Update on low-energy electron reconstruction in CYGNUS

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Differences in data production

- Head-tail capability quantified as the capability of reconstructing forward tracks $[-\pi/2,\pi/2]$

	Data with noise	H-T perc.	Data without noise	H-T perc.
$20\ keV$	$\sigma_\theta = 23.2 \pm 1.7°$	$87\ \%$		
$30\ keV$	$\sigma_\theta = 19.0 \pm 1.5°$	$84\ \%$	$\sigma_\theta = 18.5 \pm 0.9°$	$90\ \%$
$60\ keV$	$\sigma_\theta = 20.1 \pm 1.6°$	$83\ \%$	$\sigma_\theta = 12.1 \pm 0.6°$	$89\ \%$
$100\ keV$			$\sigma_\theta = 11.4 \pm 0.7°$	$91\ \%$

- Why this happened? 30 keV produced with different pedestals and digi parameters

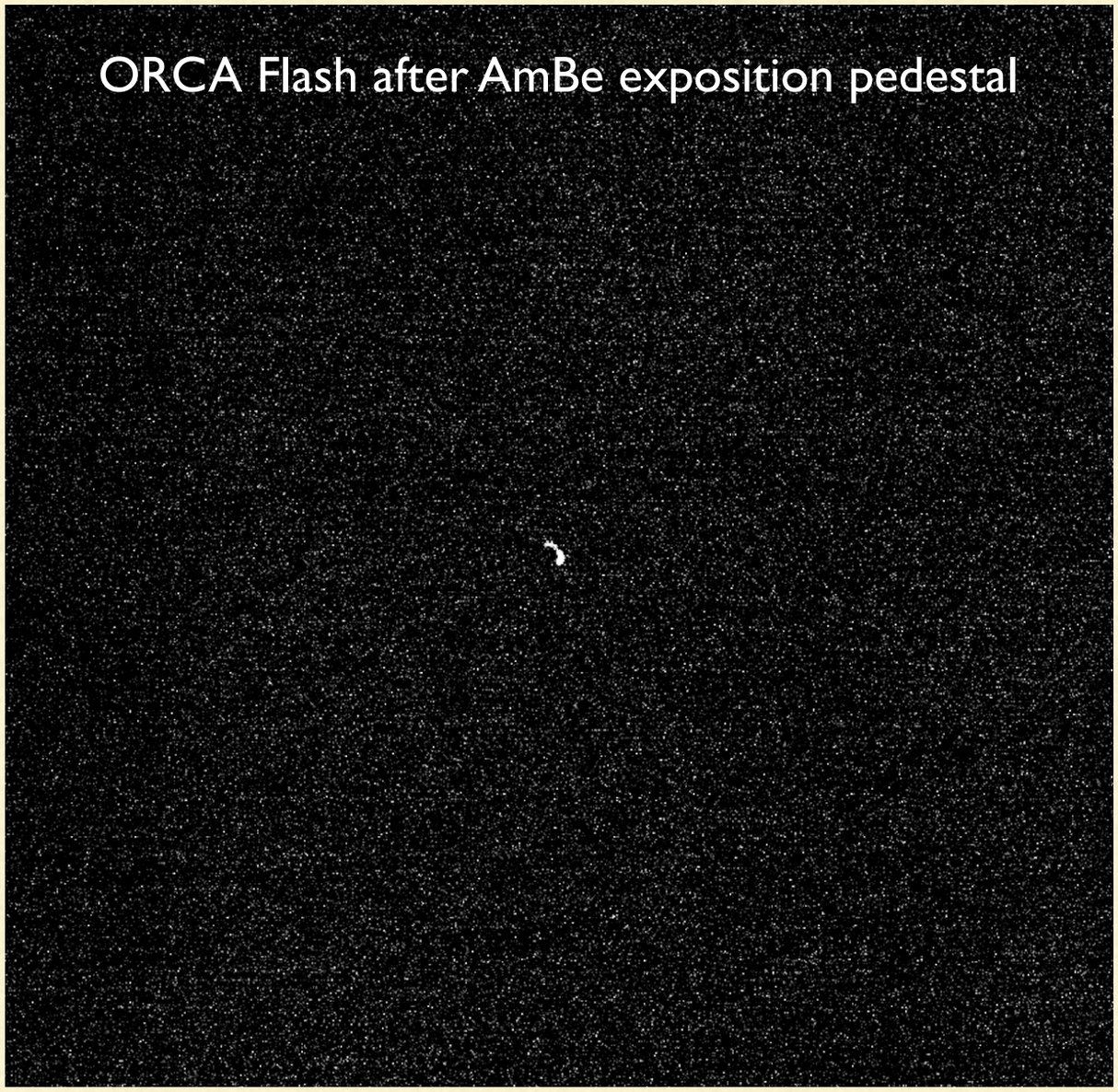
FUSION Pedestals with endcap AIR-COOLING			
3944	1000	10	Camera with endcap

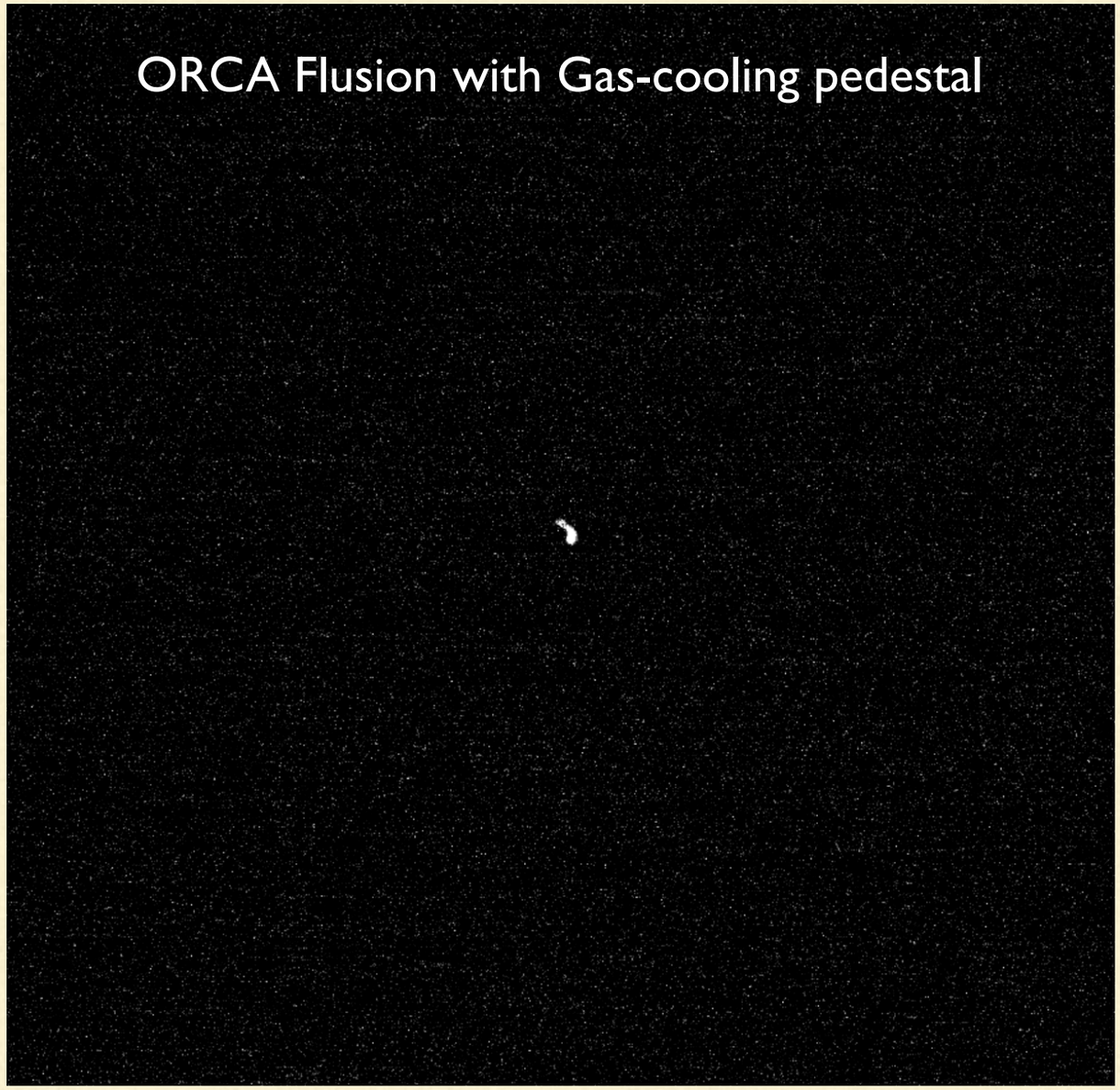
Fusion End Test with AMBE			
3797	1000	500	Pedestal (soon after source OFF)

Different exposure time (ms), we'll do a test with higher exposure time

- Better pedestal: the one used with 30 keV (less noise, near to final version of the detector)

The 3944 and 3797 pedestals





- Redigitization and reconstruction of all dataset used for this Study with new pedestal!

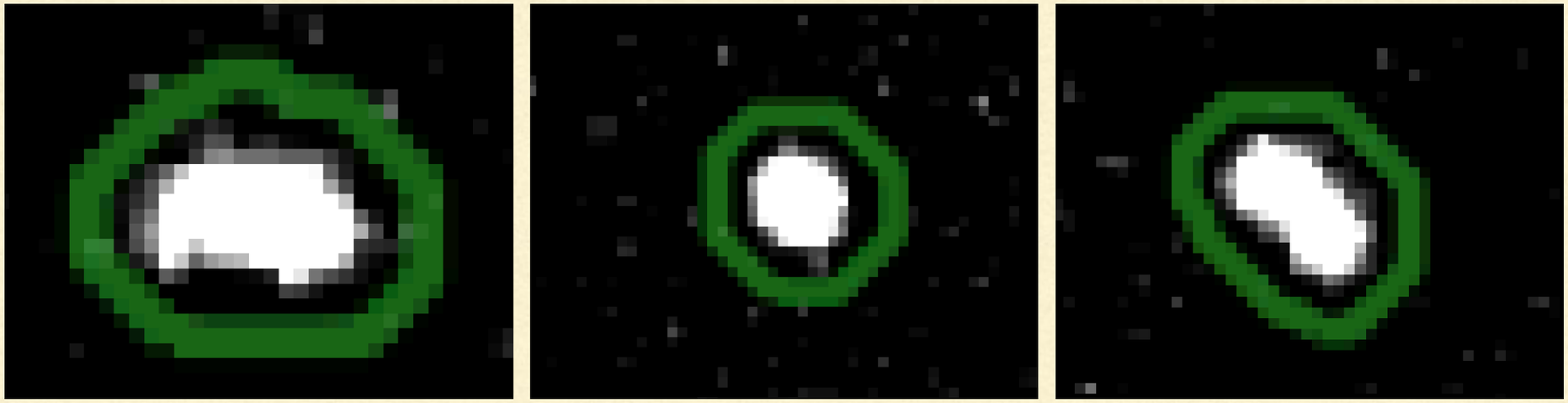
Current parameters for digitization

```
'diff_coeff_B'          : 0.0196,       #diffusion parameter [mm/sqrt(cm)]^2
'diff_const_sigma0'     : 0.0784,       # diffusion constant [mm]^2
'z_dim'                 : 350,          #first dimension of the detector
'y_dim'                 : 350,          #second dimension of the detector
'z_pix'                 : 2304,         #number of pixels in the first dimension
'y_pix'                 : 2304,         #number of pixels in the second dimension
'x_gem'                 : 510,          #coordinate of the cam in the simulation (x the is drift direction in geant4 sim) [mm]

'tag'                   : 'Data',
'noiserun'              : 3944,
'Conversion_Factor'     : 3000./6,      #Number of photoelectrons emitted per keV (iron calibration) [LIME has 60% light wrt LEMON]

'ion_pot'               : 0.0462,       #ionization potential for He/CF4 60/40 [keV]
'GEM_gain'              : 123,          #gain in a single GEM foil, value chosen to reproduce the measured light yield in LEMON
'photons_per_el'        : 0.07,         #number of photons per electron produced in the avalanche
'sensor_size'           : 14.976,        #sensor dimension [mm]
'camera_aperture'       : 0.95,

'bckg'                 : True,         #if 'True' background is added
'rootfiles'             : True,         #choose input type: True for G4 root iput, False for SRIM txt files
'events'                : 500,          #number of events to be processed, -1 = all
#'donotremove'           : True,            # Remove or not the file from the tmp folder
}
```

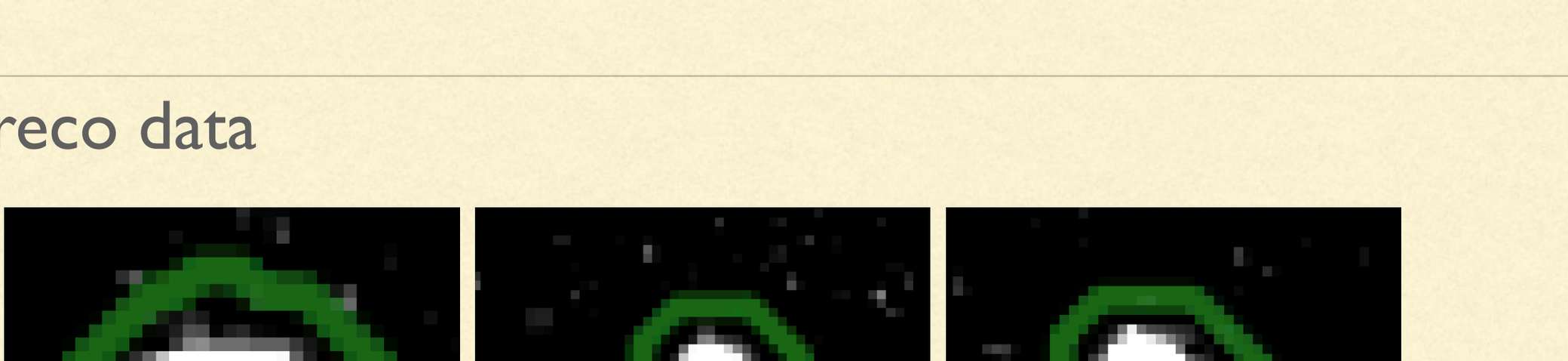
FUSION Pedestals with endcap AIR-COOLING			
3944	1000	10	Camera with endcap

New reco data

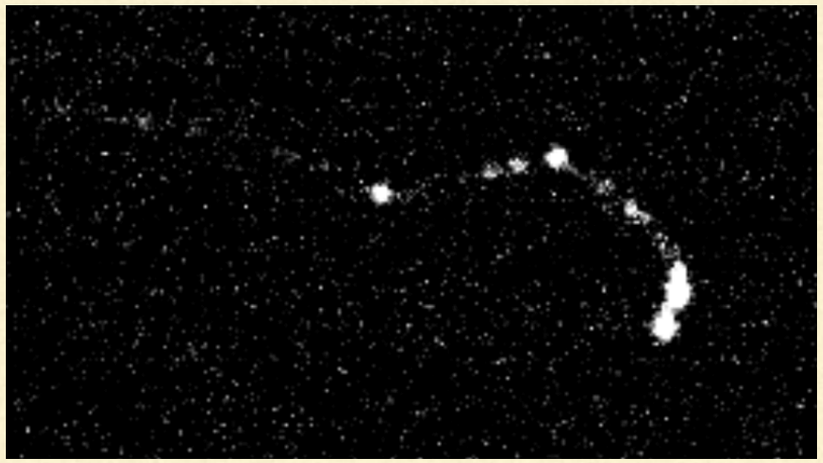
20 keV

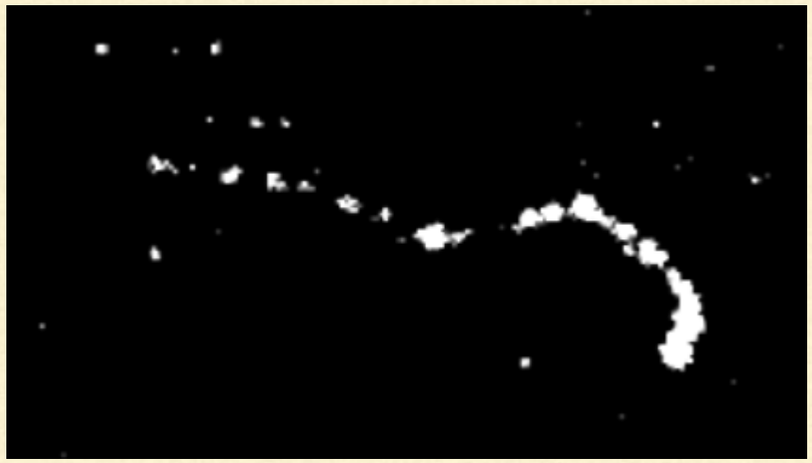
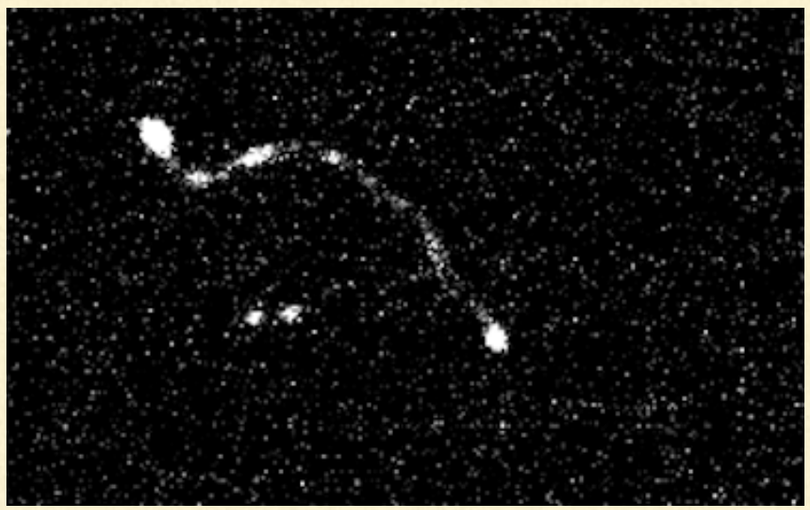
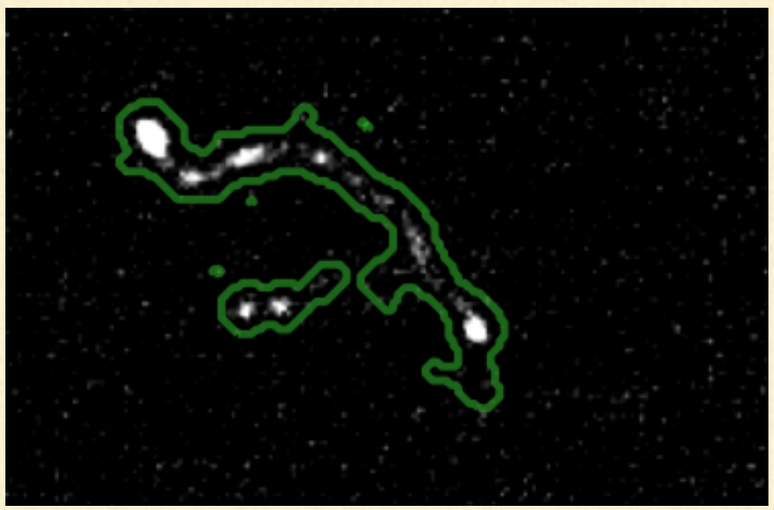
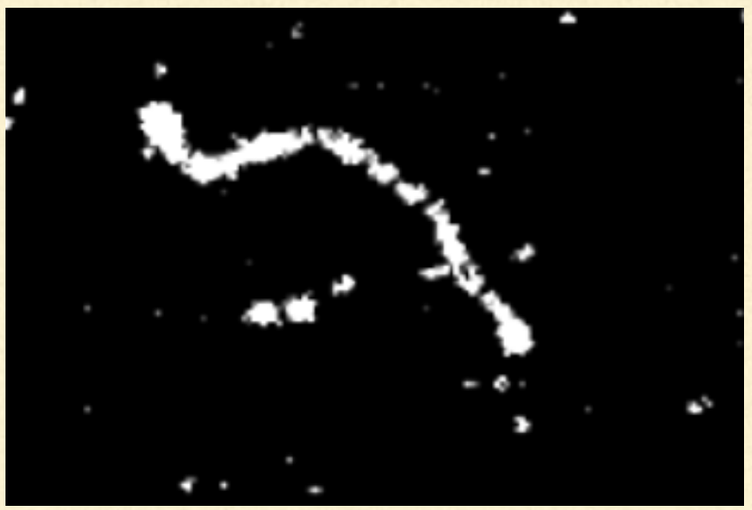


60 keV



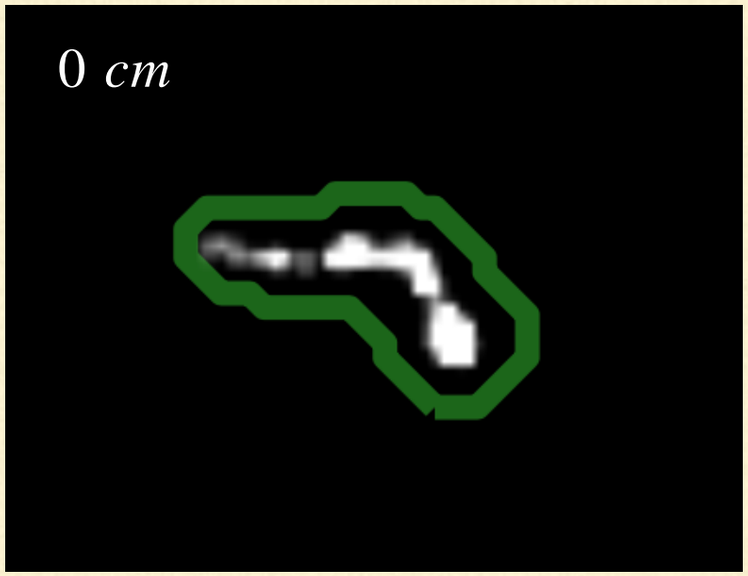
100 keV Problem

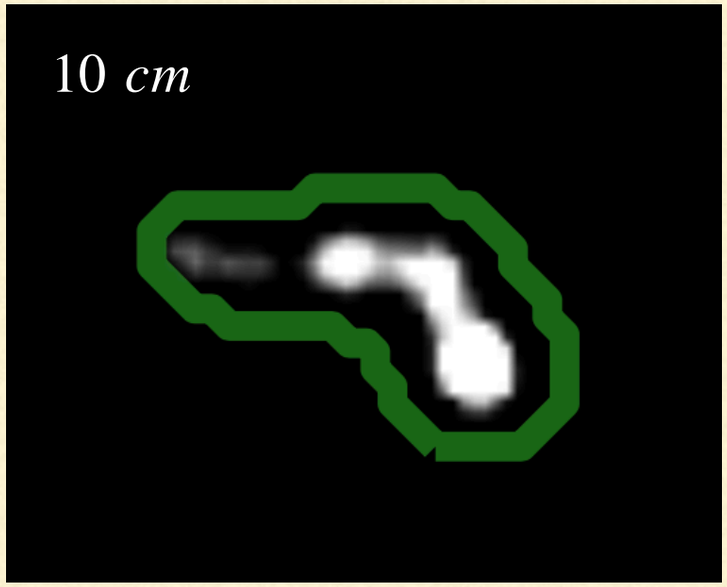


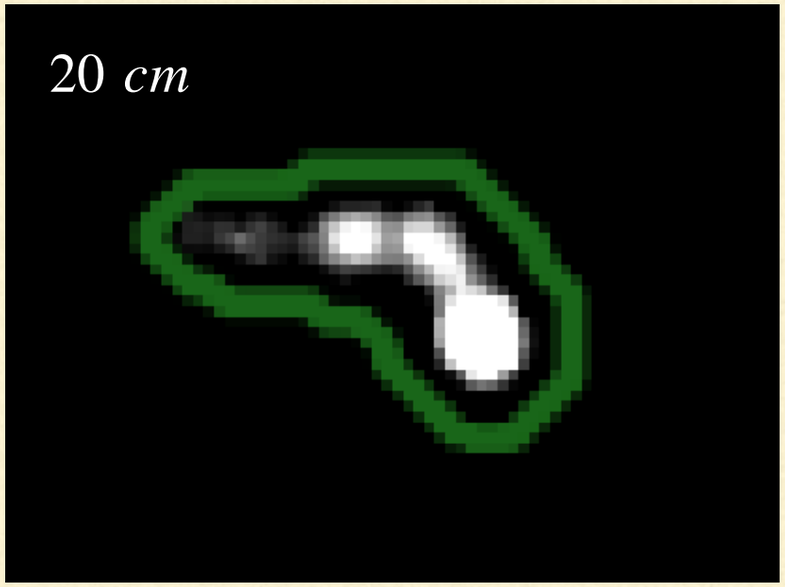





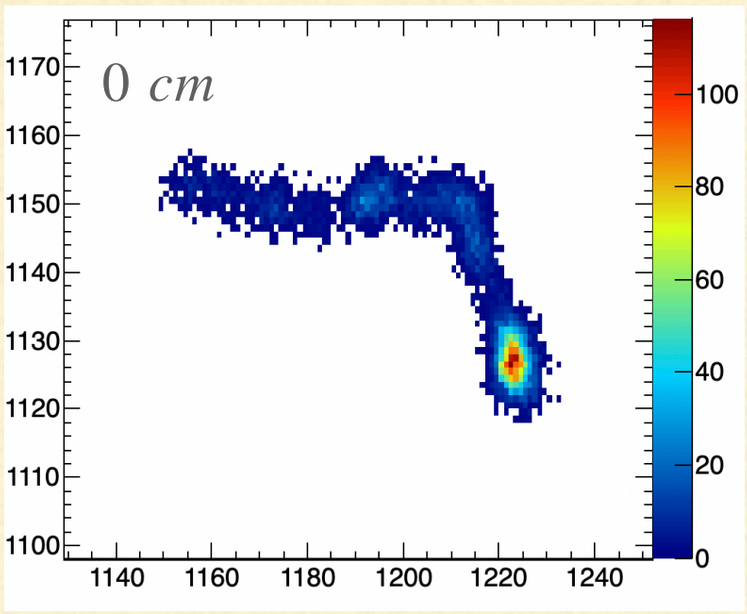
Sanity check: diffused tracks

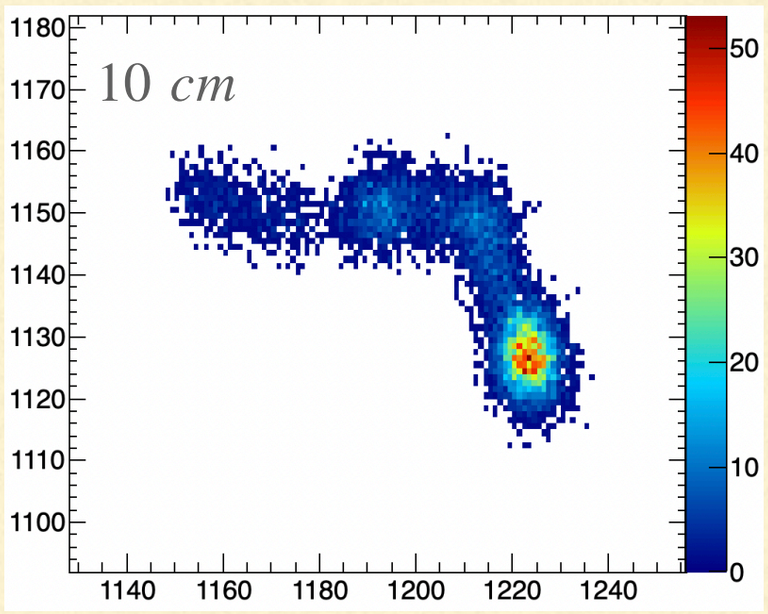
- Analysis done on tracks with less diffusion to test the algorithm

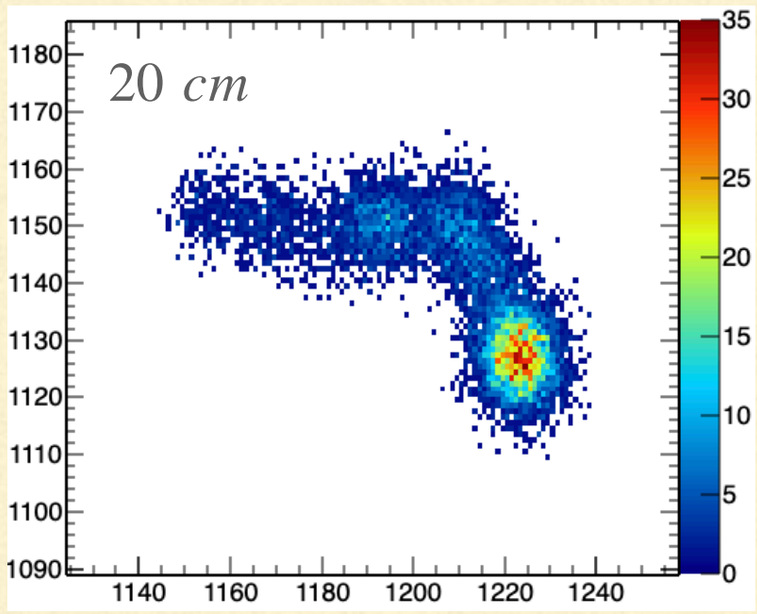










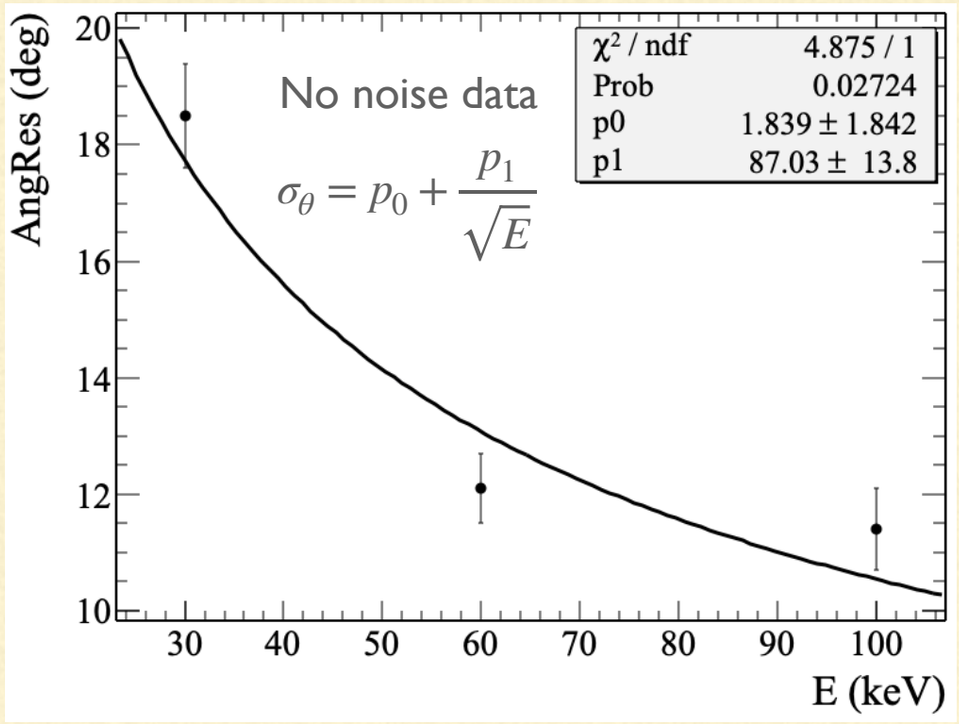


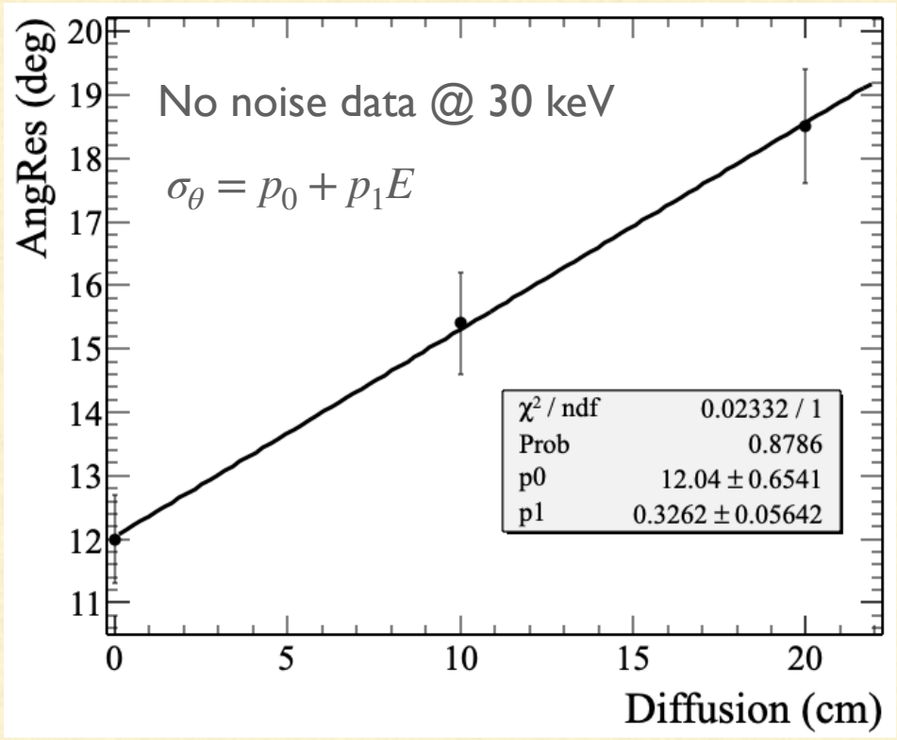
Results on different diffusion @ 30 keV

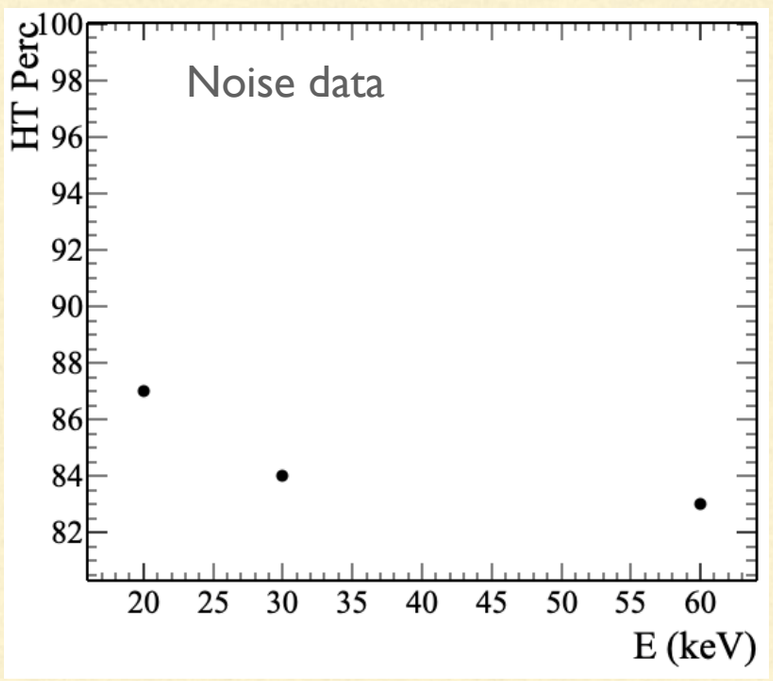
	Noise	No noise
0 cm diffusion	$\sigma_\theta = 18.3 \pm 1.0°$ $HT = 88.4\,\%$ $\sigma_x = 0.58 \pm 0.04\ mm$ $\sigma_y = 0.39 \pm 0.03\ mm$	$\sigma_\theta = 12.0 \pm 0.7°$ $HT = 90.0\,\%$ $\sigma_x = 0.274 \pm 0.021\ mm$ $\sigma_y = 0.159 \pm 0.005\ mm$
10 cm diffusion	$\sigma_\theta = 24.0 \pm 1.6°$ $HT = 86.5\,\%$ $\sigma_x = 0.78 \pm 0.05\ mm$ $\sigma_y = 0.50 \pm 0.05\ mm$	$\sigma_\theta = 15.4 \pm 0.8°$ $HT = 91.4\,\%$ $\sigma_x = 0.407 \pm 0.016\ mm$ $\sigma_y = 0.300 \pm 0.022\ mm$
20 cm diffusion	$\sigma_\theta = 19.0 \pm 1.5°$ $HT = 84\,\%$ $\sigma_x = (0.79 \pm 0.04)mm$ $\sigma_y = (0.422 \pm 0.030)mm$	$\sigma_\theta = 18.5 \pm 0.9°$ $HT = 90\,\%$ $\sigma_x = (0.350 \pm 0.020)mm$ $\sigma_y = (0.308 \pm 0.017)mm$

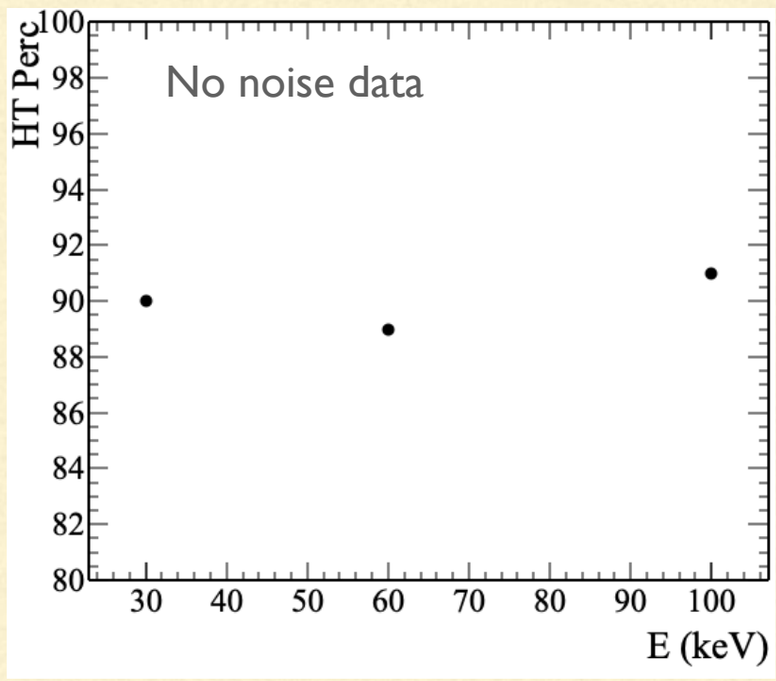
To redo

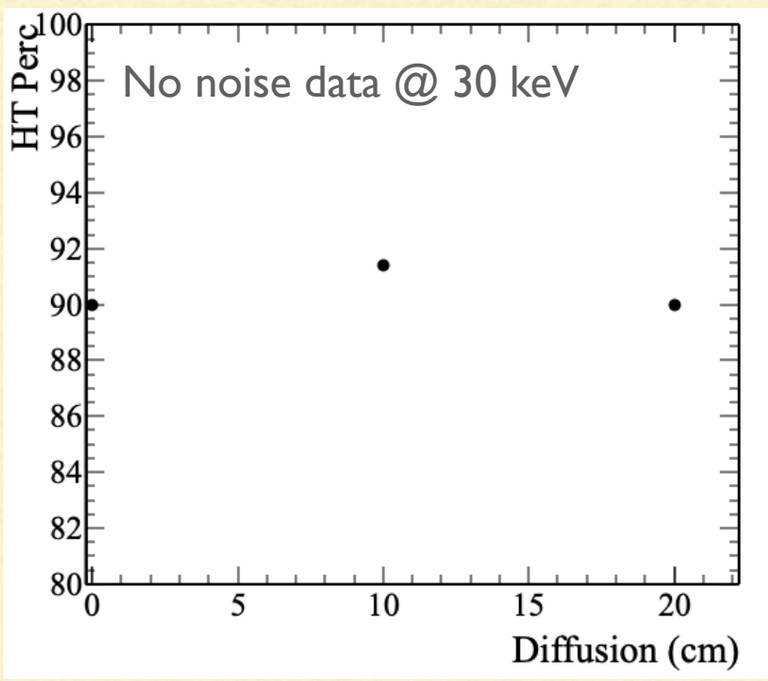
Summary plots











Conclusions

- Simulated images will be reproduce in better noise condition, to work with similar condition of the final detector

- The reconstruction of the tracks is now in Progress

- The angular resolution scaling works in tracks without noise, we expect better and final results in tracks with noise

- The head tail recognition capability is above 80% in all cases

- The algorithm respect the sanity check on the diffused tracks