Test of Peak Finders

Content

In this note we show how peak finder versions v2,3,4 work on fiber diffraction experiment exp=cxif5315:run=169 data.

Test data

exp=cxif5315:run=169

Use of peak finders

See for detail

- Hit/Peak Finding Details - description of algorithms
- ImgAlgos.PyAlgos - interface methods

We work with peak finder versions v2,3,4. Data processing and peak finding is done in

`cxif5315/proc-cxif5315-r0169-data-pfvn-2016-03-28.py`

```
from ImgAlgos.PyAlgos import PyAlgos

alg_arc = PyAlgos(windows=winds_arc, mask=mask_arc, pbits=2)
alg_arc.set_peak_selection_pars(npix_min=4, npix_max=500, amax_thr=0, atot_thr=600, son_min=5)   # for pfv2,4
#alg_arc.set_peak_selection_pars(npix_min=4, npix_max=500, amax_thr=0, atot_thr=600, son_min=10) # for pfv3

alg_equ = # all parameters are the same as for alg_arc

        peaks_arc = alg_arc.peak_finder_v2(nda, thr=10, r0=6, dr=0.5)                               # Flood-
filling
        #peaks_arc = alg_arc.peak_finder_v3(nda, rank=6, r0=6, dr=0.5)                              # Ranker
        #peaks_arc = alg_arc.peak_finder_v4(nda, thr_low=10, thr_high=150, rank=5, r0=6, dr=0.5)    # Droplet-
finder
```

This script saves a peak list:

```
# Exp     Run  Date       Time      time(sec)   time(nsec) fiduc    Evnum  Reg  Seg  Row  Col  Npix
Amax      Atot   rcent   ccent rsigma  csigma rmin rmax cmin cmax    bkgd     rms     son  imrow   imcol     x
[um]     y[um]     r[um]  phi[deg]
cxif5315  169  2015-02-22 02:20:47  1424600447  478050876  104418       0  EQU    1  162   30    38
257.1    2901.5   160.8    29.7   2.21    1.25  157  168   25   36    9.42   26.64    9.30    574     640
7582       550      7601      4.15
cxif5315  169  2015-02-22 02:20:47  1424600447  486382070  104421       1  ARC    7  126  386    22
153.6     818.7   126.5   383.6   2.76    1.77  121  132  381  388    1.80   19.08    7.95    143     618
5157     47858     48135     83.85
cxif5315  169  2015-02-22 02:20:47  1424600447  486382070  104421       1  EQU    1  159   28    50
172.0    2808.5   159.3    28.0   2.93    1.68  154  165   23   34    3.37   27.07    6.23    576     643
7912       331      7919      2.40
cxif5315  169  2015-02-22 02:20:47  1424600447  494719789  104424       2  EQU    1  150   33    44
154.4    1624.7   150.5    32.8   3.07    1.72  145  156   28   39    4.33   21.19    7.08    571     652
8900       883      8943      5.67
```

Peak list processing

For further peak list processing we use script:

`cxif5315/proc-cxif5315-r0169-peaks-from-file-v4.py`

which uses peak selectors.

Peak Selectors

In this section we list distribution of peak parameters right after peak finders and discuss parameter range for further selection stage in

peakIsSelectedArc(pk)

```
def peakIsSelectedArc(pk) :
    """Apply peak selection criteria to each peak from file
    """
    if pk.rms>60    : return False
    if pk.sonc<5    : return False
    if pk.atot<1200 : return False
    if pk.r<435     : return False
    if pk.r>443     : return False
    if pk.npix>200  : return False
    if math.fabs(pk.bkgd)>20 : return False
    return True
```

and

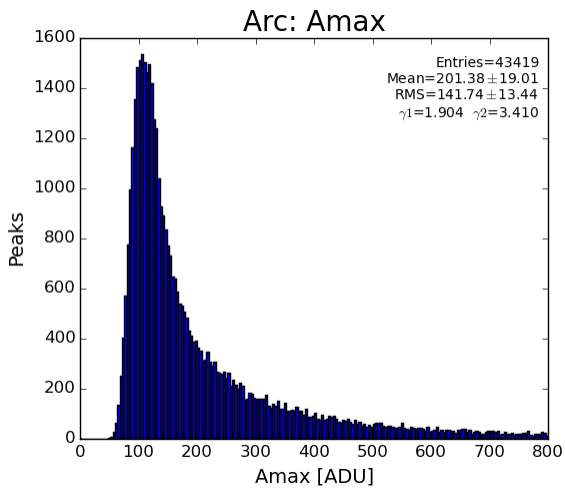
peakIsSelectedEqu(pk)

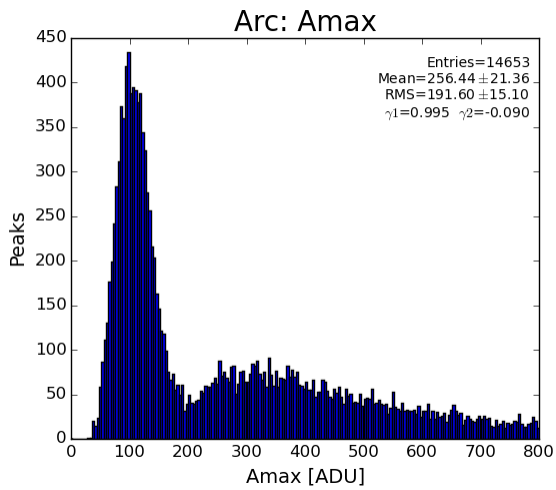
```
def peakIsSelectedEqu(pk) :
    """Apply peak selection criteria to each peak from file
    """
    if pk.rms>60    : return False
    if pk.sonc<5    : return False
    if pk.atot<1800 : return False
    if pk.r<100     : return False
    if pk.r>454     : return False
    if pk.npix>200  : return False
    if math.fabs(pk.bkgd)>20 : return False
    return True
```

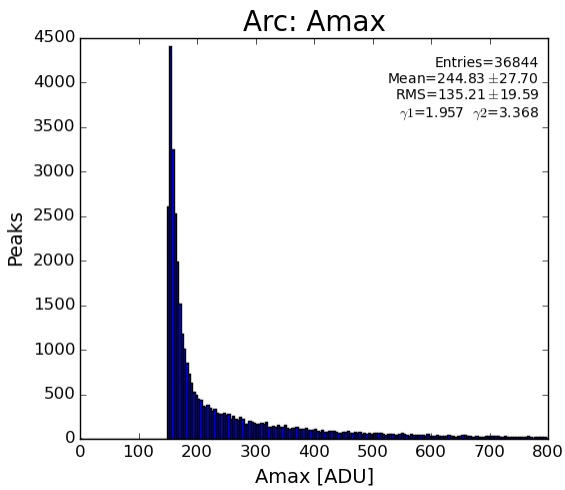
We process Data of cxif5315-r0169 for peaks in ARC and Equatorial region separately. Each triplet of histograms represents peak finder v2, v3, v4, respectively.

peak_finder_v2, v3, v4: ARC

- Amax is only used in pfv4 as
  `thr_high=150`
  that helps to reduce a number of seed peaks



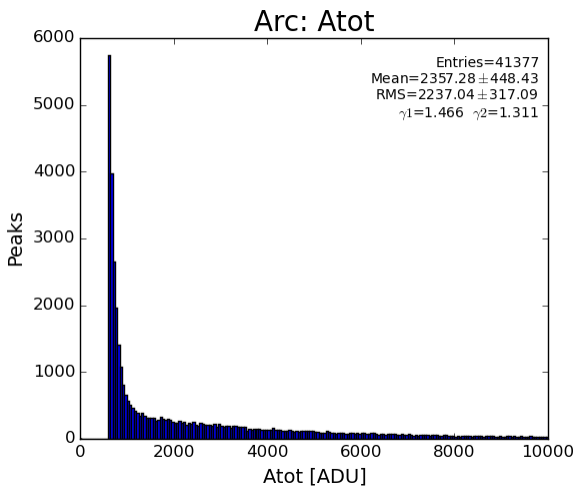


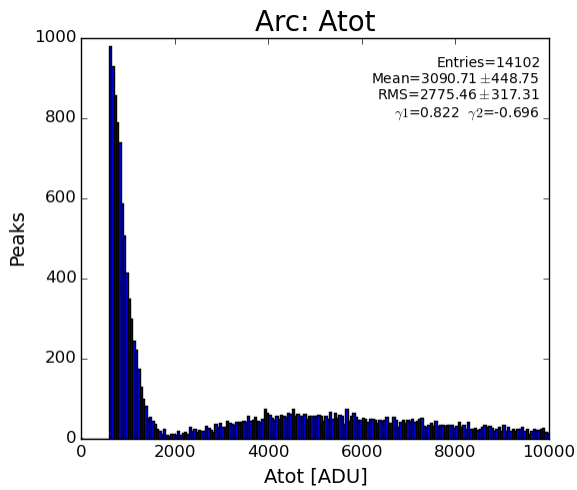


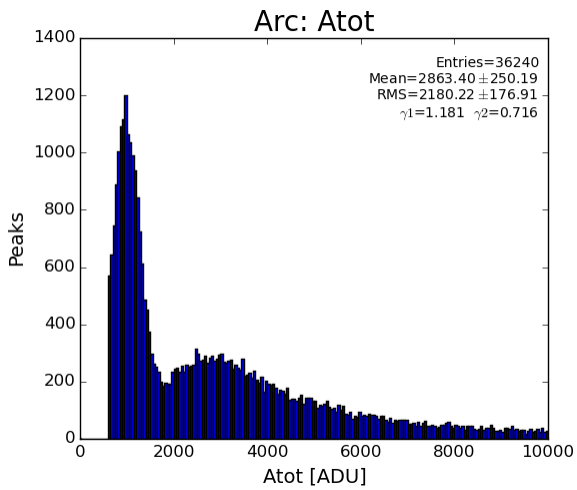
- Atot is used in all peak-finders as `atot_thr=600`

  ```
  if pk.atot<1200 : return False
  ```

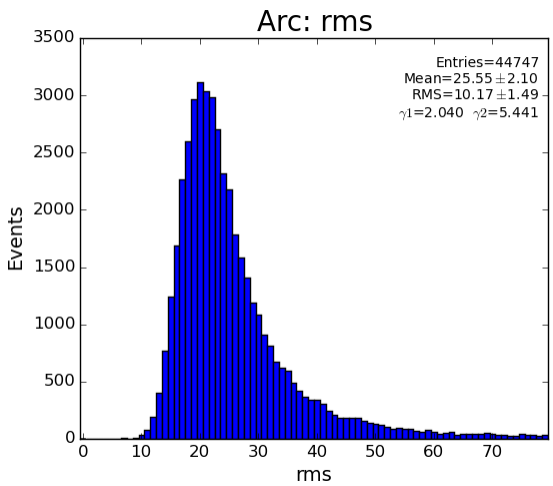
  most likely can be harmlessly increased to 1500-1800ADU

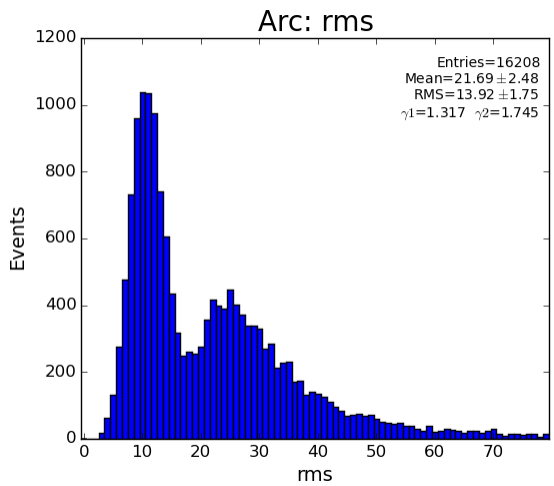


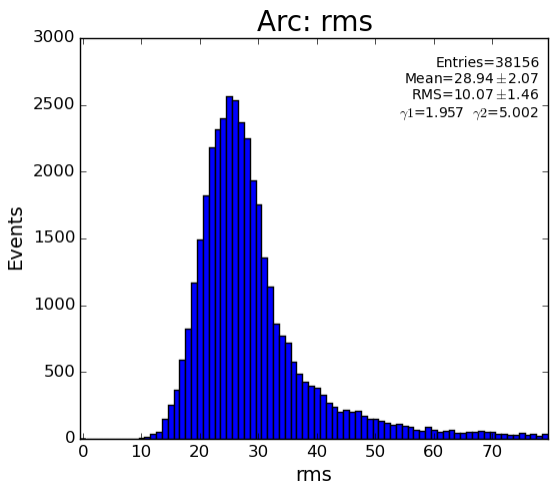




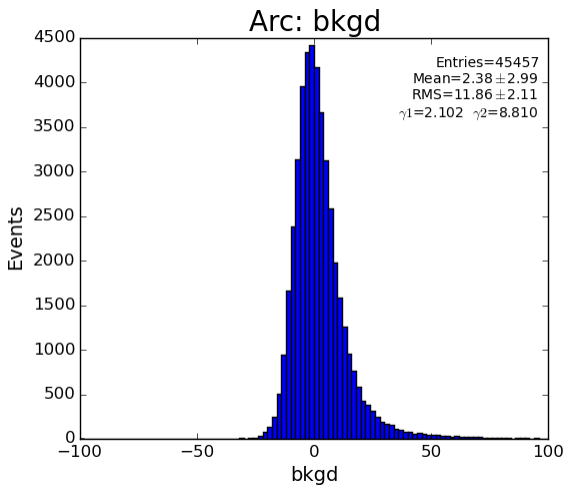
- rms is used in all peak-finders at processing in peak selector
  `if pk.rms>60 : return False`

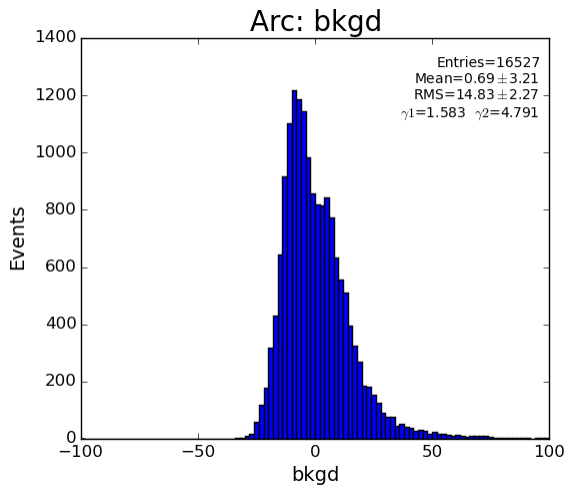


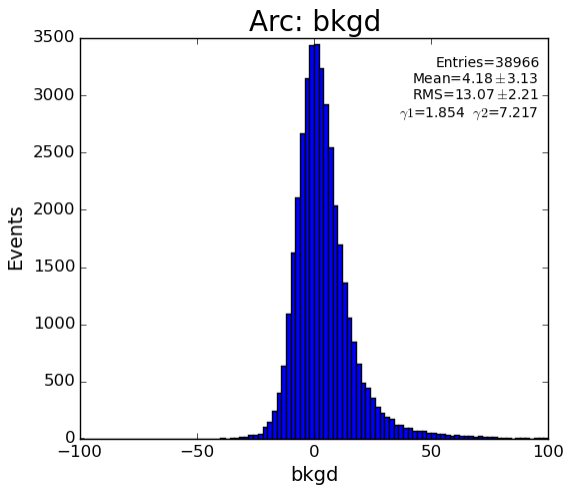




- bkgd is used in all peak-finders at processing in peak selector
  `if math.fabs(pk.bkgd)>20 : return False`

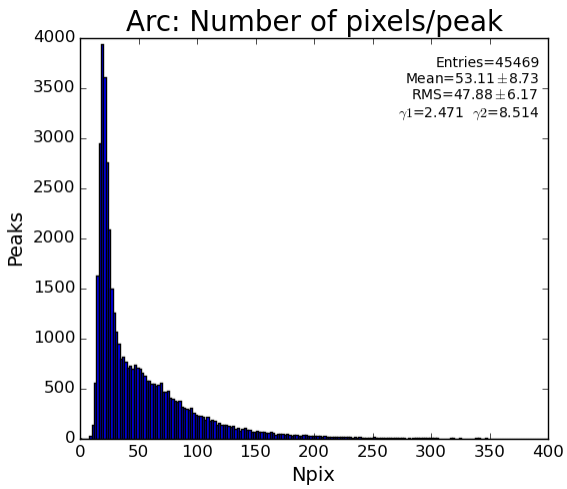


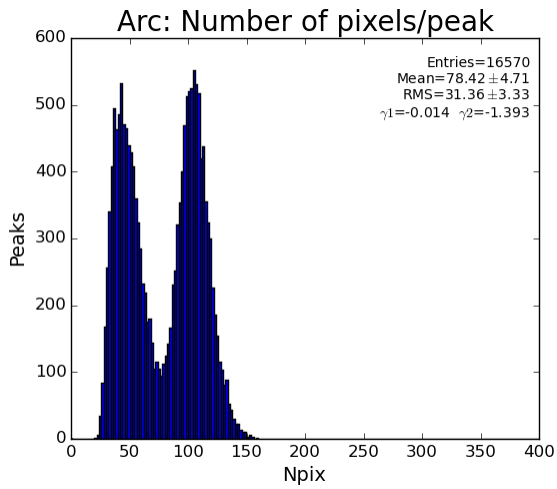


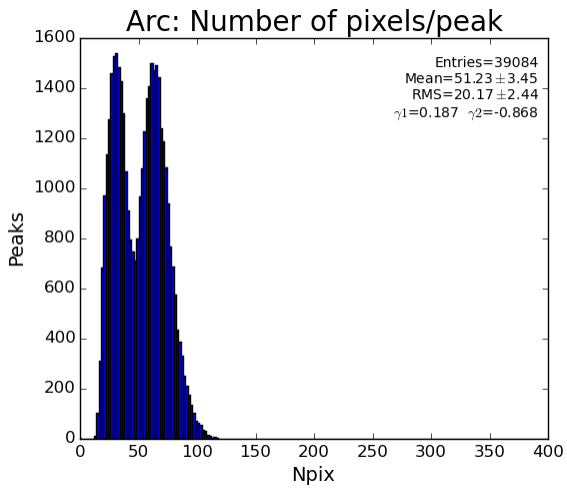


- npix is used in all peak-finders in peak selector
  `npix_min=4, npix_max=500`

  ```
  if pk.npix>200 : return False
  ```

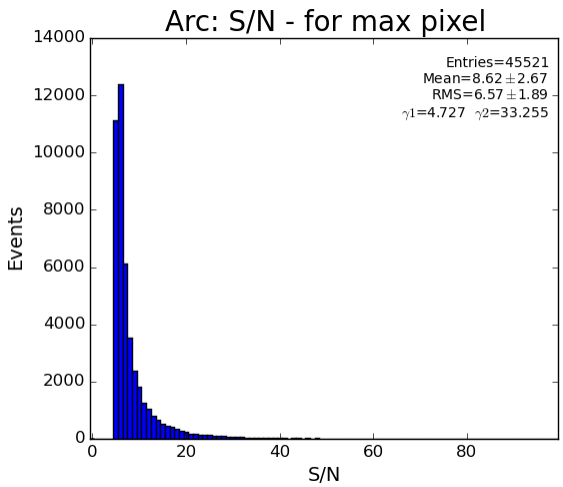


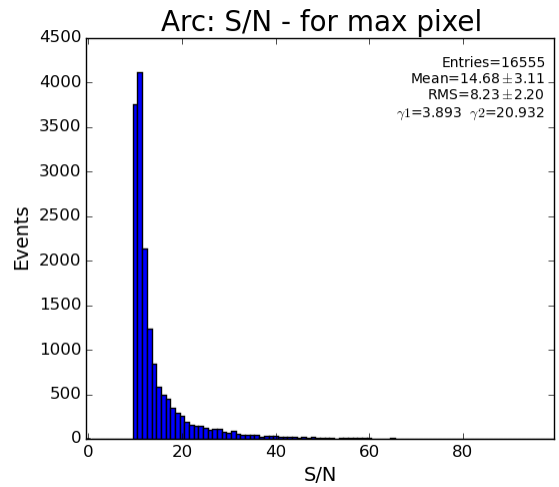


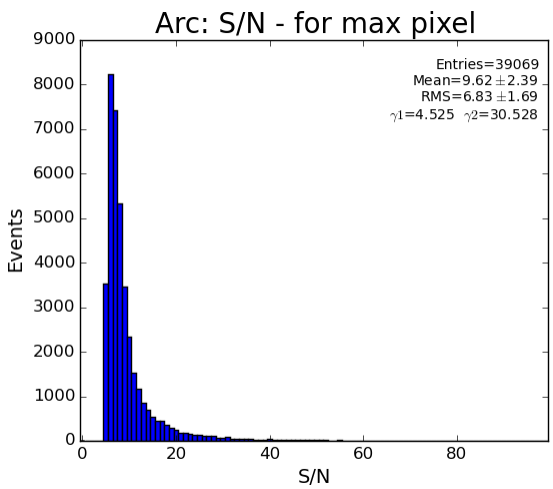


- S/N is used as
  `son_min=5 # for pfv2,4`

  `son_min=10 # for pfv3` - Ranker - to eliminate large number of purely statistical seed peaks

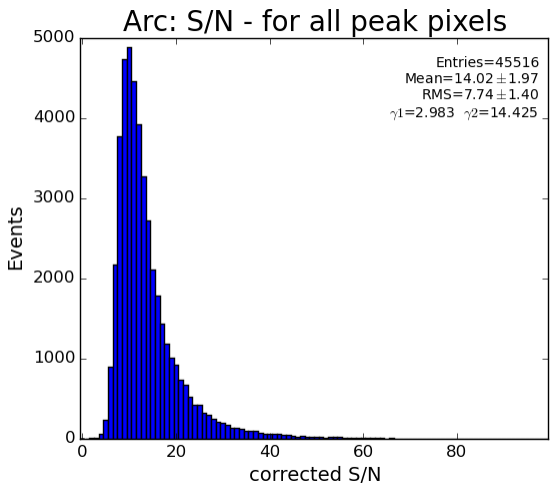


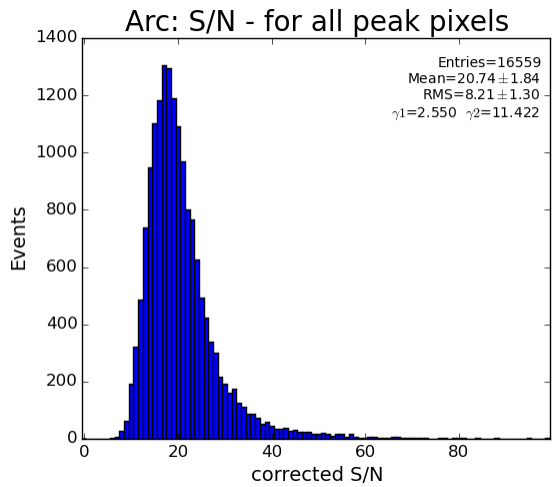


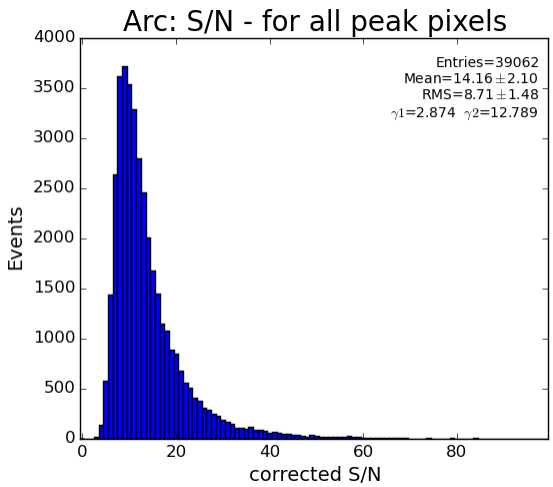


- S/N evaluated for all pixels

```
if pk.sonc<5 : return False
```

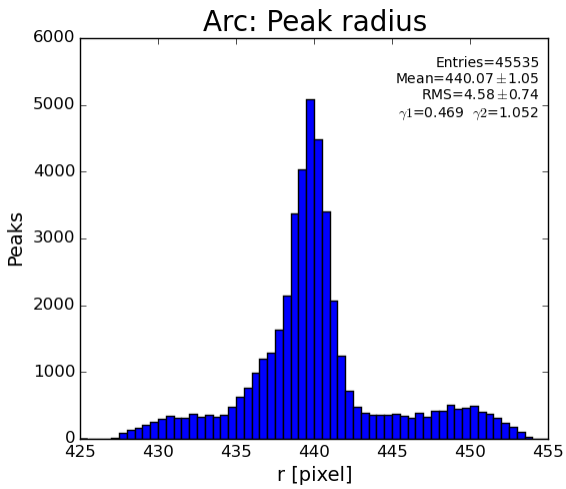


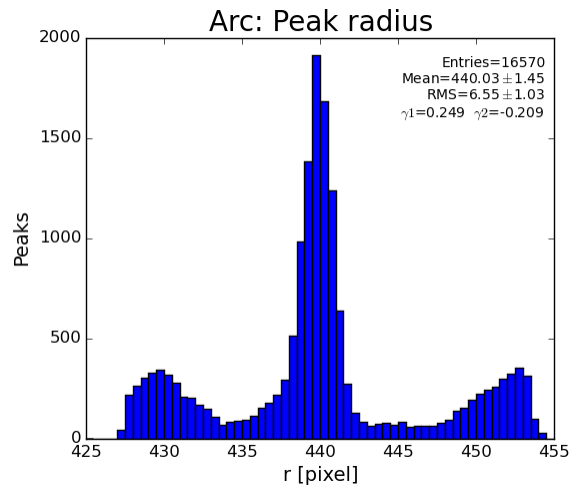


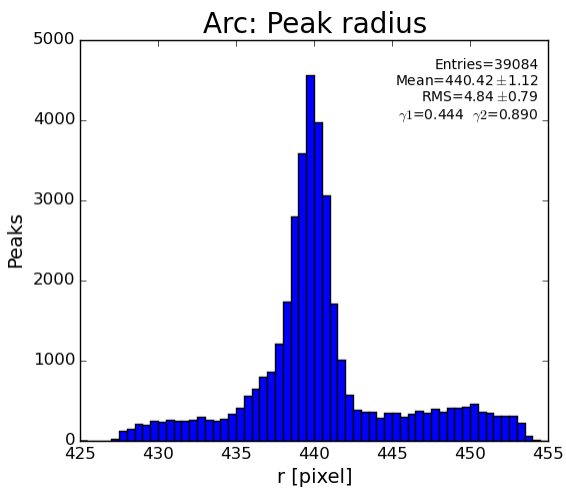


- Peak radius for ARC:

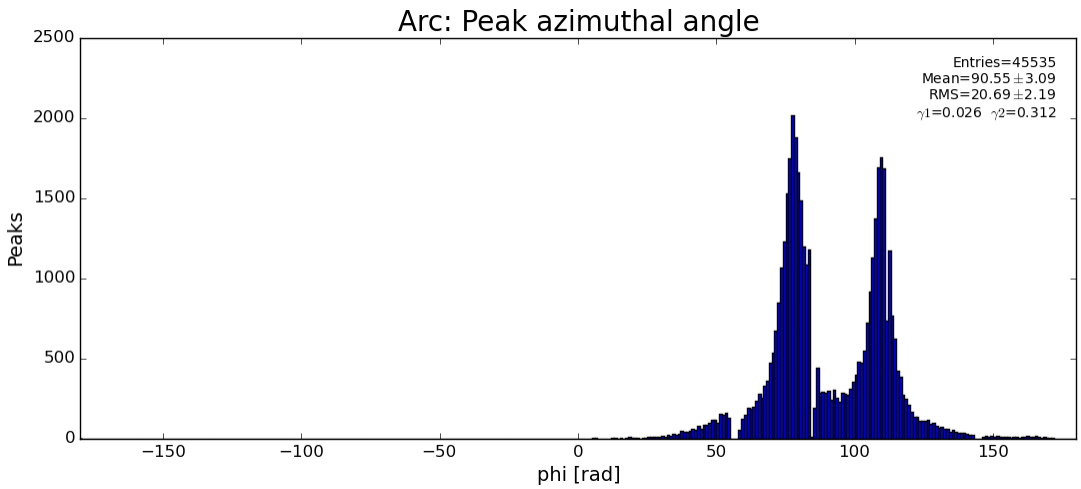
```
if pk.r<435 : return False
if pk.r>443 : return False
```

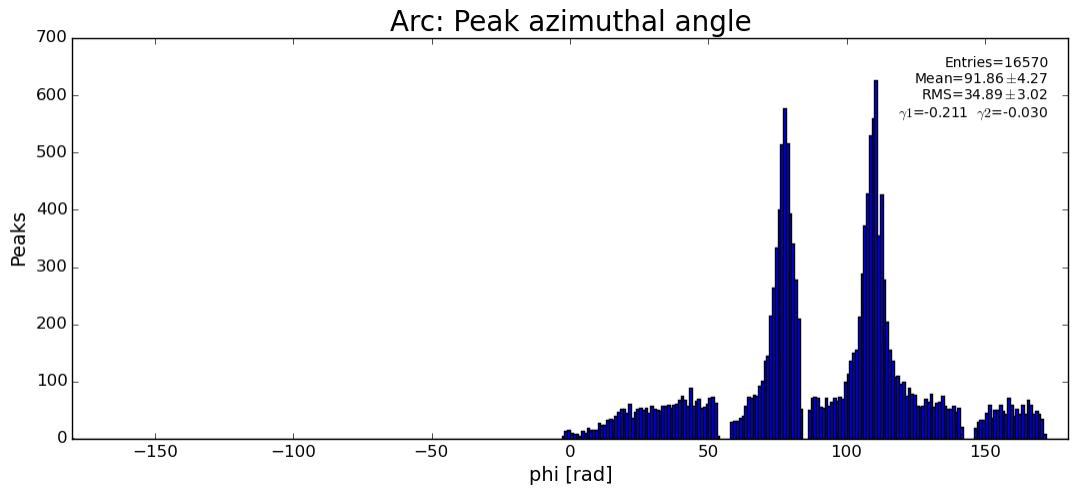


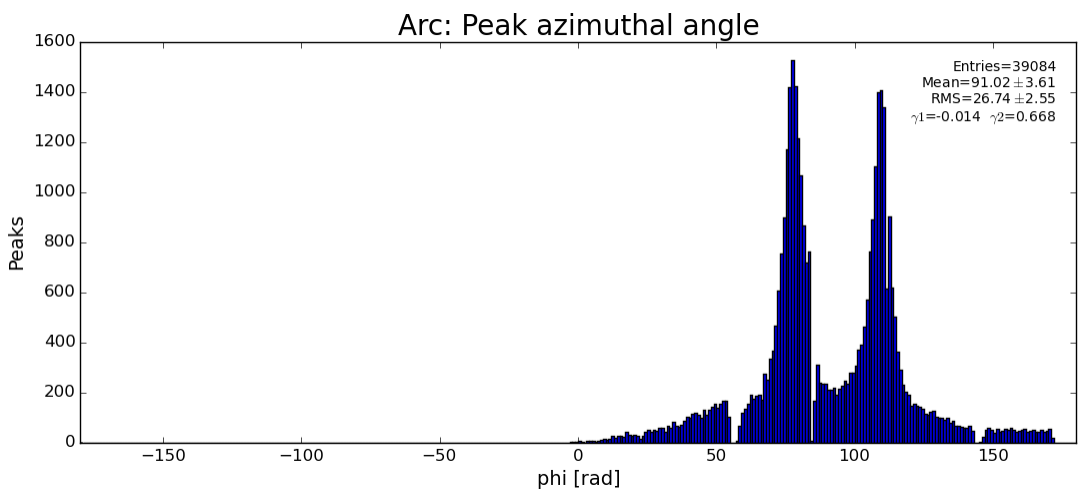




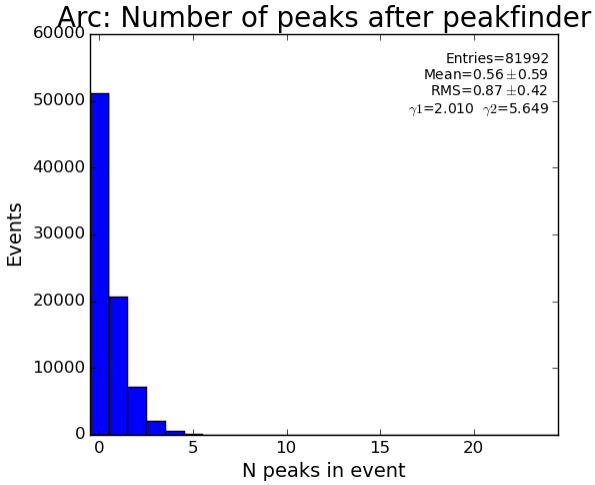
- Peak azimuthal angle is not used in selectors

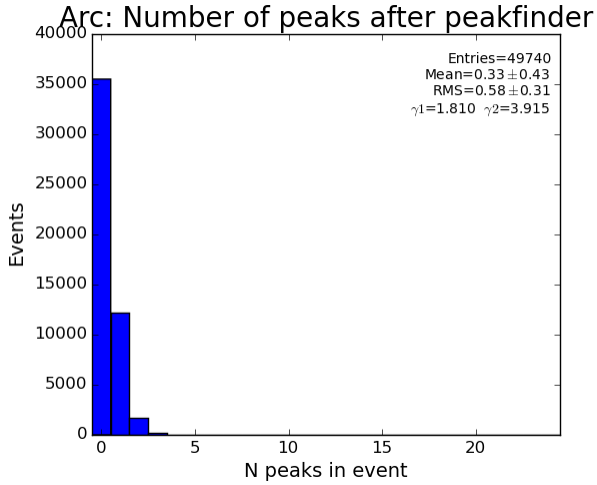


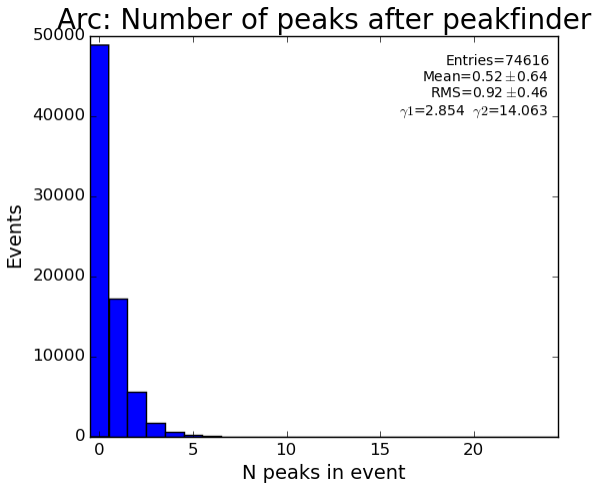




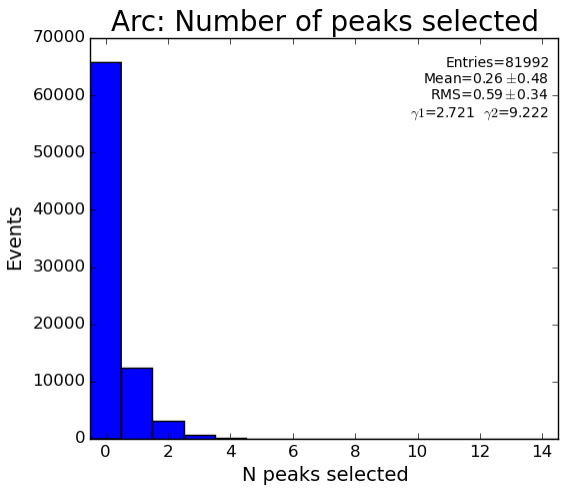
- Number of peaks after peak finder

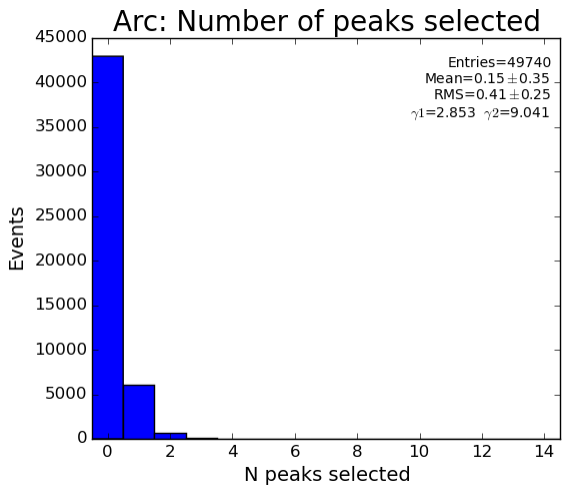


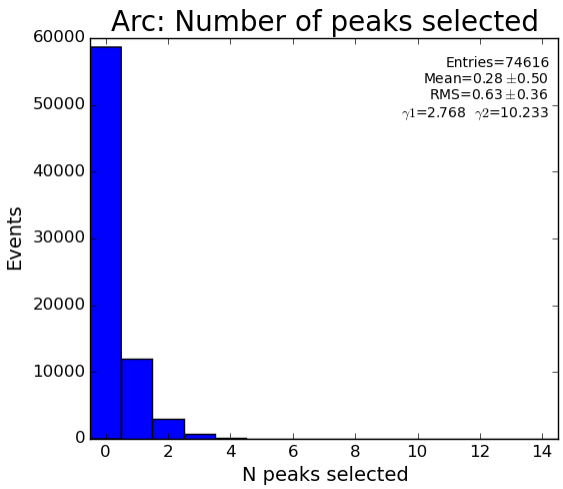




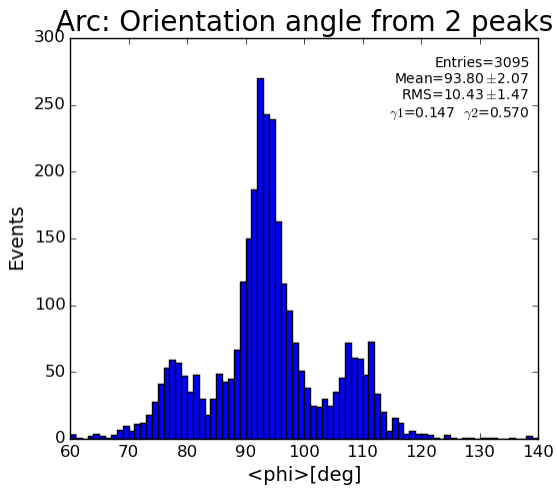
- Number of peaks after `peakIsSelectedArc(pk)`

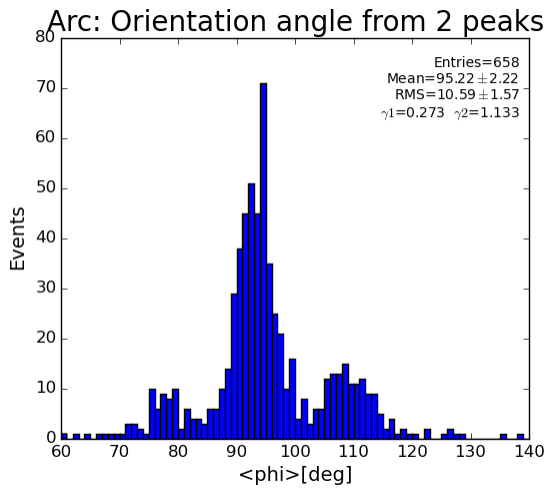


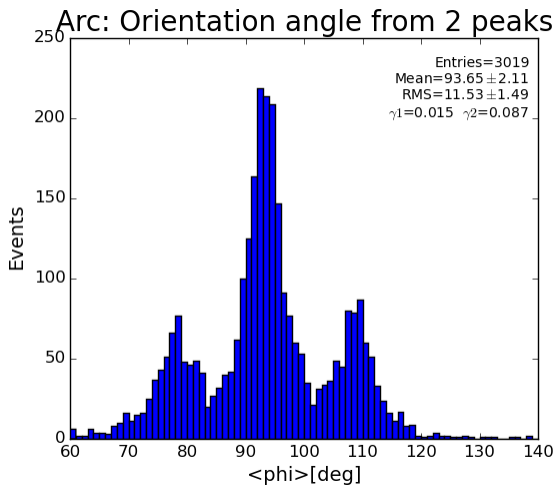




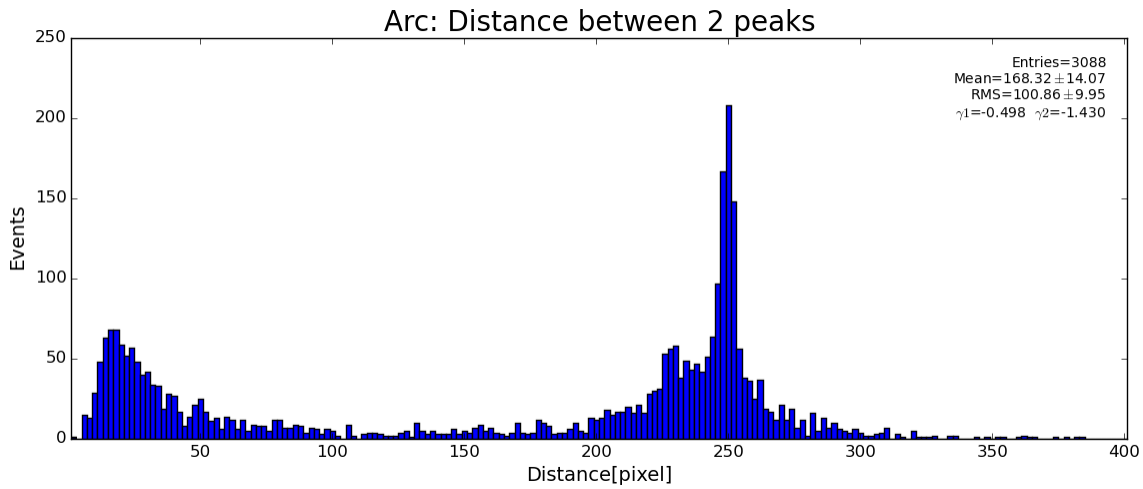
- Mean orientation angle for two peaks selected in the ARC region

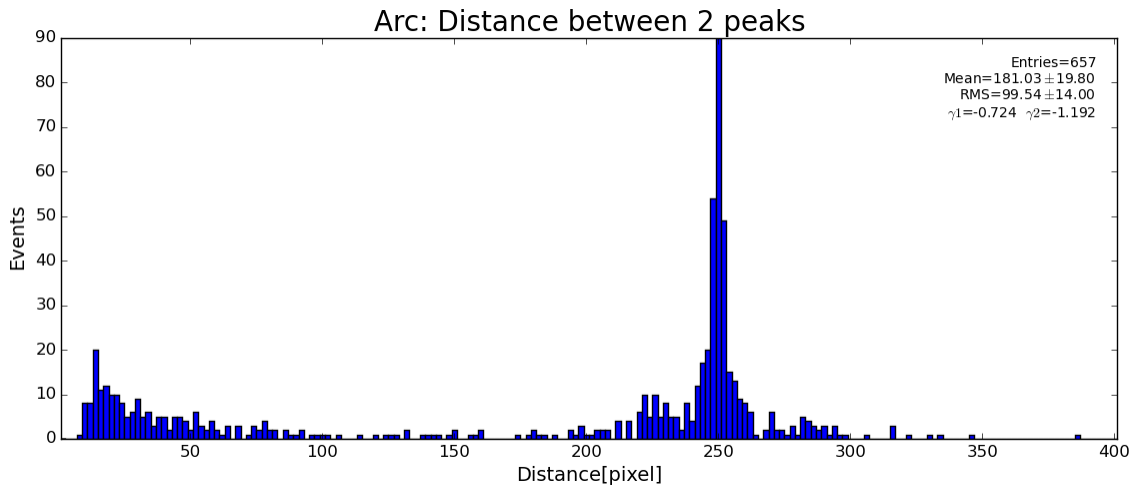


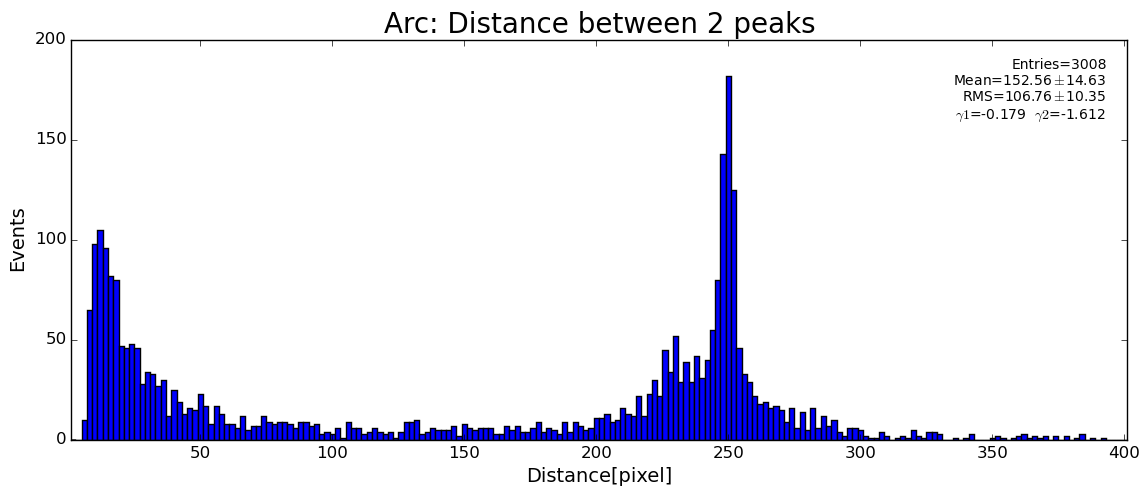




- Distance between two peaks selected in the ARC region

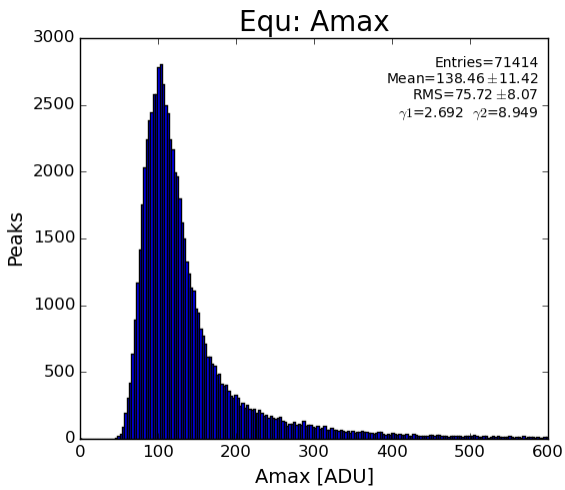


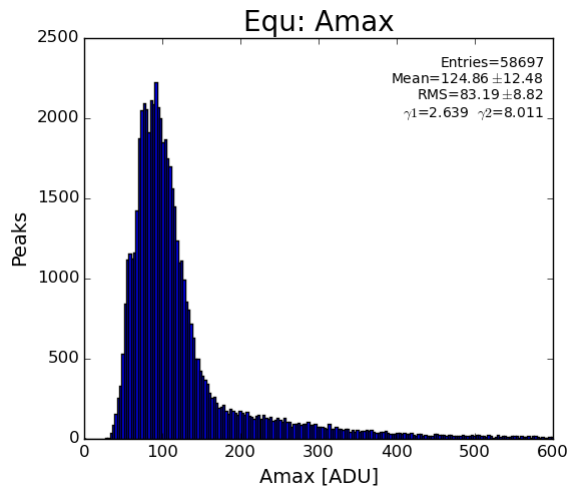


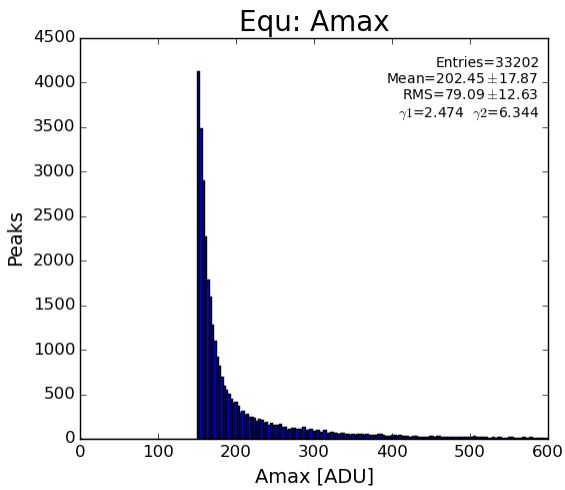


peak_finder_v2, v3, v4: EQU

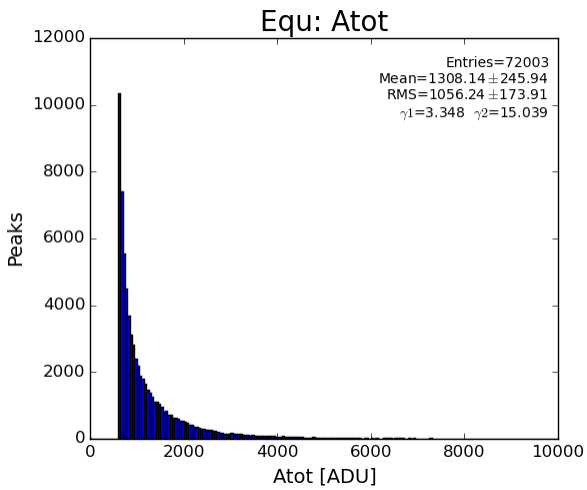
- Amax is only used in pfv4 as `thr_high=150`

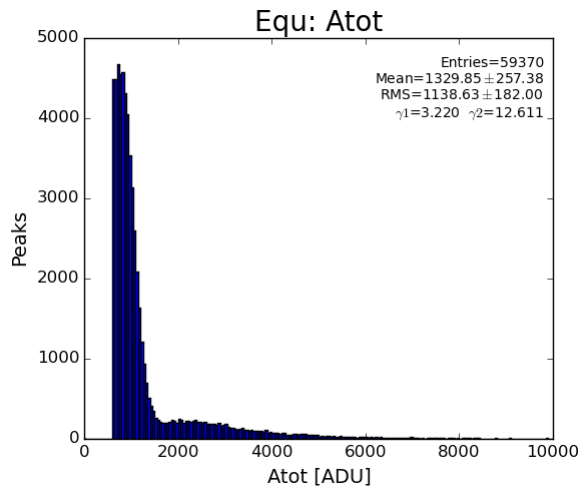


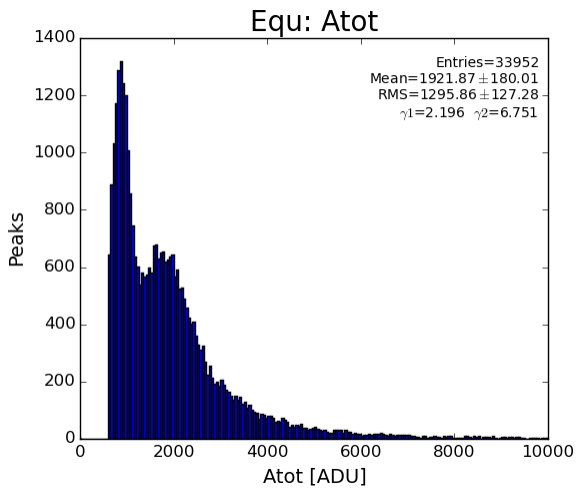




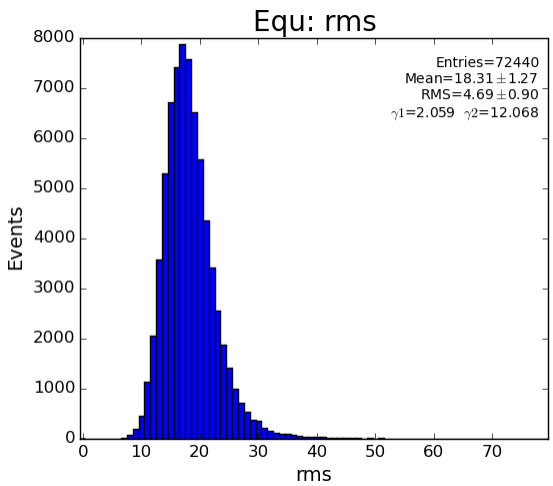
- Atot is used in all peak-finders as
  atot_thr=600
  if pk.atot<1800 : return False

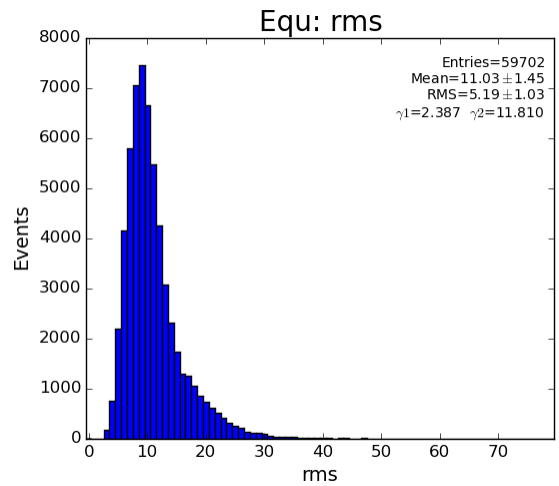


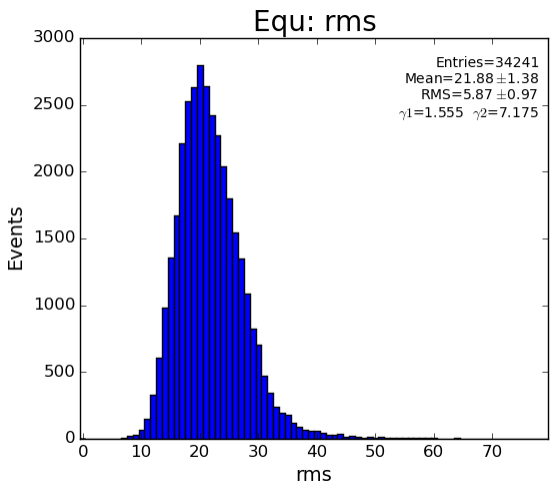




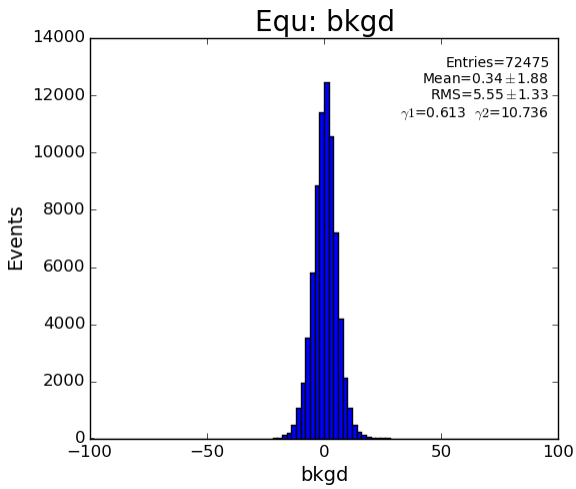
- rms is used in all peak-finders at processing in peak selector
  `if pk.rms>60 : return False`

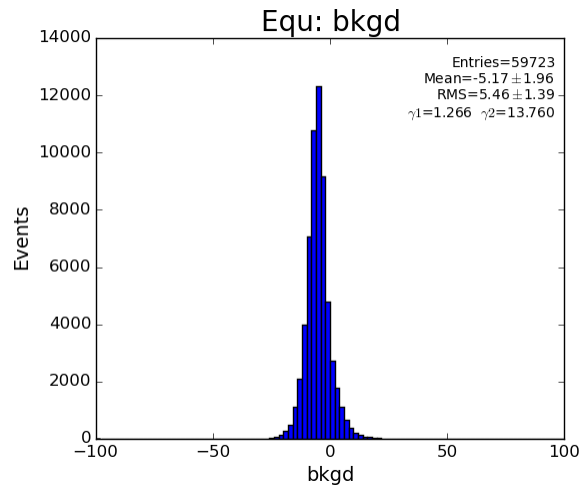


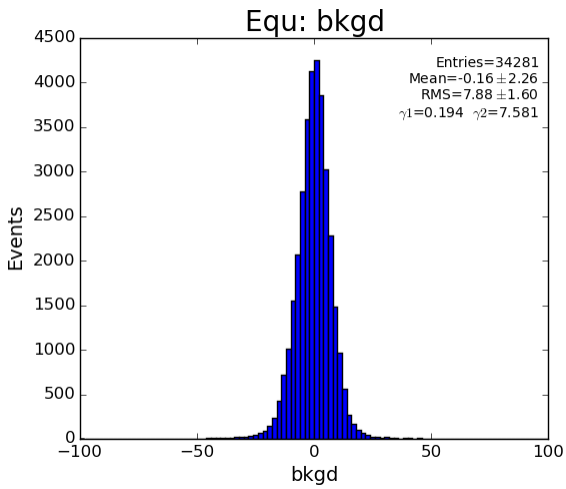




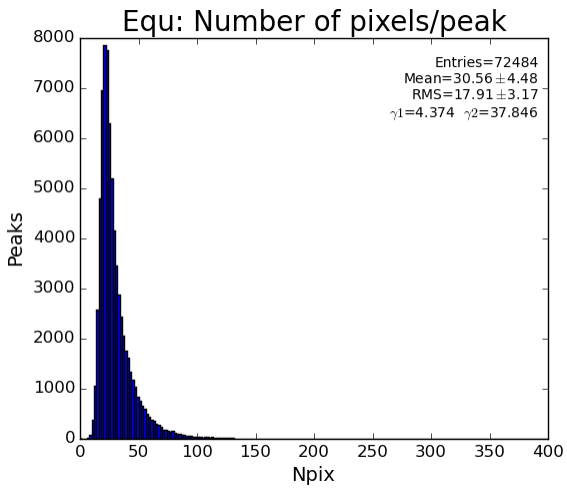
- bkgd is used in all peak-finders at processing in peak selector
  `if math.fabs(pk.bkgd)>20 : return False`

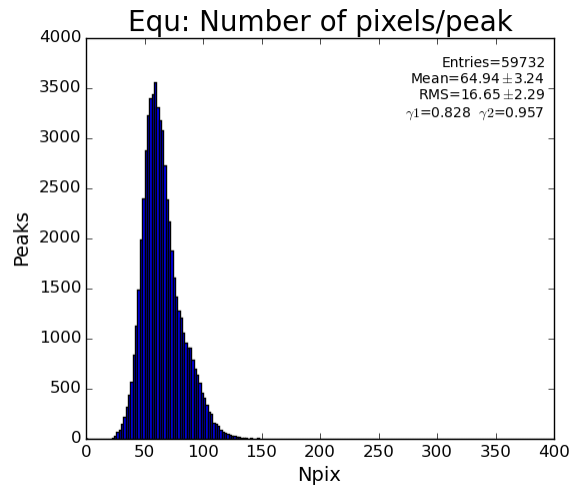


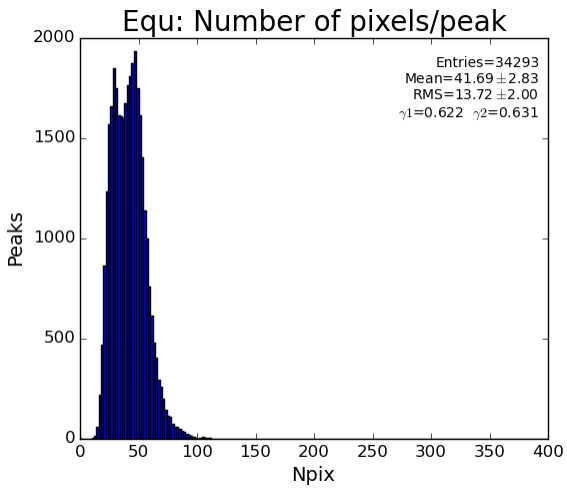




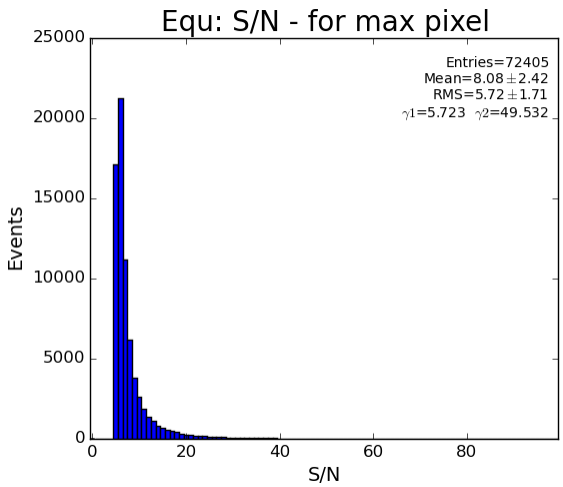
- npix is used in all peak finders in peak selector
  `npix_min=4, npix_max=500`
  `if pk.npix>200 : return False`

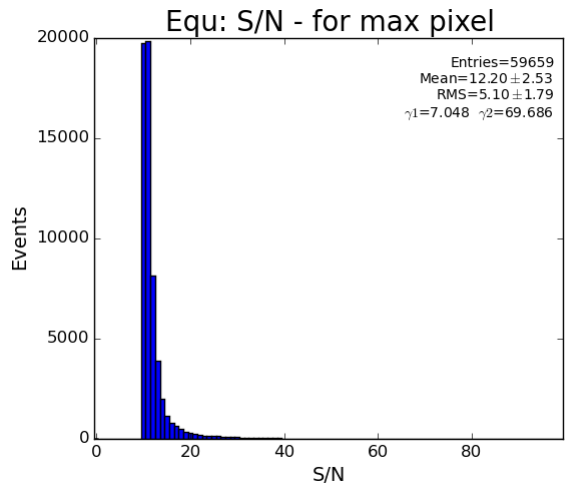


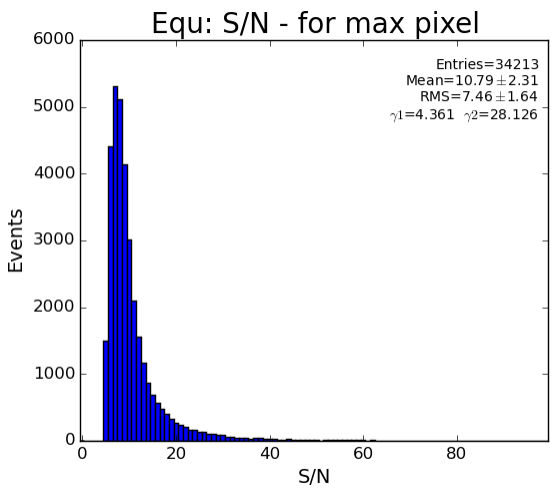




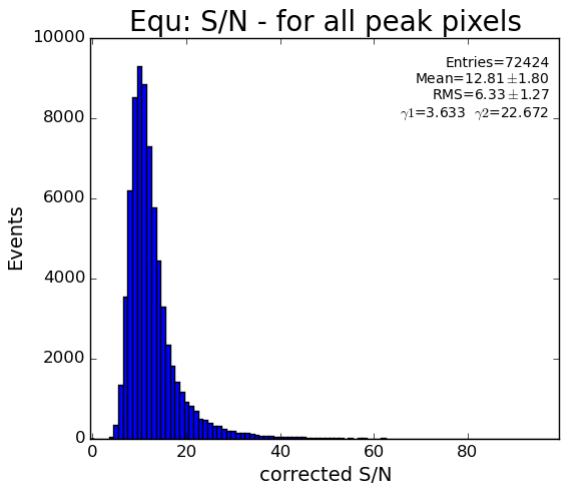
- S/N is used as
  `son_min=5` # for pfv2,4
  son_min=10 `# for pfv3` - Ranker - to eliminate large number of purely statistical seed peaks

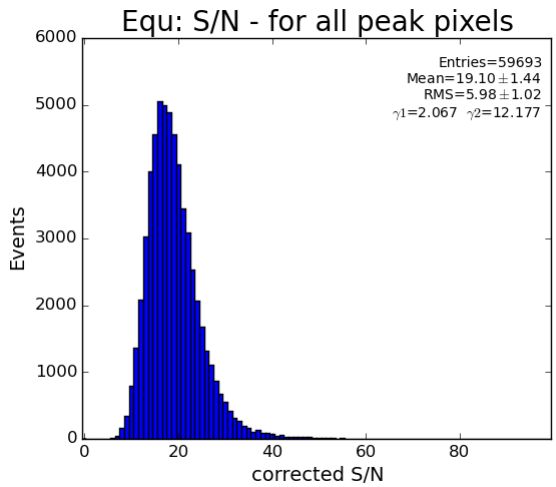


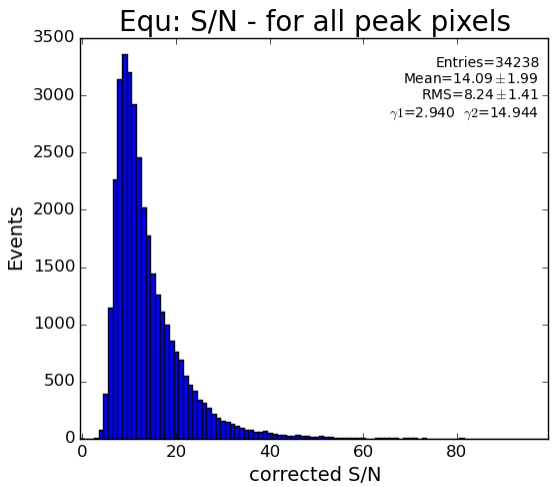




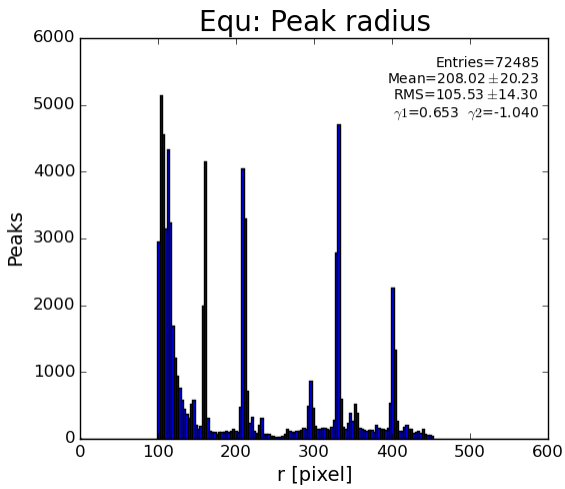
- S/N evaluated for all pixels
  if pk.sonc<5 : return False

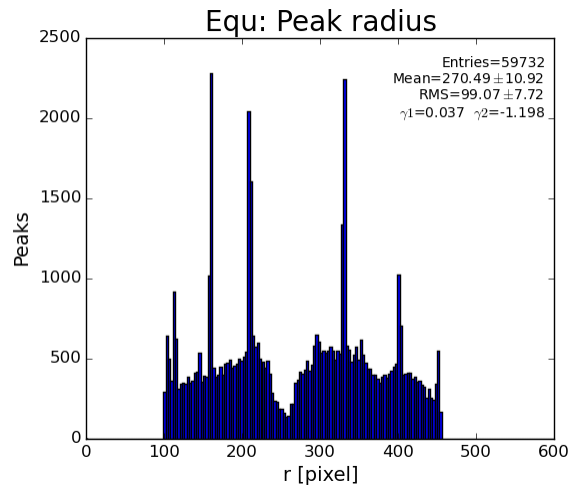


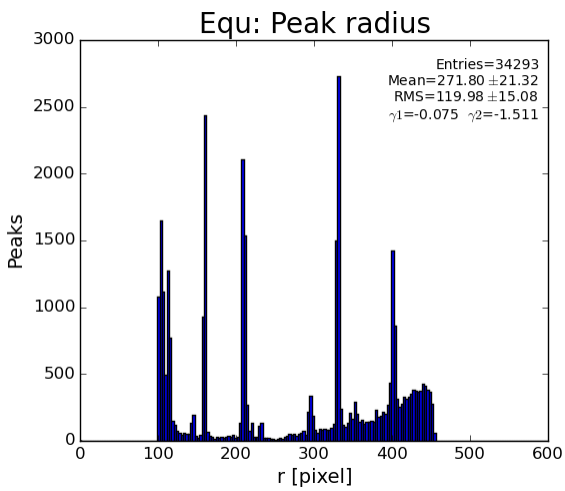




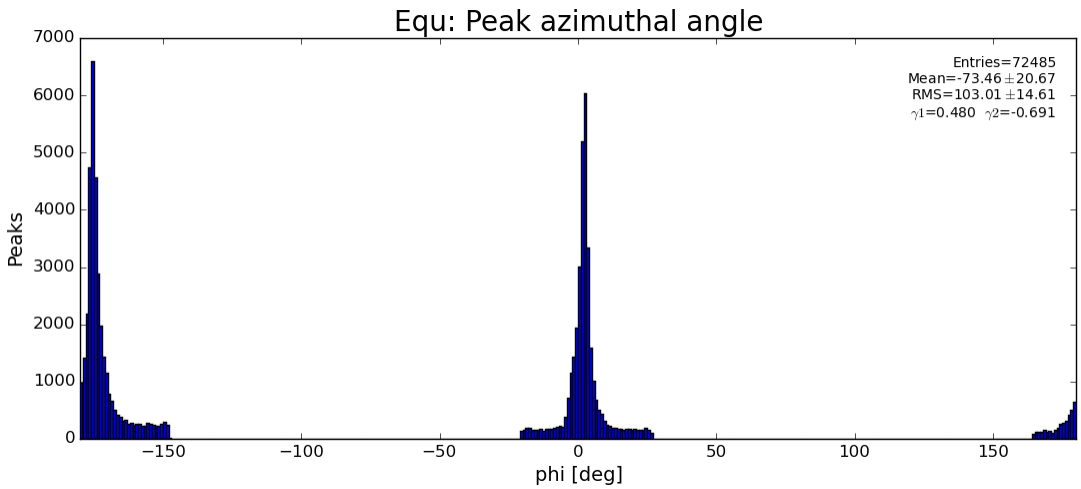
- Radial parameter for equatorial region:
  ```
  if pk.r<100 : return False
  if pk.r>454 : return False
  ```

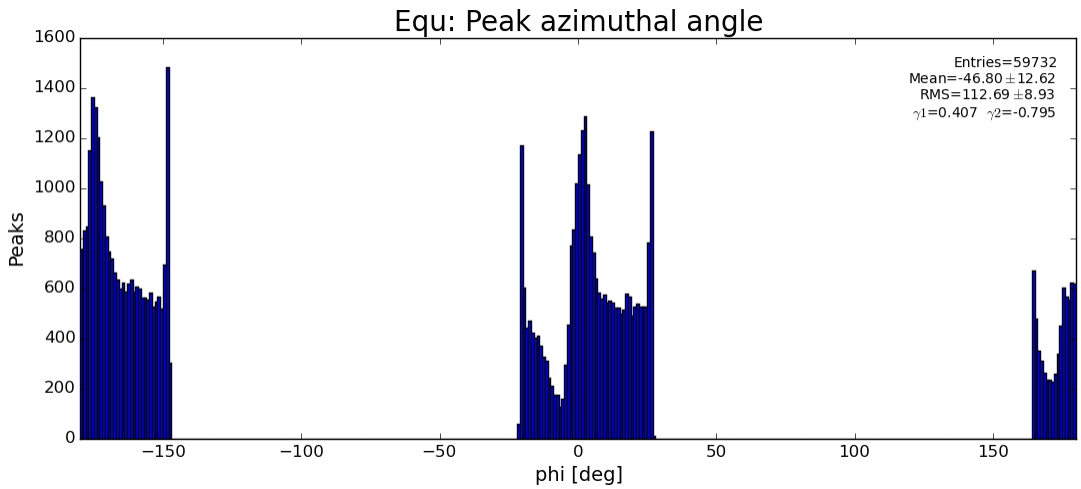


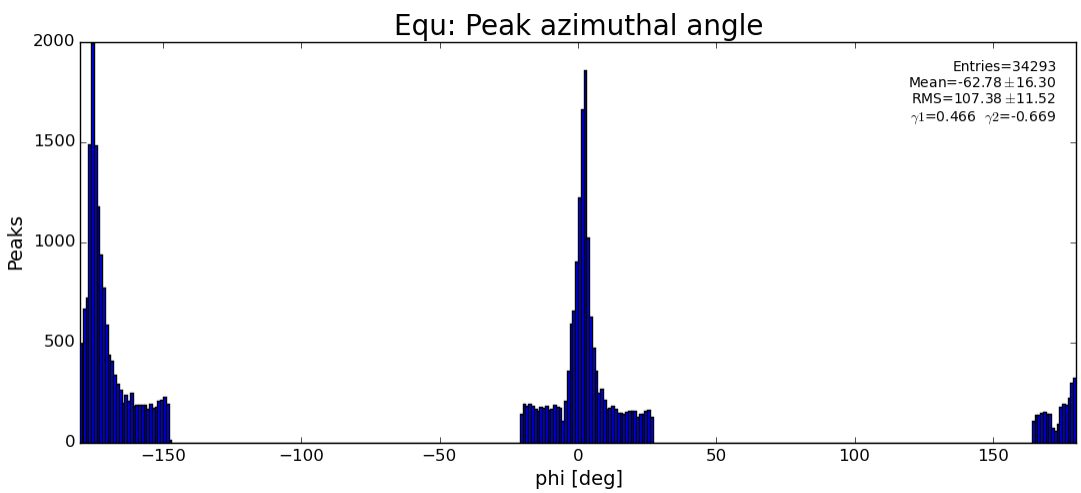




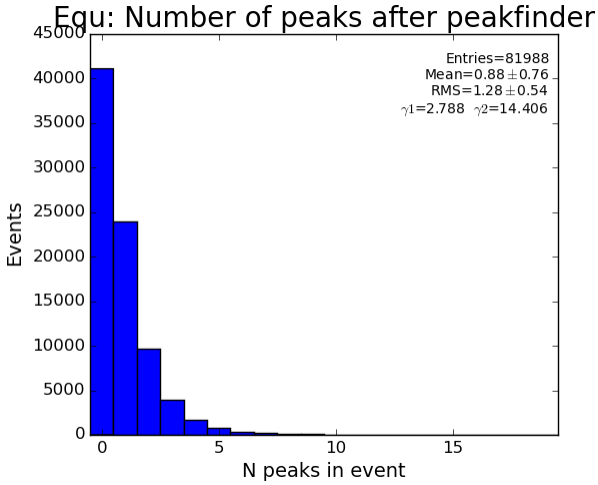
- Peak azimuthal angle is not used in selectors

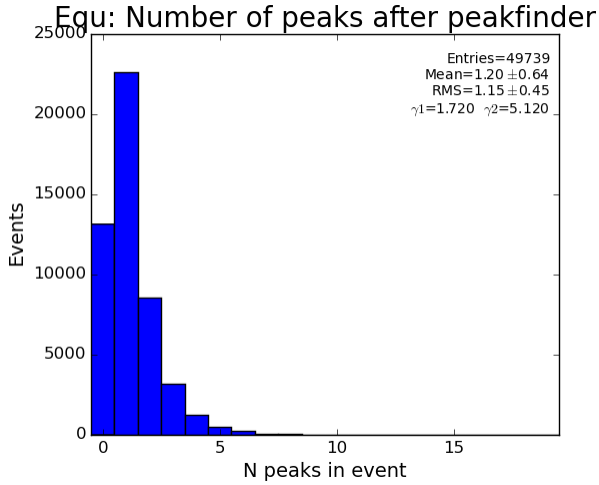


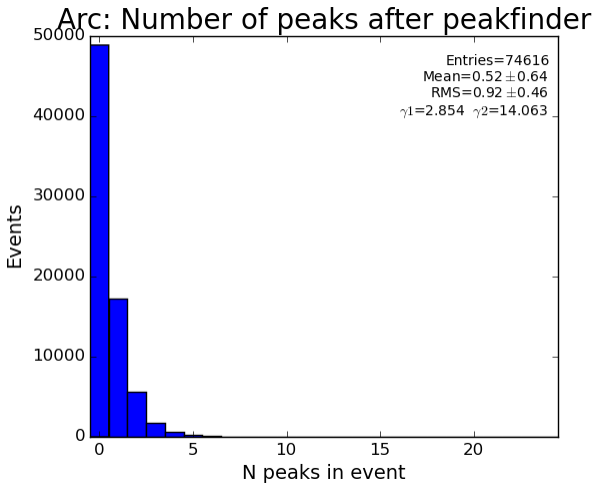




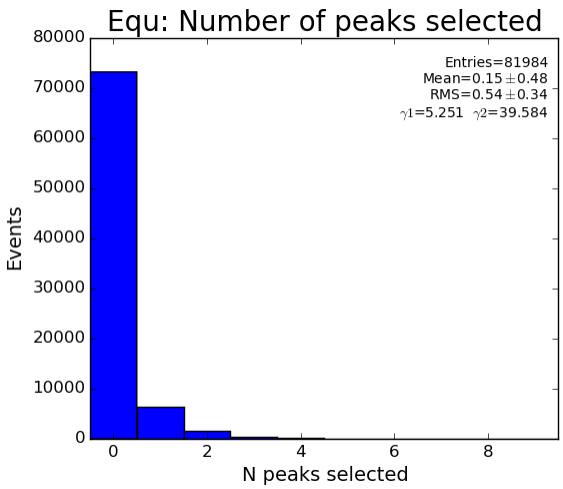
- Number of peaks after peak finder

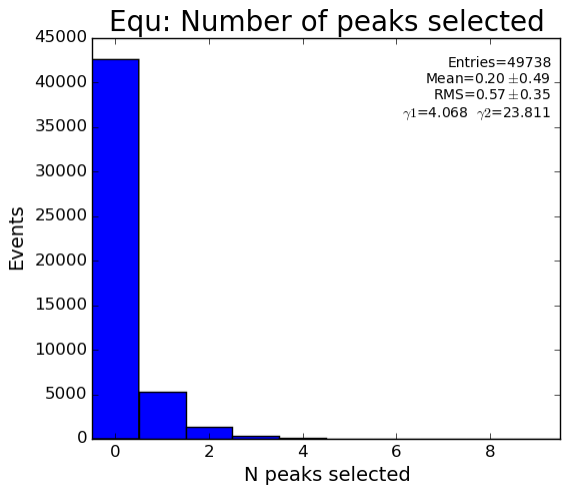


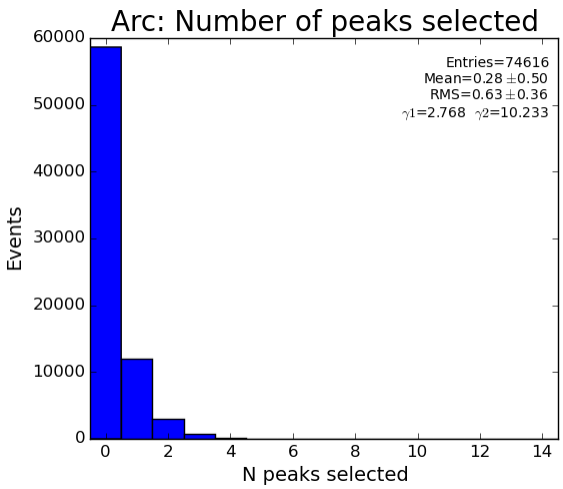




- Number of peaks after `peakIsSelectedArc(pk)`







Comparison of the pfv2 with Cheetah list of peaks

Code for comparison: `cxif5315/peak-list-comp-cheetah.py`

Peak lists for comparison:

- peakfinder: `pfv2-cxif5315-r0169-2016-03-28T15:02:47.txt`
- cheetah: r0169-cheetah-peaks.txt - with unknown origin...

Comparison algorithm and conditions

Use pyimgalgos.TDFileContainer for both peakfinder and cheetah

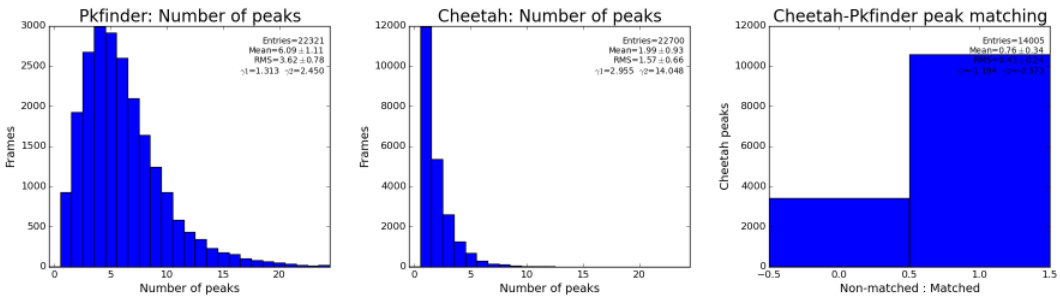
```
fc_ch = TDFileContainer(fncheet, indhdr='frameNumber', objtype=TDCheetahPeakRecord) # , pbits=256)
fc_pf = TDFileContainer(fnpeaks, indhdr='Evnum', objtype=TDPeakRecord) #, pbits=256)
```

- Loop over all groups (frames/events) in cheetah
    - Find associated peak-finder group: gr_pf = fc_pf.group(evnum-1) # accounts for -1 offset in event numeration in Cheetah and pf.
    - count cases when peak-finder group does not exist (peaks not found)
    - discard frames if fidelity do not match
    - discard frames with more than 5 peaks
    - loop over cheetah peaks
        - discard cheetah peaks outside ROI mask
        - loop over pf-peaks and check that cheetah peak can be matched with one of them by location (s, r, c)
        - if not-matched - print peak main features

Statistics for number of peaks:

- total in Cheetah: 14002
- matched: 10593
- not-matched: 3409
- fraction of matched: 0.757

Plots for number of peaks in peak-finder, Cheetah, and number of non-matched:matched Cheetah peaks.



Peak-finder number of peaks accounts for arc region.

References

- ImgAlgos.PyAlgos
- Hit/Peak Finding Details