DC2.1 status and wishes

Brought to you by Matias, Lukas and Lech

What we expect from DC2

- Trigger simulation (please implement one for grandlib!!)

- Quality cuts/Simulation cuts/Antenna selection (not yet)

- Reconstruction Routines:

   – Efield

   - Energy

   - Direction

   - Xmax

   - Polarization?

   - Deal with noise? (simulation of digital filters?)

Progress!
(but no reco implemented AFAIK)

DC2.1rc5 (ZHAireS release)

- Available in lyon, at **/sps/grand/DC2.1rc4**

- based in **dev** branch, commit **tagged DC2.1rc5 (things happened)**

- ZHAireS 1.0.30a, Aires 19.08.04

- 2000 events per **directory**, grandlib file structure

- **250 events per file (new grandlib feature)**

- 25000 events (you get all the events!)

- Ideal GP300 **(now very old)** layout

- **With electromagnetic energy computed**

- **With all proper longitudinal tables!**

3 Flavors

- sims with gps jitter, calibration jitter and galactic noise

- "NJ" → sims without jitters and without galactic noise

- "AN" → sims with jitters and **measured and baselined** noise (by PECC)

DC2.1rc5 (ZHAireS release)

xmax_pos_shc bug fix! (in ZHAireS sims only!)

Before, this was given with respect to sea level

Now it is corrected

DC2.1 (Corsika release)

- **Available soon in Lyon**

- **based in <u>dev</u> branch**

- **CoREAS V1.4 / CORSIKA 7.755**

- **100 events per file, grandlib file structure**

- **10000 events**

- **Official GP300 (old) layout**

<u>**3 Flavors**</u>

- **sims with gps jitter, calibration jitter and galactic noise**

- **"NJ" → sims without jitters and without galactic noise**

- **"AN" → sims with jitters and <u>measured and baselined noise</u> (by PECC)**
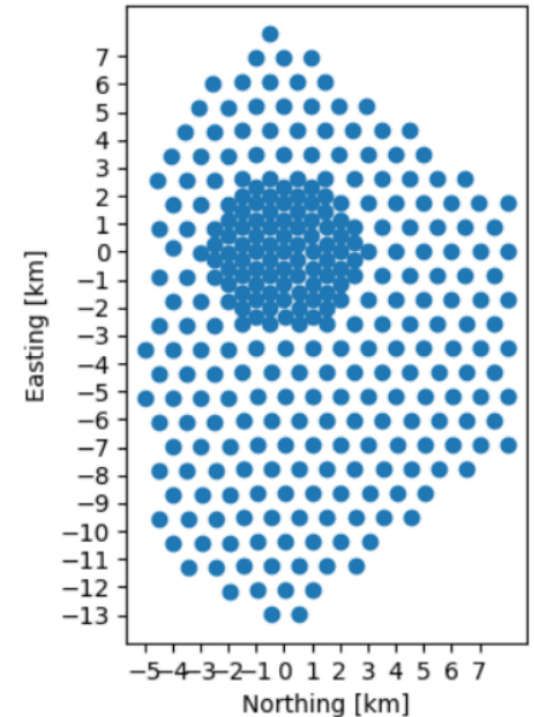
DC2.1 Bonus: GP289 sims

- Available in lyon, at /sps/grand/DC2_Coreas
- based in dev branch, commit tagged DC2.1rc5
- ZHAireS 1.0.30a, Aires 19.08.04
- 250 events per file, grandlib file structure
- 9000 events
- Official GP300 (old) layout
- 40 to 88 deg, continuous log(1/cos) distribution
- 0.03 to 10 EeV, uniform in Log E
- Core NOT Contained, Shooting area variable with zenith

<u>3 Flavors</u>
- sims with gps jitter, calibration jitter and galactic noise
- "NJ" → sims without jitters and without galactic noise
- "AN" → sims with jitters and <u>measured and baselined</u> noise (by PECC)

DC2.1 ADC traces

Our state of the art simulation of the experiment

- **Reduced to 2.048 us**

- **Trigger position around 550ns (ZHAireS) or 800ns (CoREAS) after trace start**

- **Downsampled to 500Mhz, with saturation**

- **NEW Antenna response and RF chain (20250313)**

In files with Jitter (so on "plain" and -AN)

- **5 ns Gaussian smeared "trigger" time**

- **"Amplitude Calibration" gaussian smeared 7.5%**

- **Galactic Noise or Experimental Noise (AN))**

DC2.1 Efield

 A placeholder for a truly reconstructed efield

- **Reduced to 2.048 us**

- **Trigger position around 550ns (ZHAireS) or 800ns (CoREAS) after trace start**

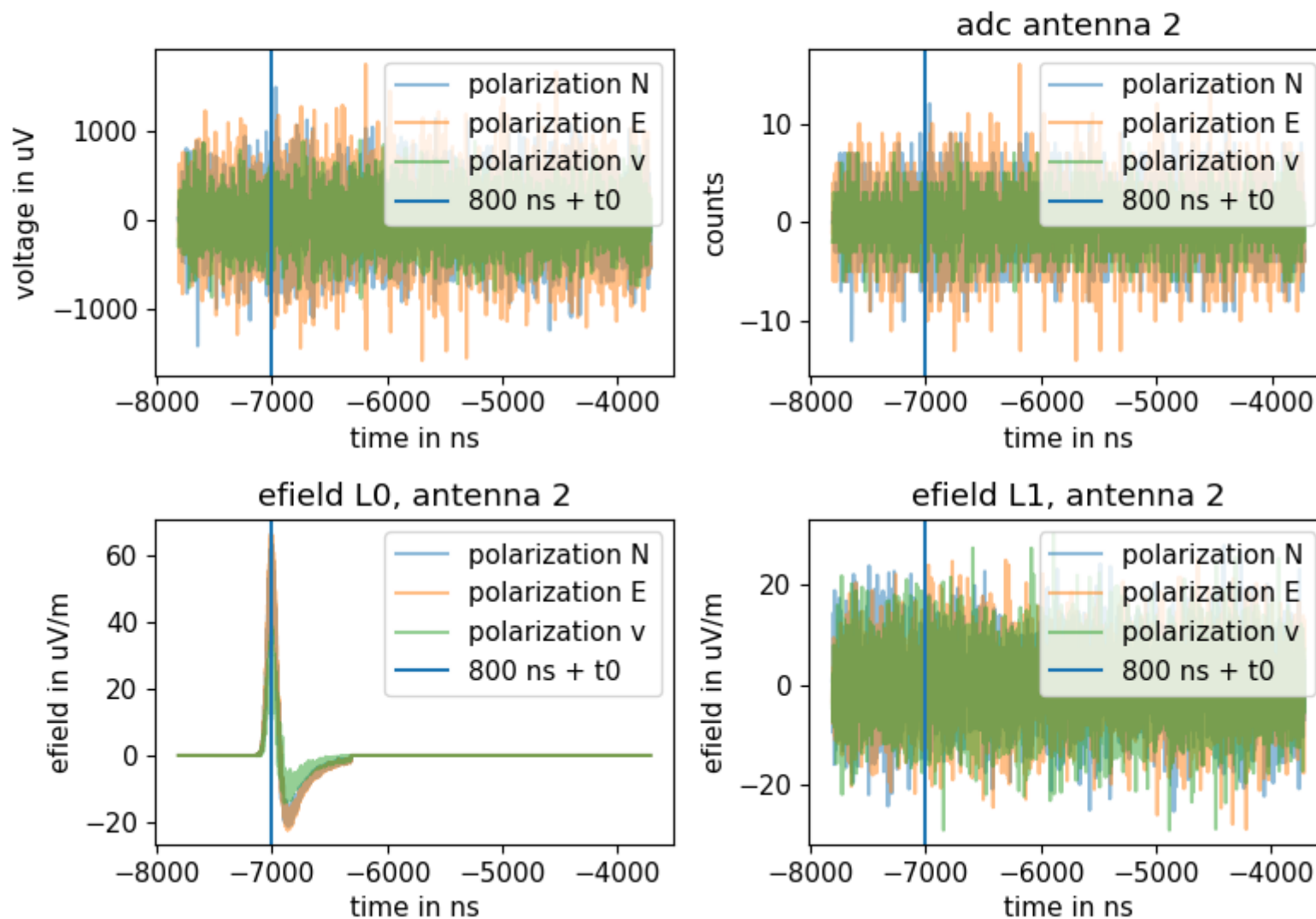- **Causally filtered between 50 and 200MHz**

- **Downsampled to 500Mhz**

In files with Jitter (so on "plain" and -AN)

- **Gaussian noise, 32uV/m in plain and 64uV/m in -AN**

- **5 ns Gaussian smeared "trigger" time**

- **"Amplitude Calibration" gaussian smeared 7.5%**

event 13790, run 1, antenna 2 - WITH t0 SHIFT

What is missing - Documentation

Not enough manpower for that (outdated).

AOI (Analysis Oriented Interface)

http://grand.fuw.edu.pl/analysis_oriented_api/

grand/examples/grandlib_classes/
browse_sim2root_events_example.py

DOI (Data Oriented Interface)

http://grand.fuw.edu.pl/data_oriented_api/

IllustrateSimPipe.py is your best friend.

https://forge.in2p3.fr/projects/dc2/documents (list of variables)

What is missing

- several variables are still empty, but less than before.

→ use root TBrowser to look if they are filled.

→ most are "reconstructed" values I.e xmax_pos

→some are missing because they don't come directly from the MonteCarlo and some routine is needed to get it (like xmax_pos)

PLEASE CONTRIBUTE YOUR ROUTINES TO GRANDLIB.

include in grandlib those routines you develop to compute variables that are needed (or at least discuss it with the software/analysis teams)

What is wrong?

→**Finding bugs is one of the objectives of DC2**

Please fill in issues on github for errors you found, or work-arounds you had to make.

CoREAS and ZHAires files should be identical!.

Have you tried both with your code?

What we would we like to have?

We lack an antenna trigger algorithm (T1)

This is not a problem to produce the sims,

but it is to evaluate analysis made with them.

We lack the simulation of the digital filters. This is important

We lack a global trigger algorithm (T2)

We lack a better antenna selection for more efficient sims

We lack an event selector for more efficient sims

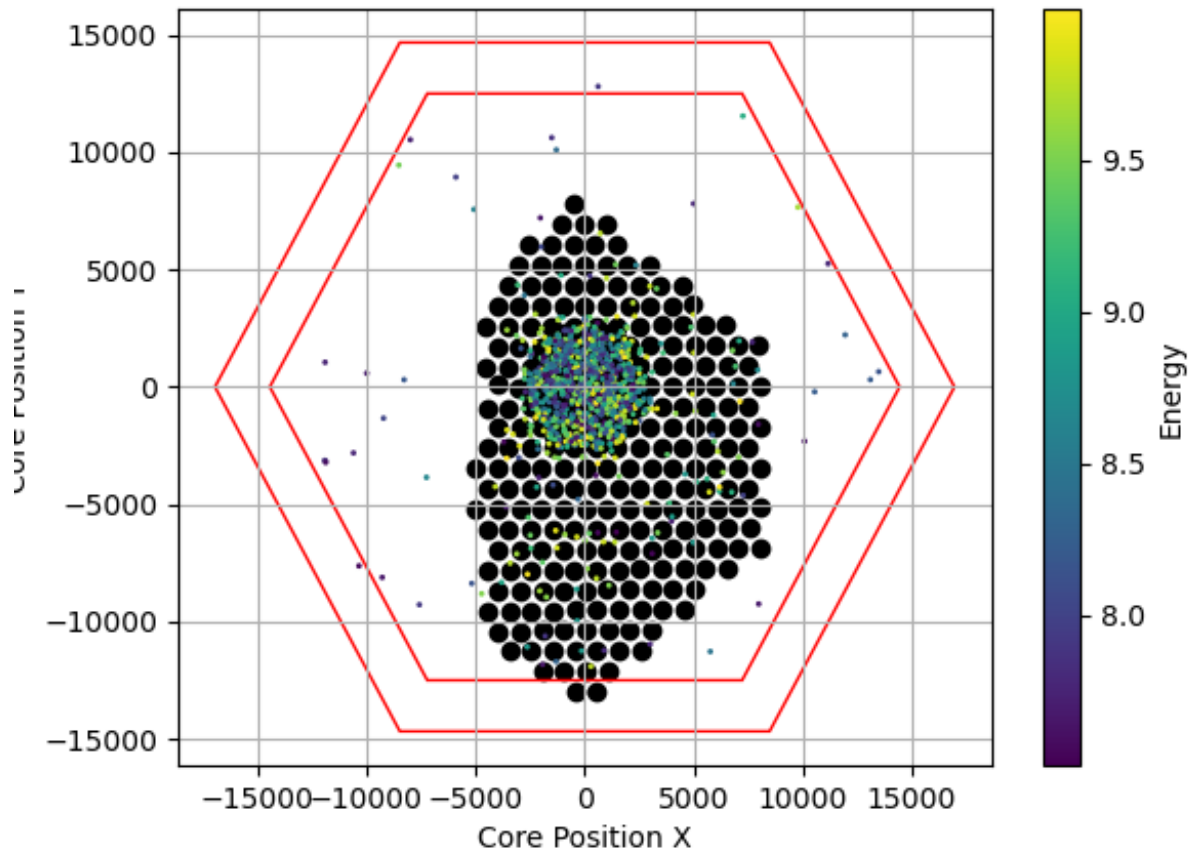# DC2 planning ahead

1) Run new Library with Real Antenna positions (on GP300)

2) We still have to converge on what is a triggered event
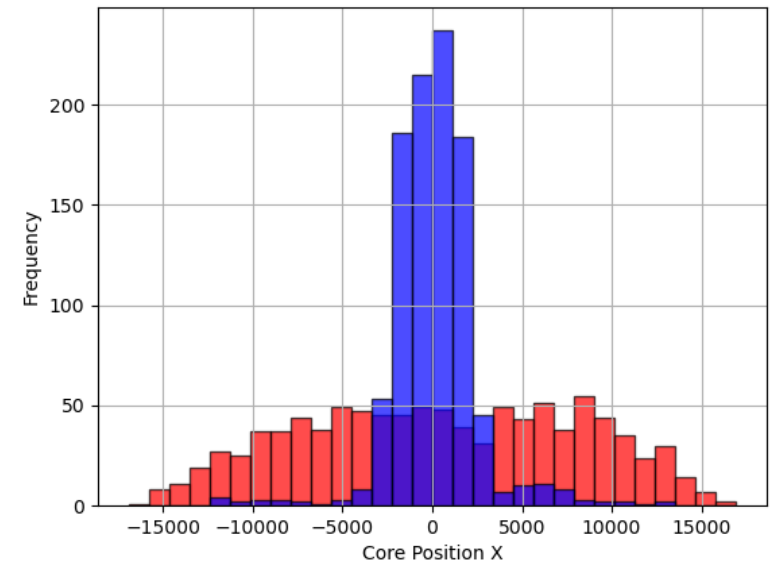
3) Then evaluate on blind data.

HOW TO SIMULATE THE EVENTS?

Vertical cascades

1k simulated events
165k tested positions

Inclined Events

Core Positions for Zenith Bin 73.66 to 76.13

Core Positions for Zenith Bin 73.66 to 76.13
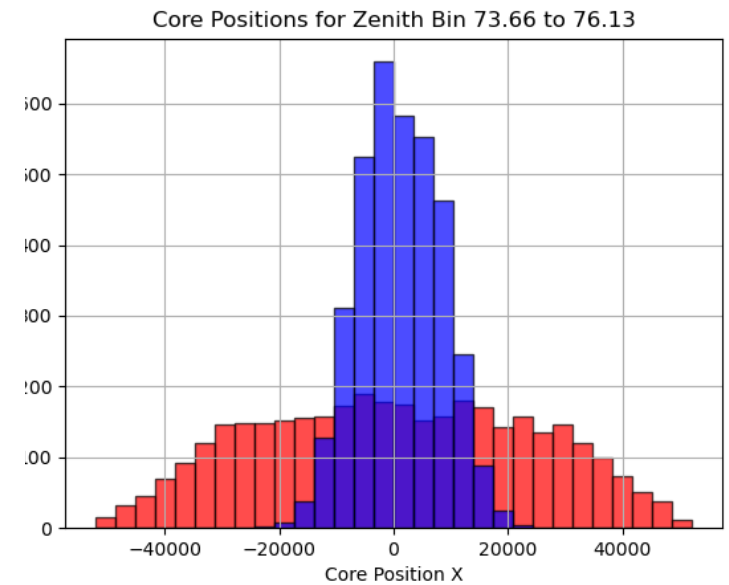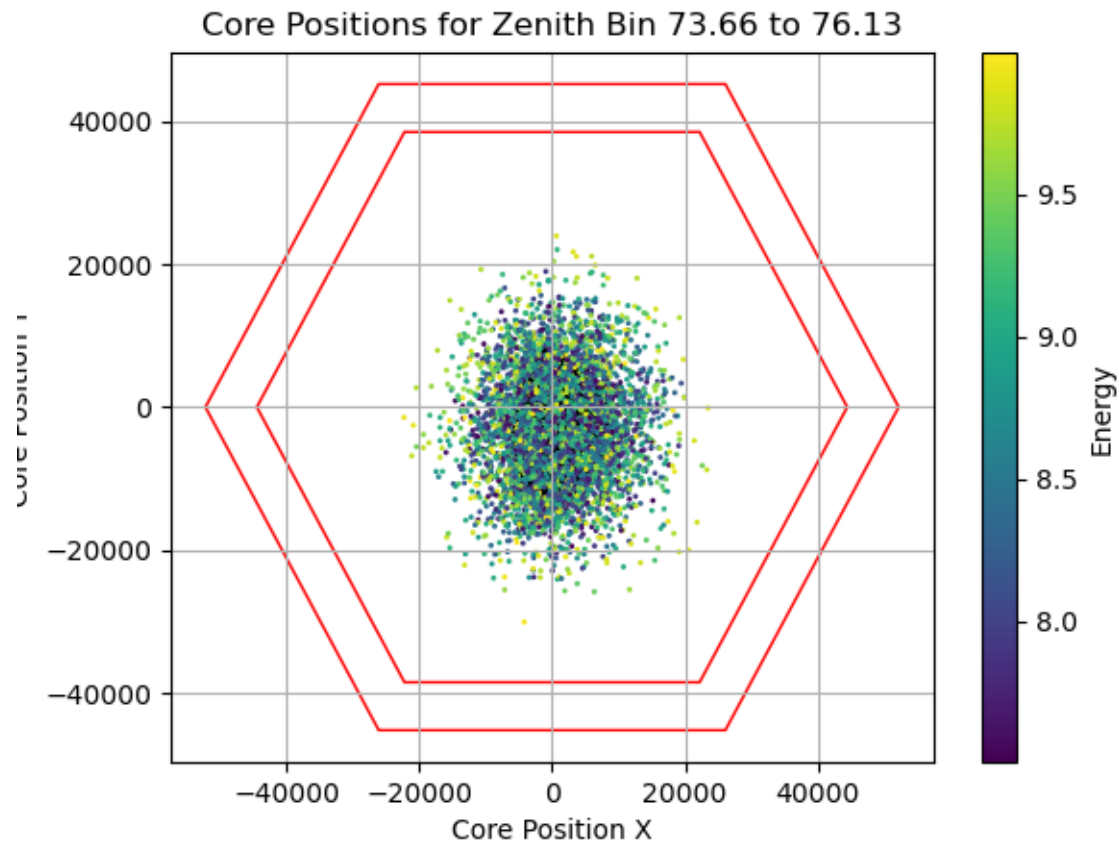
3.6k sim events

35k tested core positions

Extremely Inclined Events™

Core Positions for Zenith Bin 87.65 to 88.00

Core Positions for Zenith Bin 87.65 to 88.00
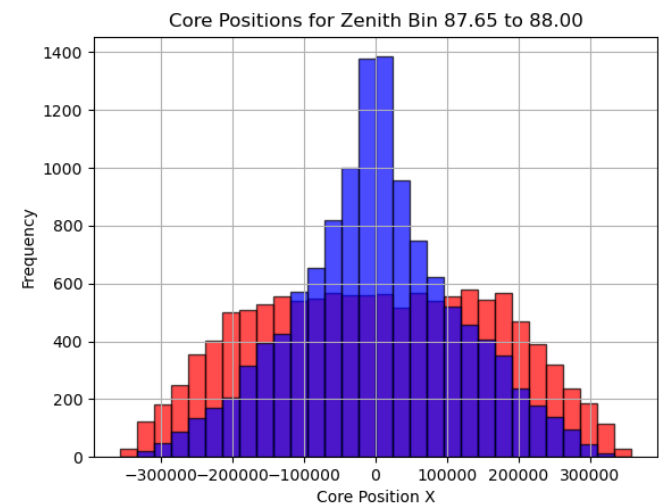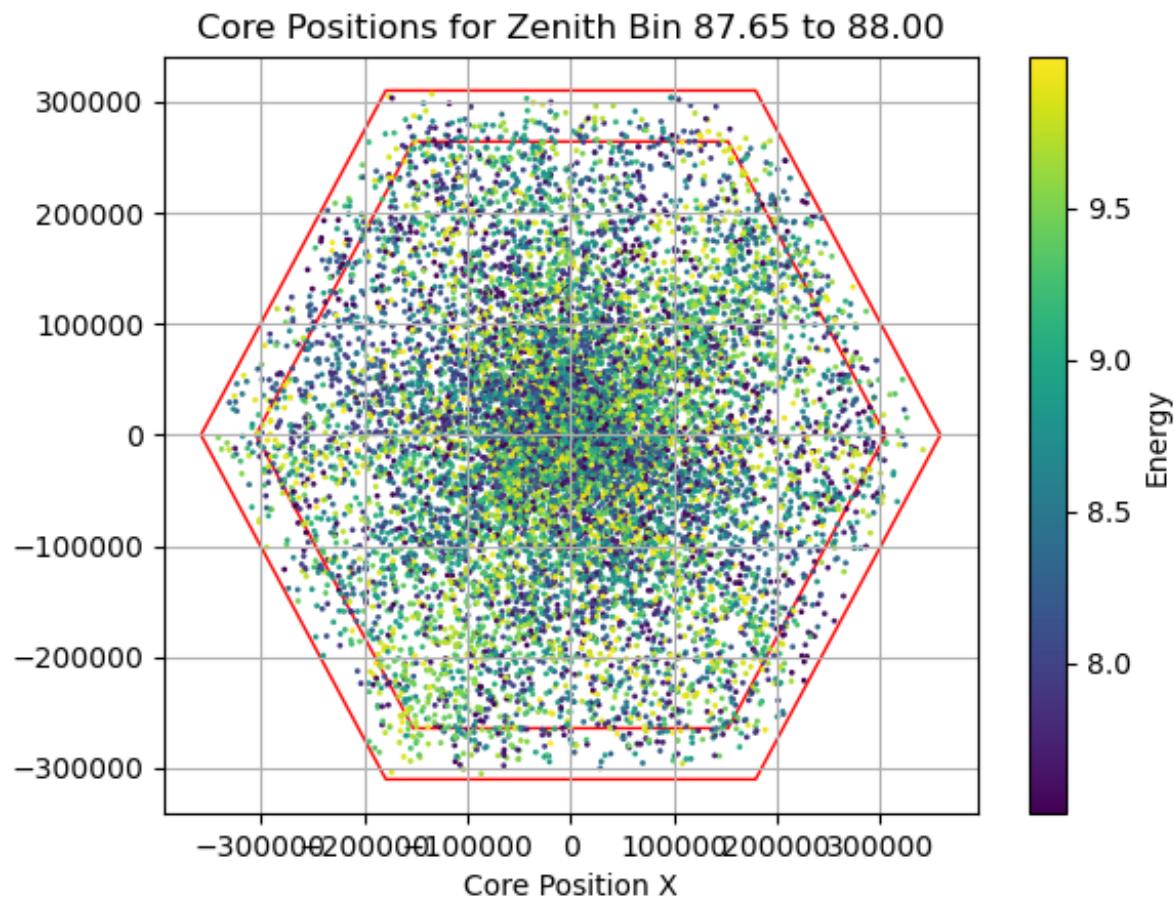
12k sim events
150k tested core positions