Extending ctapipe image reconstruction using FACT methods

Lukas Nickel and Maximilian Nöthe

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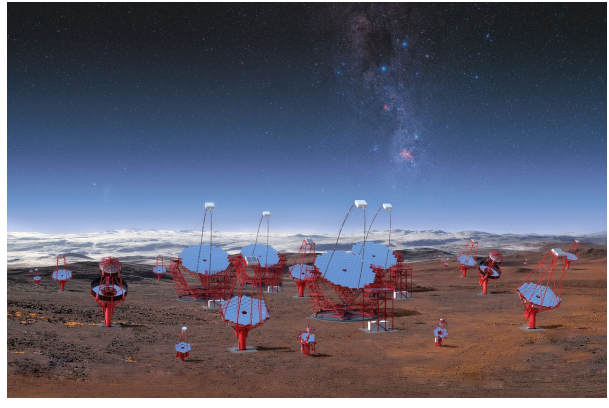
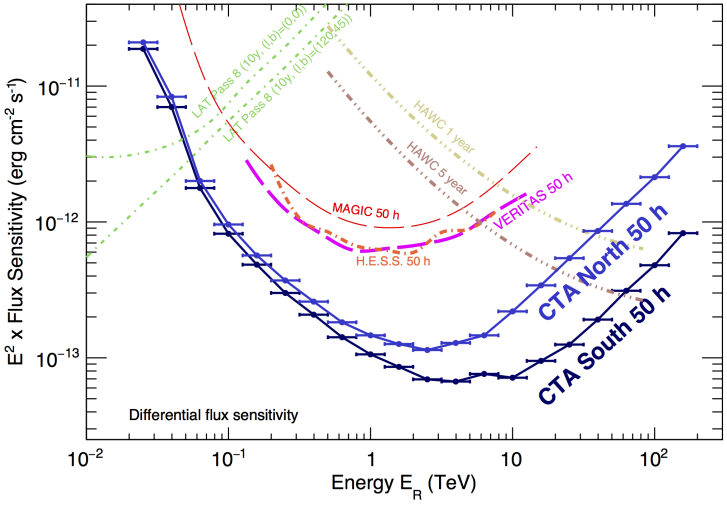
Overview

- ”Cherenkov Telescope Array”
- Proposed in 2005, currently in pre-production
- Two arrays of multiple telescopes (of different size) instead of single telescopes
- Goals: Extend observable energy range(20GeV-300TeV), huge field of view() (EM Spektrum mit Einordnung der verschiedenen Experimente?)
- Status: First light on LST and Schwarzschildt-Couder-Telescope



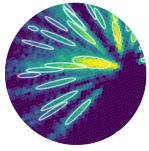
Visualization of the different telescope types. [3]

Expected sensitivity [2]



CTA: ctapipe

- Pipeline for low level cta data
- https://github.com/cta-observatory/ctapipe
- Mainly **python** based
- Calibration, Cleaning, Coordinate Transformations, Hillas-Parameter, 3D-Reconstruction, Visualization

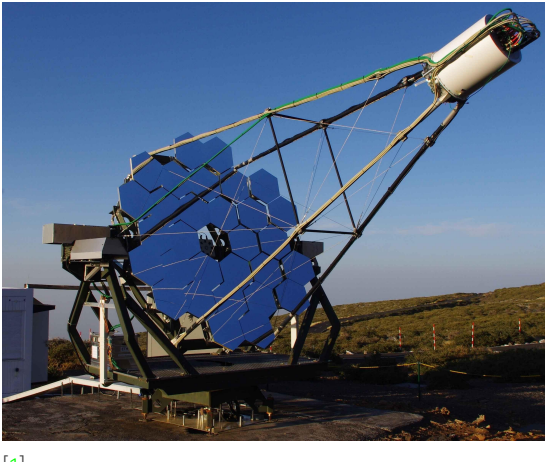


ctapipe

python™

The FACT experiment

- "First G-APD Cherenkov Telescope"
- Operating in La Palma since 2011
- Monoscopic reconstruction only
- What did we take a look at?
  - More advanced cleaning method
  - Distinction of "islands" in shower images
  - → Possible improvements for monoscopic reconstruction in ctapipe
  - → First use case: LST1



[1]

Image cleaning in FACT

Cleaning methods

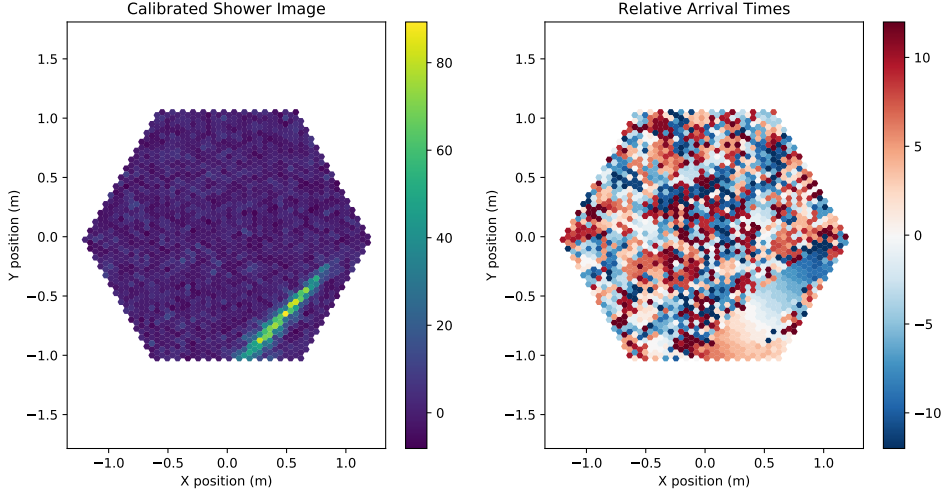
Tailcuts cleaning

1. ”Two treshold procedure”
2. Pixels above t1 will be kept
3. Neighboring pixels above t2 will be kept
4. ”Lonely” pixels get removed

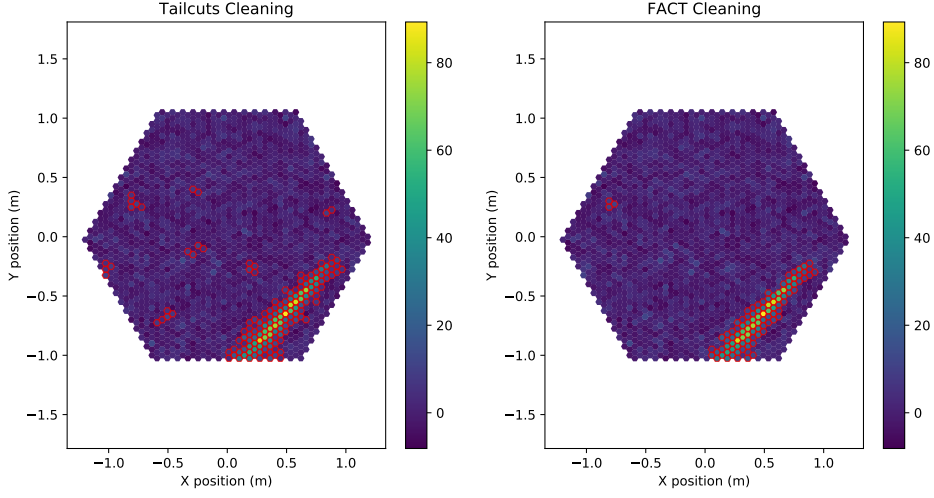
FACT image cleaning

1. Similar behaviour, but also uses information about the arrival times
2. Pixels with a very different arrival time than their neighbours get removed
3. Removes ”lonely” pixels multiple times
4. Probably removes more pixels with the same thresholds

Sample MC event on a Flash Cam

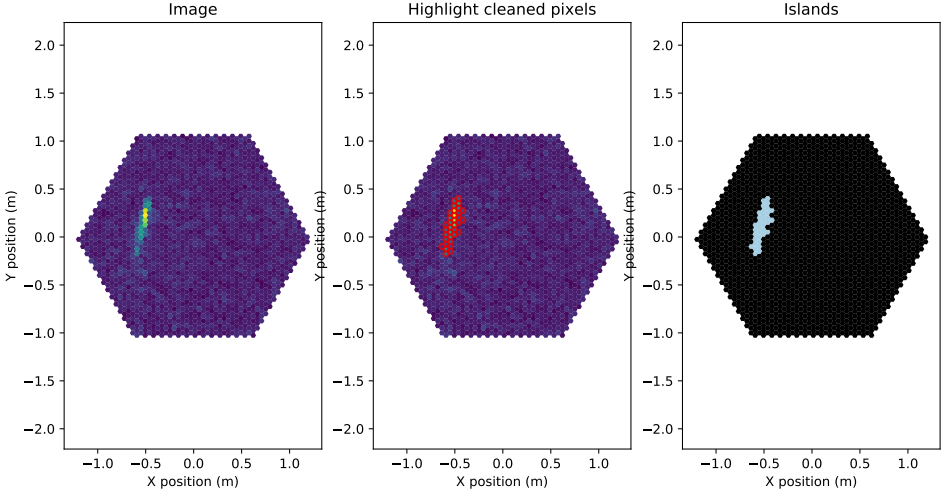


Comparing the cleaning results

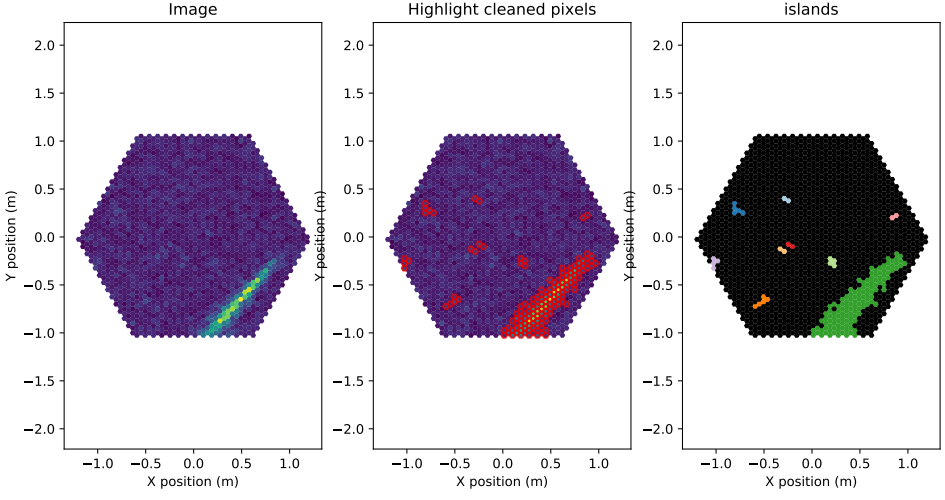


Finding islands

A well cleaned gamma event



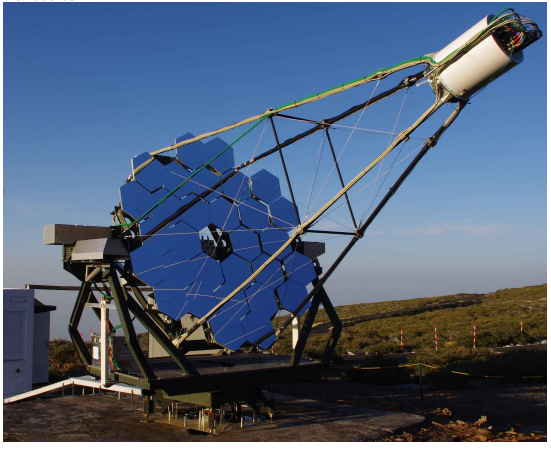
Our poorly cleaned sample event



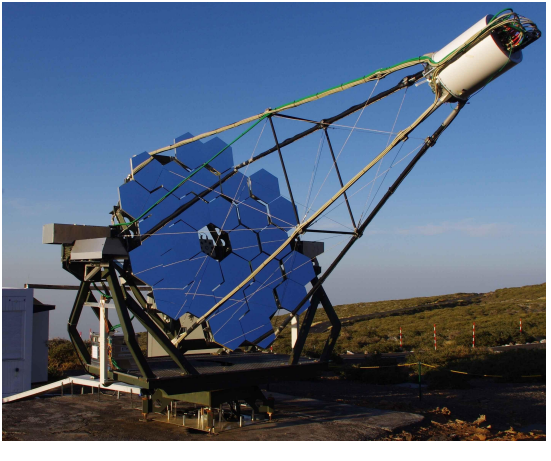
Machine learning impacts

g/h separation

Tailcuts

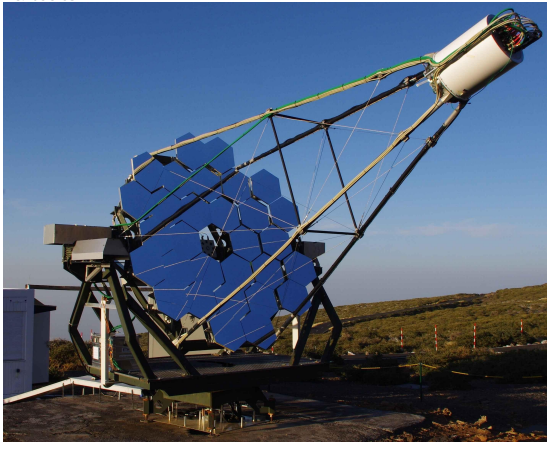


FACT



energy regression

Tailcuts



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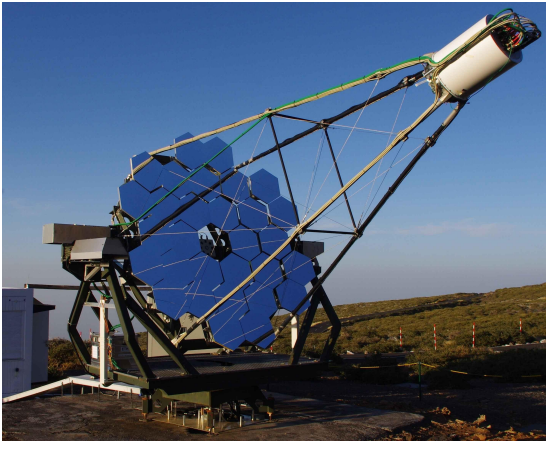
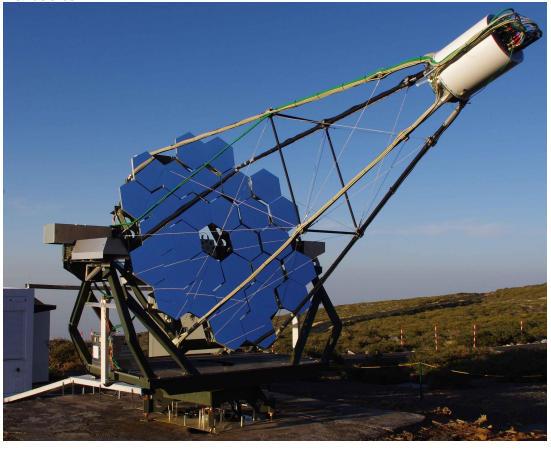
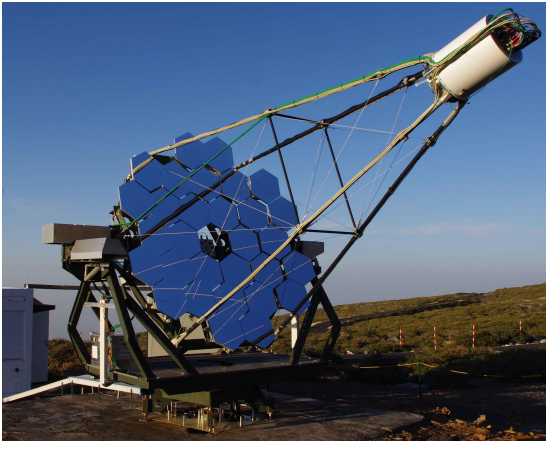


islands

Tailcuts



FACT




H Anderhub u. a. „Design and operation of FACT – the first G-APD Cherenkov telescope“. In: Journal of Instrumentation 8.06 (Juni 2013), P06008–P06008. DOI: 10.1088/1748-0221/8/06/p06008. URL: https://doi.org/10.1088%2F1748-0221%2F8%2F06%2Fp06008.


The CTA Consortium. Die Quellen hiervon noch angeben? URL: https://www.cta-observatory.org/science/cta-performance.


CTA/M-A. Besel/IAC (G.P. Diaz)/ESO. 2018. URL: https://www.eso.org/public/germany/images/eso1841a/.