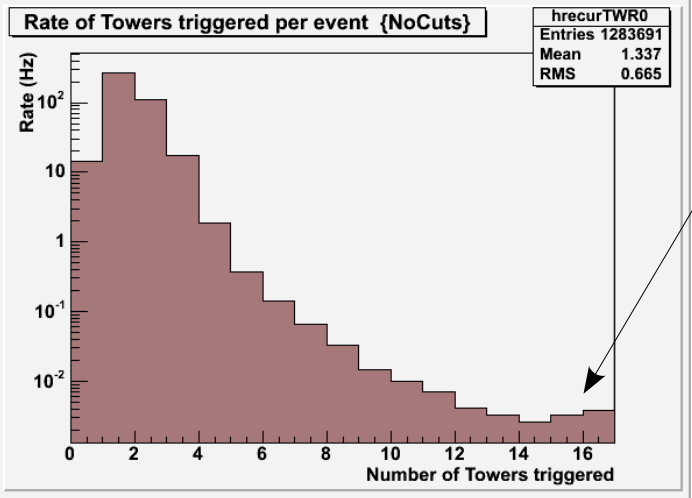


- Need to explain the peak at 2, 4 and 6

- **In Engine rate:**
  - No solicited and periodic trigger
  - The highest is Engine 10 with ~300Hz
  - The distribution is similar to that of Non FSW
    - except for Engine 2 & 3
      - » see Andrea's presentation of April 7 2006
- **In ROI conditions rate:**
  - rate of ~60Hz per ROI condition
    - expected 43Hz per TWR...
  - rate of ROI conditions 5, 6, 9, 10 is significant lower
    - ROI shadows of central tower (see Jane Day IA6)
- **In ROI conditions per event Distribution**
  - 2 & 4 conditions per event have a rate of ~100Hz
  - we see decreasing rate until 16 conditions per event
    - in practice all the ACD detector

Towers trigger rate (No cuts)



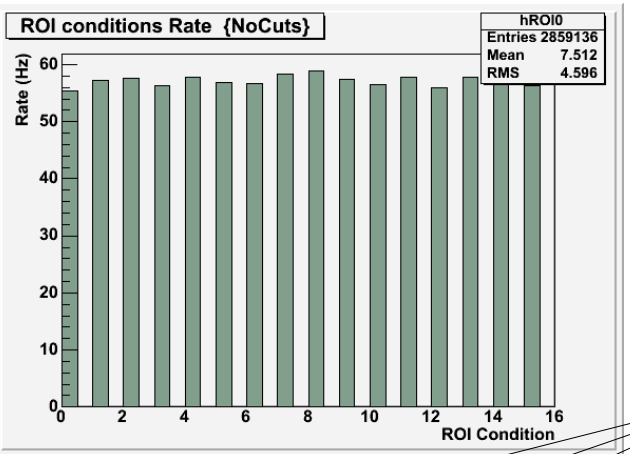


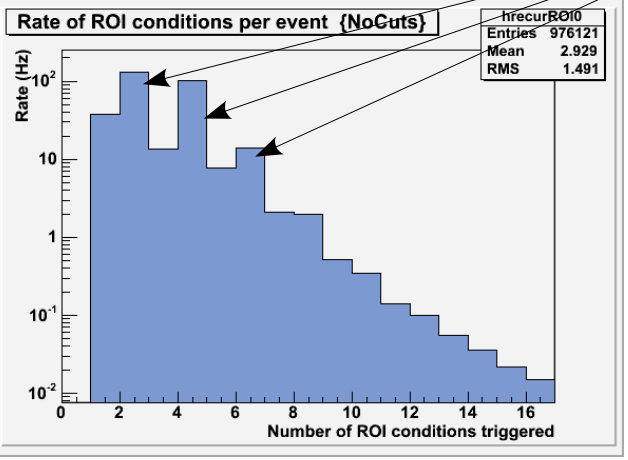
- The Tower trigger rate is ~35Hz
  - central towers do not have a significant lower rate
- The histogram of the Towers triggered per event is quite different from the ROIs triggered per event
  - the distribution is smooth
  - there aren't the peaks at 2, 4, 6 towers triggered per event
  - there is an increasing in rate after 14 towers triggered
- **Why we have all these differences if the topological trigger condition of the ROI is:**
  - ROI = 1 just if the particle hits the ACD tiles configured to shadow the triggered TKR
- Following this condition the Tower trigger rate should be greater or equal of the ROI trigger rate
  - but we have the opposite case
  - the answer on the next slide....

GemTkrVector & GemRoiVector

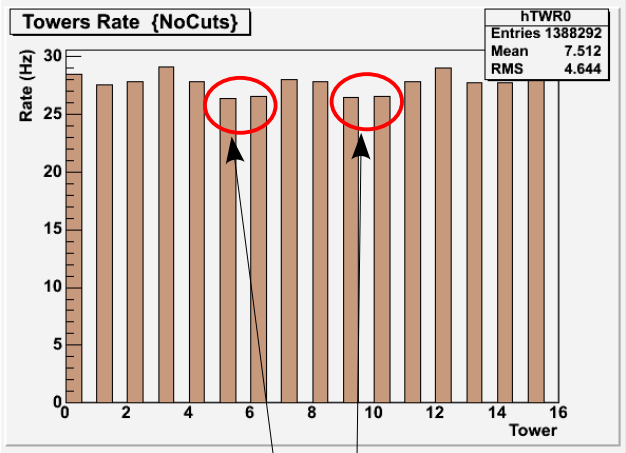
- To obtain these distribution I have used the GemTkrVector and the GemRoiVector
- GemTkrVector:
  - is a vector of 16 elements corresponding to each tracker
  - a bit is set if 3(XY layer) on a row of the corresponding tracker are hits
- GemRoiVector
  - is a vector of 16 elements corresponding to each ROI
  - a bit is set if a tiles of the corresponding ROI is hit
- This means that to set a bit in GemRoiVector it is not needed the coincident with the tracker trigger
  - as requested by the topological condition
- the coincident ROI-Tracker is instead requested by GemConditionsWord

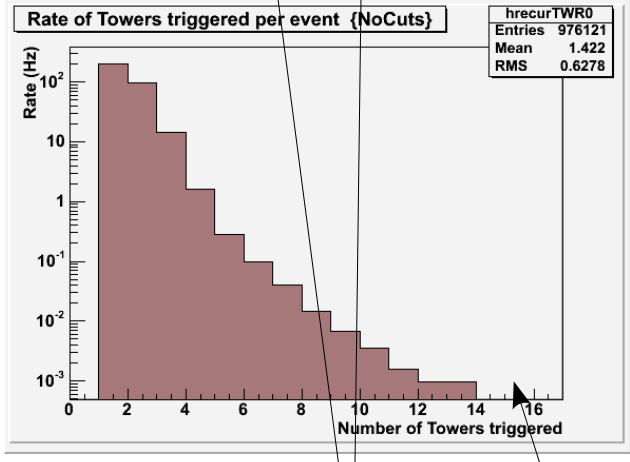
Engine 10 (or GemConditionsWord==3)





- With this conditions the distribution should be less different
- But it is not the case
  - ROI rate is already greater than Tkr
  - in ROI conditions per event Distribution are present the peaks at 2, 4 and 6
- This features can be explain taking into account the ACD structure and the ROI definitions
  - A single ACD tiles could belong to different ROI
    - see next and slide 3

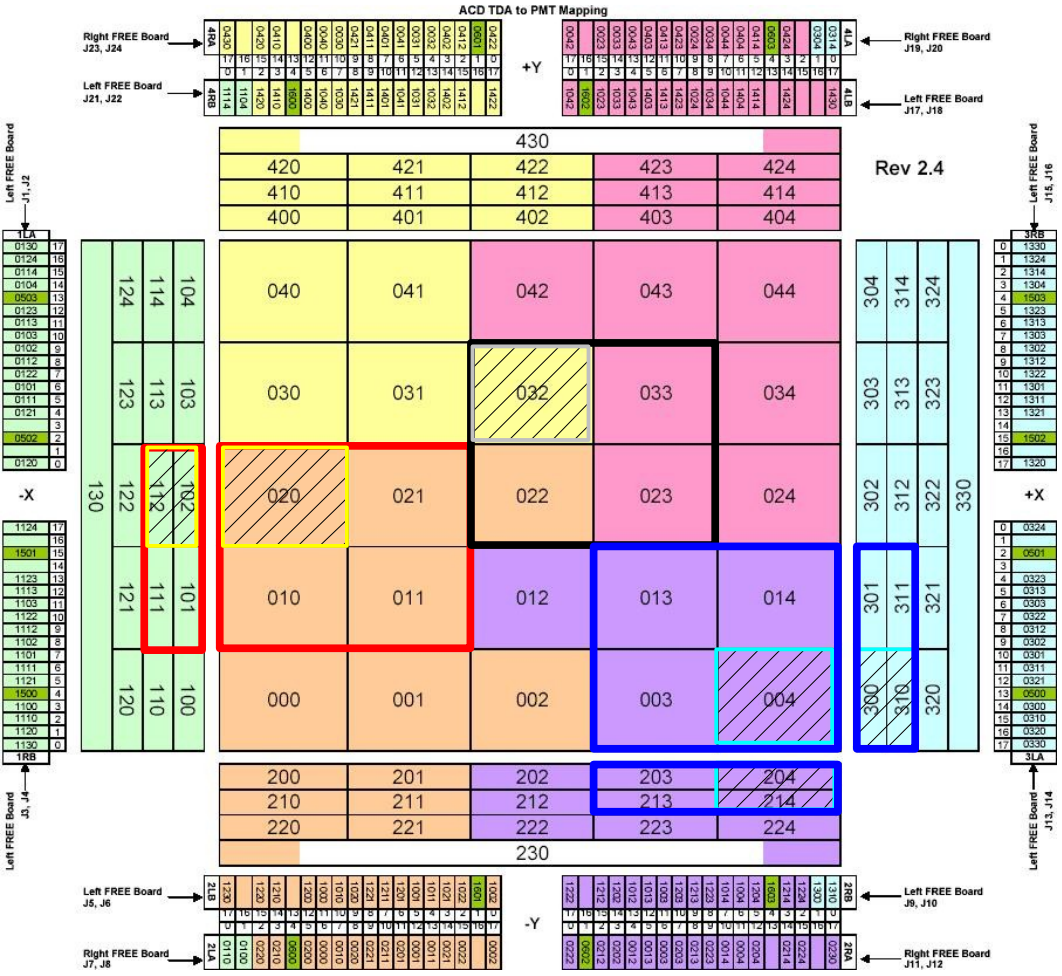




- In the Towers distributions
  - we can see the lower rate of central towers
  - in Towers triggered per event distribution the rate is zero after 14 towers

Shadow ROI trigger conditions

ACD map



Shared Tiles

Shared 1 times:

000, 100, 110, 200, 210	(roi 0)
004, 204, 214, 300, 310	(roi 3)
040, 104, 114, 400, 410	(roi C)
044, 304, 314, 404, 414	(roi F)

Shared 2 times:

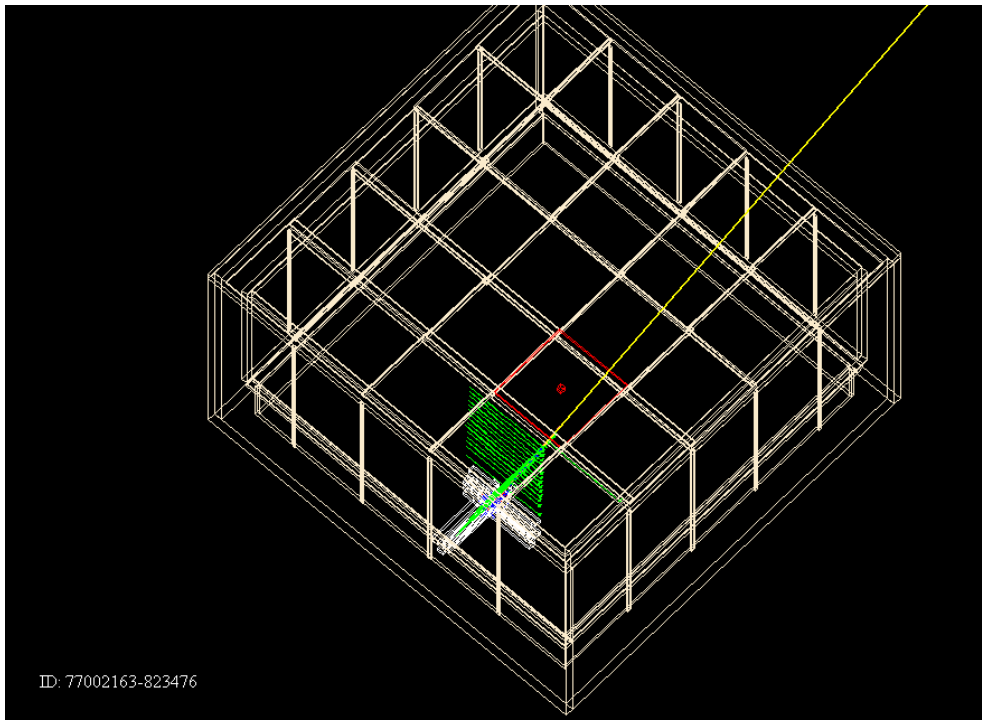
001, 201, 211	(roi 0, roi 1)
002, 202, 212	(roi 1, roi 2)
003, 203, 213	(roi 2, roi 3)
014, 301, 311	(roi 3, roi 7)
024, 302, 312	(roi 7, roi B)
034, 303, 313	(roi B, roi F)
041, 401, 411	(roi C, roi D)
042, 402, 412	(roi D, roi E)
043, 403, 413	(roi E, roi F)
010, 101, 111	(roi 0, roi 4)
020, 102, 112	(roi 4, roi 8)
030, 103, 113	(roi 8, roi B)

Shared 4 times:

011	(roi 0, roi 1, roi 4, roi 5)
012	(roi 1, roi 2, roi 5, roi 6)
013	(roi 2, roi 3, roi 6, roi 7)
021	(roi 4, roi 5, roi 8, roi 9)
022	(roi 5, roi 6, roi 9, roi A)
023	(roi 6, roi 7, roi A, roi B)
031	(roi 8, roi 9, roi C, roi D)
032	(roi 9, roi A, roi D, roi E)
033	(roi A, roi B, roi E, roi F)

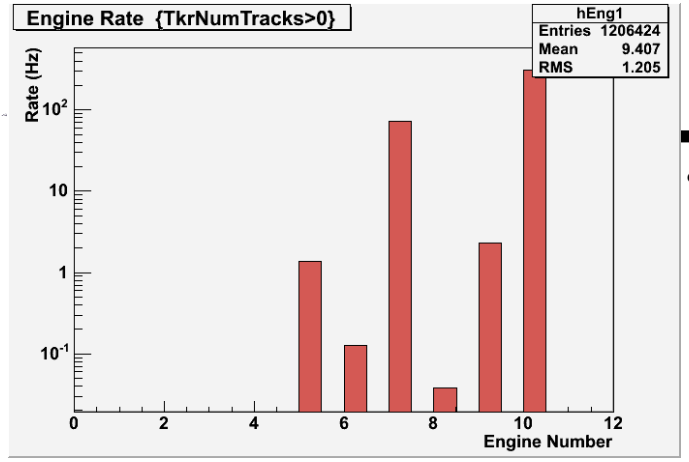
Answer

- It happens that when a particle hit a tiles, can be triggered just one ROI but also 2 or 4 ROIs
  - the tiles not shared are just the corner ones
    - 20 tiles
    - 4 on the top
  - tiles shared 2 times
    - 36 tiles
    - 8 on the top
  - tiles shared 4 times
    - 9 tiles
    - all on the top

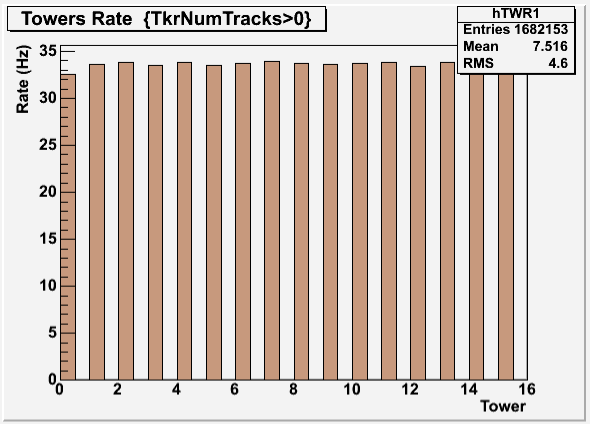


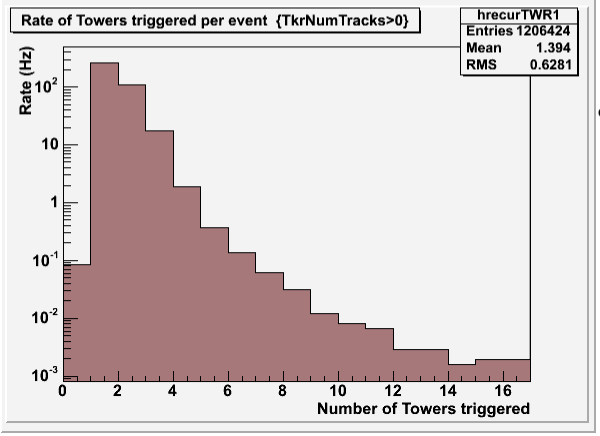
- This structure explain the peaks at 2, 4 and 6 ROI per event
- and also the ROI trigger rate greater than the Tracker

At least 1 Track per event

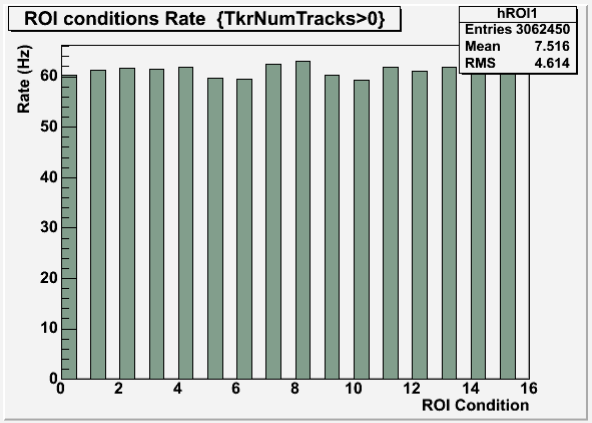


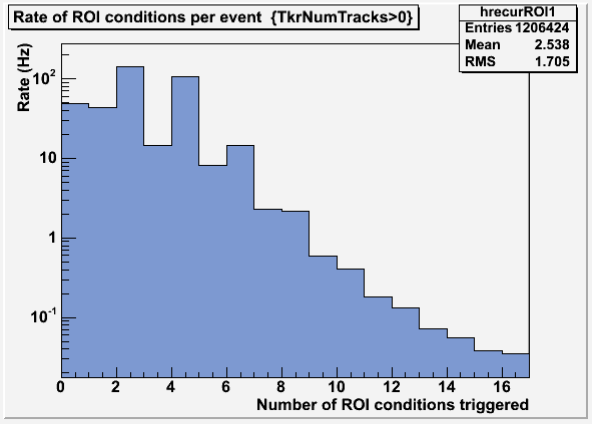
- In Engine rate:
  - the ratio between the Engines is much different
  - except for Engine 10 & 7



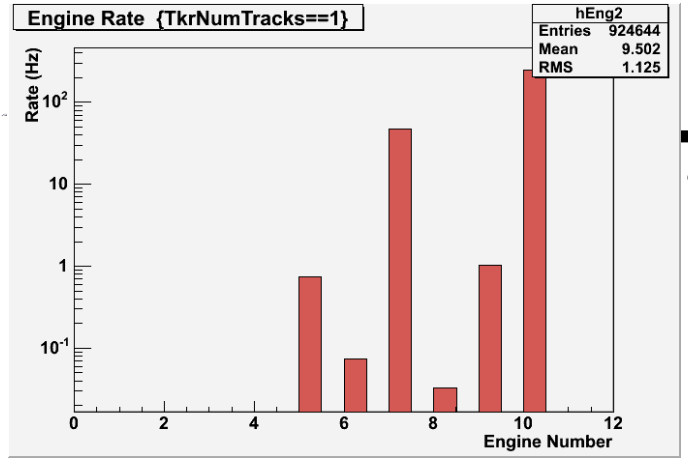


- the rate and the shape of the ROI and Tkr trigger distributions do not have significant changes respect to No cuts case
  - see slides 4 & 5
- In Tkr triggered per event Distribution
  - 0 Tkr rate is 2 order of magnitude lower than in No cuts case
    - 0.1Hz vs 10Hz
- In ROI conditions per event distribution
  - we always see the peaks

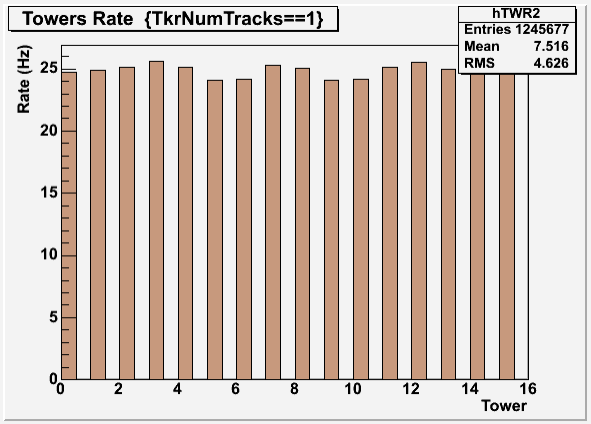


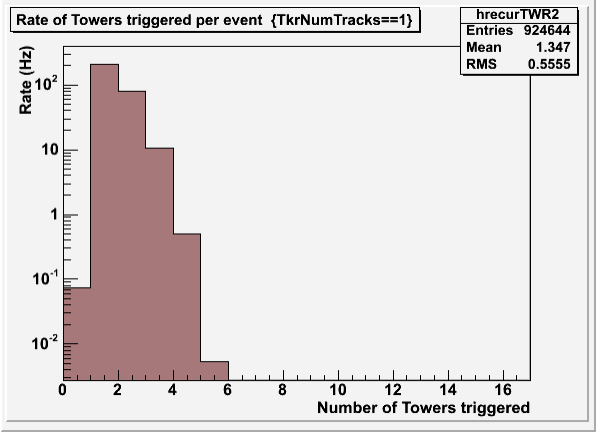


Single Track per event

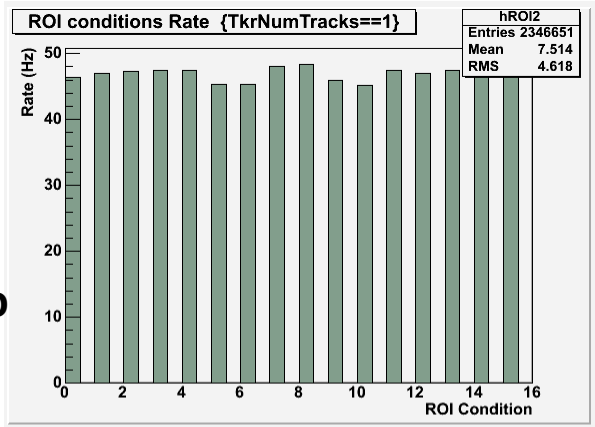


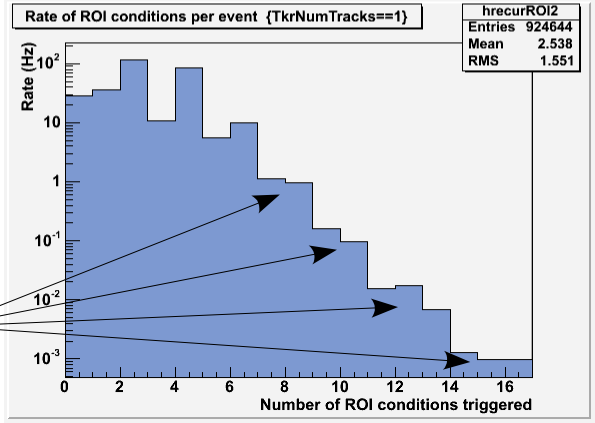
- In Engine rate:
  - The relative hight of Engine 4, 6 & 9 is just a little bit lower than in the precedent case



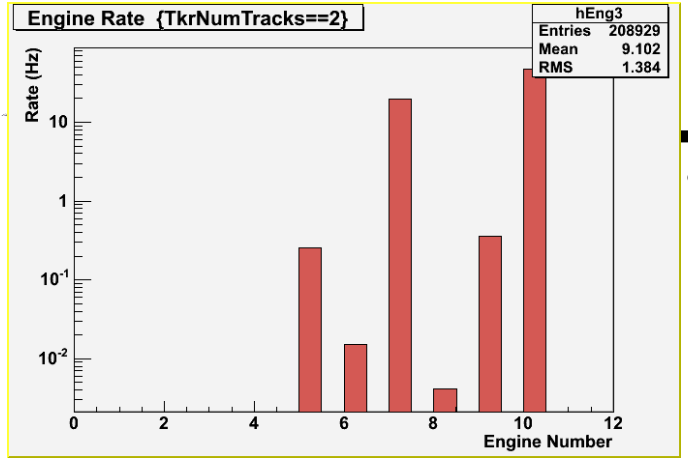


- In ROI and Tkr trigger rate
  - no changes but for the lower rate
- Tkr triggered per event
  - is cut at 5 Tkr
- In ROI conditions per event distrib
  - with this cut the rate of 0 ROI conditions per event is lower than rate of 1 ROI conditions
    - this could be explained taking into account that with this cut should be a more fraction of muons
  - the tail of the distribution is not smooth
    - seems that there is a stair structure with the bin grouped in this way:
      - » (7, 8) (9, 10) (11, 12, 13) (14, 15, 16)
    - maybe due to the overlapped tails

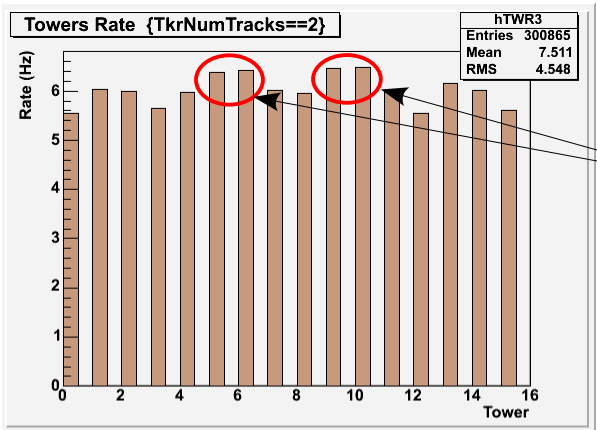


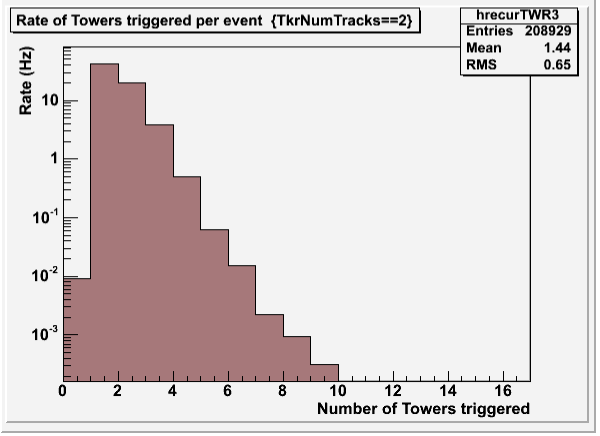


2 Tracks per event

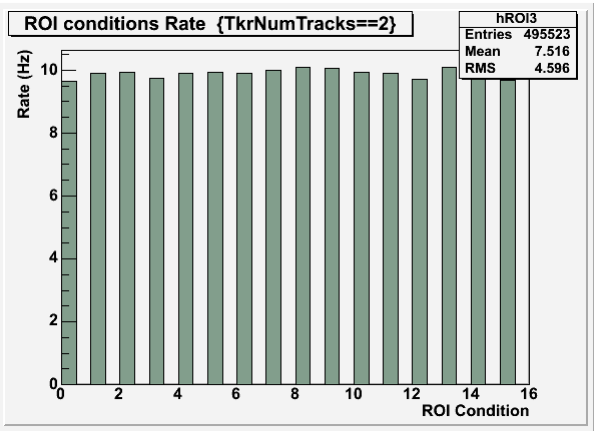


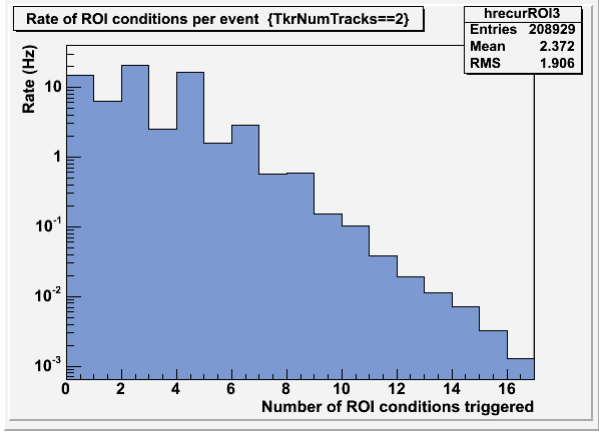
- In Engine rate:
  - the ratio between the Engines is not so different from the case of at least 1 Track per event (TkrNumTracks>0)



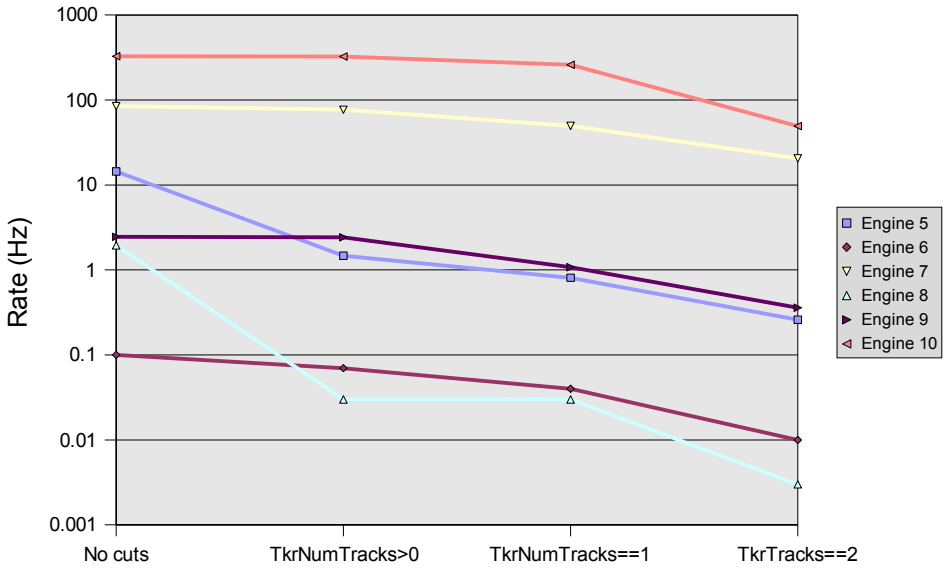


- In Tkr trigger rate
  - the distribution is not so flat
  - the central tower has the highest rate now
- In ROI conditions
  - the rate here is very low (~10Hz)
- In Tkr triggered per event
  - the distribution fall until 10 Tkr
- In ROI conditions per event Distribution
  - the rate of 0 ROI conditions per event is very hight compared to the other
  - this means that we have a large fraction of photons with this cut





Trigger Rate per Engine



	No cuts	TkrNumTracks>0	TkrNumTracks==1	TkrTracks==2
Engine 5	14.42	1.47	0.81	0.26
Engine 6	0.1	0.07	0.04	0.01
Engine 7	84.53	76.93	49.7	20.51
Engine 8	1.95	0.03	0.03	0.003
Engine 9	2.46	2.42	1.08	0.36
Engine 10	328.06	324.71	258.97	49.24

- **Rate of each Engine vs cuts effectuated**
  - **in this plot we can see a not regular behavior of Engine 5 and Engine 8**
  - **to check**

Engine	Condition Summary for Trigger Engines								Trigger Engine				Notes
number	Ext	solic	period	CNO	CAL-HI	CAL-LO	TKR	ROI	Zero Supp.	CAL FE	Prescale	Marker	
0	1	X	x	x	x	x	x	x	Enable	1-range	0	0	Should never happen
1	0	X	x	x	x	x	0	1	Enable	1-range	0	0	Forbiddencondition; Should never happen
2	0	1	x	x	x	x	x	x	Enable	1-range	0	0	Solicited triggers for a special purpose
3	0	0	1	x	x	x	x	x	Disable	4-range	0	0	Pedestals, both clean pedestals and random sample of typical LAT state
4	0	0	0	1	x	1	1	1	Enable	4-range	0	1	Want to restrict 4-range readout to useful CNO
5	0	0	0	1	x	x	x	x	Enable	1-range	0	0	Rate of CNO-only is ~750 Hz so let's keep only a trickle of these (prescale=255) on orbit. On ground: set prescale=0
6	0	0	0	0	1	x	x	x	Enable	1-range	0	2	CAL-HI photons with and without backsplash. Primary science HE photons
7	0	0	0	0	0	x	1	0	Enable	1-range	0	3	Primary science photons with or without CAL-LO
8	0	0	0	0	0	1	0	0	Enable	1-range	0	4	Mostly CAL-only photons
9	0	0	0	0	0	1	1	1	Enable	1-range	0	0	Medium-energy photons with backsplash and some medium GCRs
10	0	0	0	0	0	0	1	1	Enable	1-range	0	0	Deliberate leakage of GCR protons but for ground ops the prescale is 0
11	0	0	0	0	0	0	0	0	Enable	1-range	0	7	Should never happen

Conclusion

- We have studied the ROI and Tracker trigger rate
- We have explained the differences between the distributions
  - we have understand how work GemTkrVector and GemRoiVector
    - GemRoiVector do not require the coincidence with the Tkr trigger
  - the request of the coincidence between ROI and Tkr is requested just by GemConditionsWord
- We have understand the presence of the peaks in the Distribution of ROI conditions per event
  - it is due to the structure of the ACD and the ROI definition
- To do:
  - understand the behavior of the rate of Engine 5 and Engine 8
    - » see the plot in the precedent slide