



Eye Scanning with Idraw

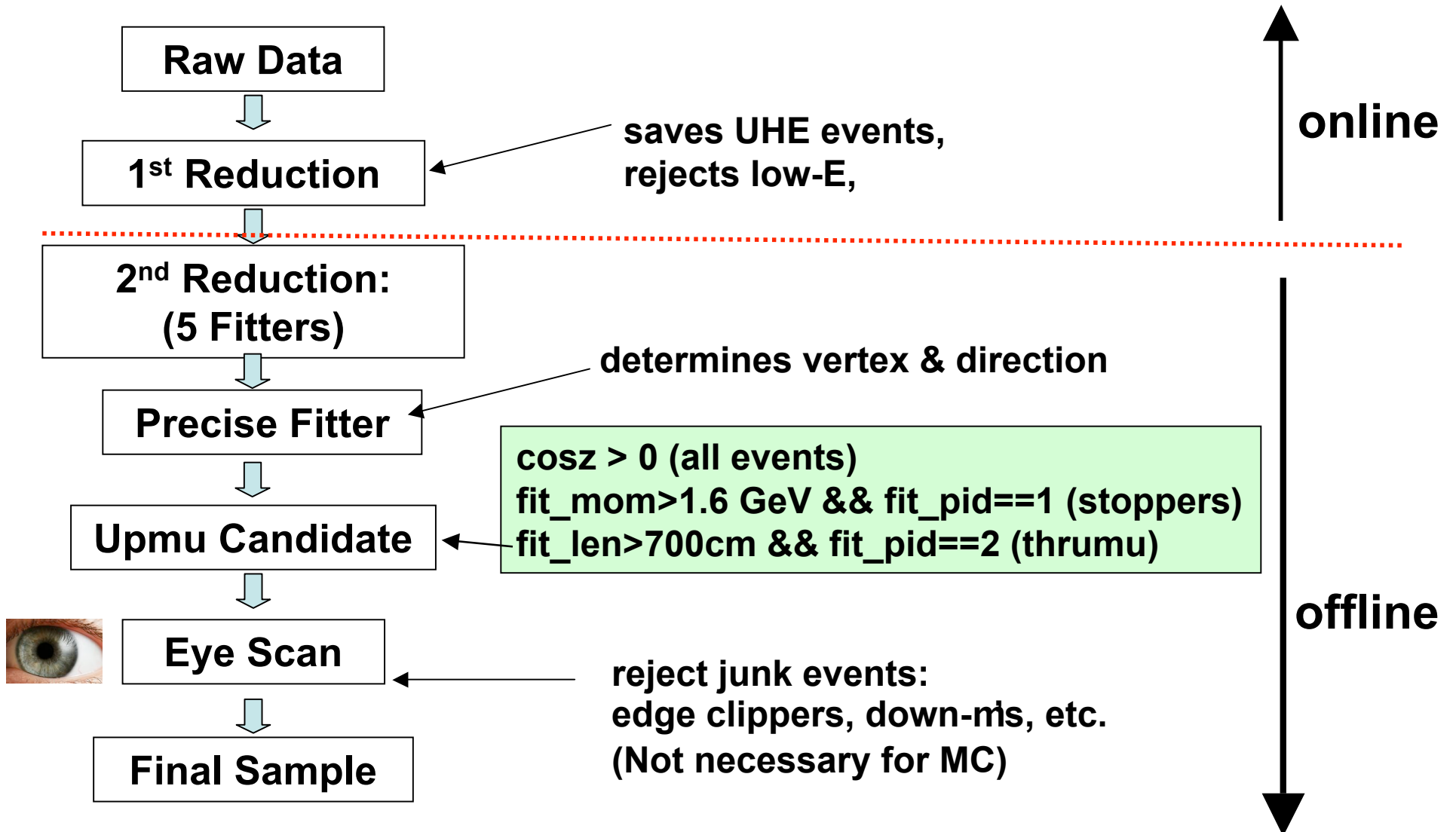
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Outline

- Purpose
- Procedure

Muon Reduction Schematic



Efficiencies for SK-I

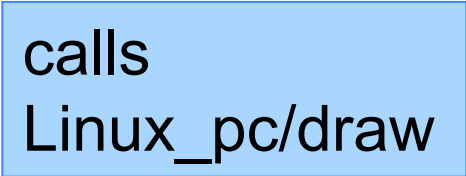
Reduction Stage	μ Events	ϵ
Raw Data	288,204,582	100.0%
1 st Reduction	2,732,726	.9482%
2 nd Reduction	89,911	.0312%
Precise Fit	4,266	.0015%
Eye Scan 	2,447	.0008%
Stop / Through	1,892 / 467	

Precise fit results have ~56% contamination due to pathological down- μ events. These events must be removed by eye scanning.

ldraw

- Eye scanning is performed using an application called ldraw.
- Eventually ldraw will be merged with apdraw, but for now it is located here:
/disk/usr4/jlraaf/draw
- It is already compiled, but should you need to recompile it, use `COMPILE.sh`
- **To run: `ldraw.sh good_upmus.zbs`**

calls
Linux_pc/draw



.zbs data file



Running Idraw with x-windows

- Before you run Idraw, make sure your terminal supports x-windows.
- On a mac use X11 (instead of Terminal) and connect like so:
ssh -XC kmgate01.icrr.u-tokyo.ac.jp
- The -X flag enables x-windows and the -C flag turns on compression.

event display

tq window

X11 (terminal window)

The screenshot displays a Mac OS X desktop with three overlapping windows:

- HIGZ_01 @ sukap003:** An event display window showing two circular detector views at the top and a large scatter plot at the bottom. A red line is drawn across the scatter plot. A menu is open at the bottom left with options: Manual Fit, Redraw, Spin, Zoom In, Zoom Out, Save as .., Show FITVTK, Type, and Quit Menu.
- HIGZ_02 @ sukap003:** A tq window titled "event 67" containing two histograms. The top histogram shows a distribution from 600 to 1400 on the x-axis and 0 to 225 on the y-axis. The bottom histogram shows a distribution from 0 to 80 on the x-axis and 0 to 700 on the y-axis.
- xterm:** A terminal window displaying the output of a program. The output includes:


```

*****
* This is for SK-III map *
*****
findconsts: connection table file: /skam/pro/const/connection.super.dat
gexyz: PMT # FOR EACH SECTION      1 7650 7651 9398 9399 11146
gexyz: maxpm,nlwal      11146      7650
findfile: checking /skam/pro/const/misch3.dat
findfile: found /skam/pro/const/misch3.dat
findconsts: mis channel file: /skam/pro/const/misch3.dat
findfile: checking /skam/pro/const/skpmt.dat
findfile: found /skam/pro/const/skpmt.dat
findconsts: pmt file: /skam/pro/const/skpmt.dat
gestpma: TOTAL NUMBER anti PMT: WALL; TOP; BOTTOM; ALL 1275 302 308 1885
gexyza: anti PMT # FOR EACH SECTION      1 1275 1276 1577 1578 1885
maxpma,nlwala      1885      1275
findfile: checking /skam/const/badch2/badch.031035
findfile: checking /skam/const/badch2/badch.031099.t
findfile: checking /skam/const/badch/badch.031035
findfile: found /skam/const/badch/badch.031035
48CLK= 2.4906844E+09[usec]  TDIFF= 2.4906844E+09[usec]
APGETBNK
**** COMDIR init.*** 0. 0. 0.
COMWTX 6 1689.99023 -5.73898792 -1515.3136 -0.81134516 -0.583496273
0.035373088
**** get muboy cosz ****
muboy_decision 12 3
MUBOY 12 1688.43262 -72.7700577 -1551.69995 934.270264 -0.82164371
-0.56500566 0.0752996877
MAGETBNK
ISWBEF 1 1
Warning: BEF command does not work for this event because of large size.
finish drreadev
### START APGETBNK
### START DRDISPLAY
CLOCK of previous : 28 65197 61053
CLOCK of current : 28 65233 25645
GPS= 1156102602 0
LTCTRG/LTRCBIP= -321047673 0 321047673
IFFSCC -2013102192
ITDCT0 -12035 -12033 -12033 -12031
----- ahoahoaho -----
----- Muon Fit Info. -----
pos,dir : 1689.99023 -5.73898792 -1515.3136 -0.81134516 -0.583496273
0.035373088
Run, Event : 31035 67807
path length(m) = 27.3906021
costh,theta(deg.) = 0.035373088 87.9728394
total Q / path length(p.e./m) = 1283.91968
-----
### Get Command

```


Explanation of Each x-Window

- The tq window displays histograms of PMT hit times (in ns) and of PMT charge deposition.
- The event display provides a map of the event as well as other details such as event# and run#. (Bigger circles indicate bigger charge deposition.)
- If upmu3 has been run, there will also be a red curve indicating the precise fitter result.

The Terminal Window

- The terminal window provides numerical results for the the precise fit:

```
----- ahoahoaho -----  
----- Muon Fit Info.-----  
pos,dir : 1689.99023 -5.73898792 -1515.3136  
-0.81134516 -0.583496273 0.035373088  
Run, Event : 31035 67807
```

- The last number following “pos,dir” is $\hat{z} = \cos(\theta)$ which is **POSITIVE** if the μ is upward going.

Eye Scanning with Idraw

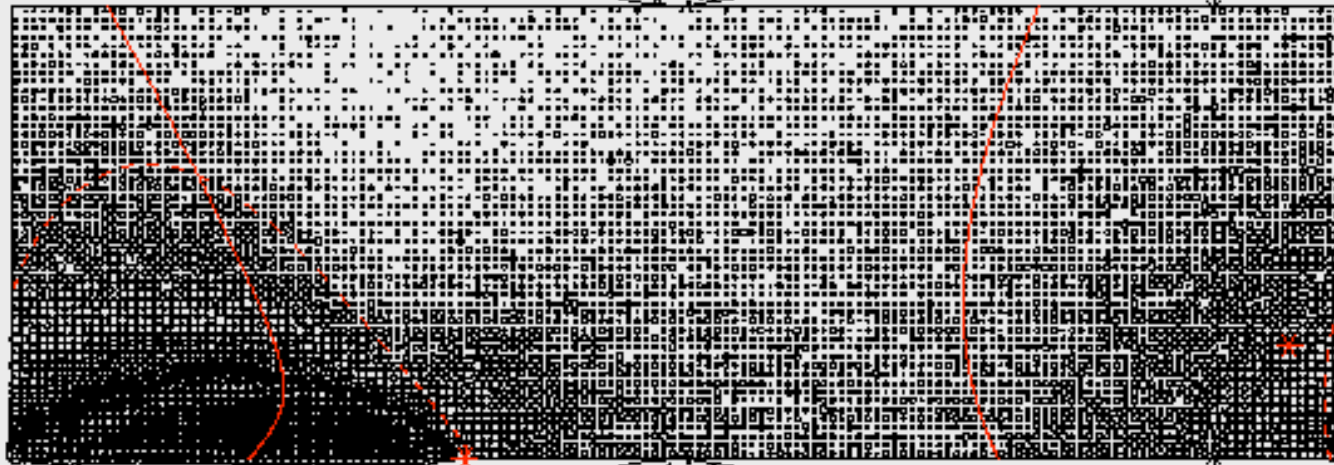
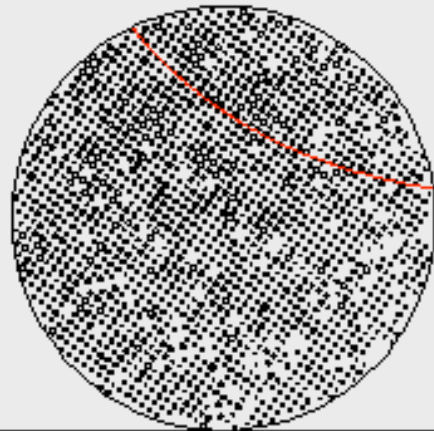
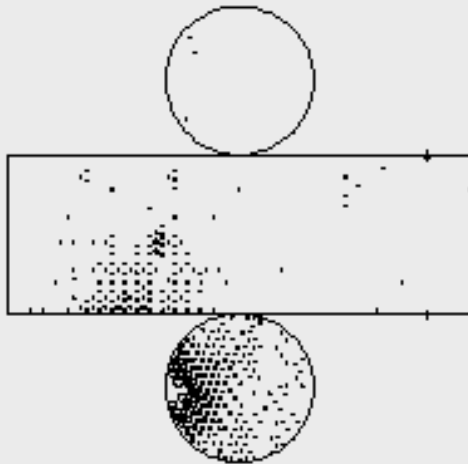
- There are a variety of commands we will need in order to use Idraw.
- Let's do some eye scanning, even though you don't know the commands yet, and we can learn as we go.
- I will provide a list of the commands when we're done.
- Please use Idraw.sh to look at these events:
 /disk/usr4/jlraaf/old_scanfiles/*.selcuts
- Let's take a look at some of these events...

★ Super Kamiokande ★

NUM # 2
RUN # 31173
EVENT# 622828
DATE 2006-Sep-8
TIME 22:12:55

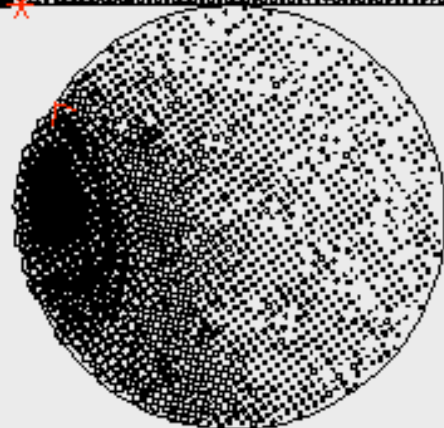
TOT PE: 191014.6
MAX PE: 247.3
NMHIT : 10373
ANT-PE: 8198.1
ANT-MX: 328.3
NMHITA: 547

Your First Event



RunMODE: NORMAL
TRG ID : 00001011
T diff.: 0.153E+04us
: 1.53 ms
FSCC: *****
TDC0: 8892.2
Q thr. : 0.0
BAD ch.: masked
SUB EV : 0/0

- Manual Fit
- Redraw
- Spin
- Zoom In
- Zoom Out
- Save as ..
- Show FITVTX

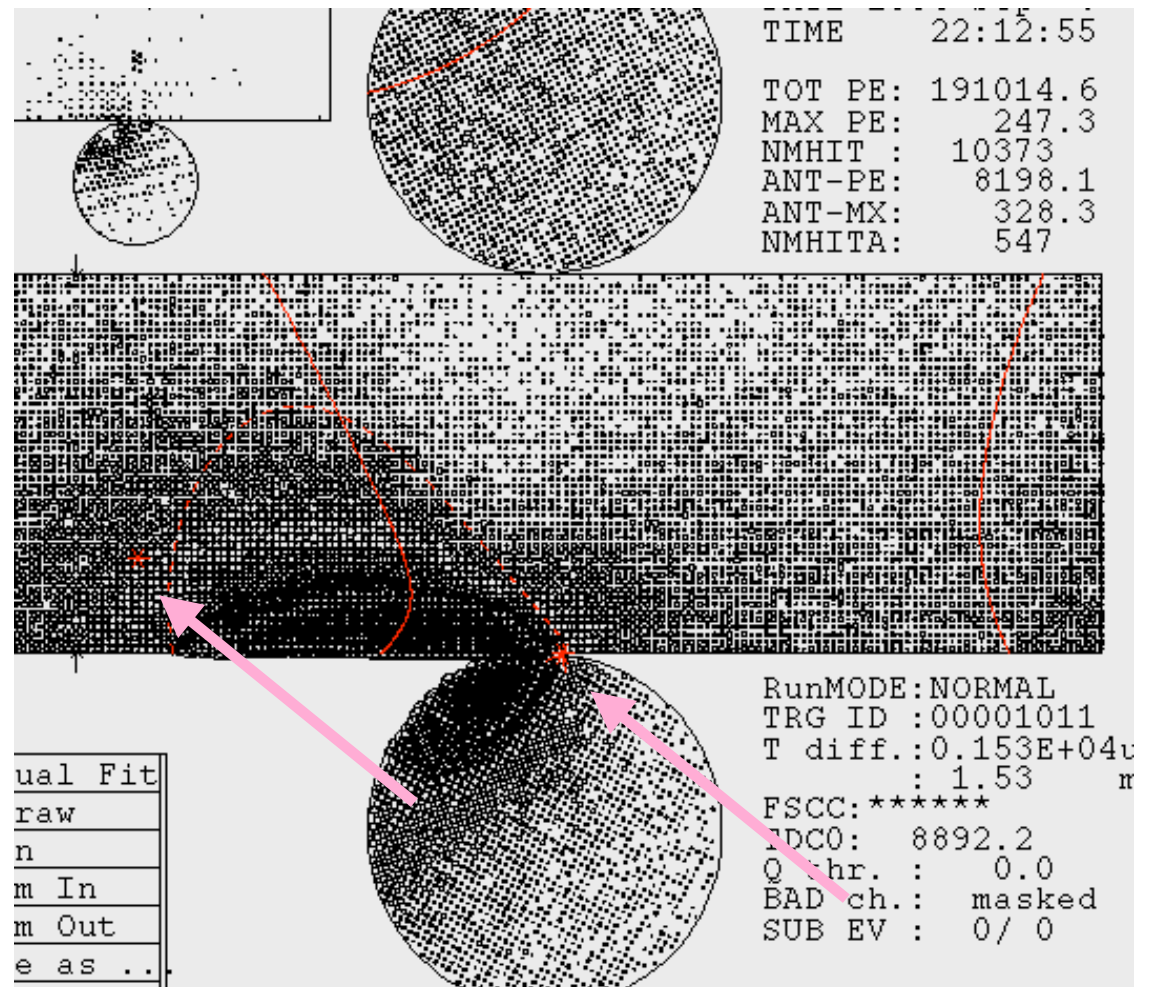


Corner Clipper

- This event is an example of a **BAD** event.
- Here a downward going μ has clipped the edge of the detector and tricked the fitter into reconstructing it as an upmu.
- Click “spin” from the menu at the lower left-hand corner. Then click on the event display near the fitted vertex.
- This will rotate the event so that the vertex is centered. Sometimes this gives you a better view. Now your event should look like this:

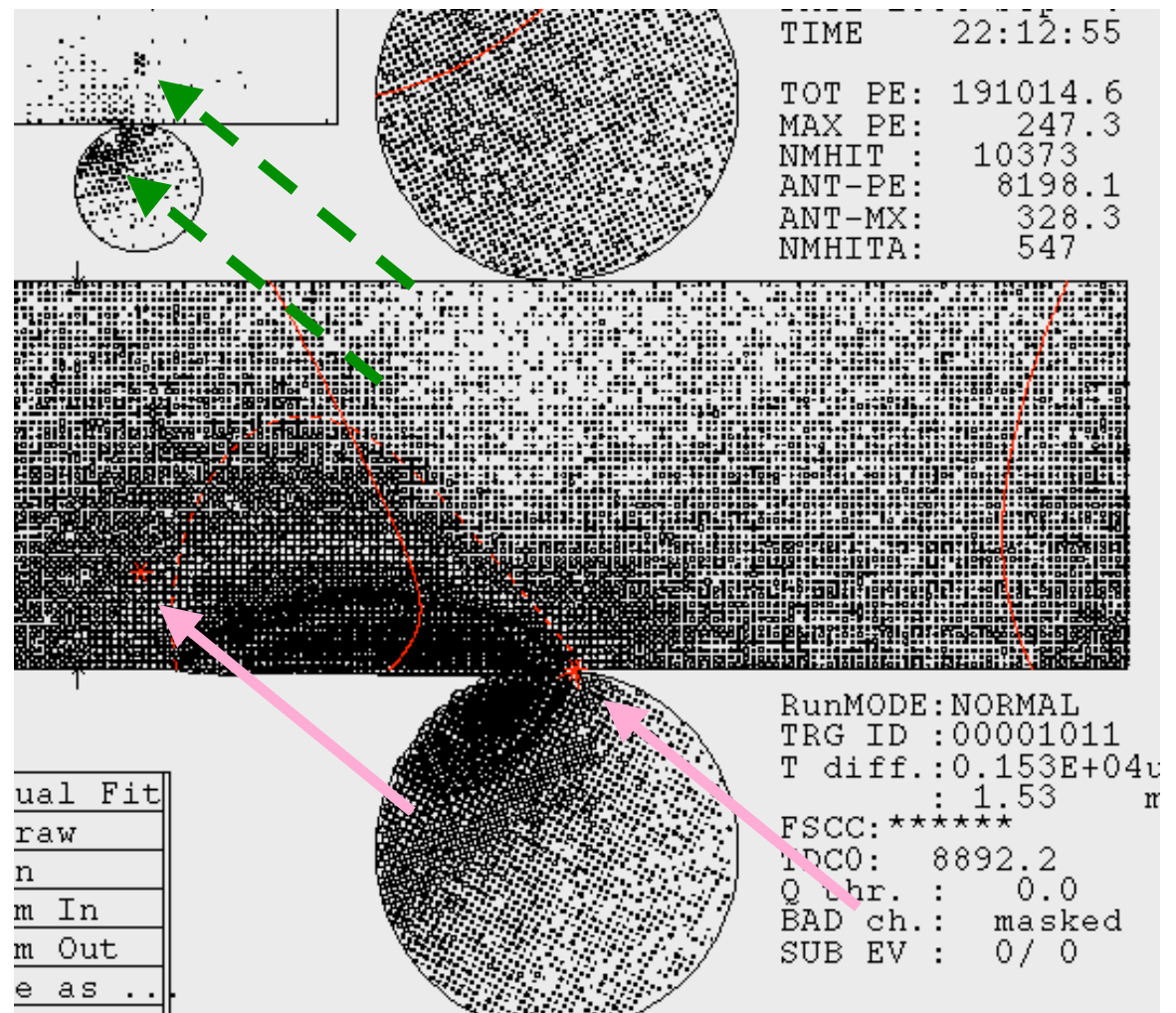
Spun Event (Corner Clipper)

- Notice that there are two red dots. They represent the entry and exit points as determined by the fitter.
- Do you see the red precise fit curve? Notice that it does not match up with the Cherenkov rings. Bad fits are often corner-clippers.



Corner Clipper OD Hits

- Another sign that this is not a real upmu comes from looking at the OD.
- See how the entry and exit clusters (green/dashed) do not match up with ID fit (solid/pink)?



Manual Fit

- Suppose you aren't sure about this event and you want to test whether it might be a corner clipper.
- You can use a manual fitter to check:
 - Click on “Manual Fit”.
 - Click to select the exit point.
 - Option-click (middle-click) to select the entry point.
 - Command-click (right-click) when you are all done.
 - Click “Redraw” to remove old fits.

pos,dir : -1508.09778 -762.719482 -90.1499023 0.430710435 -
0.394076049 **-0.811906755** ← manual fit zenith angle

Results of Manual Fit

- The upper fit is the automated fit.
- The lower fit is a manual fit.
- The manual fit information appears in the terminal window. In this case $z < 0$ so it's a down- μ .



Consult Timing Information

- Left-click on “Type”.
- You can color code the timing information by typing: `dct 1000 1200`
- This will color code the PMT hits using 5 color bins between 1000ns and 1200ns.
- You can use this command to better find the entry points (green) and exit (red) points.
- Check the timing window to pick useful minimum and maximum times.

Record Your Decision

- Record your decision in a .scan file with the follow format:

```
run   subrun   event   S/R?  comments
31173  2           622828  R     corncer-clipper
```

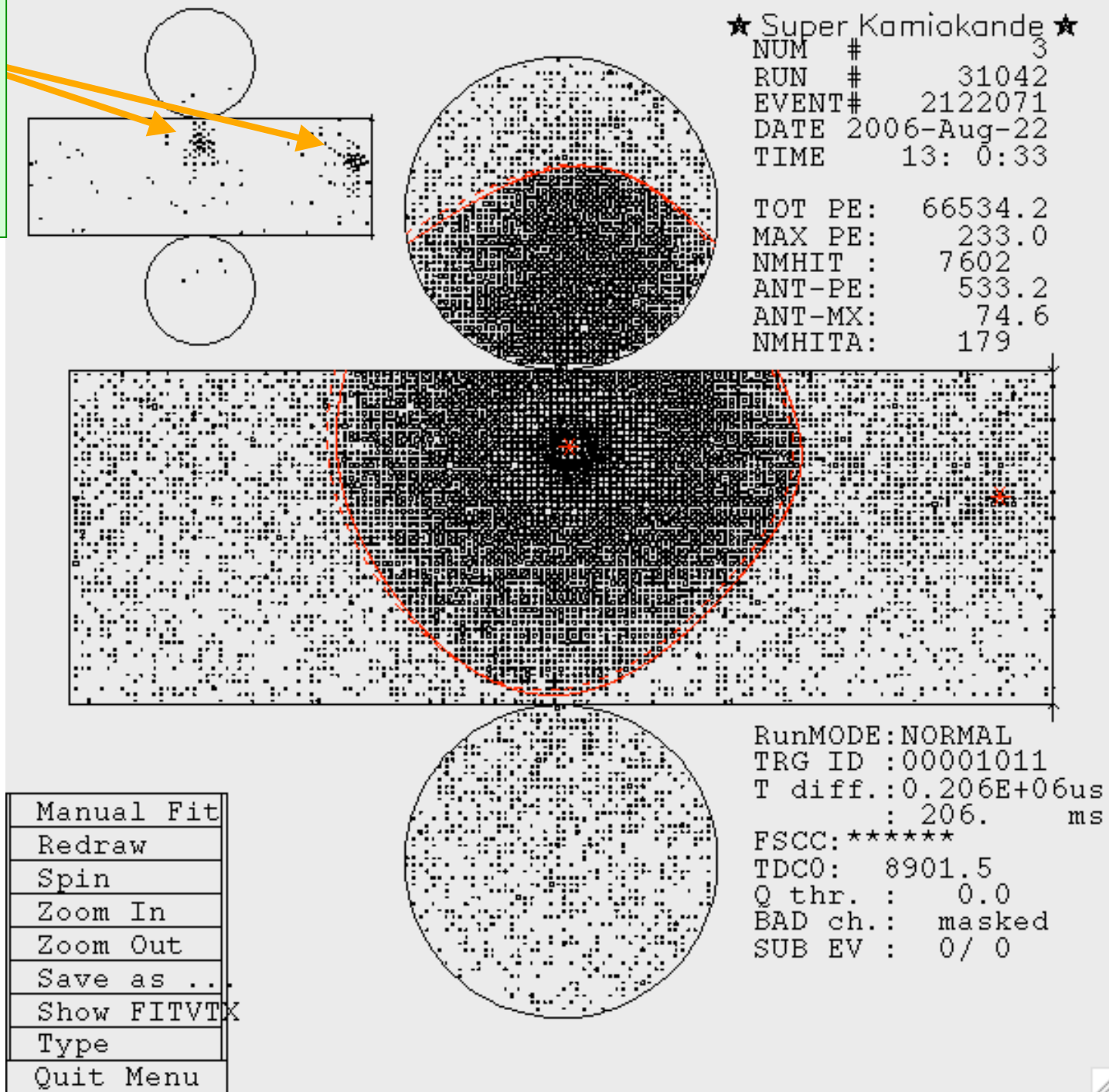
- One scanner should create .scan1 files, the second scanner should create .scan2 files.
- Don't look at each other's files while scanning.
- Keep a list of who is scanning what.

Next Event

- To go to the next event (on a mac) hold down the command key and click. On a PC you must right-click.
- **Caution:** if you fail to hold down the command key (on a mac) the program will abort.
- Before you go to the next event, create a text file to keep track of your decisions.
- The format is: run# event# S/R comments
E.g.: *31173 622828 R corner-clipper*

Here's the next event:

OD clusters support upmu hypothesis.

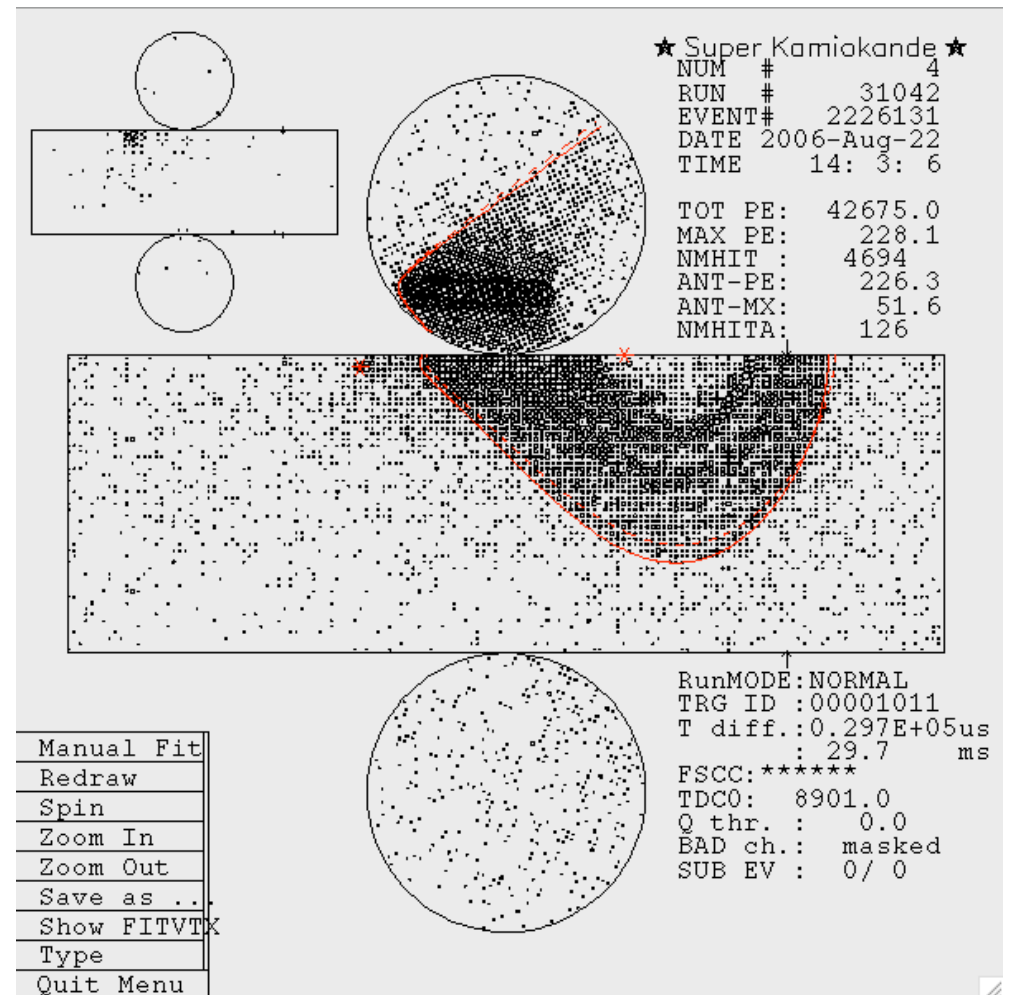


A Perfect Upmu:

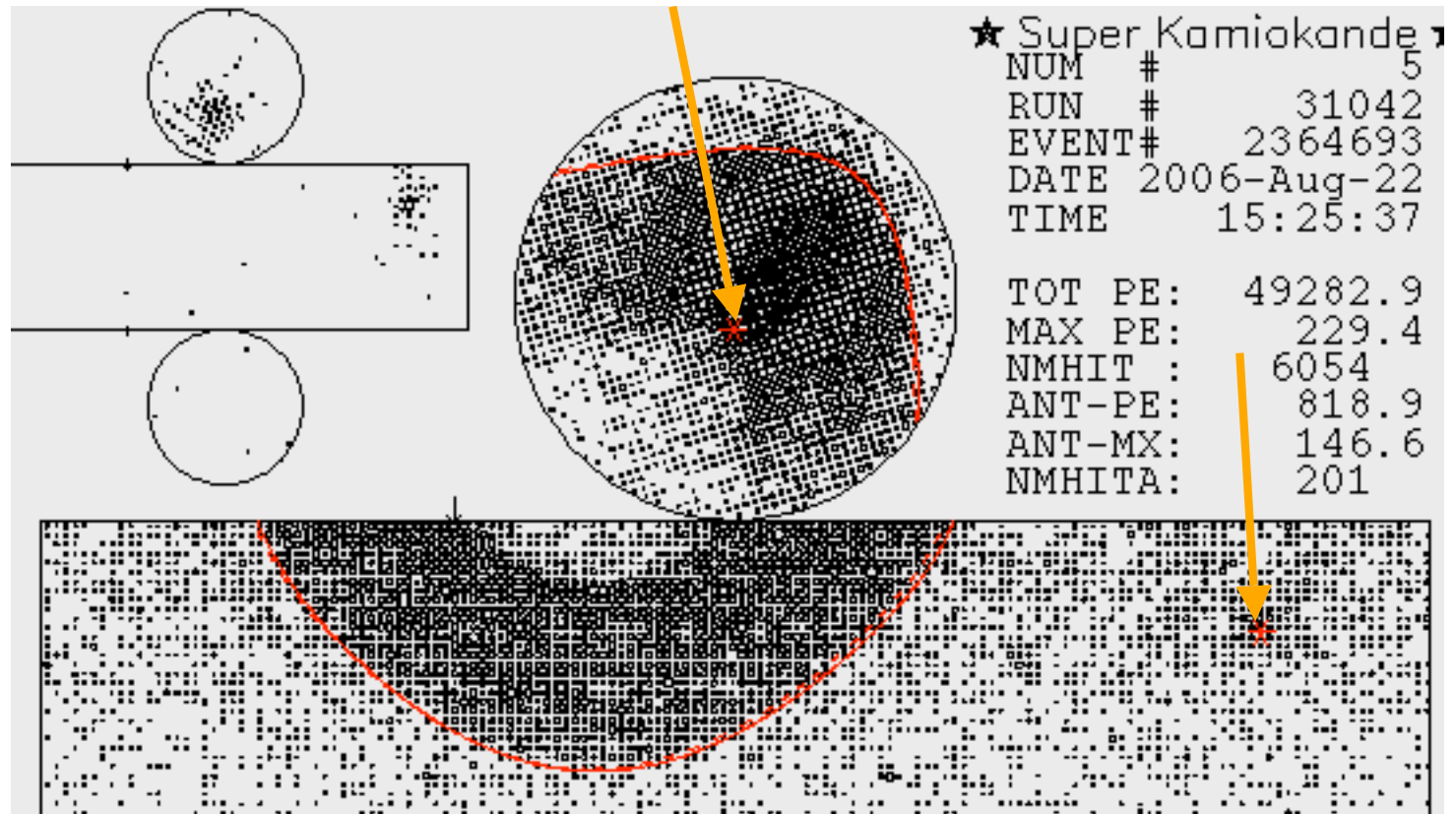
One you could take home to meet your parents

What If You're Not Sure?

- Here's the next event.
- Suppose you think this is an upmu--(it is)--but you're not sure.
- If this happens record your best guess with a question mark to indicate your uncertainty.
- If you have no idea whatsoever, just record a question mark and let the experts decide.



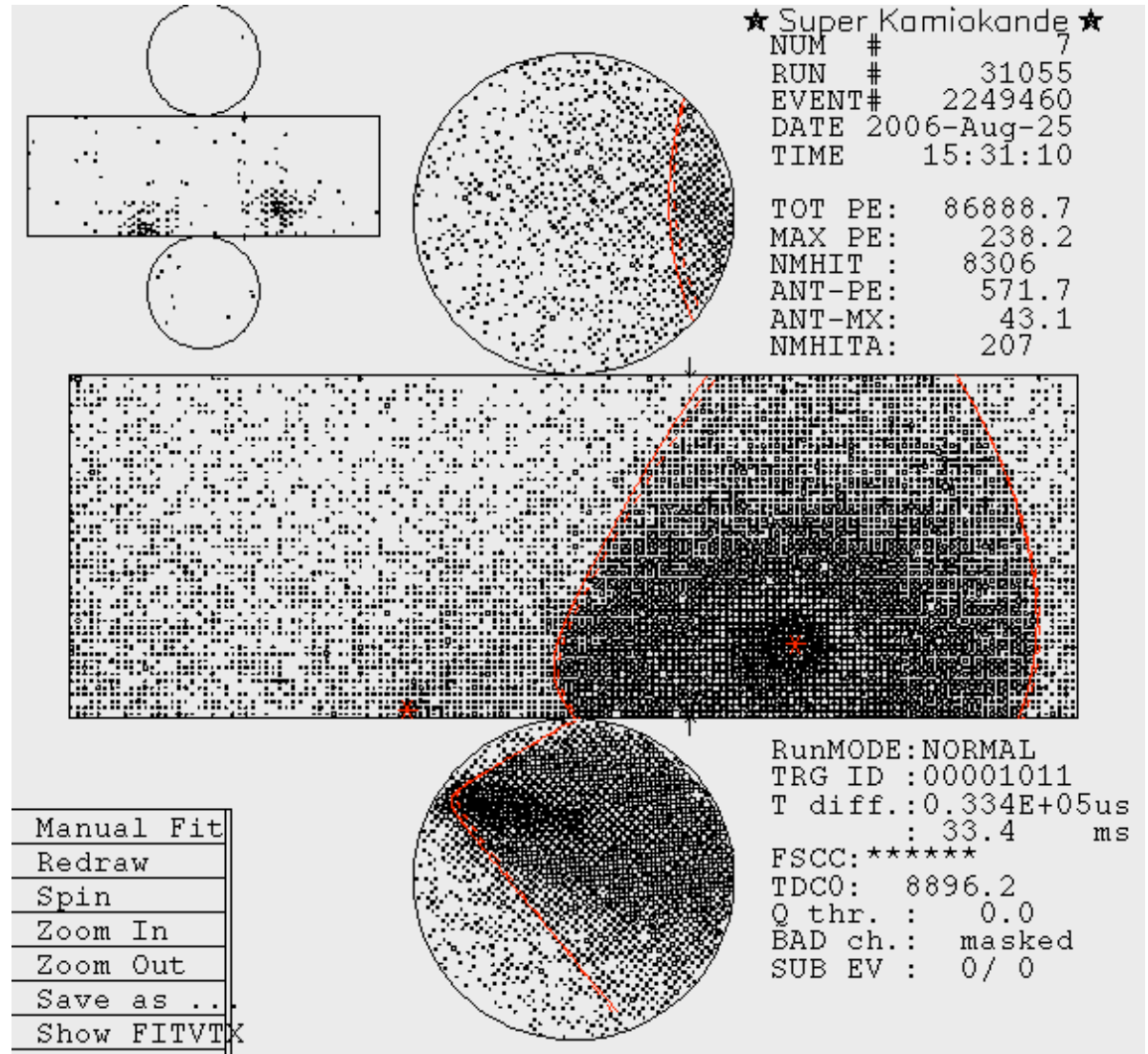
Another Good Upmu



- This is another good upmu, but it looks different from the last one we saved.
- Looking at the ring, a novice might be tempted to think that he/she is looking at a down- μ due to the shape of the ring.
- Remember, however, that the ring is formed by a cone intersecting a cylinder, and so the geometry is complicated.
- Look at how good the fit is. Also, notice that the OD clusters agree with the fit. If the fit is this good, trust it.

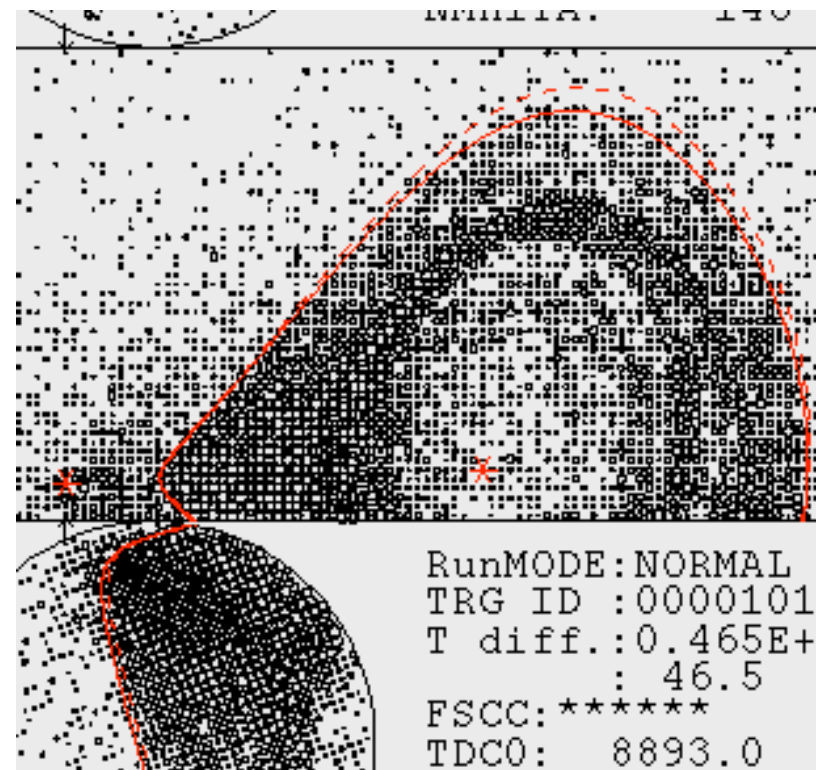
High-E Upmus Can Be Messy

- Check that the fit is good.
- Check that the OD clusters make sense.
- This is a good upmu.



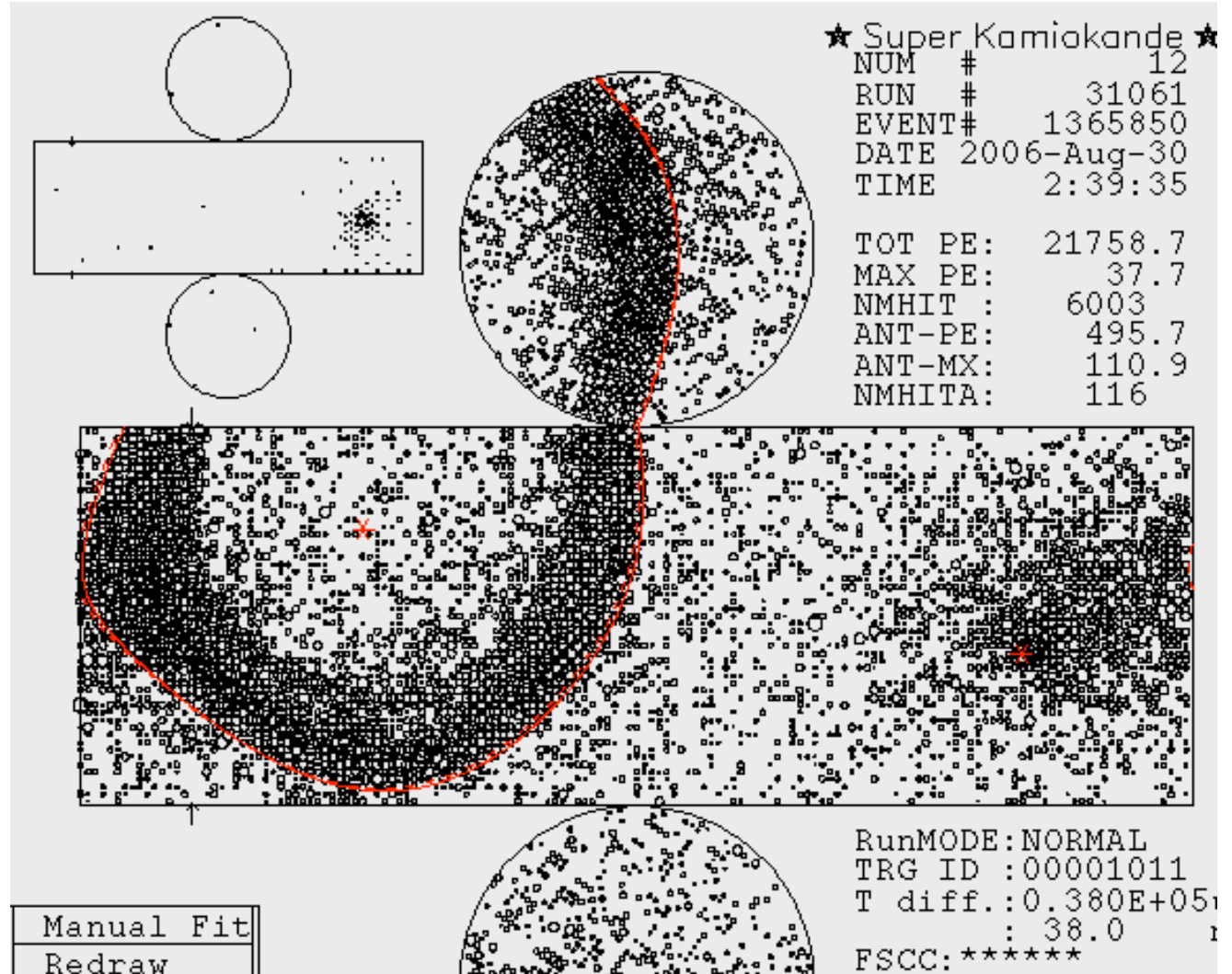
Scattering Effects

- Sometimes an upmu will scatter slightly creating multiple rings.
- In this case check that the fitter does a reasonable job fitting. If it's not a real upmu the fit is usually way off.
- This example is a real upmu.



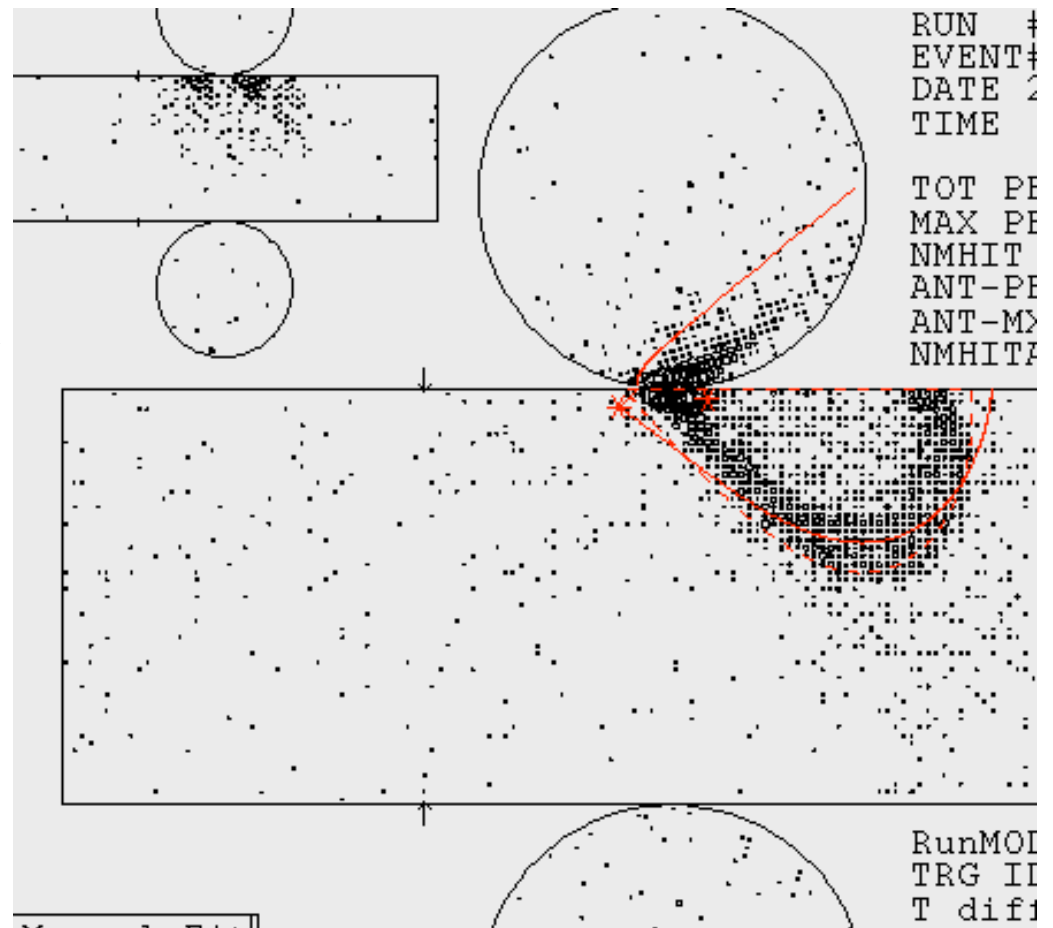
Stopping Events

- Stopping events are usually pretty easy to tag since they make a nice single ring with only one OD cluster.
- This is a stopping upmu.



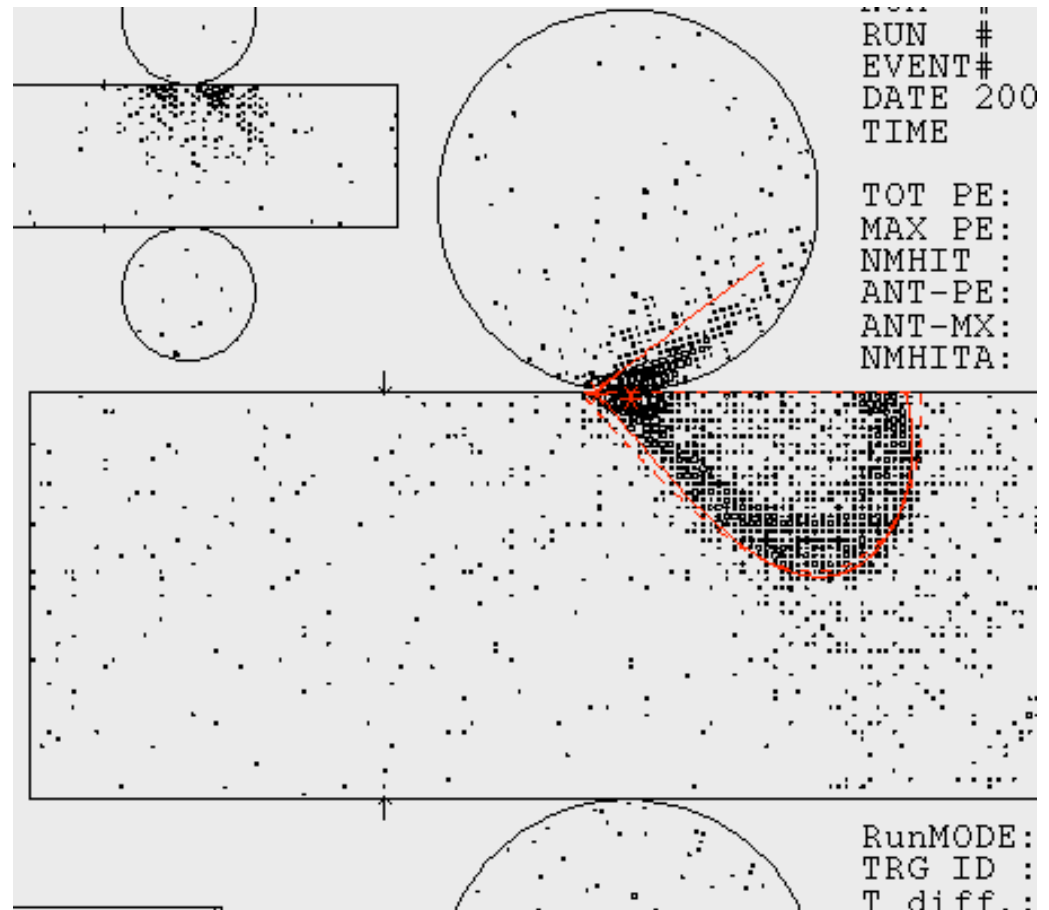
Near Horizontal, So-So Fit

- Sometimes you will encounter near horizontal events with fits that are not great, but they are also not wildly off.
- In these cases perform a manual fit...



Near Horizontal Manual Fit

- If the manual fit produces a negative $\cos(\theta)$ that differs from the computer fit by $>5^\circ$ then the event is rejected.
- If the hand fit differs by $<5^\circ$, the event is saved—even if the hand fit says it is a downward going μ .



Review

- Your mission: save upmu events, reject multi- μ and corner-clipper events.
- Your tools: look at OD clusters and fit quality, do manual fits, try spinning the event and/or zooming in on the event.
- **Caution:** as far as I know, (on a mac) there is no command to skip events or go back an event. On Linux click “Type” then type “sk - 1” to go back one event for example.
- A complete list of ldraw commands is here: `/disk/usr4/jlraaf/draw/draw_command.doc`