

中国科学院高能物理研究所

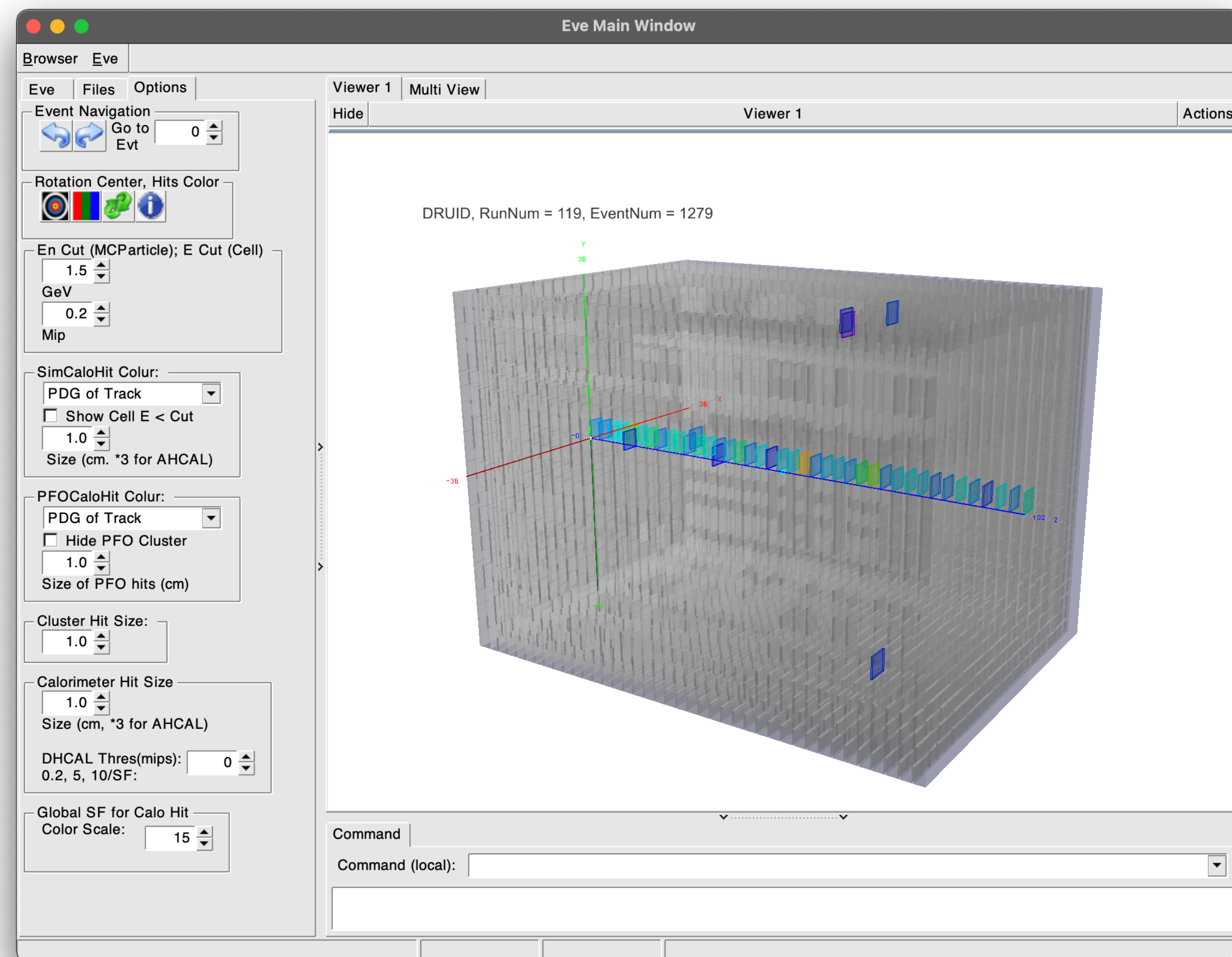
Institute of High Energy Physics, Chinese Academy of Sciences

Test Beam Raw Data Conversion: Validation & Display

Yuzhi Che

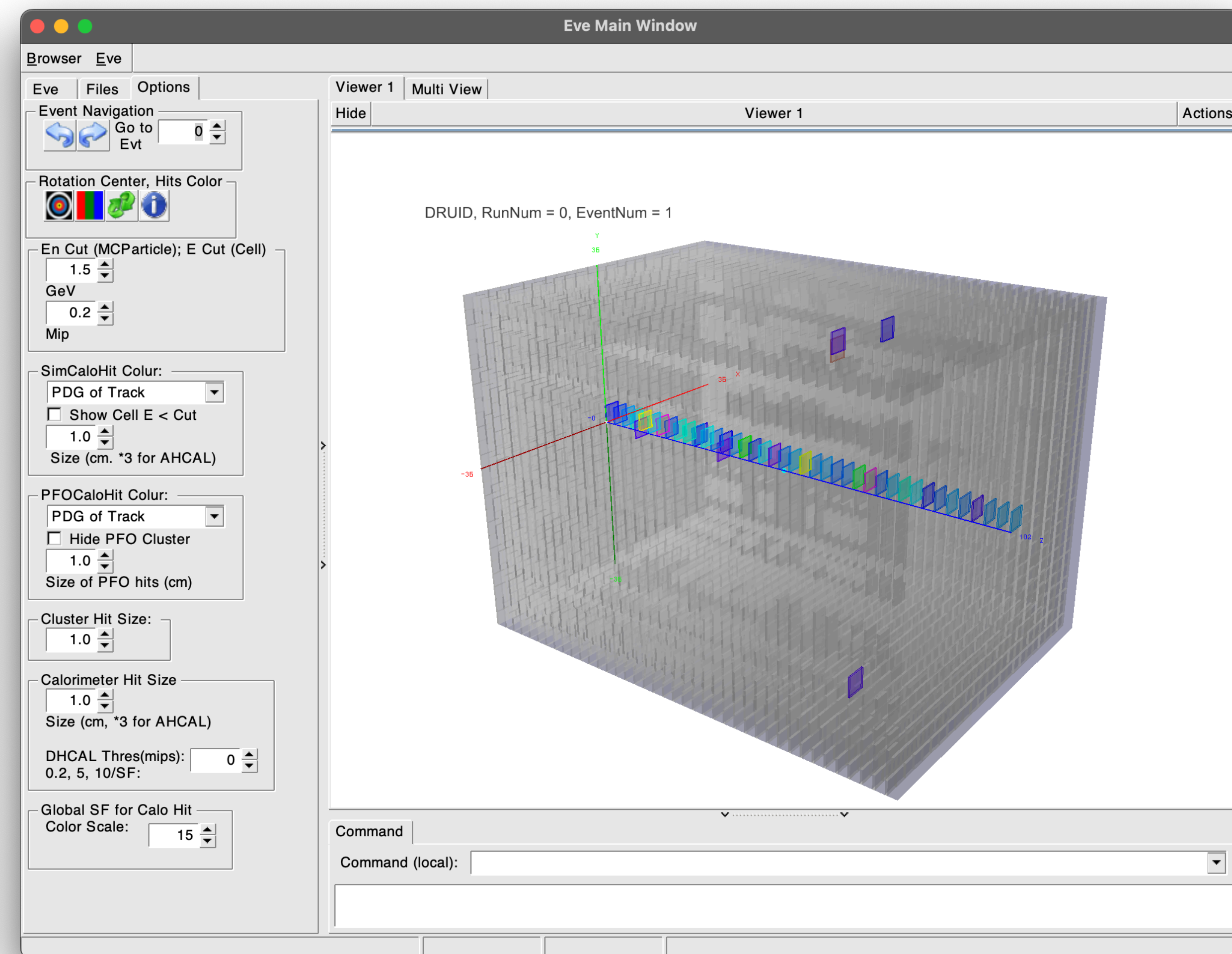
Feb. 16, 2023

News: Druid now displays Raw & Calib LCIO Data



Calibrated data of the first iteration

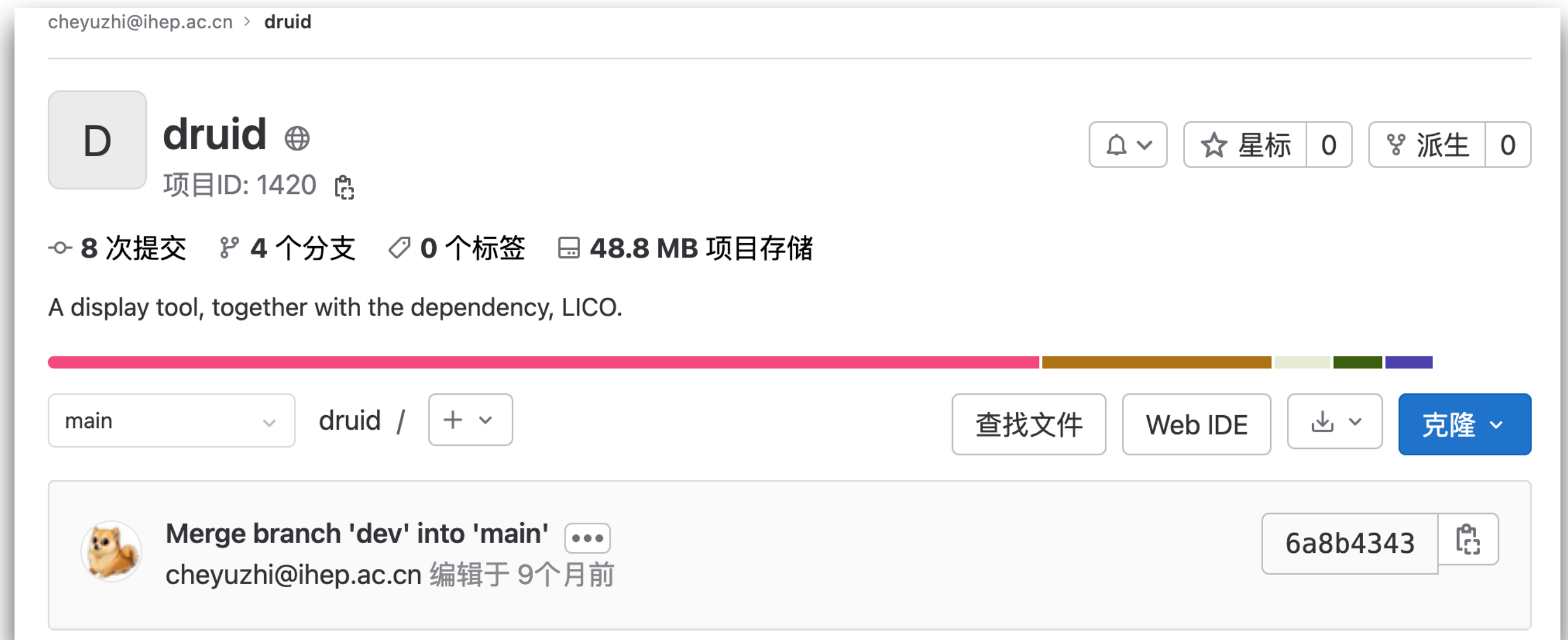
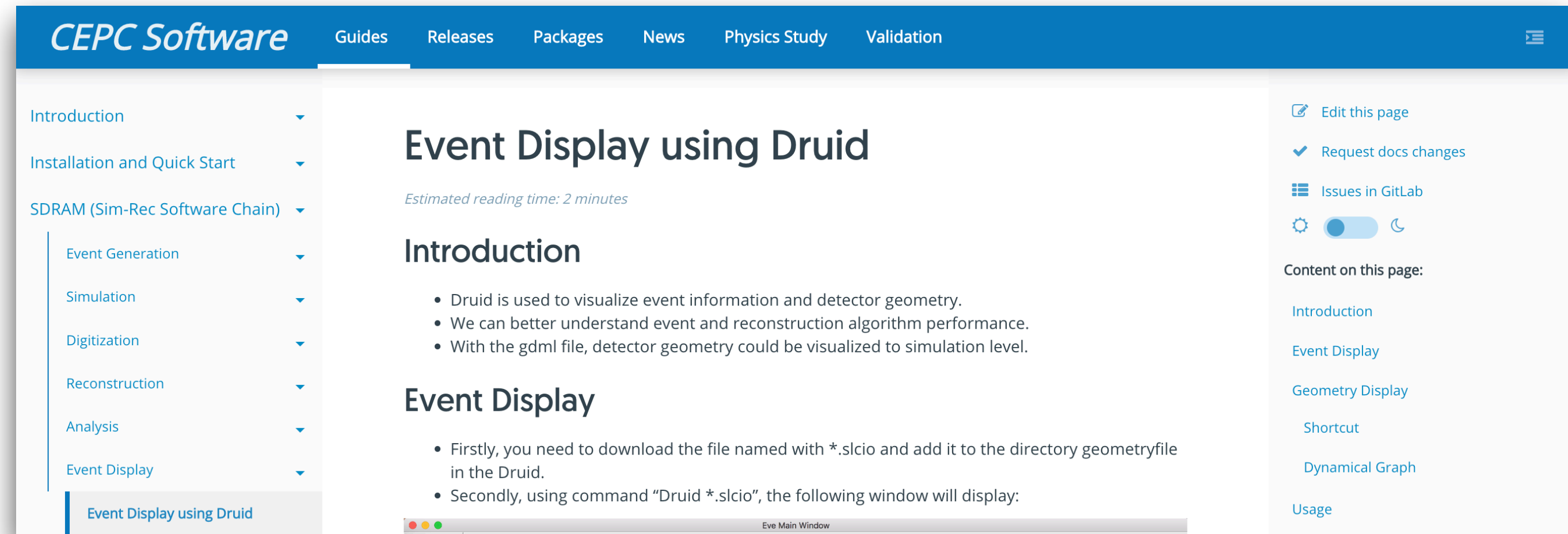
Geometry provided by Baohua



Raw data created by Francios

About Druid

- Public Page:
<http://cepcsoft.ihep.ac.cn/guides/EventDisplay/docs/druid/>
- GitLab link:
<https://code.ihep.ac.cn/cheyuzhi/druid.git>
- Compiled on MacOS
- on Linux with newer LCIO version:
on the way ...



Relative Conventions

- Ignore pedestal hits (hittag == 0)
- cellid: $ID_{\text{chip, Yukun}} = ID_{\text{chip, Fran}} - 1$
- CellID–Position map

```
218      /*
219      * !!! Should be varify!
220      */
221      if (idDecoder(hit)["hit"] == 0) {
222          continue;
223      }
224      LayerNum = idDecoder(hit)["layer"];
225      IndexI = idDecoder(hit)["chip"] -
226              1; ///< For test-beam prototype, IndexI denots chip index.
227              ///< WARNING: should be valiated
228      IndexJ = idDecoder(hit)["channel"]; ///< ..., ... channel index.
229      ///< decode position with dedicate functions.
230      std::cout << LayerNum << ", " << IndexI << ", " << IndexJ << std::endl;
231      TVector3 pos;
232      if (name == "ECALRawHits") {
233          pos = TVector3(GetScEcalHitPos(LayerNum, IndexI, IndexJ));
234      } else {
235          pos = TVector3(GetAhcalHitPos(LayerNum, IndexI, IndexJ));
236      }
```

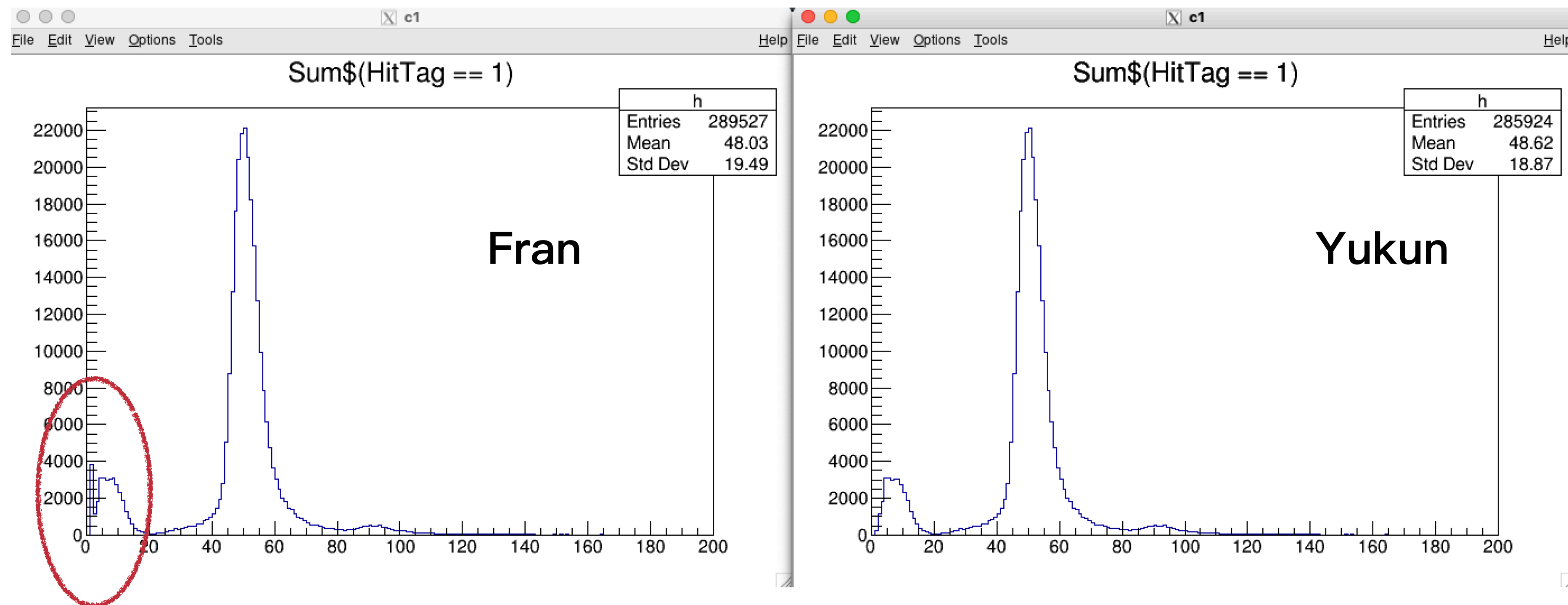
```
//----- For AHCAL -----
// Copy from Yukun @ USTC
// scintillator strips wrt. 6 SPIROC2E chips * 36 channels
TVector3 GetAhcalHitPos(int layer_ID, int chip_ID, int channel_ID) {
    const int cell_SP = 16;
    const int chip_No = 9;
    const int channel_No = 36;
    const int Layer_No = 40;
    const double _Pos_X[channel_No] = {
        100.2411, 100.2411, 100.2411, 59.94146, 59.94146, 59.94146,
        19.64182, 19.64182, 19.64182, 19.64182, 59.94146, 100.2411,
        100.2411, 59.94146, 19.64182, 100.2411, 59.94146, 19.64182,
        -20.65782, -60.95746, -101.2571, -20.65782, -60.95746, -101.2571,
        -101.2571, -60.95746, -20.65782, -20.65782, -20.65782, -20.65782,
        -60.95746, -60.95746, -60.95746, -101.2571, -101.2571, -101.2571};
    const double _Pos_Y[channel_No] = {
        141.04874, 181.34838, 221.64802, 141.04874, 181.34838, 221.64802,
        141.04874, 181.34838, 221.64802, 261.94766, 261.94766, 261.94766,
        302.2473, 302.2473, 302.2473, 342.54694, 342.54694, 342.54694,
        342.54694, 342.54694, 342.54694, 302.2473, 302.2473, 302.2473,
        261.94766, 261.94766, 261.94766, 221.64802, 181.34838, 141.04874,
        221.64802, 181.34838, 141.04874, 221.64802, 181.34838, 141.04874};
    const double chip_dis_X = 239.3;
    const double chip_dis_Y = 241.8;
    const double HBU_X = 239.3;
    const double HBU_Y = 725.4;
    const double HBU_Z = 26;

    TVector3 pos;
    int HBU_ID = chip_ID / 3;
    chip_ID = chip_ID % 3;
    pos.SetX(_Pos_Y[channel_ID] - chip_ID * chip_dis_Y);
    pos.SetY(-(_Pos_X[channel_ID] + (HBU_ID - 1) * HBU_X));
    pos.SetZ(layer_ID * HBU_Z);
    return pos;
}
```


Consistence on #.hit per Event

The current two decoder shows better consistence on the distribution of #.hit per event (Run119 muon)

Some strange events are saved by Fran's decoder.

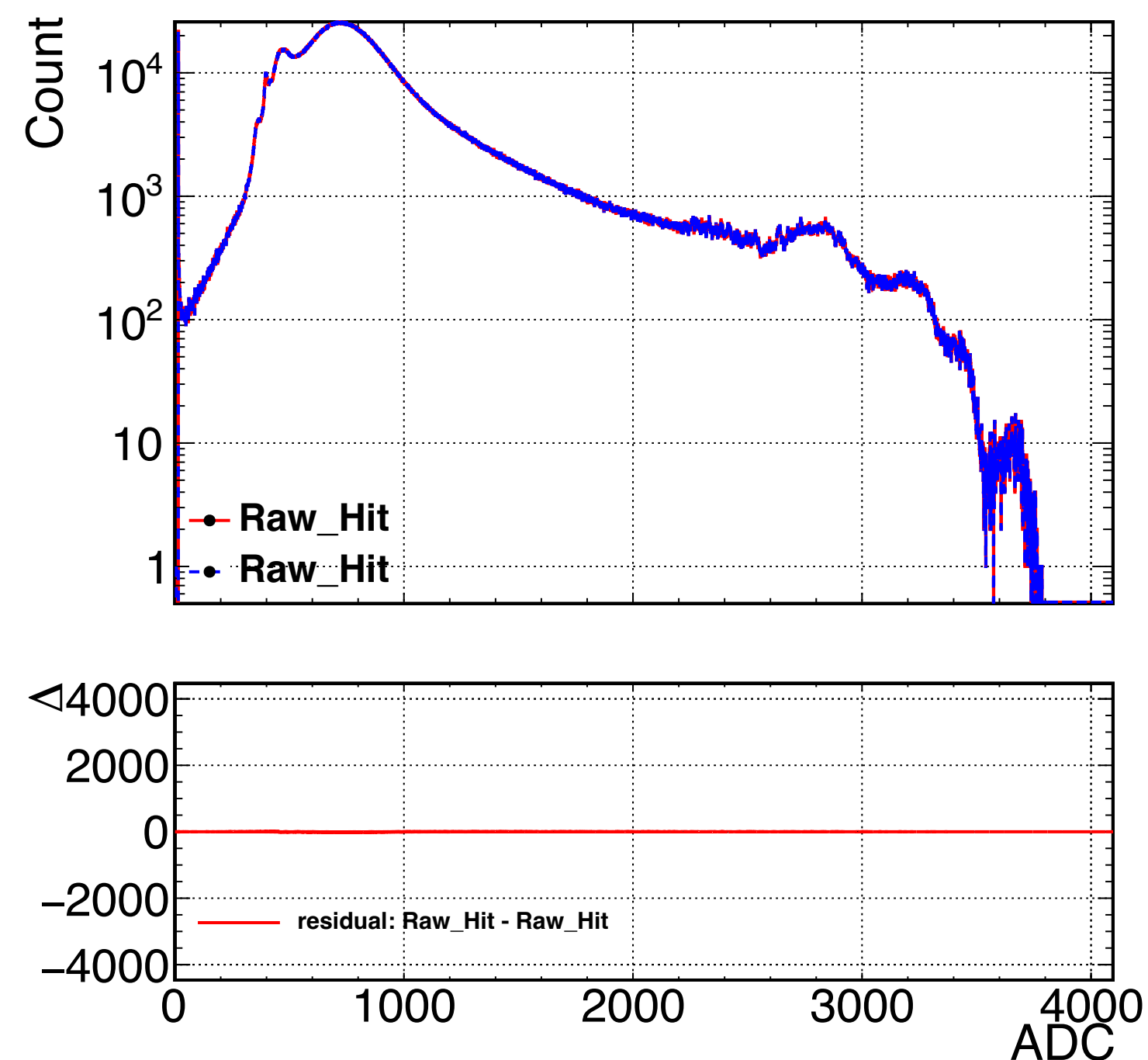


Consistence on #.hit per Evnent

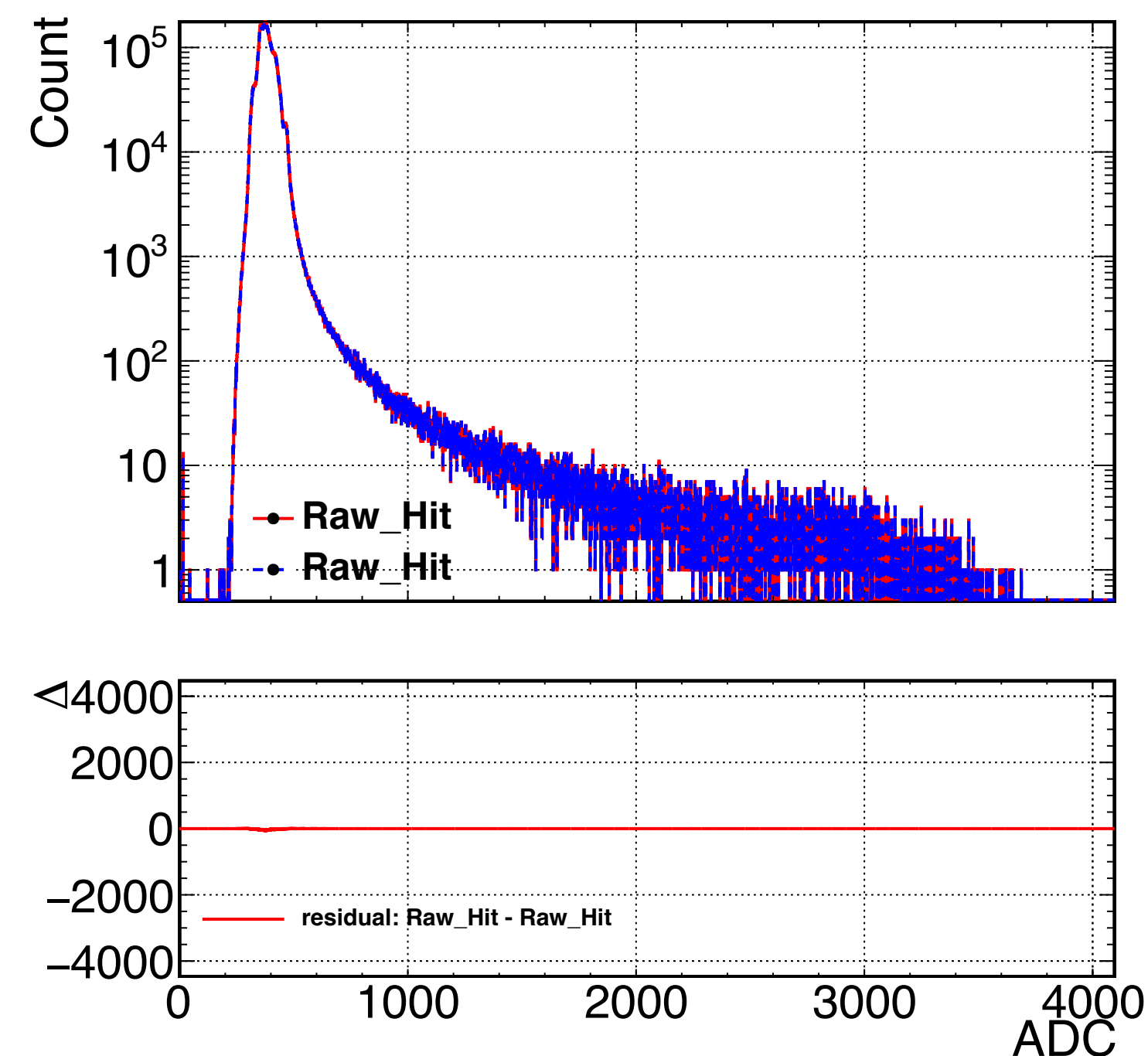
Red curve: Yukun's decoder

- Better consistence.

Blue curve: Fran's decoder



Top: hit energy spectrum of the fast conversion input & output; bottom: their difference and cumulative difference.

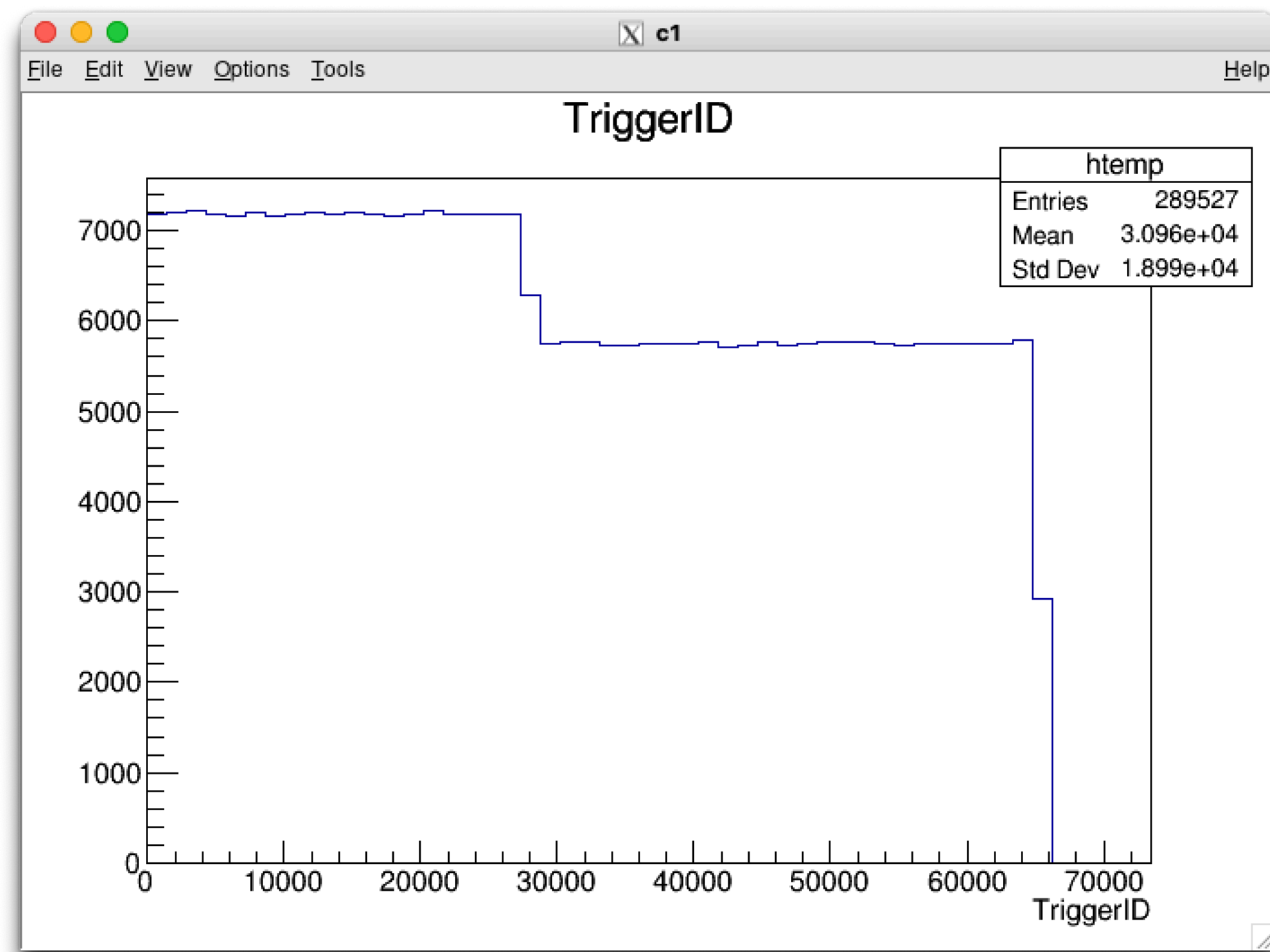


Number of hits per event of the two samples.

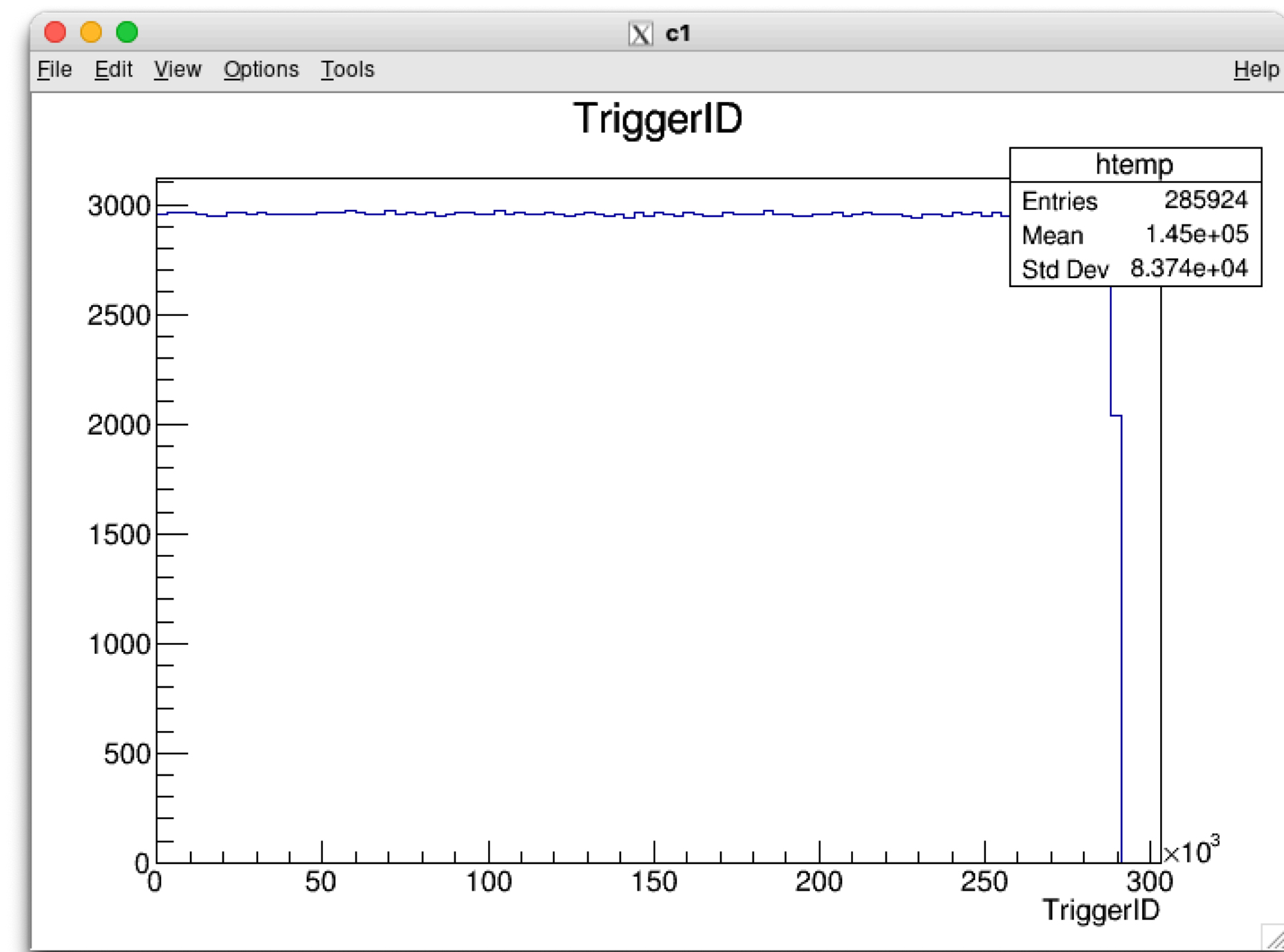
TriggerID Convention

In Fran's decode ROOT:

A trigger ID appears for multiple times: potential event split + periodic cycle



Run119: Fran's decoder

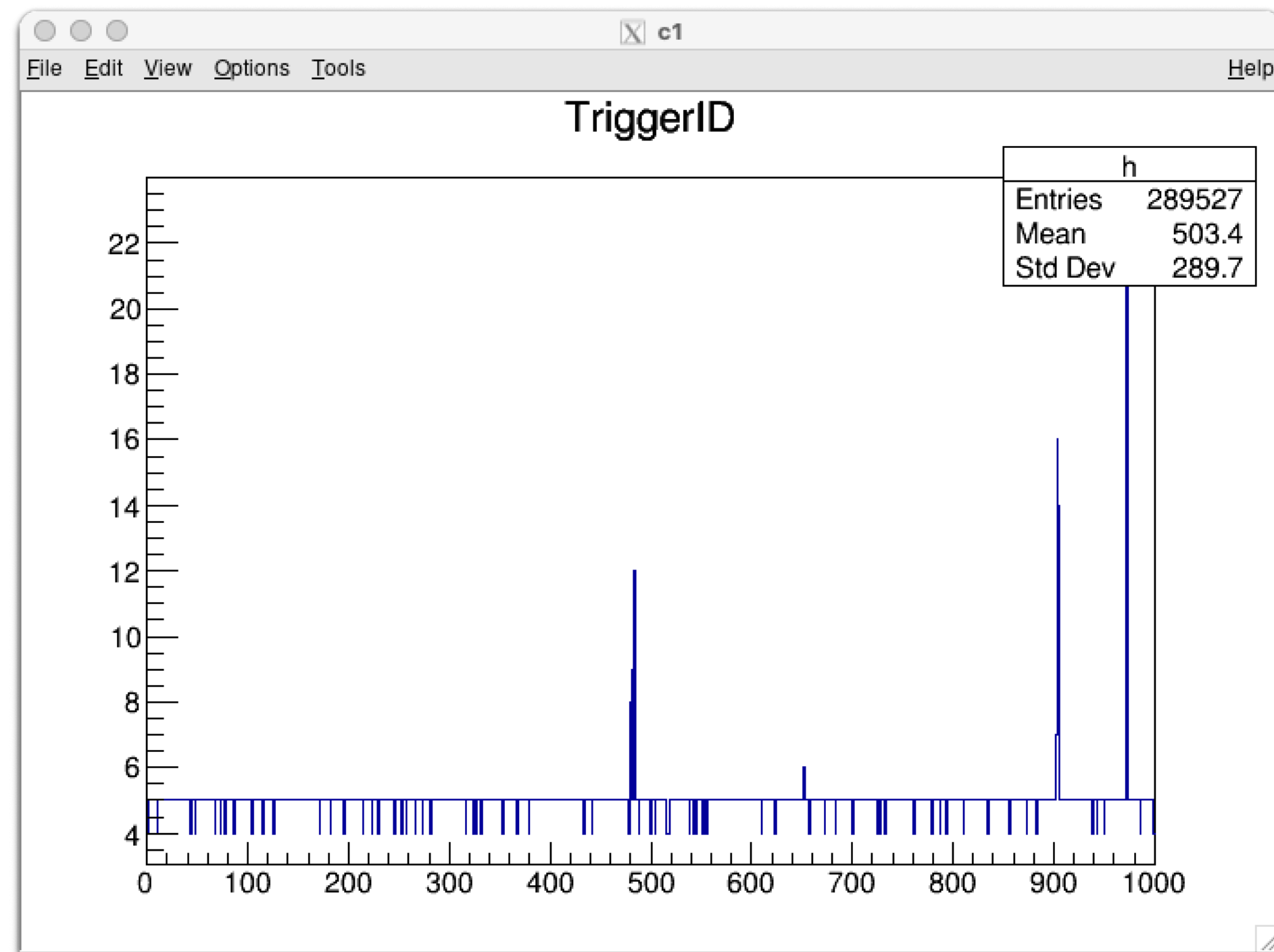


Run119: Yukun's decoder

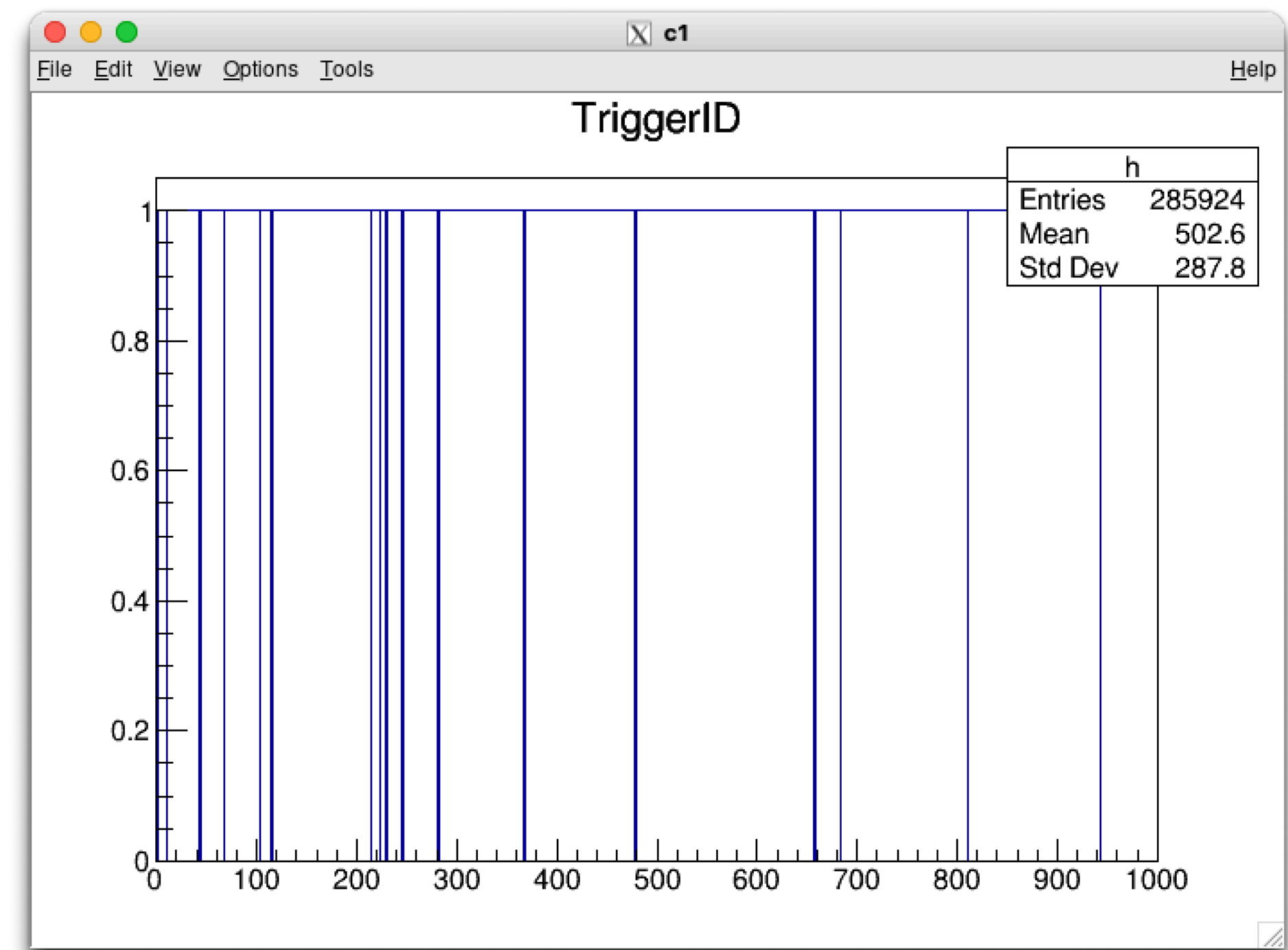
TriggerID Convention

In Fran's decode ROOT:

A trigger ID appears for multiple times, which implies the corresponding event split to more.



Run119: Fran's decoder



Run119: Yukun's decoder

TriggerID vs. #.hits

Fran

```
*****
*      Row      * Entry$ + *      Run_Num * Event_Num * TriggerID * Sum$(HitT *
*****
*          0 *          1 *          119 *          1 *          11060 *          6 *
*          1 *          2 *          119 *          81 *          11060 *          1 *
*          2 *          3 *          119 *          149 *          11060 *          1 *
*          3 *          4 *          119 *          204 *          11060 *          1 *
*          4 *          5 *          119 *          380 *          11060 *          1 *
*          5 *          6 *          119 *          383 *          11060 *          1 *
*          6 *          7 *          119 *          441 *          11060 *          1 *
*          7 *          8 *          119 *          750 *          11060 *          1 *
*          8 *          9 *          119 *          810 *          11060 *          1 *
*          9 *         10 *          119 *         1153 *          11060 *          1 *
*         10 *         11 *          119 *         1279 *              1 *          47 *
*         11 *         12 *          119 *         1280 *              2 *          45 *
*         12 *         13 *          119 *         1281 *              3 *          51 *
*         13 *         14 *          119 *         1282 *              4 *          51 *
*         14 *         15 *          119 *         1283 *              5 *          57 *
*         15 *         16 *          119 *         1285 *              6 *          47 *
*         16 *         17 *          119 *         1286 *              7 *          51 *
*         17 *         18 *          119 *         1287 *              8 *          44 *
*         18 *         19 *          119 *         1289 *              9 *          59 *
*         19 *         20 *          119 *         1291 *             11 *          50 *
*         20 *         21 *          119 *         1293 *             12 *           9 *
*         21 *         22 *          119 *         1294 *             13 *          48 *
*         22 *         23 *          119 *         1295 *             14 *          47 *
*         23 *         24 *          119 *         1296 *             15 *          51 *
*         24 *         25 *          119 *         1297 *             16 *          51 *
```

Yukun

```
*****
*      Row      * Entry$ + *      TriggerID * Sum$(HitT *
*****
*          0 *          1 *          11060 *          6 *
*          1 *          2 *              1 *          47 *
*          2 *          3 *              2 *          45 *
*          3 *          4 *              3 *          51 *
*          4 *          5 *              4 *          51 *
*          5 *          6 *              5 *          57 *
*          6 *          7 *              6 *          47 *
*          7 *          8 *              7 *          51 *
*          8 *          9 *              8 *          44 *
*          9 *         10 *              9 *          59 *
*         10 *         11 *             11 *          50 *
*         11 *         12 *             12 *           9 *
*         12 *         13 *             13 *          48 *
*         13 *         14 *             14 *          47 *
*         14 *         15 *             15 *          51 *
*         15 *         16 *             16 *          51 *
*         16 *         17 *             17 *          58 *
*         17 *         18 *             18 *           2 *
*         18 *         19 *             19 *          50 *
*         19 *         20 *             20 *          48 *
*         20 *         21 *             21 *          47 *
*         21 *         22 *             22 *          49 *
*         22 *         23 *             23 *          63 *
*         23 *         24 *             24 *          52 *
*         24 *         25 *             25 *          49 *
```


Display of Split Events

Pane #1

SCROLL: 0/36

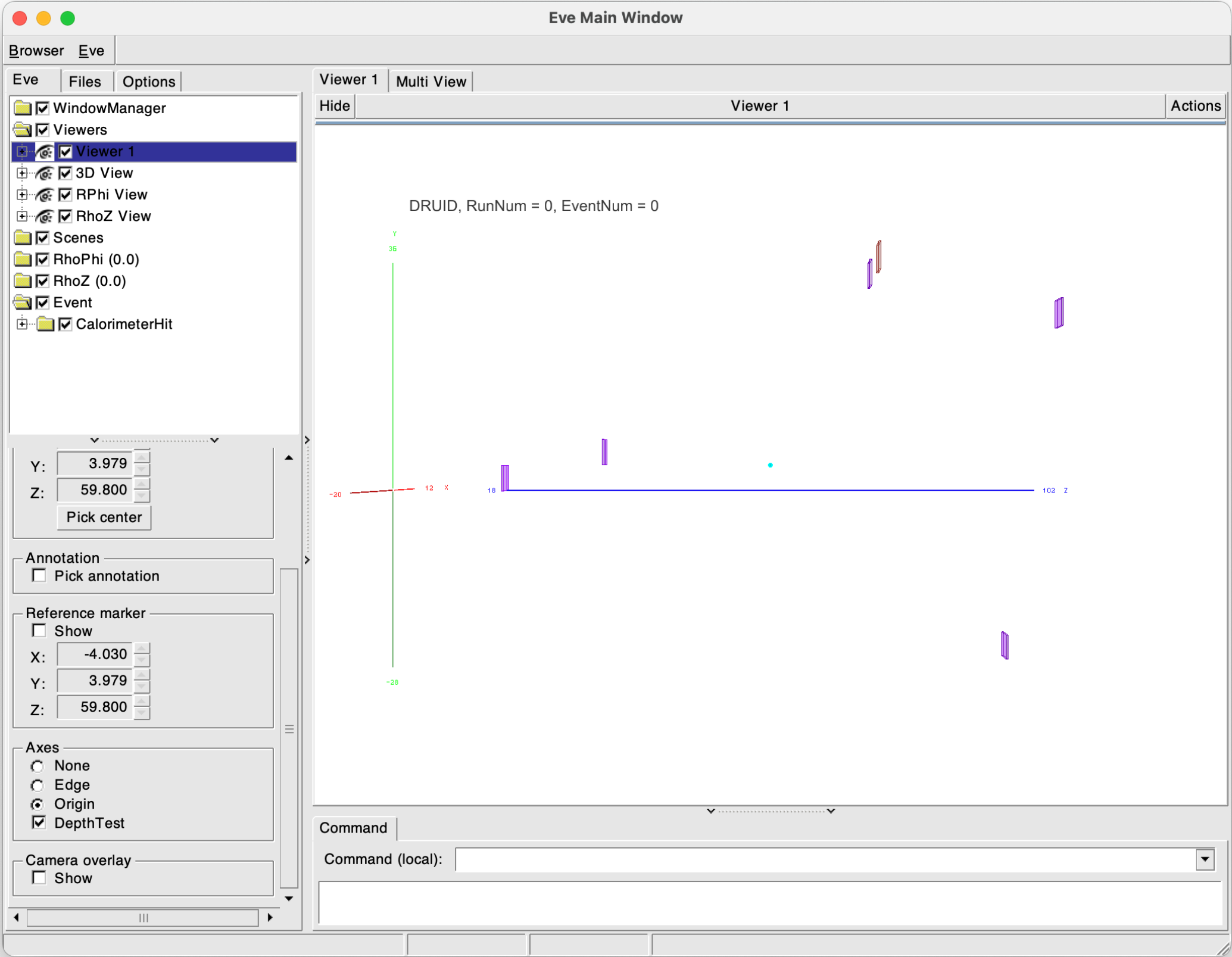
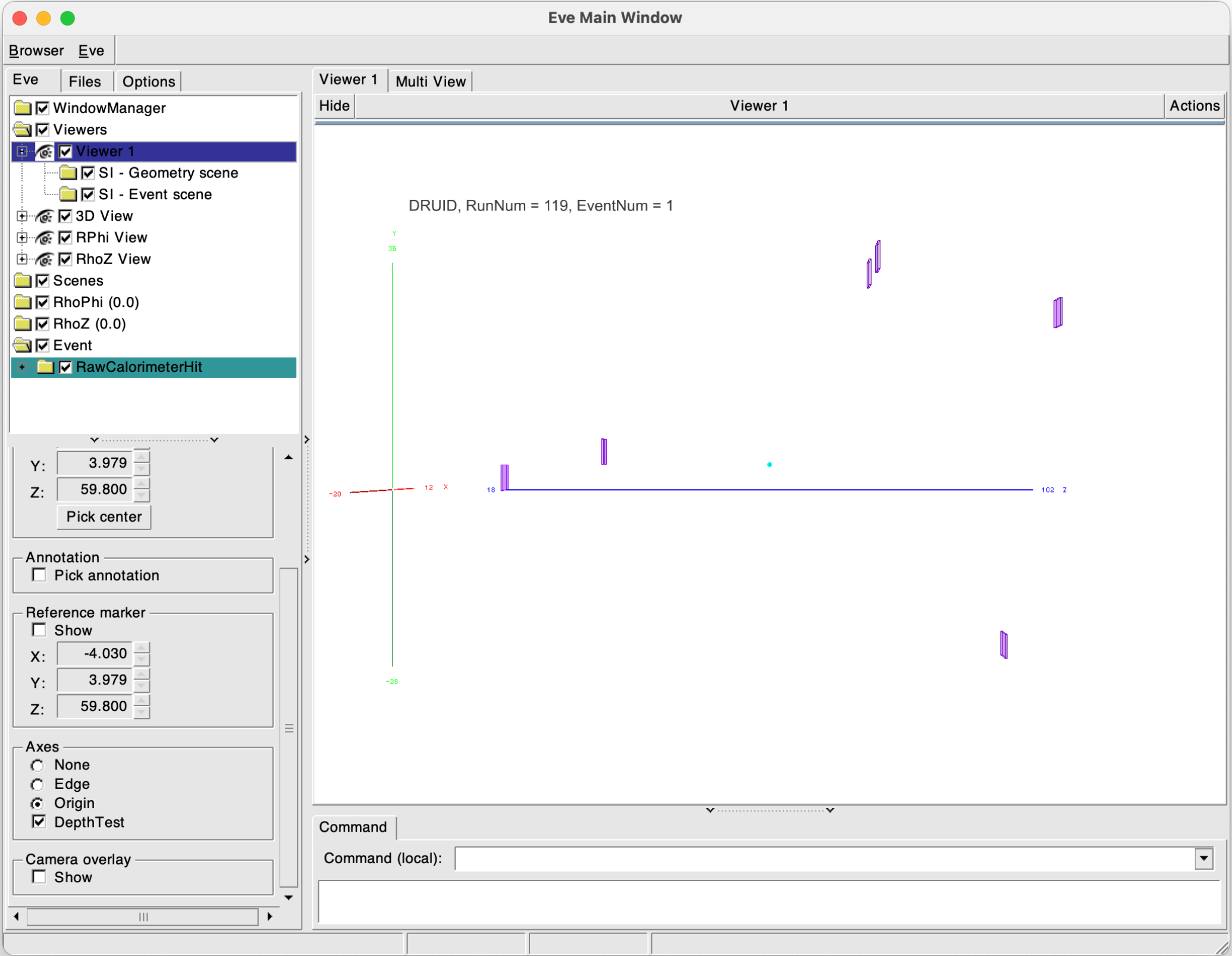
root [7] Raw_Hit->Scan("Entry\$ + 1:Run_Num:Event_Number:TriggerID:Sum\$(HitTag == 1)")

* Row	* Entry\$ +	* Run_Num	* Event_Num	* TriggerID	* Sum\$(HitT
* 0 *	1 *	119 *	1 *	11060 *	6 *
* 1 *	2 *	119 *	81 *	11060 *	1 *
* 2 *	3 *	119 *	149 *	11060 *	1 *
* 3 *	4 *	119 *	204 *	11060 *	1 *
* 4 *	5 *	119 *	380 *	11060 *	1 *
* 5 *	6 *	119 *	383 *	11060 *	1 *
* 6 *	7 *	119 *	441 *	11060 *	1 *
* 7 *	8 *	119 *	750 *	11060 *	1 *
* 8 *	9 *	119 *	810 *	11060 *	1 *

Pane #2

root [9] Raw_Hit->Scan("Entry\$ + 1:TriggerID:Sum\$(HitTag == 1)")

* Row	* Entry\$ +	* TriggerID	* Sum\$(HitT
* 0 *	1 *	11060 *	6 *
* 1 *	2 *	1 *	47 *
* 2 *	3 *	2 *	45 *
* 3 *	4 *	3 *	51 *
* 4 *	5 *	4 *	51 *
* 5 *	6 *	5 *	57 *
* 6 *	7 *	6 *	47 *
* 7 *	8 *	7 *	51 *
* 8 *	9 *	8 *	44 *
* 9 *	10 *	9 *	59 *



Display of Split Events

Pane #1

SCROLL: 0/36

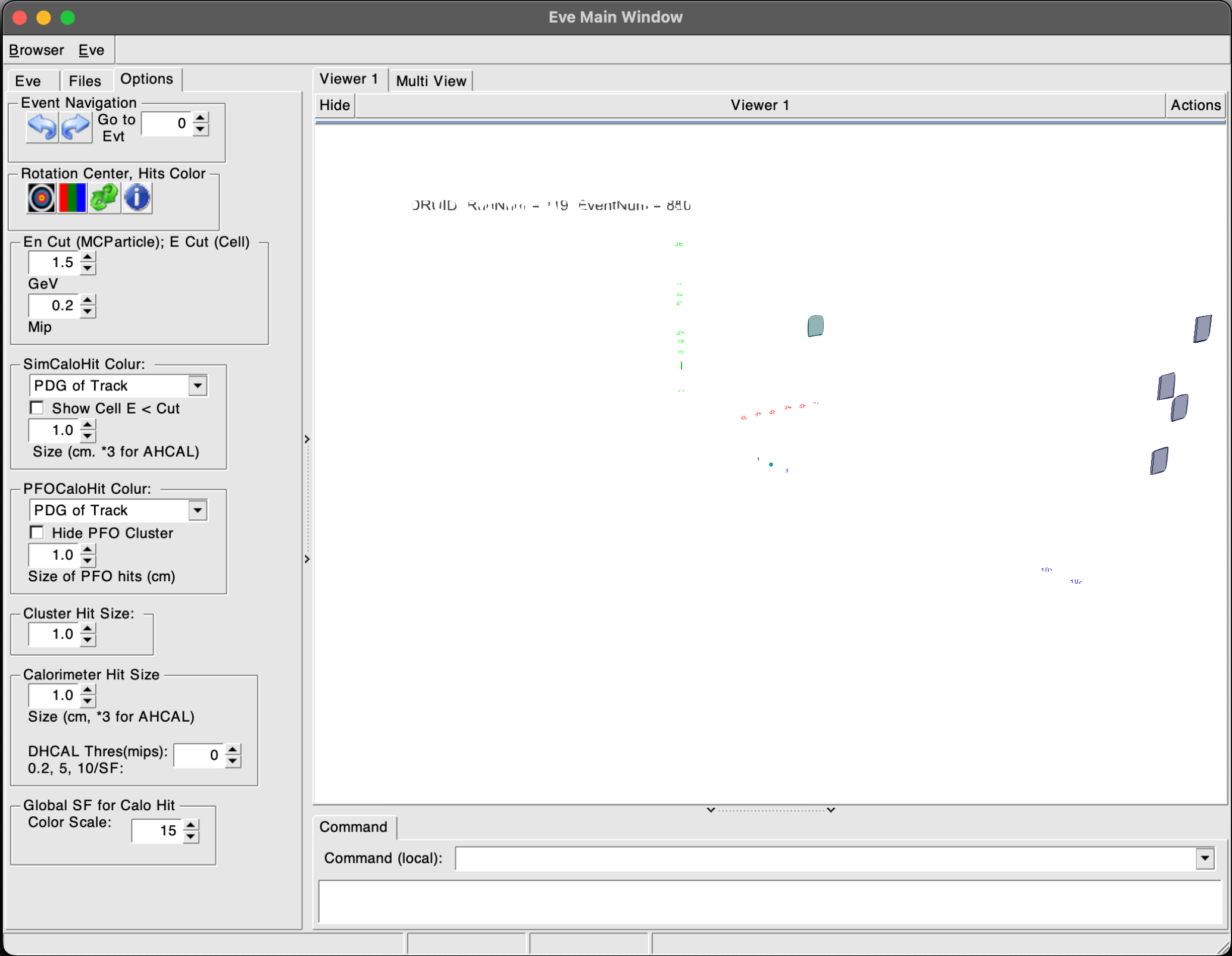
root [7] Raw_Hit->Scan("Entry\$ + 1:Run_Num:Event_Number:TriggerID:Sum\$(HitTag == 1)")

Row	Entry\$ +	Run_Num	Event_Num	TriggerID	Sum\$(HitT
0	1	119	1	11060	6
1	2	119	81	11060	1
2	3	119	149	11060	1
3	4	119	204	11060	1
4	5	119	380	11060	1
5	6	119	383	11060	1
6	7	119	441	11060	1
7	8	119	750	11060	1
8	9	119	810	11060	1

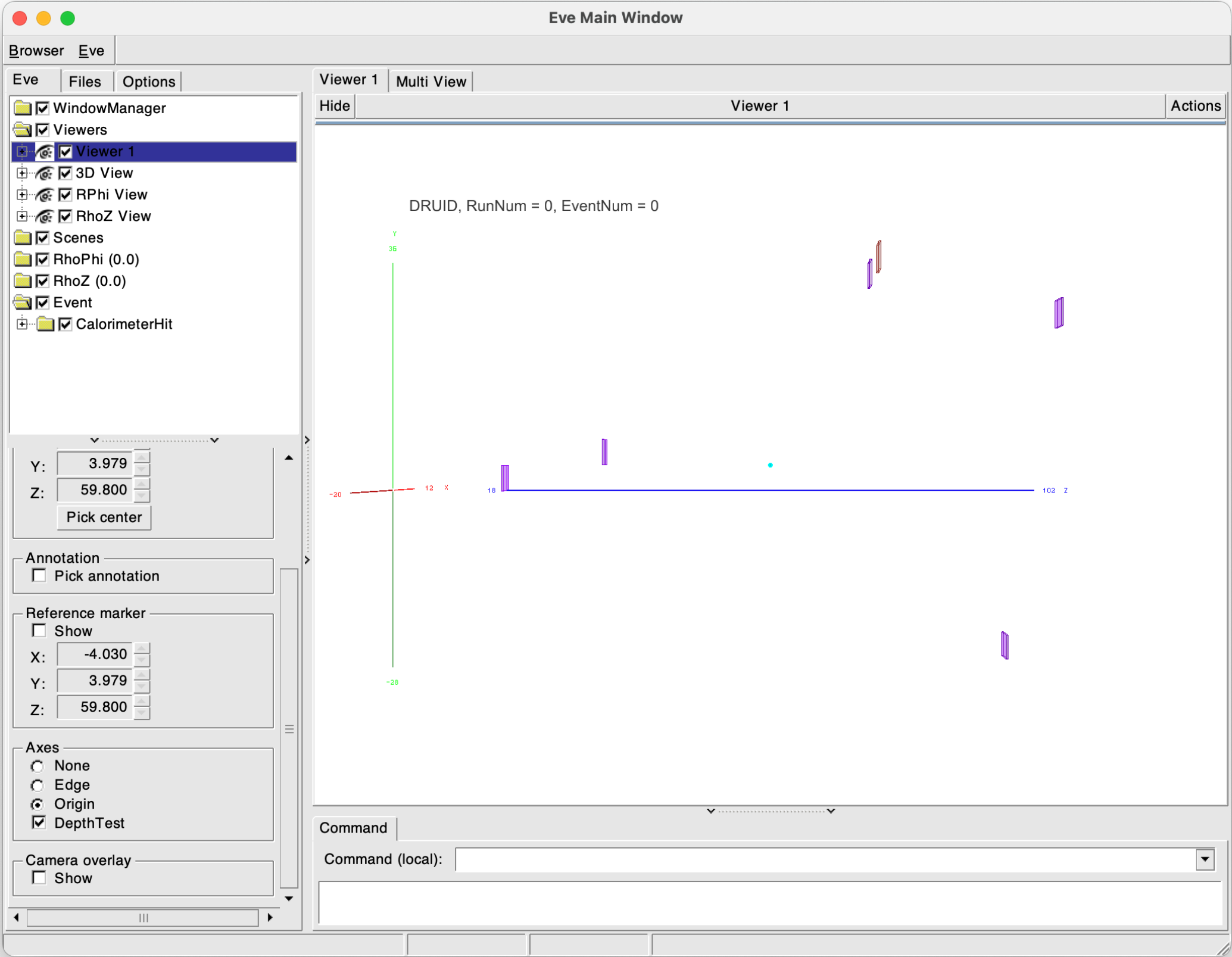
Pane #2

root [9] Raw_Hit->Scan("Entry\$ + 1:TriggerID:Sum\$(HitTag == 1)")

Row	Entry\$ +	TriggerID	Sum\$(HitT
0	1	11060	6
1	2	3	45
2	3	4	51
3	4	5	51
4	5	6	57
5	6	7	47
6	7	8	51
7	8	9	44
8	9	10	59



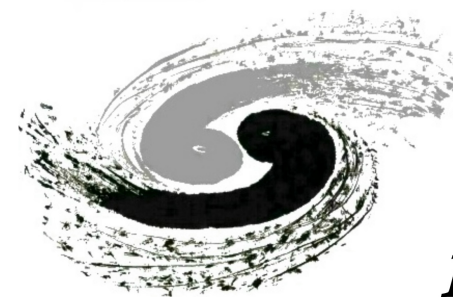
Fran



Yukun

Summary

- **News:** Druid is able to display both raw & calibrated LCIO data
- **Raw data conversion:**
 - Consistence improved
 - Conventions to unify/validate:
 - save the strange events or not?
 - CellID – Position Map
 - convention of trigger IDs and chip IDs.



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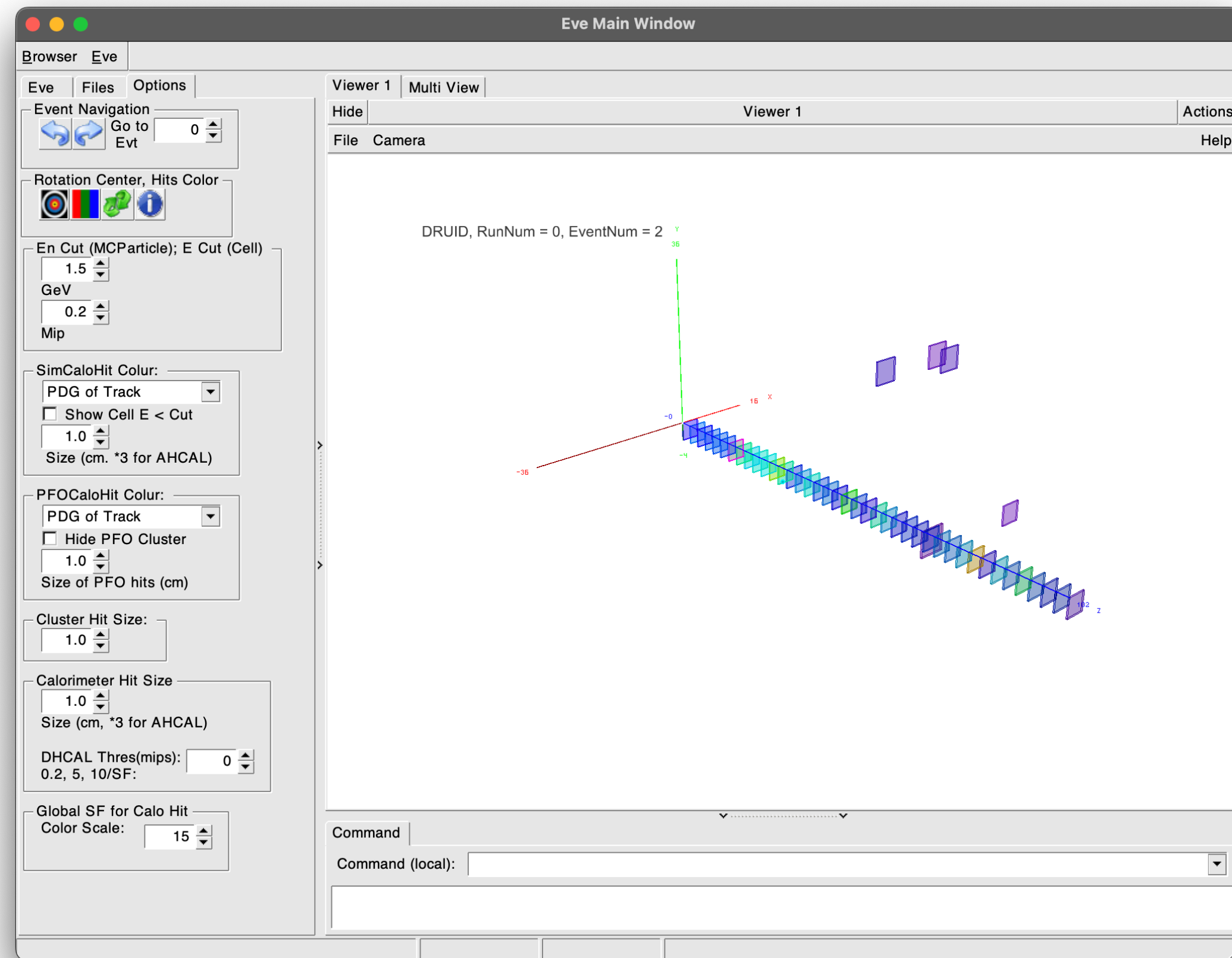
Back Up

Yuzhi Che

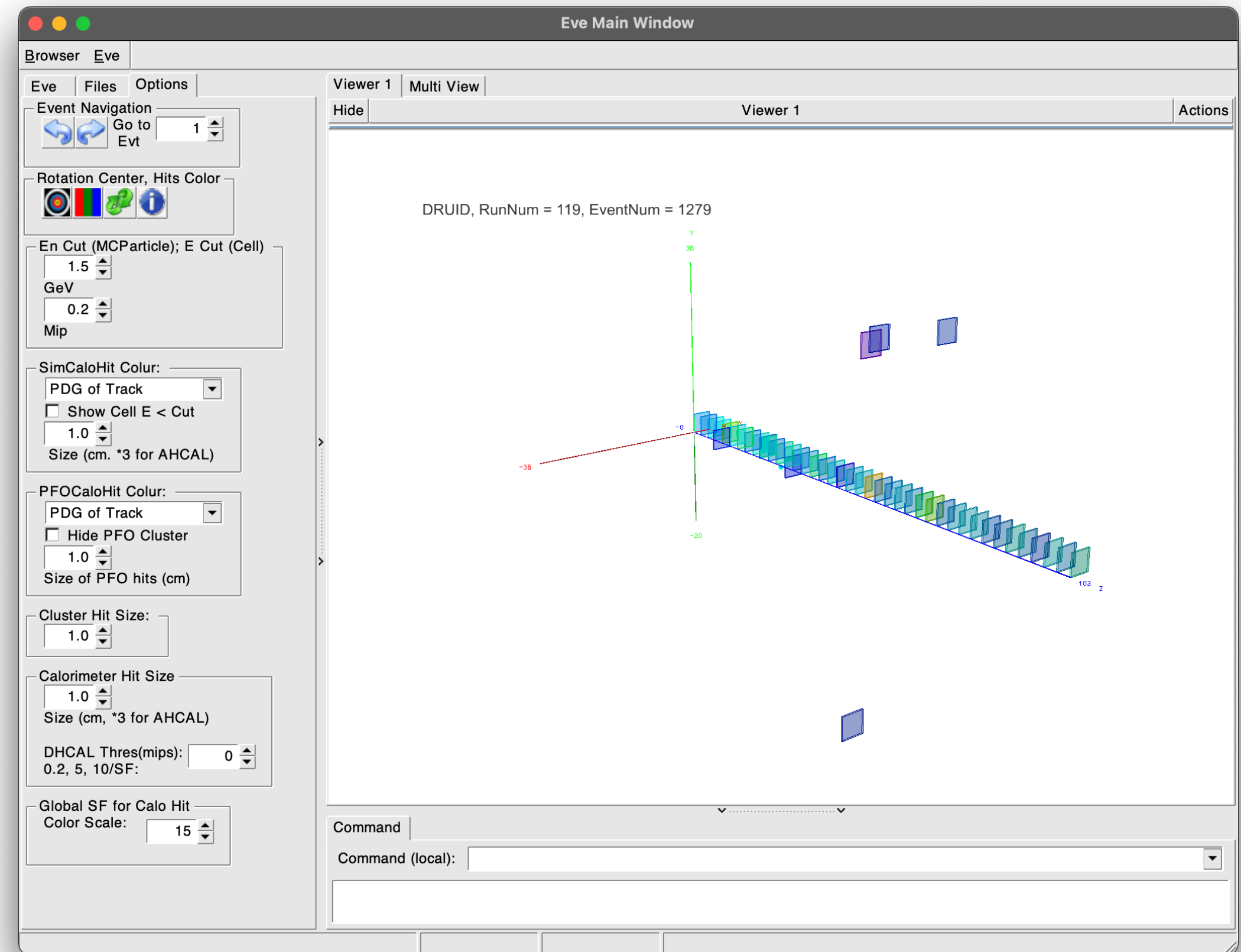
Feb. 16, 2023

Display of Split Events

- TriggerID: 1



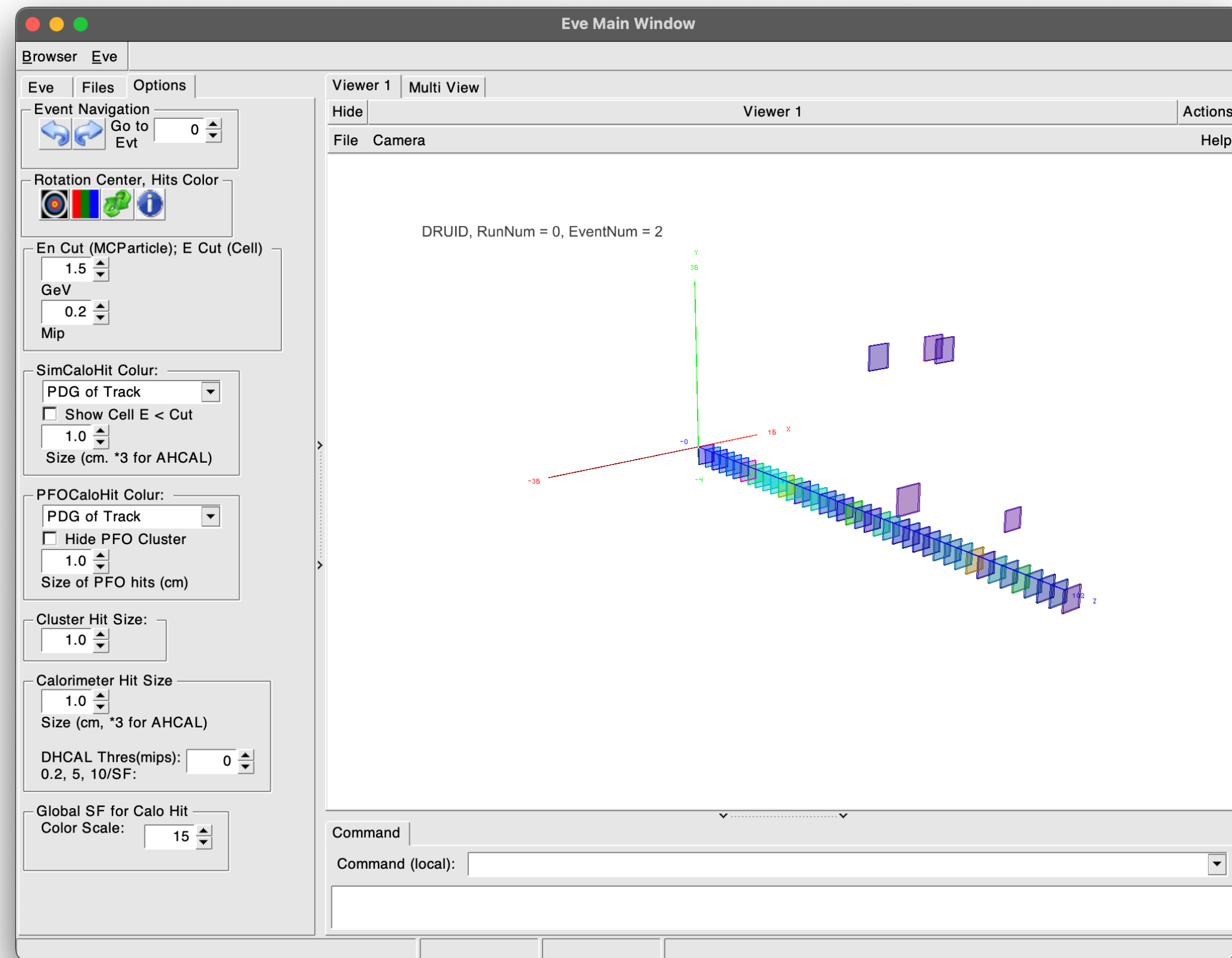
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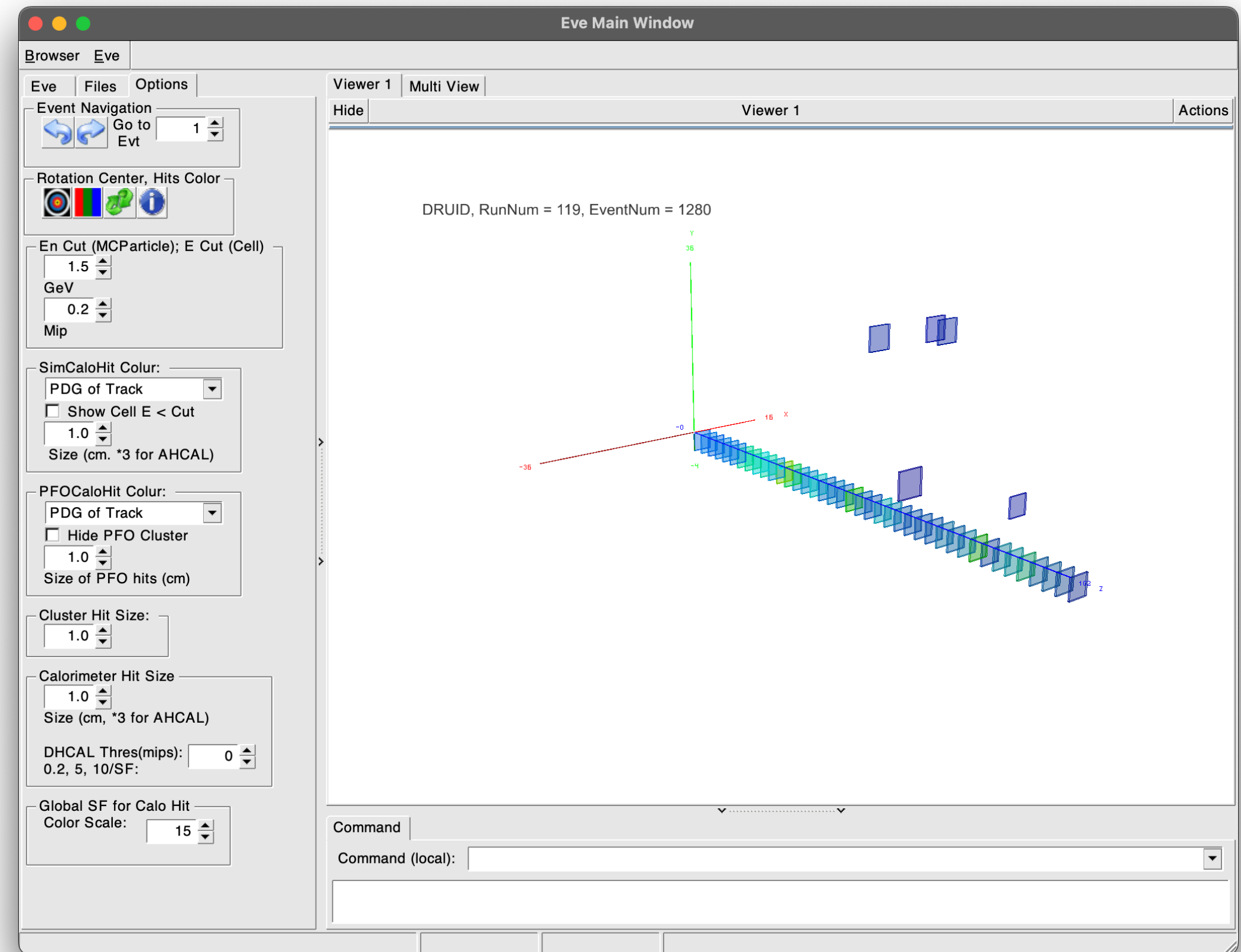
Fran

Display of Split Events

- TriggerID: 2



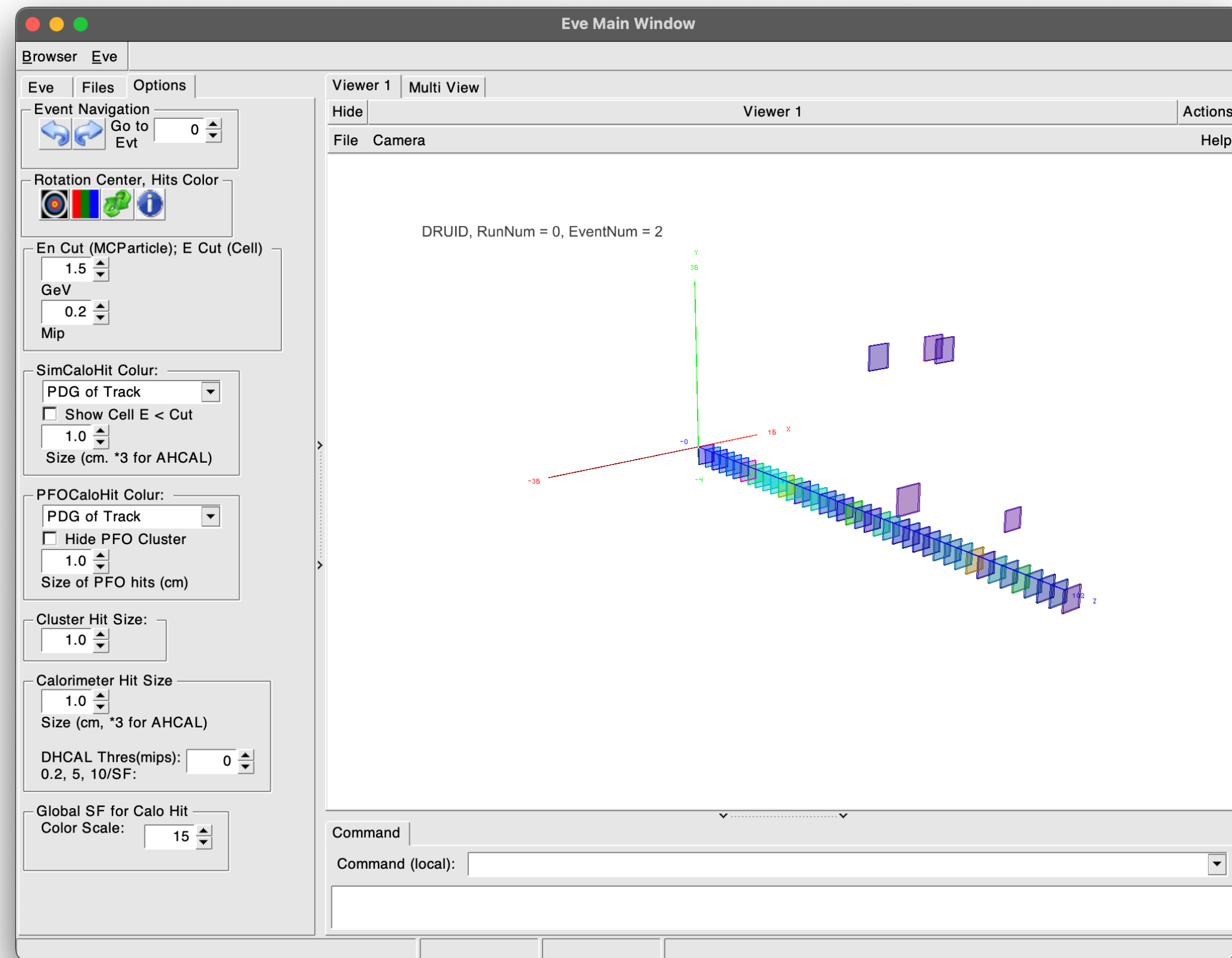
Yukun



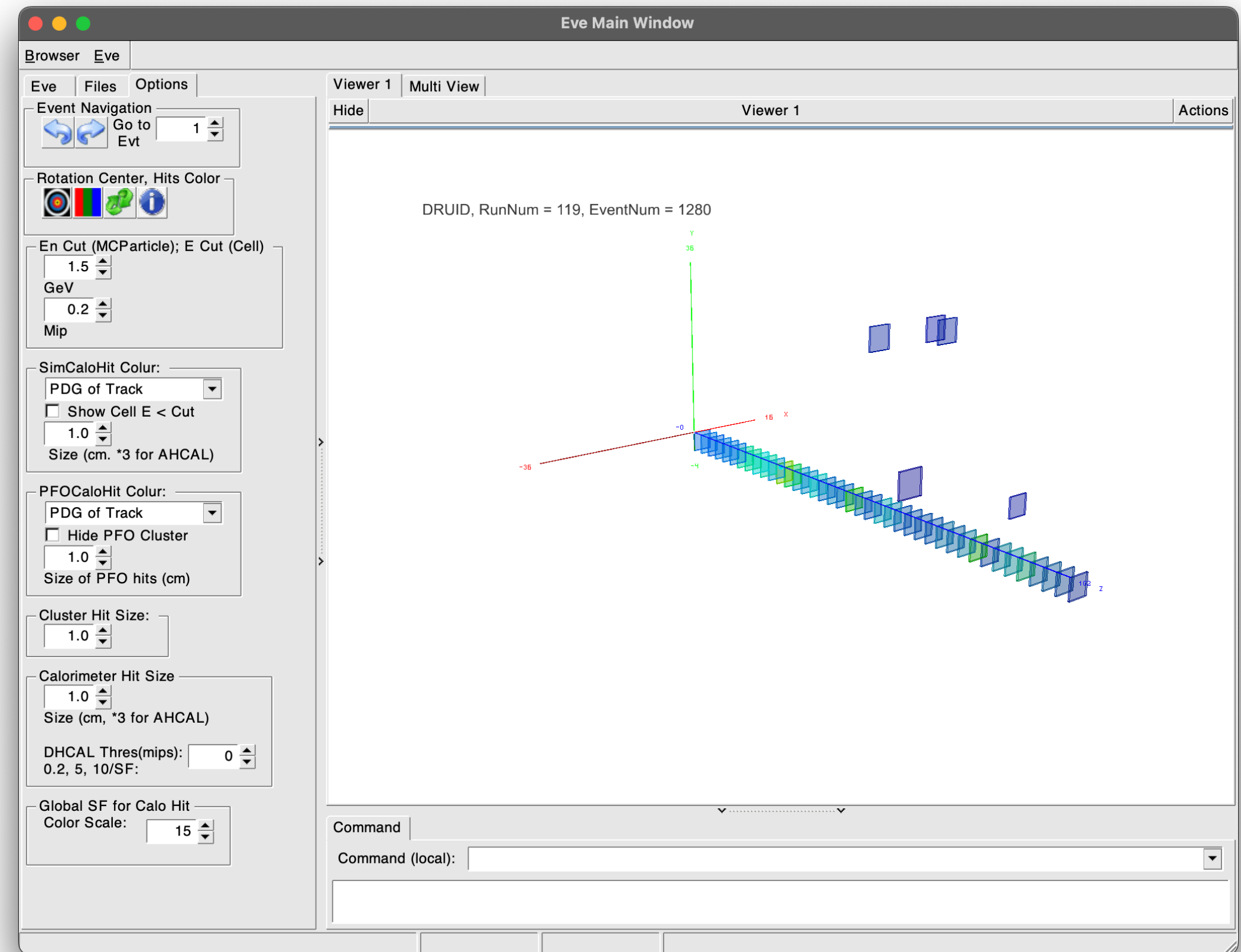
Fran

Display of Split Events

- TriggerID: 483



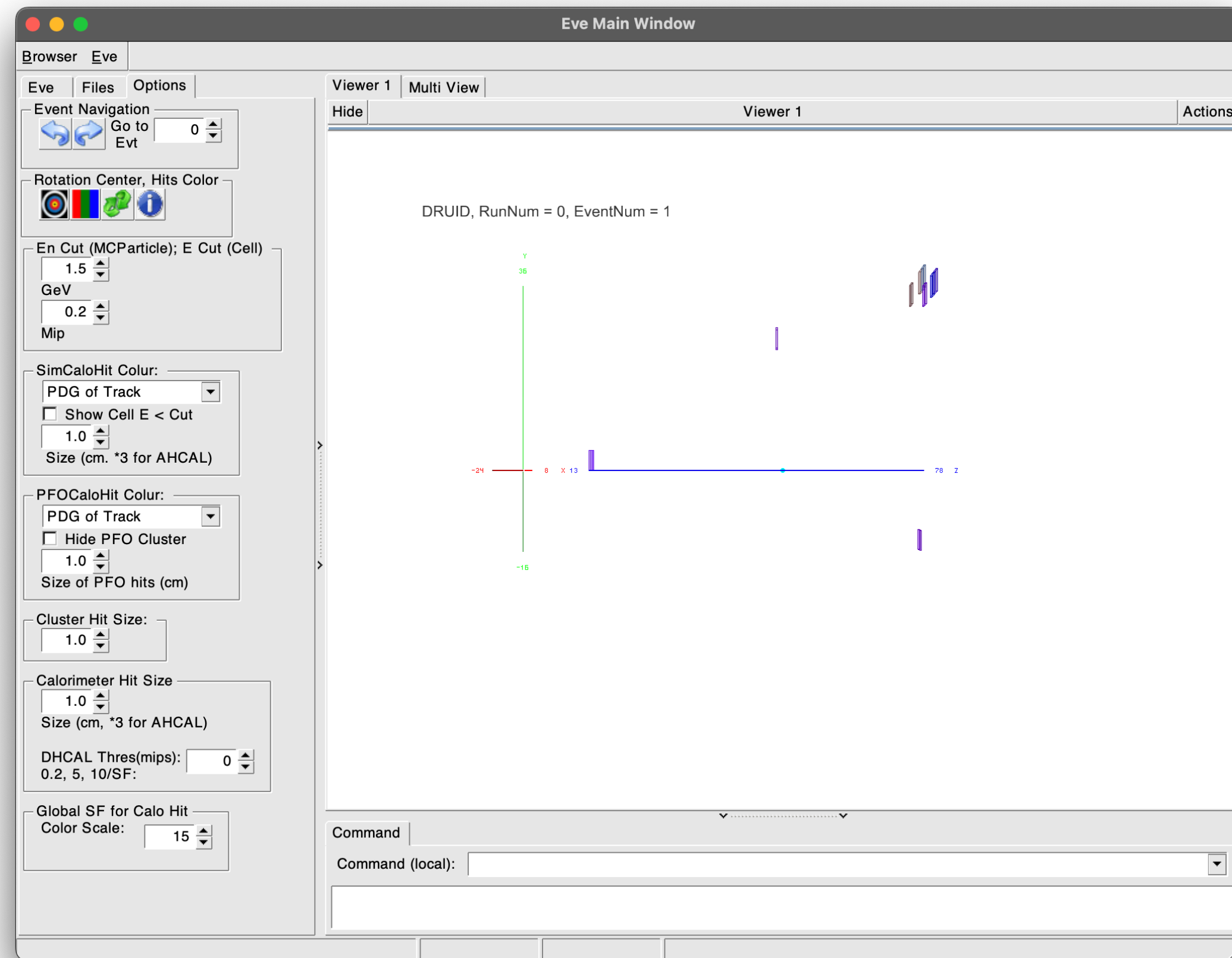
Yukun



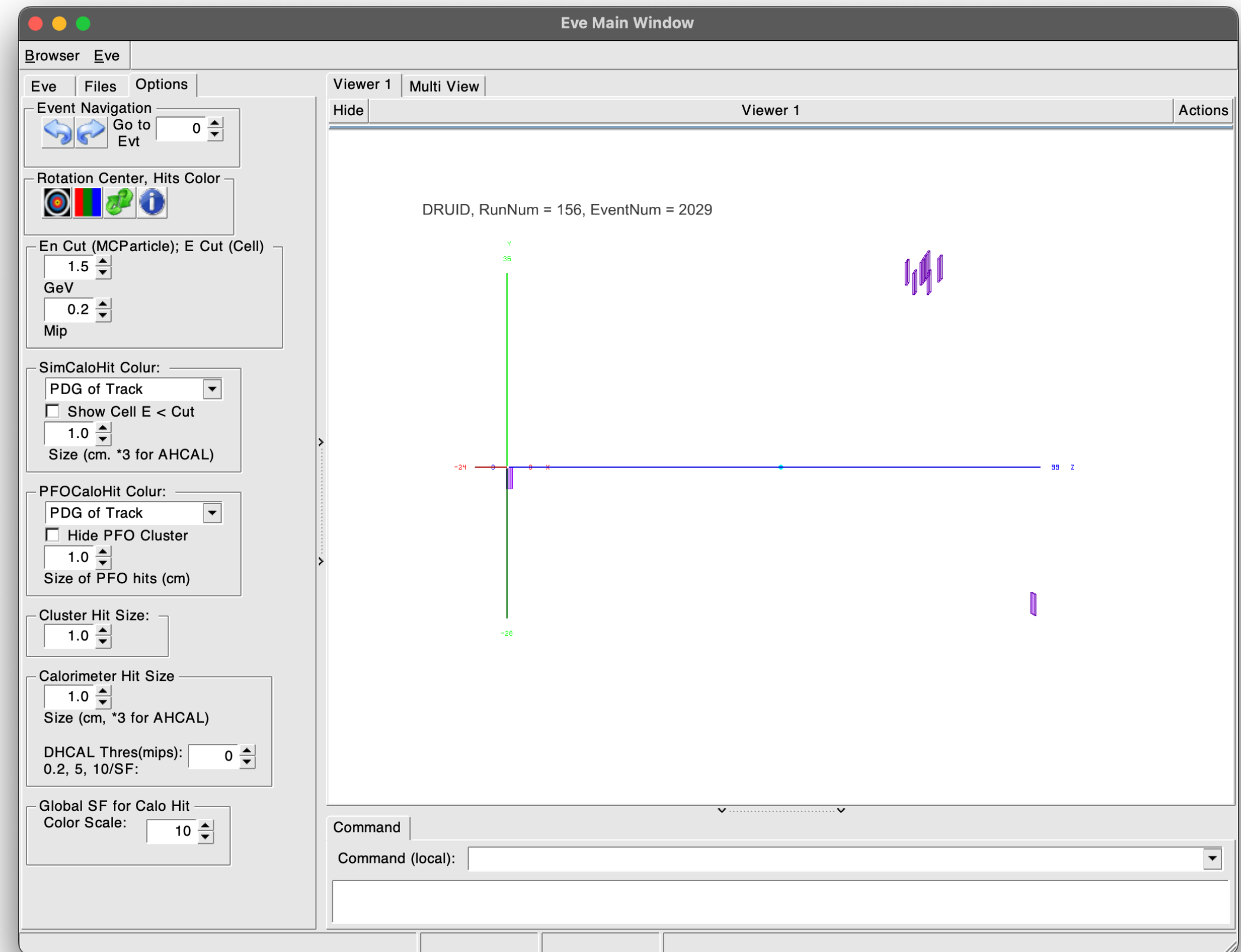
Fran

Display of Split Events

- Run 156 (10 GeV pi)



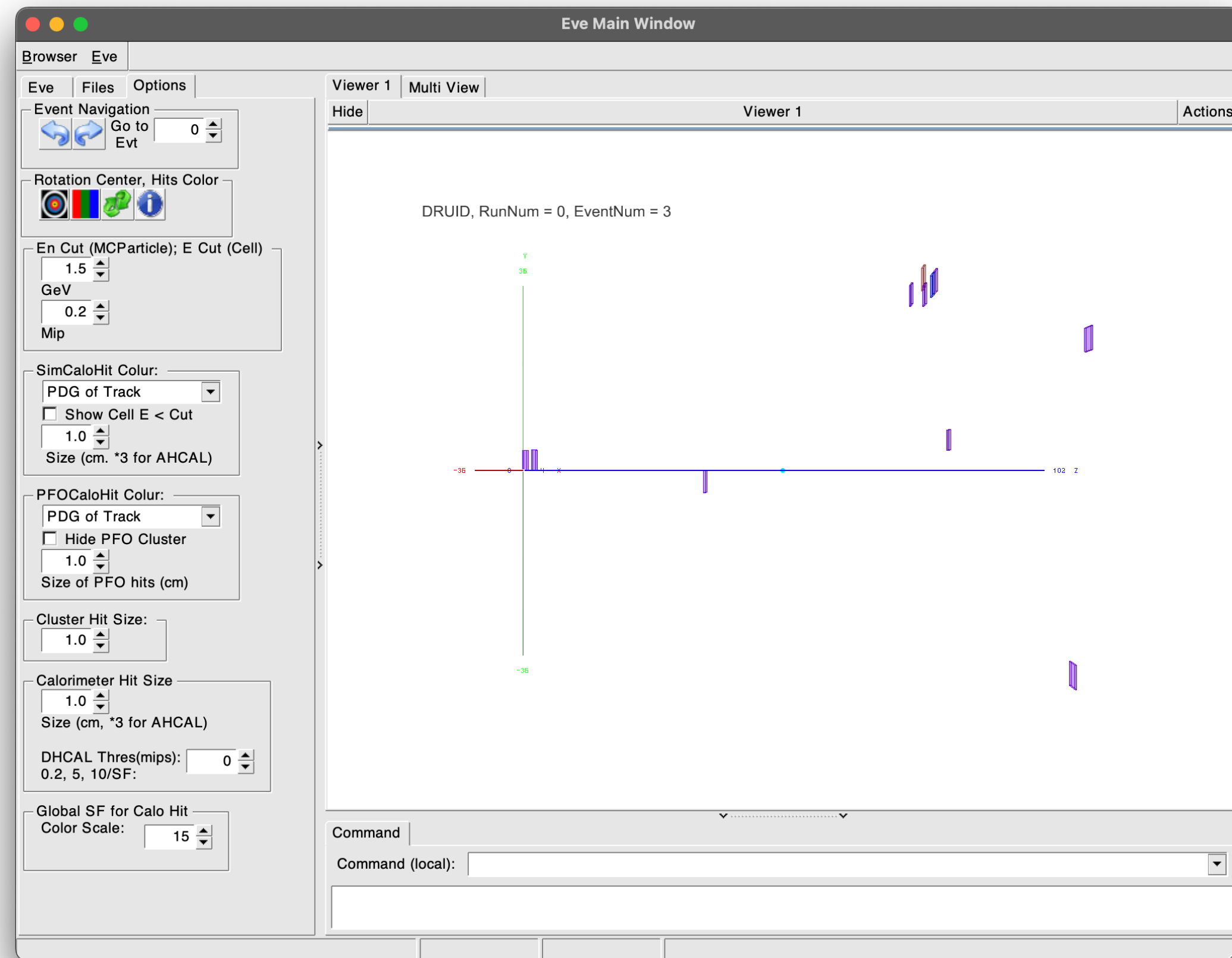
Yukun



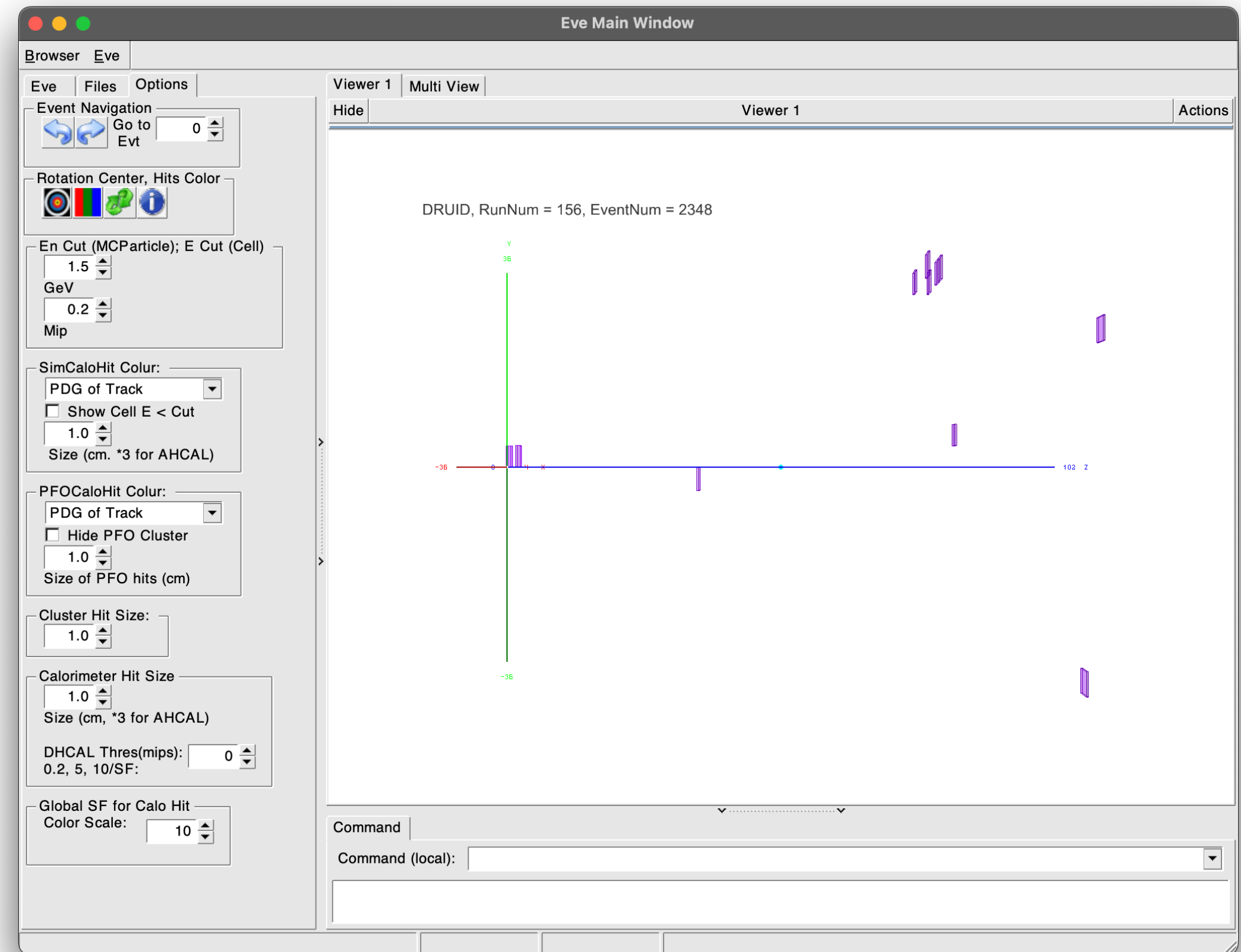
Fran

Display of Split Events

- Run 156 (10 GeV pi)



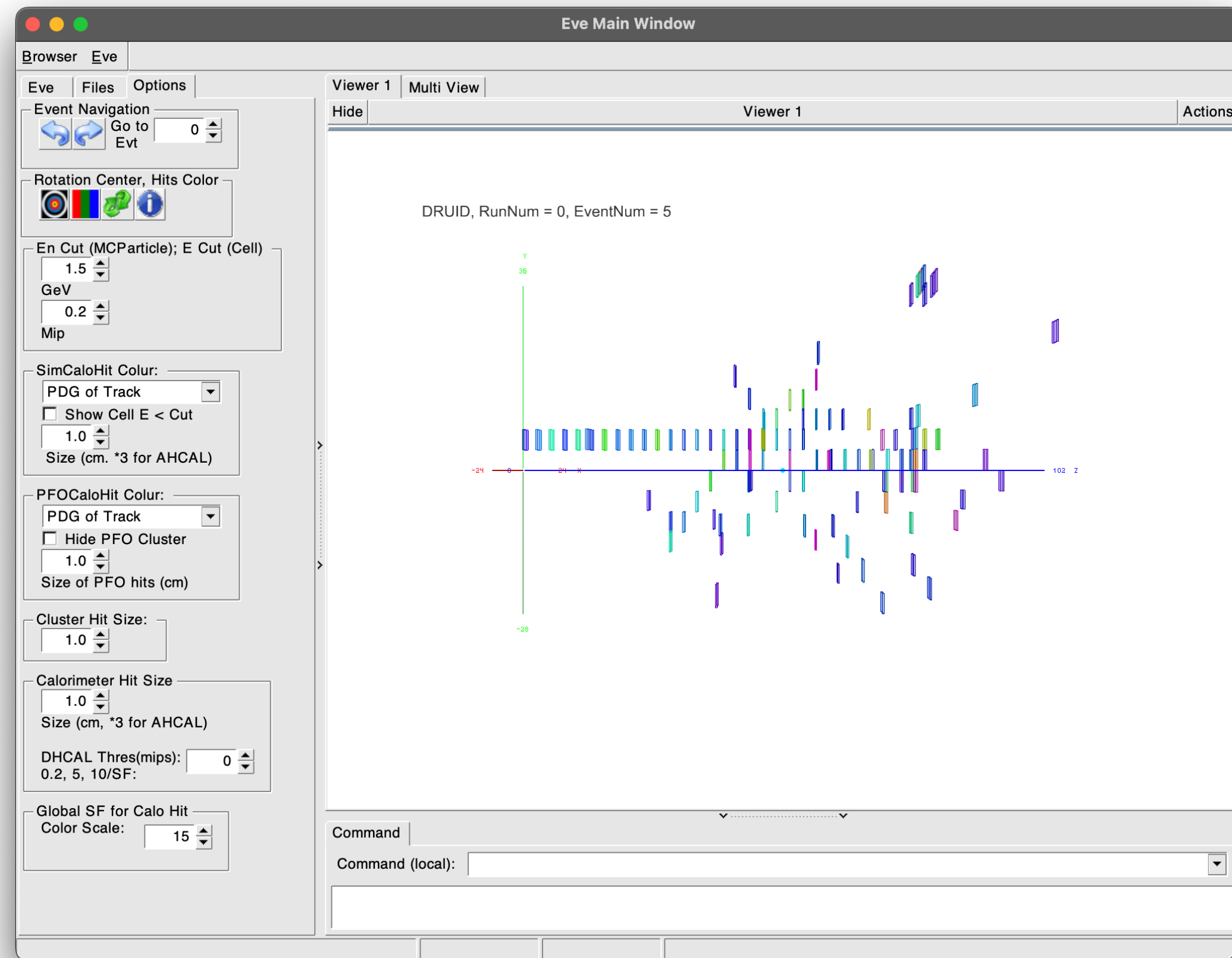
Yukun



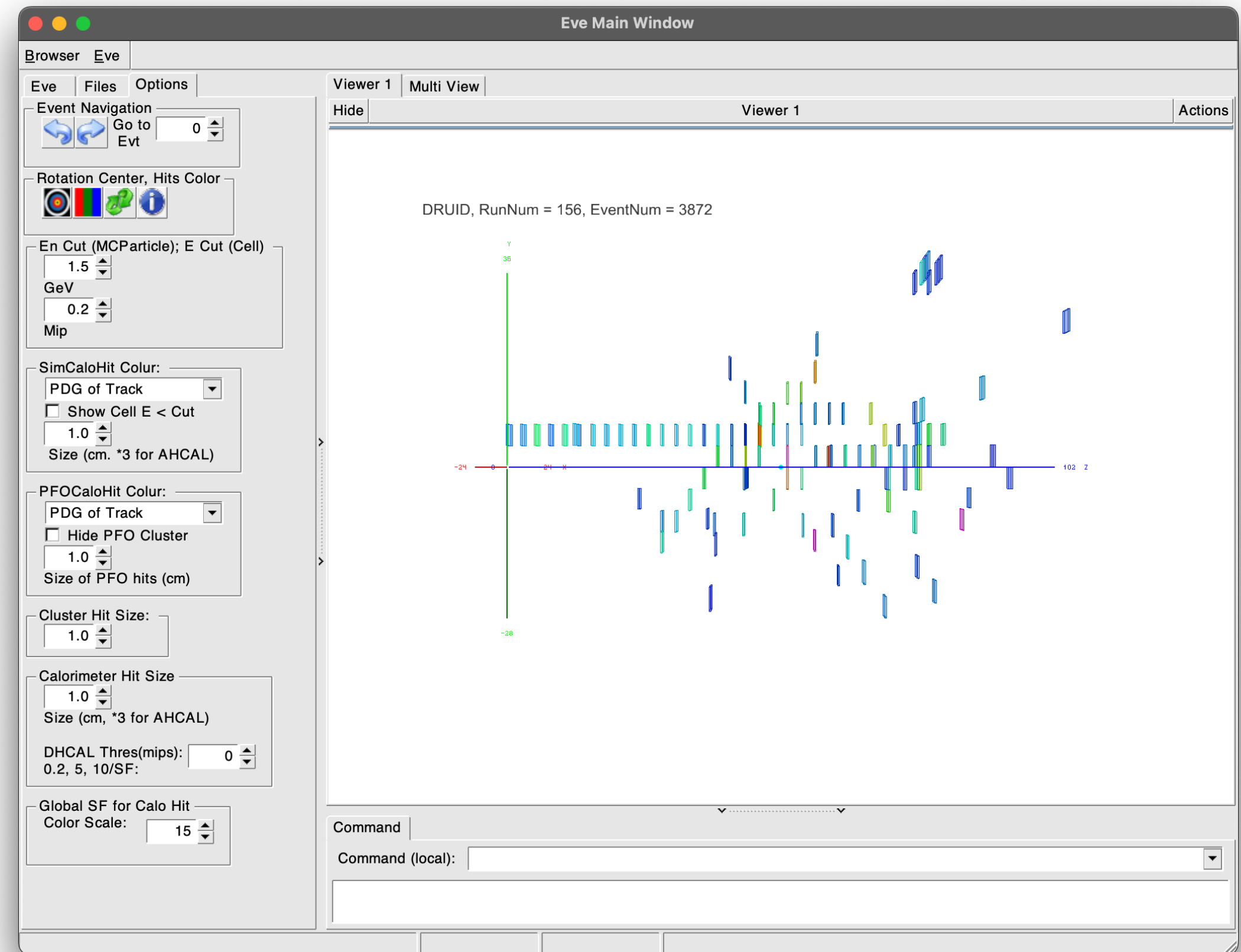
Fran

Display of Split Events

- Run 156 (10 GeV pi)



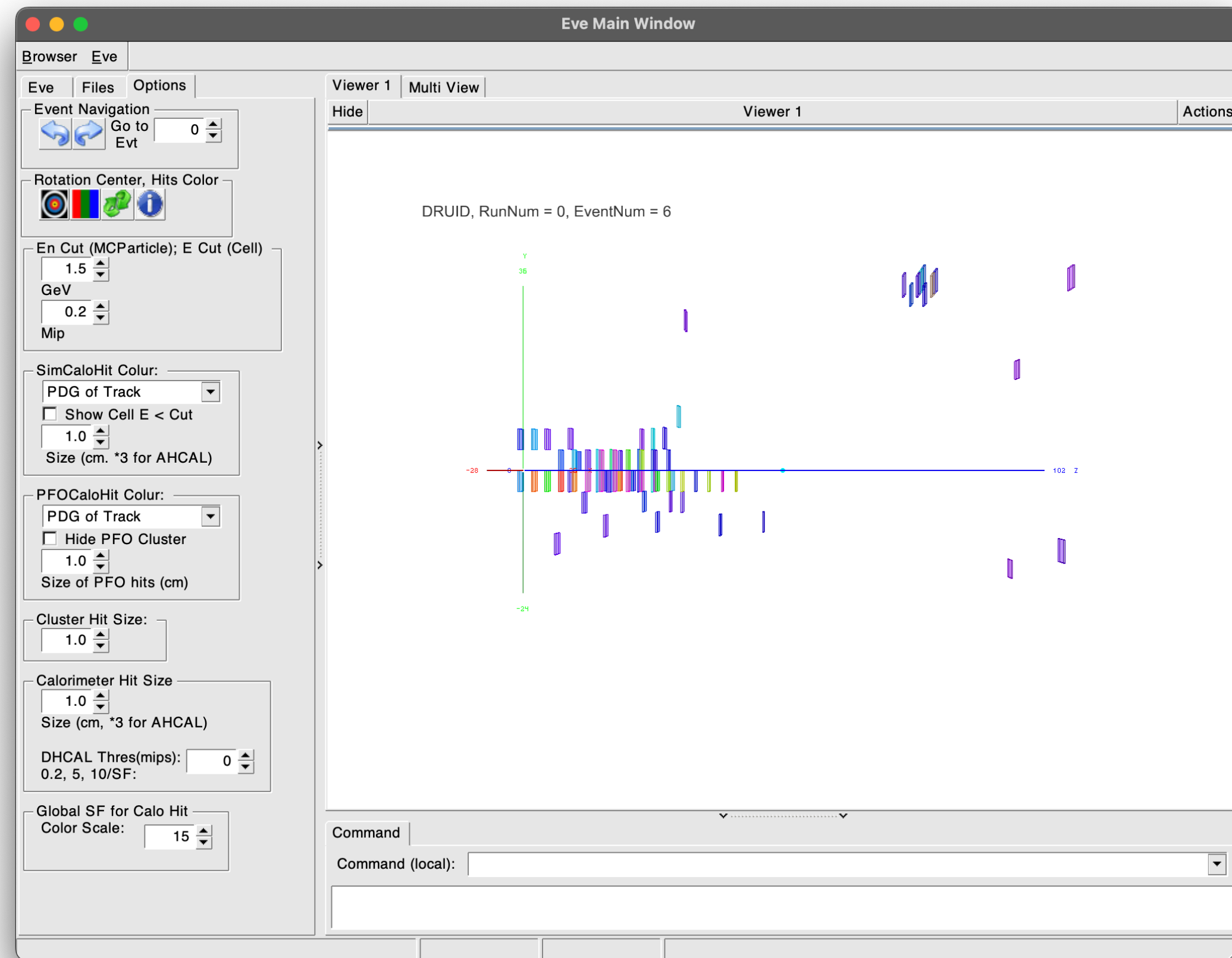
Yukun



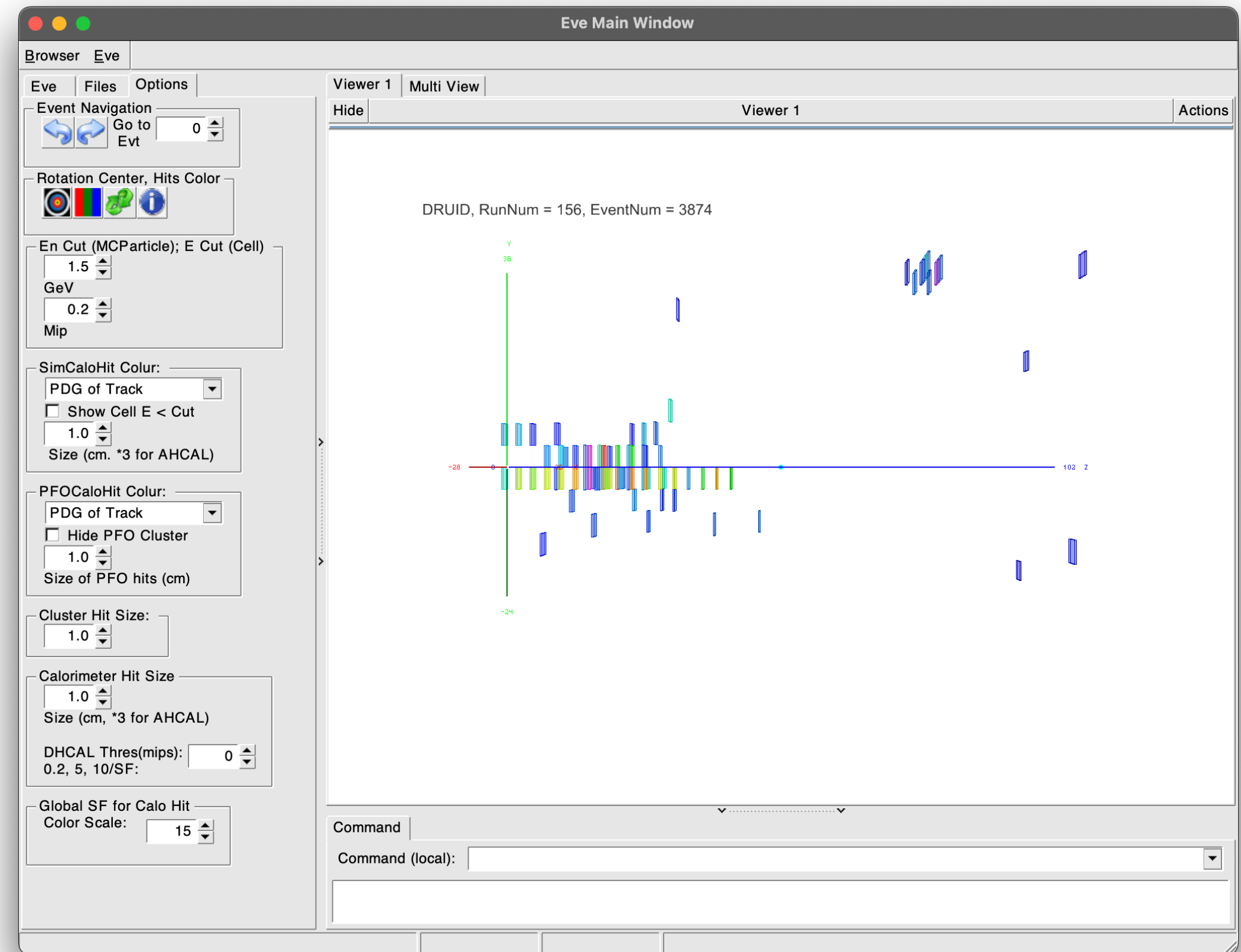
Fran

Display of Split Events

- Run 156 (10 GeV pi)



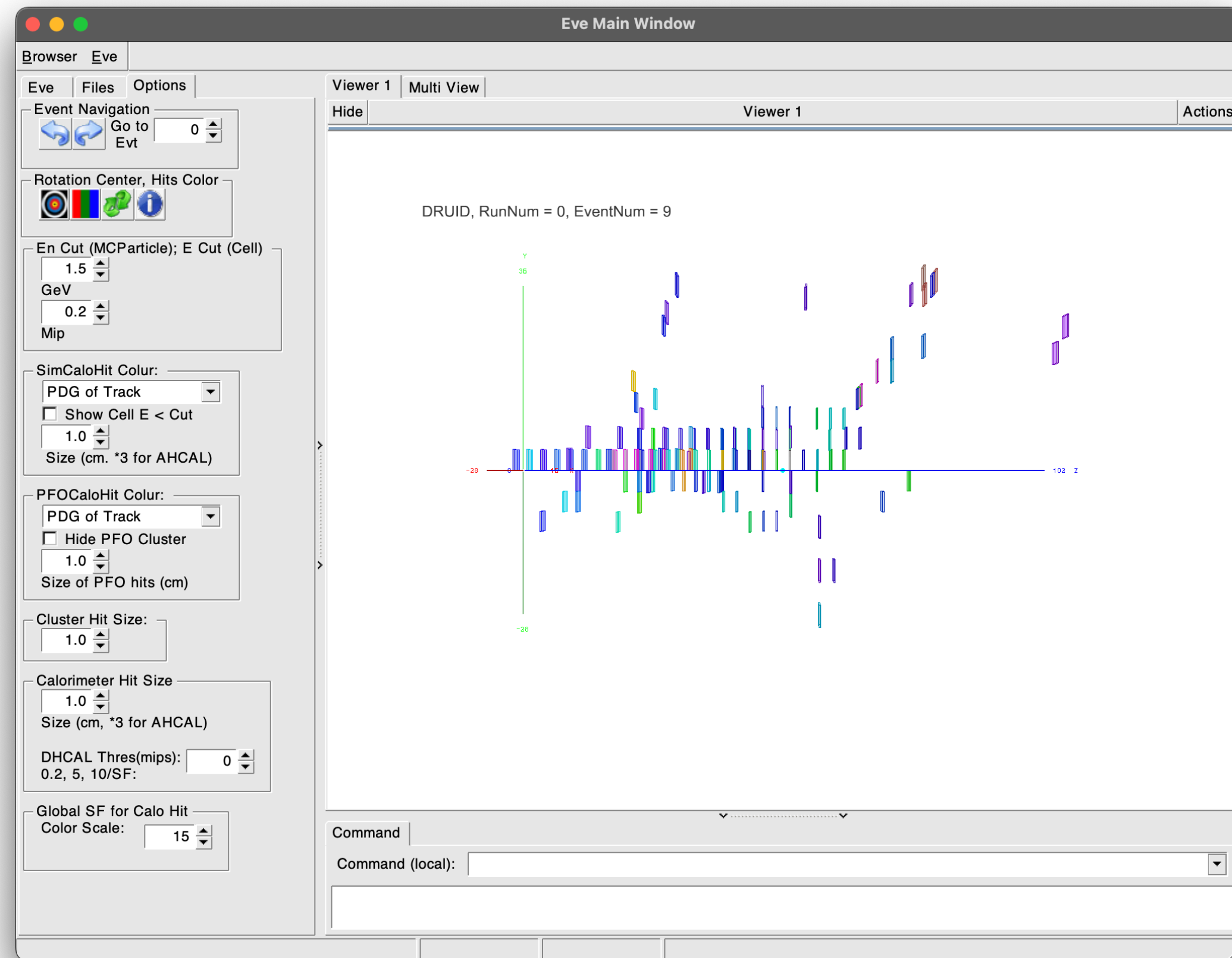
Yukun



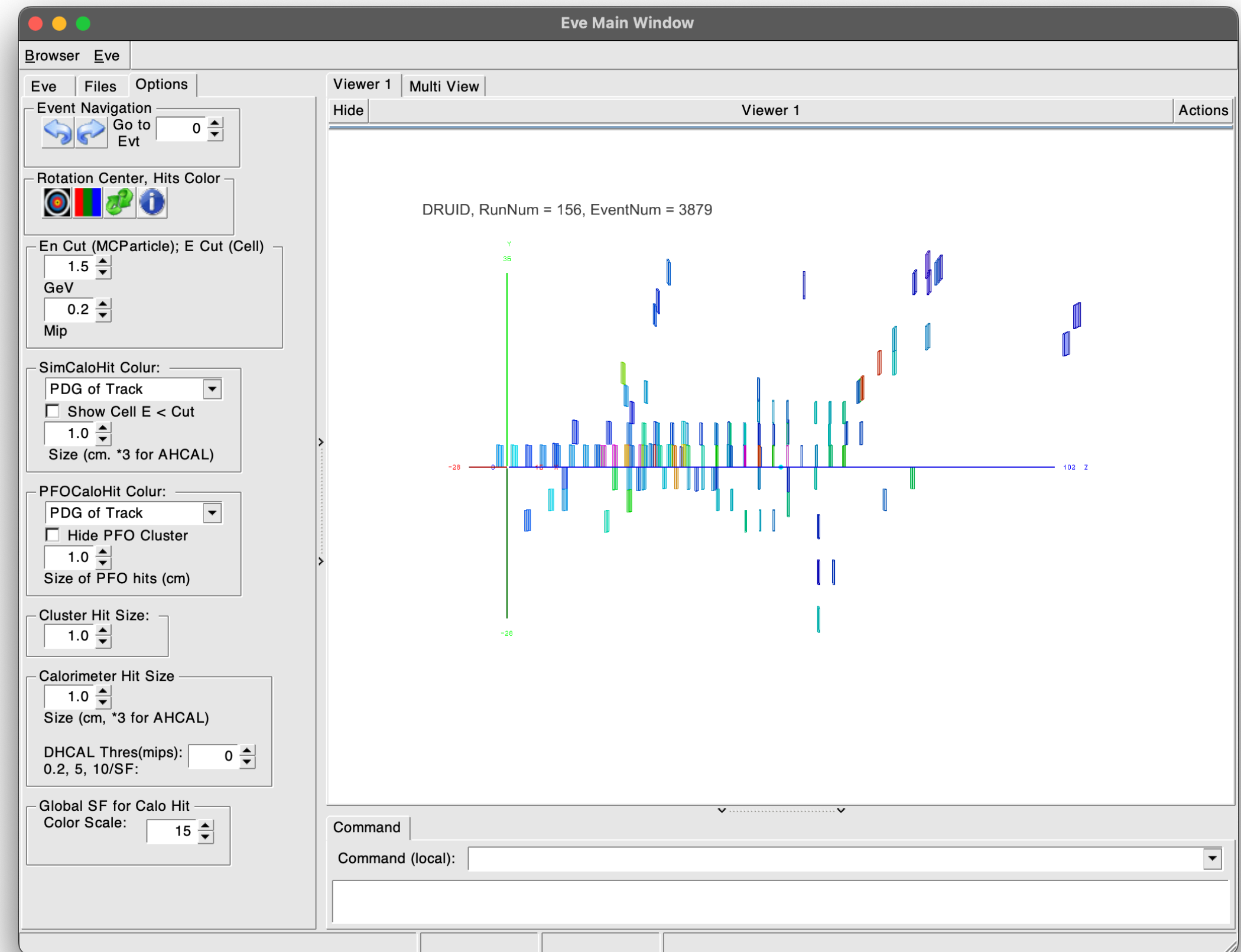
Fran

Display of Split Events

- Run 156 (10 GeV pi)



Yukun



Fran