

Muons :=


D:\..IMU32.DAT

data :=


C:\..135004388_svac.dat

data := csort(data, 19)

Muons₀ = 20073719

[sec]

EvtTicks := data^{<19>}EvtTime := data^{<12>}calE := data^{<10>}Approx := Muons₀ - [EvtTime₀ - (4.365) · 86400 - 7.3600]VtxXDir := data^{<4>}calMaxEne := data^{<13>}EvtTicks := .999999059 · (EvtTicks - EvtTicks₀) · 50 · 10⁻⁹VtxYDir := data^{<5>}Muons := Muons - Muons₀

ev := 0 .. length(EvtTicks) - 1

Approx = -5928.0

VtxZDir := data^{<6>}

mu := 0 .. length(Muons) - 1

length(Muons) = 3091

 $\phi_{ev} := \text{atan2}(VtxXDir_{ev}, VtxYDir_{ev})$

Make bins of width dt with the lower edge at the Muon time.

edge_{2.mu} := Muons_{mu}

dt := .000001

edge_{2.mu+1} := Muons_{mu} + dt

tshift := Approx + .714123

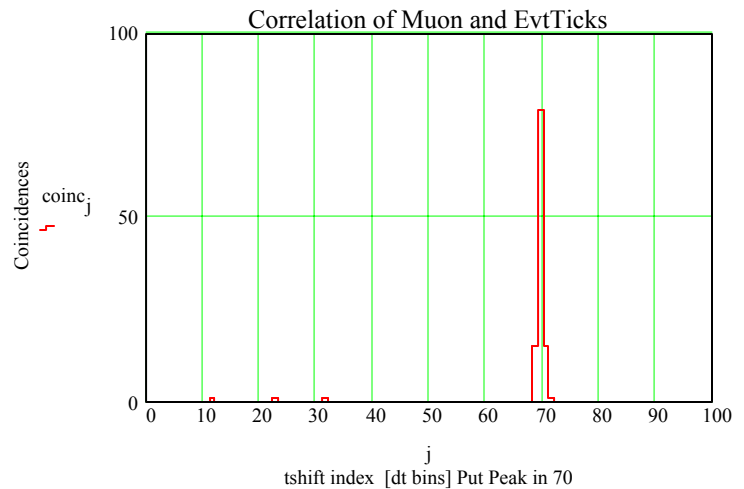
Histogram EvtTicks into these tshifted bins. Then count the contents of the even bins.

$$\text{Monotonic}(\text{vec}) := \begin{cases} \text{for } i \in 1 \dots \text{length}(\text{vec}) - 1 \\ \text{vec}_i \leftarrow \text{vec}_{i-1} + .00000000001 \text{ if } \text{vec}_i < \text{vec}_{i-1} \\ \text{vec} \end{cases}$$

jbins := 100 j := 0 .. jbins

ts_j := tshift + ((j - 70) · dt)

edge := Monotonic(edge)

$$\text{Coinc}(\text{tshift}) := \begin{cases} h \leftarrow \text{hist}(\text{edge} + \text{tshift}, \text{EvtTicks}) \\ \text{coinc} \leftarrow 0 \\ \text{for } i \in 0 \dots \text{floor}\left(\frac{\text{length}(h)}{2}\right) \\ \text{coinc} \leftarrow \text{coinc} + h_{2 \cdot i} \\ \text{coinc} \end{cases}$$
coinc_j := Coinc(ts_j)

$$\text{Ndead} := \sum_{j=2}^{66} \text{coinc}_j$$

Ndead = 3

$$\text{Ncoinc} := \sum_{j=67}^{75} \text{coinc}_j$$

Ncoinc = 110

$$\text{Nlivemuons} := \left[\sum_{j=0}^{\text{length}(\text{Muons}) - 1} (\text{EvtTicks}_0 \leq \text{Muons}_j + \text{tshift} \leq \text{EvtTicks}_{\text{length}(\text{EvtTicks}) - 1}) \right] - \text{Ndead}$$

Nlivemuons = 112

Nmissed := Nlivemuons - Ncoinc

$$\text{TkrIneff} := \frac{\text{Nmissed}}{\text{Nlivemuons}}$$

TkrIneff = 0.018

$$\sigma := \frac{\sqrt{\text{Nmissed}}}{\text{Nlivemuons}}$$

σ = 0.013

Find the closest EvtTick within δt associated with each Muon. Assume both arrays are monotonically increasing.

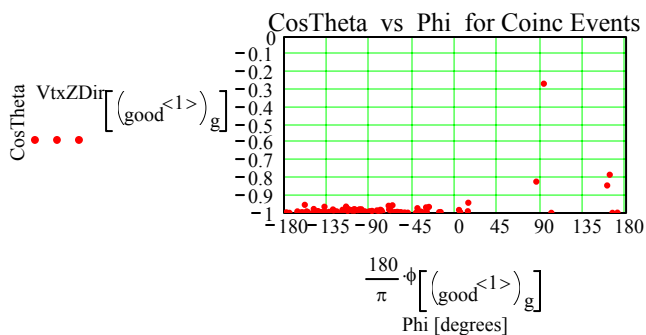
```

Good(Muons, EvtTicks, tshift,  $\delta t$ ) :=
  j ← - 1
  nmax ← length(EvtTicks) - 1
  nstart ← 0
  mstart ← 0
   $\Delta_{last} \leftarrow 10^{12}$ 
  while (Muonsmstart + tshift) < EvtTicks0
    mstart ← mstart + 1
  for m ∈ mstart - 1 .. length(Muons) - 1
    for n ∈ nstart .. nmax
       $\Delta \leftarrow \text{Muons}_m + \text{tshift} - \text{EvtTicks}_n$ 
      break if  $|\Delta| > |\Delta_{last}|$ 
       $\Delta_{last} \leftarrow \Delta$ 
    if  $|\Delta_{last}| \leq \delta t$ 
      j ← j + 1
      goodj,0 ← m
      goodj,1 ← n - 1
      goodj,2 ←  $\Delta_{last}$ 
     $\Delta_{last} \leftarrow 10^{15}$ 
    nstart ← n
  good

```

good := Good(Muons, EvtTicks, tshift, $3 \cdot dt$)

g := 0 .. rows(good) - 1 rows(good) = 110 Ncoinc = 110



Tracker doesn't always point at the scintillators (though these events are near the pole and can give wild phis).

 C:\..IM32_4388_good.dat

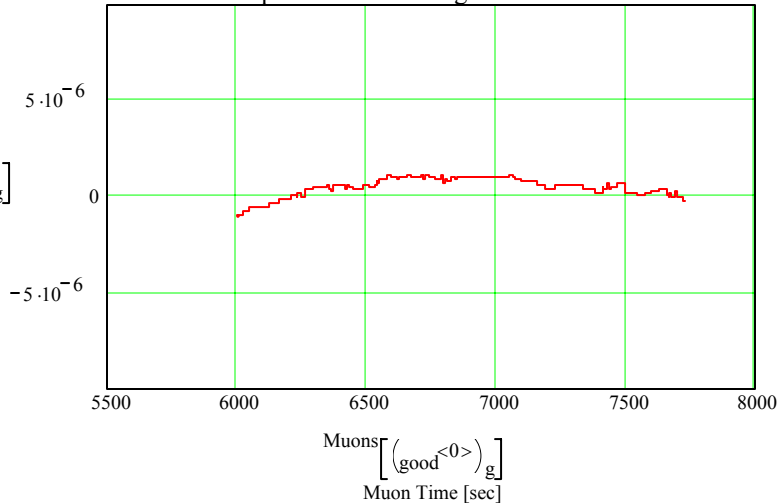
$\text{TkrNumTracks}_g := \left(\text{data}^{<7>} \right) \left[\left(\text{good}^{<1>} \right)_g \right]$

good

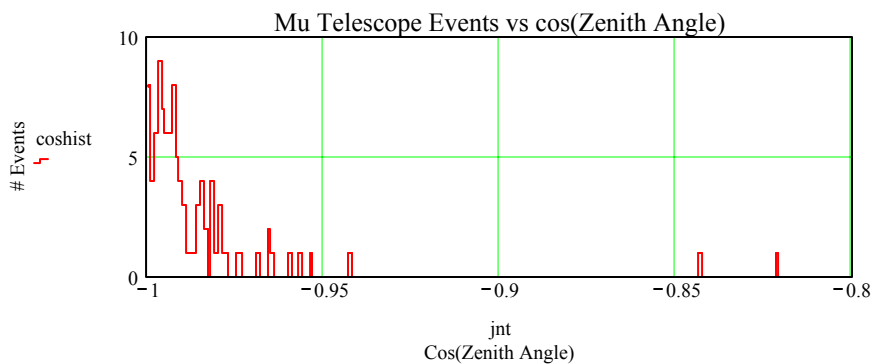
Muon - Closest LAT Time [sec]

$$\text{Muons} \left[\left(\text{good}^{<0>} \right)_g \right] + \text{tshift} - \text{EvtTicks} \left[\left(\text{good}^{<1>} \right)_g \right]$$

Compare the Clks Using the Coinc Muons



j := 0 .. 200 jnt₀ := -1. jnt_{j+1} := jnt_j + .001 cosz_g := VtxZDir [(good<1>)_g] coshist := hist(jnt, cosz)



The Muon telescope downward unit vector appears to be:

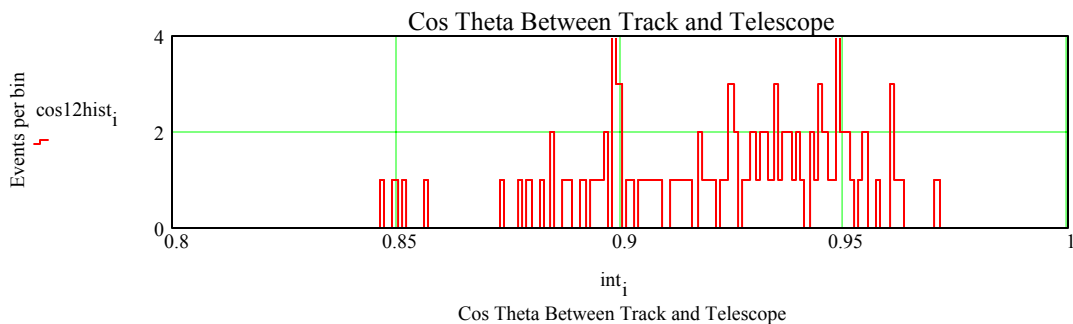
$$\cos\theta := -.96 \quad \sin\theta := \sqrt{1 - \cos^2\theta} \quad \phi := 1.5$$

$$\text{Unit} := \begin{bmatrix} \sin\theta \cdot \cos(\phi) \\ \sin\theta \cdot \sin(\phi) \\ \cos\theta \end{bmatrix}$$

i := 0 .. 200 int₀ := .8 int_{i+1} := int_i + .001

$$\cos12_g := \text{Unit}_0 \cdot \text{VtxXDir} \left[\left(\text{good}^{<1>} \right)_g \right] + \text{Unit}_1 \cdot \text{VtxYDir} \left[\left(\text{good}^{<1>} \right)_g \right] + \text{Unit}_2 \cdot \text{VtxZDir} \left[\left(\text{good}^{<1>} \right)_g \right]$$

$$\text{Unit} \cdot \text{Unit} = 1.000000 \quad \cos12\text{hist} := \text{hist}(\text{int}, \cos12)$$



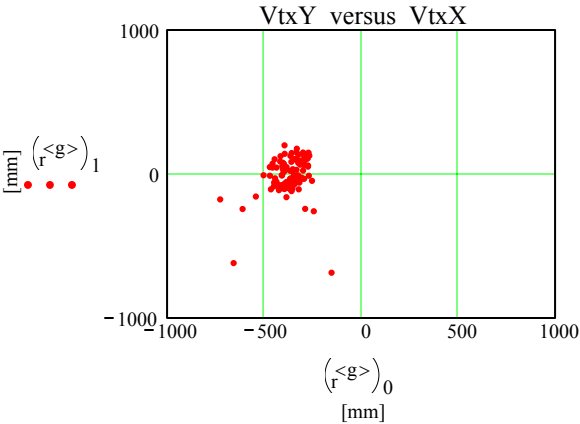
$$r^{<g>} := \begin{bmatrix} (data^{<1>})[(good^{<1>})_g] \\ (data^{<2>})[(good^{<1>})_g] \\ (data^{<3>})[(good^{<1>})_g] \end{bmatrix} \quad u^{<g>} := \begin{bmatrix} (data^{<4>})[(good^{<1>})_g] \\ (data^{<5>})[(good^{<1>})_g] \\ (data^{<6>})[(good^{<1>})_g] \end{bmatrix}$$

$$calE_g := (data^{<10>})[(good^{<1>})_g]$$

$$GemCond_g := (data^{<21>})[(good^{<1>})_g]$$

$$k := 0..5$$

$$OK_g := \left[50 < (calE)_g < 200\right] \cdot \left(1 \leq TkrNumTracks_g \leq 2\right) \qquad \sum_g OK_g = 61$$



$$hitvec(planepoint,planenormal,r,u) := \frac{planenormal \cdot (planepoint - r)}{(planenormal \cdot u)} \cdot u + r$$

$$hittop^{<g>} := hitvec \left[\begin{bmatrix} 0 \\ 0 \\ 47.5 \cdot 25.4 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, r^{<g>}, u^{<g>} \right] \quad hitbot^{<g>} := hitvec \left[\begin{bmatrix} 0 \\ 0 \\ -34.5 \cdot 25.4 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix}, r^{<g>}, u^{<g>} \right] \quad T := \begin{bmatrix} 0 & 0 \\ 0 & 2 \\ -2 & 2 \\ -2 & -2 \\ 0 & -2 \\ 0 & 0 \end{bmatrix} \cdot 380.$$

$$good^{<1>} + 131073 =$$

	0
0	150659
1	156413
2	162268
3	169647
4	173691
5	184081
6	194715
7	207063
8	213318
9	214296
10	218693
11	221524
12	224505
13	230671
14	237461
15	242151

$$calE =$$

	0
0	81.521
1	26.937
2	114.395
3	74.529
4	52.385
5	0
6	116.323
7	127.815
8	45.042
9	3.455·10 ³
10	108.66
11	-9.999·10 ³
12	96.622
13	94.886
14	109.798
15	92.933

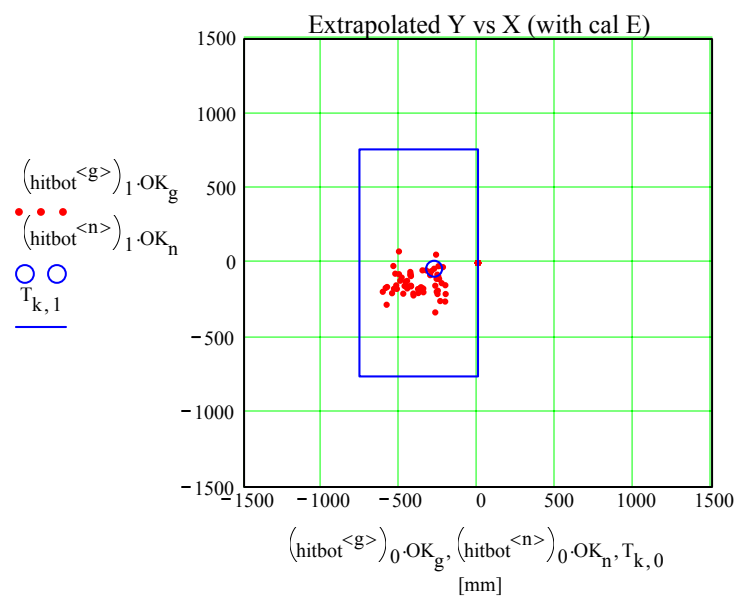
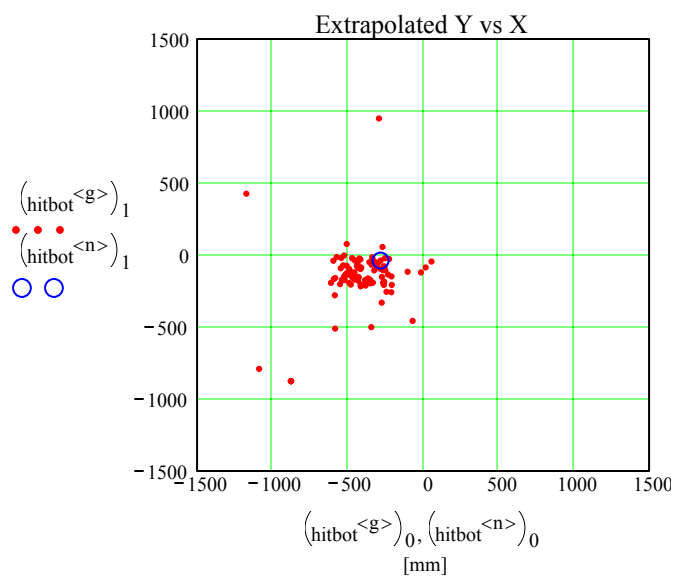
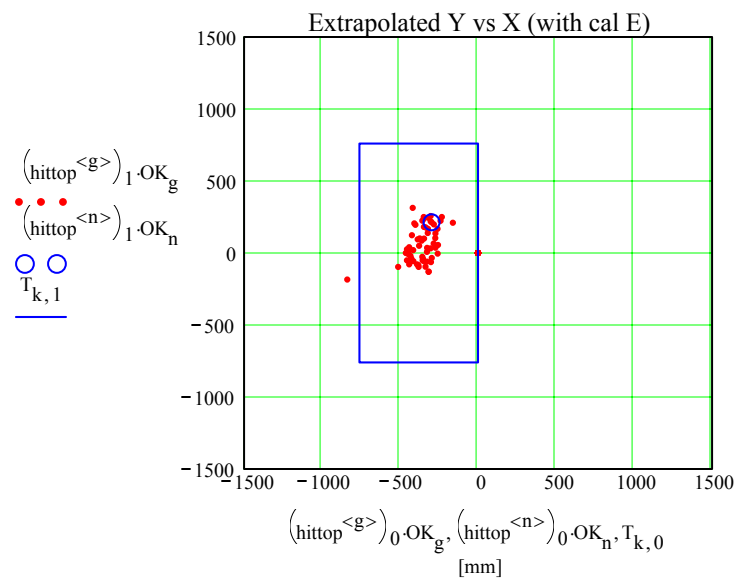
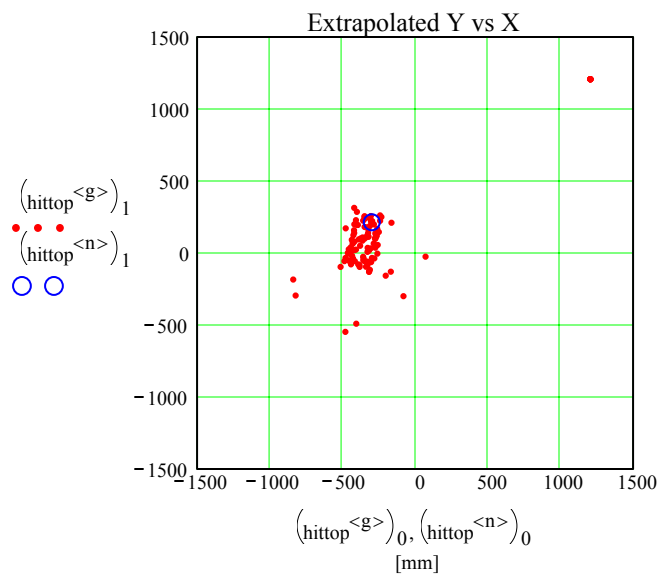
$$good^{<0>} =$$

	0
0	350
1	351
2	352
3	353
4	354
5	355
6	356
7	357
8	358
9	359
10	360
11	361
12	362
13	363
14	364
15	365

$$Muons =$$

	0
0	0
1	8.104
2	72.639
3	75.013
4	81.828
5	87.689
6	127.711
7	128.444
8	137.826
9	143.81
10	144.286
11	164.541
12	169.697
13	194.769
14	214.219
15	217.78

$n := 0$



```
ReconBad :=
| b←- 1
| for g ∈ 0 .. rows(good) - 1
|   if TkrNumTracks_g=0
|     | b← b + 1
|     | Bad_b← (good<1>)_g
|   Bad
```

BadEvtList_b =

	0
0	83223
1	90451
2	121779
3	235452
4	252921
5	410548
6	421020
7	465606

```
b := 0 .. length(BadEvtList) - 1
```

Run 135004388

calE _(BadEvtList_b) =	calMaxEne _(BadEvtList_b) =
3.455·10 ³	166.143
-9.999·10 ³	-9.999·10 ³
1.084·10 ⁴	870.646
-9.999·10 ³	-9.999·10 ³
-9.999·10 ³	-9.999·10 ³
-9.999·10 ³	-9.999·10 ³
5.833·10 ³	317.197
5.867·10 ³	182.405

```
c := 0 .. 20      Abin := 100.      bin0 := 0      binc+1 := binc + Δbin
```

```
Latg := EvtTicks[(good<1>)_g]      LatHist := hist(bin, Lat)
```

```
Mu :=
| i←- 1
| for j ∈ 0 .. length(Muons) - 1
|   if (EvtTicks0 ≤ Muonsj + tshift ≤ EvtTickslength(EvtTicks) - 1)
|     | i← i + 1
|     | Mui← Muonsj + tshift
|   Mu
```

```
MuonHist := hist(bin, Mu)
```

