

Gamma-Ray Astronomy

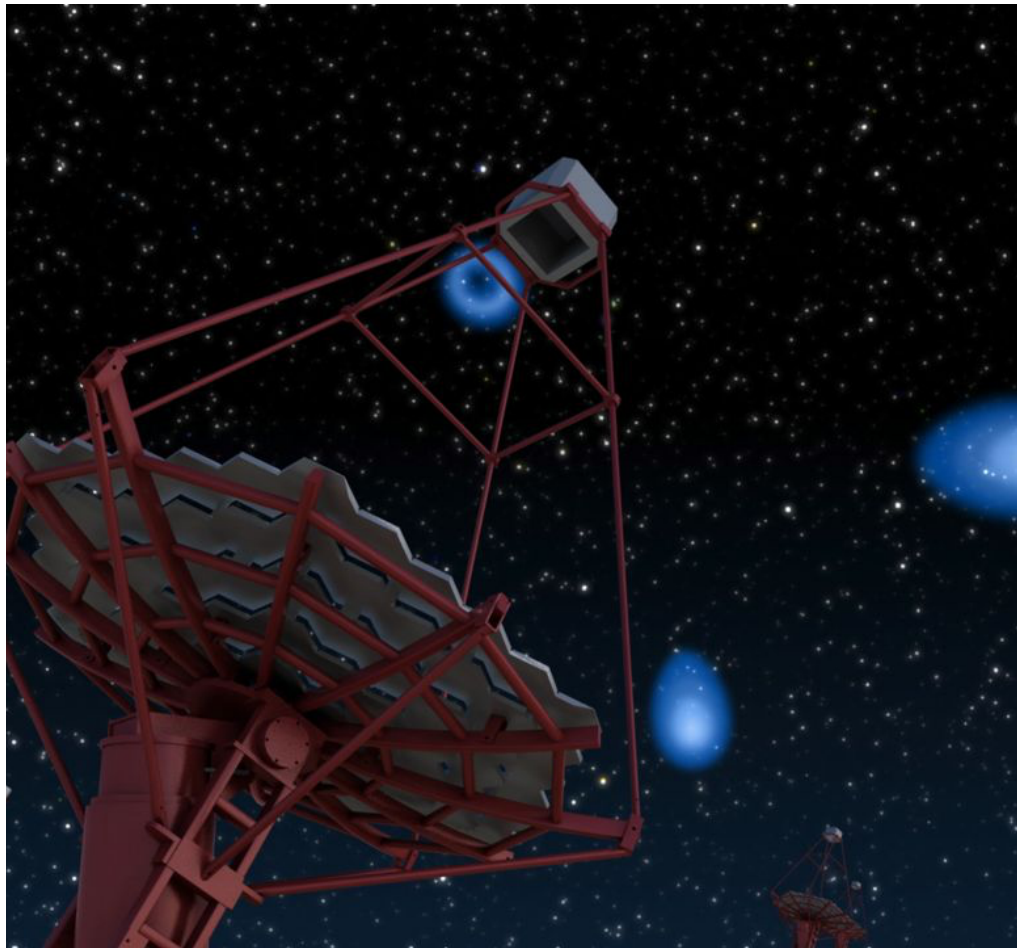
at DESY in Zeuthen



Stefan Klepser

PRC meeting
Hamburg, April 2016

Staff Members of Gamma-ray Astronomy in Zeuthen



> CTA

- Bühler, Garczarczyk, Knapp, Maier, Schlenstedt, Stegmann

> Fermi

- Bühler, Ackermann, Franckowiak

> H.E.S.S.

- Klepser, Stegmann

> MAGIC

- Bernardini, Garczarczyk

> VERITAS

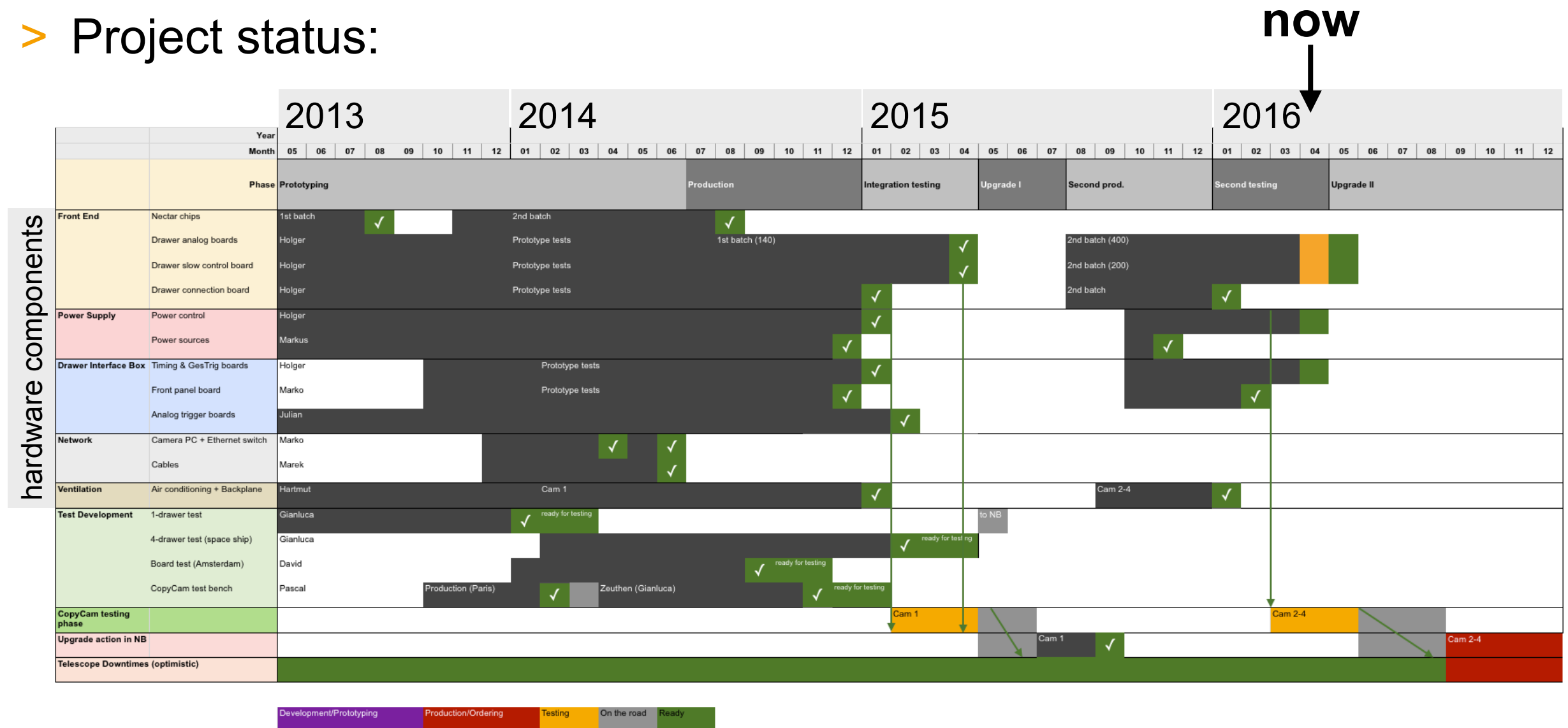
- Maier, Pohl, Schlenstedt

> THAT (Theory)

- Pohl, Winter, Yan

Building Stuff, part I: H.E.S.S. Camera Upgrade

> Project status:



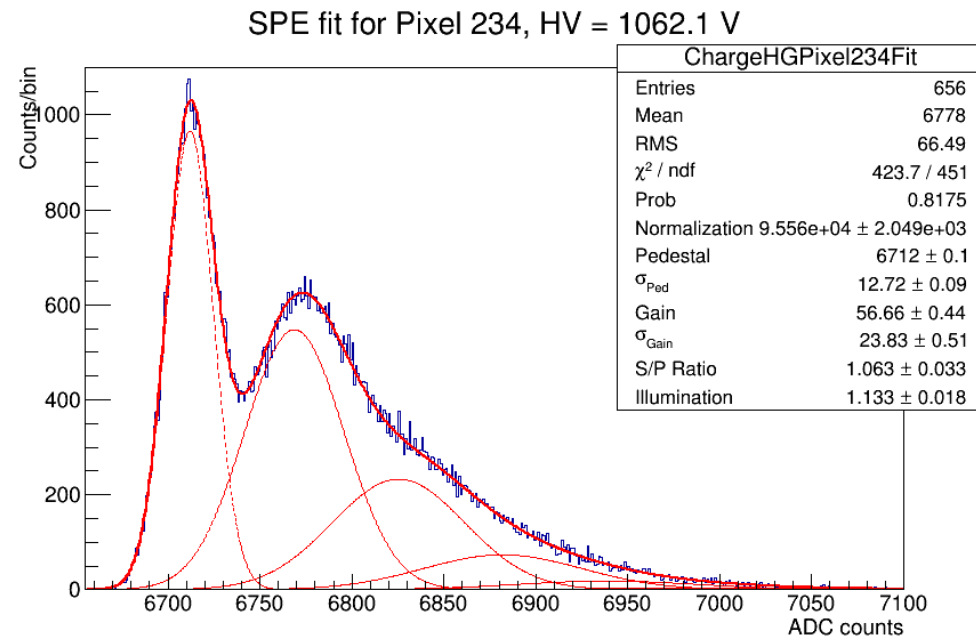
- > First camera deployed last summer
- > Production of cameras 2-4 almost finished
- > Deployment in September, to be confirmed by H.E.S.S. coll.

Commissioning and Calibrating the First Camera

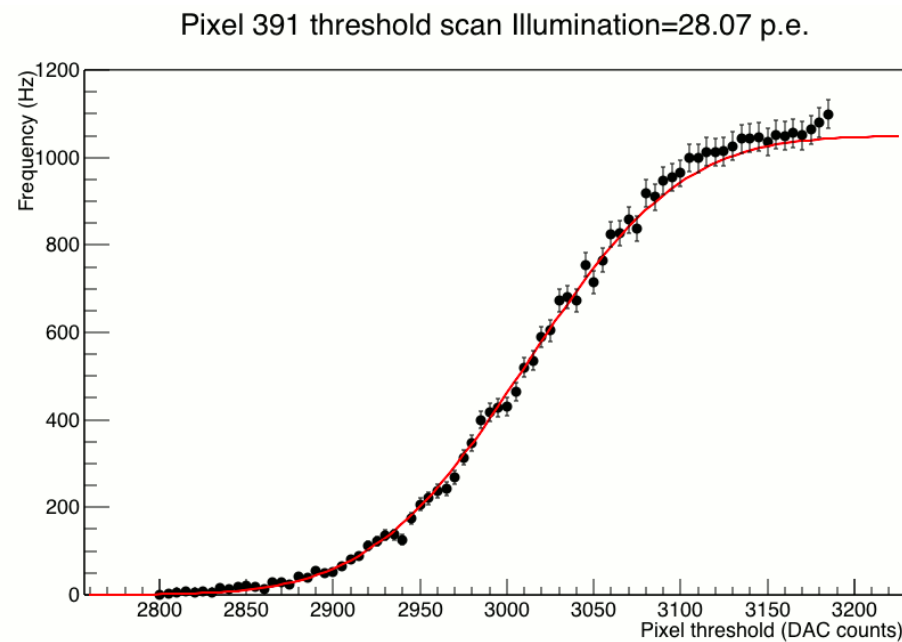
G. Giavitto, H.E.S.S. group

> Long list of tasks...

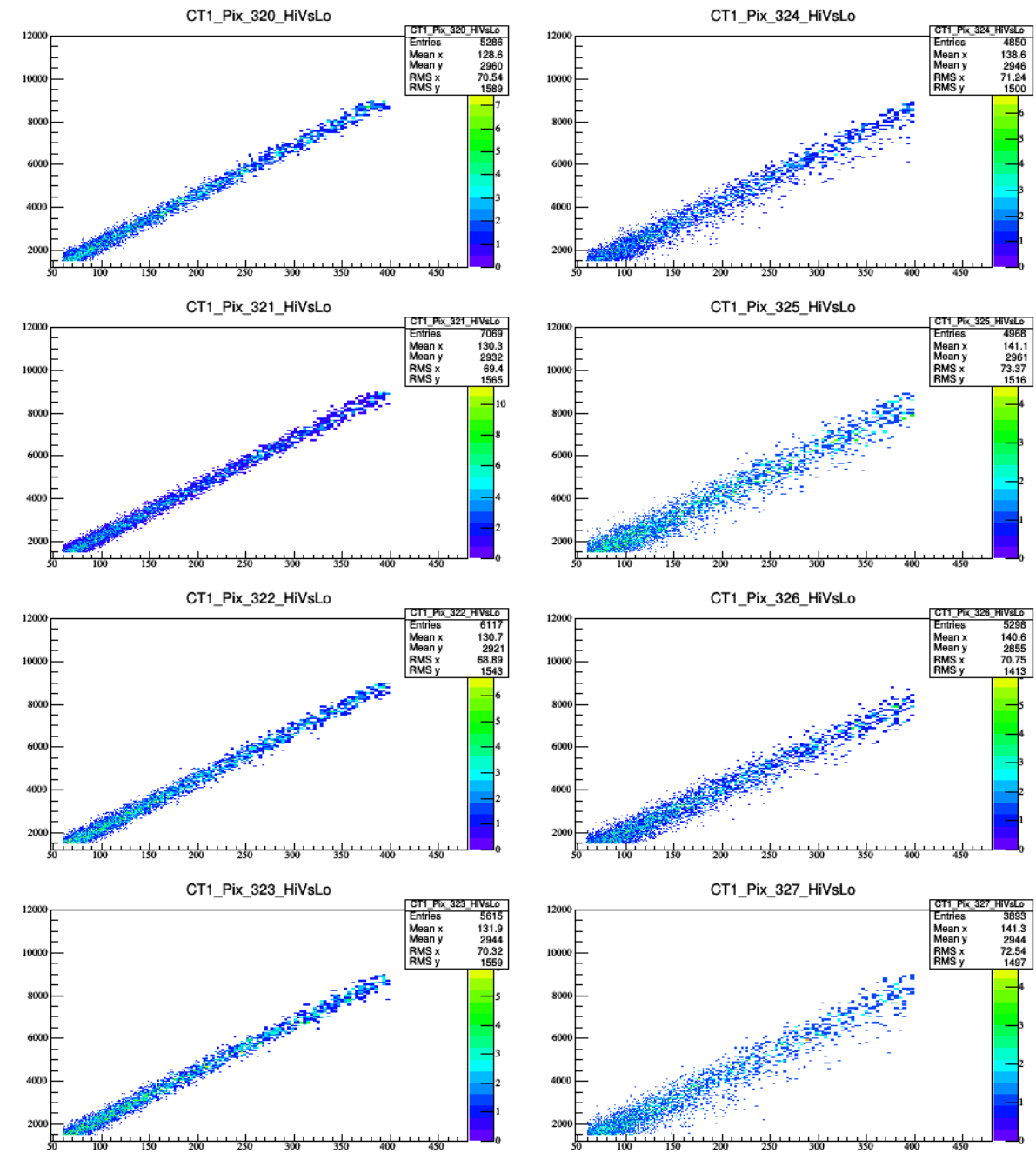
Single photo-electron calibration



Trigger threshold calibration

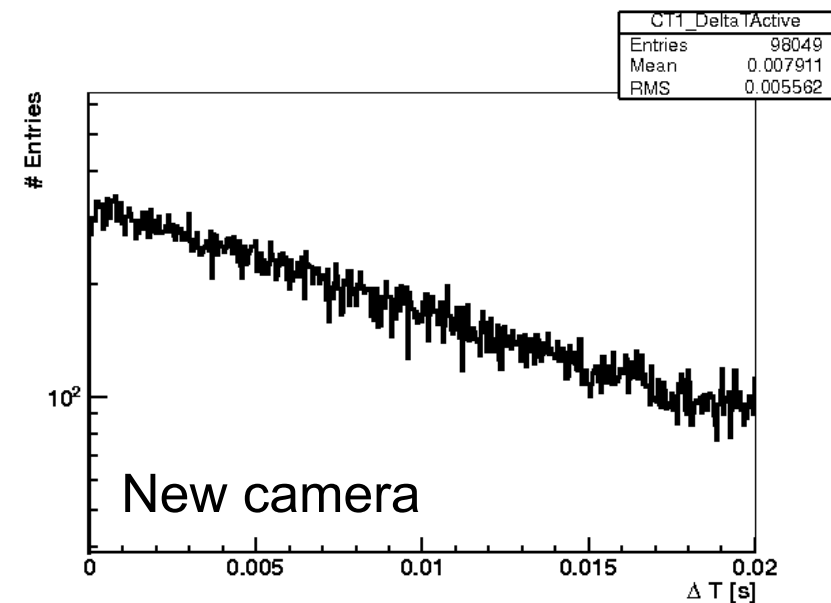
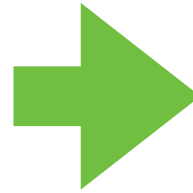
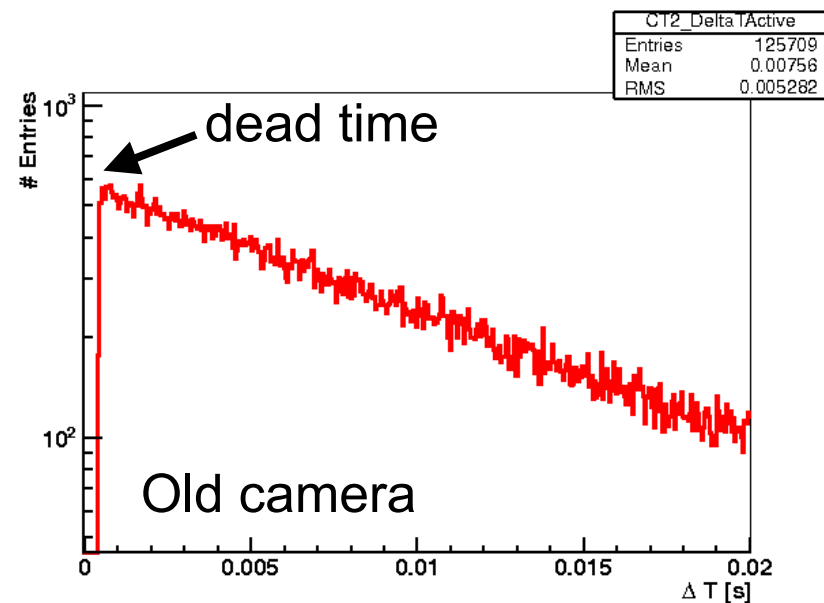


High-gain vs. Low-gain channel comparisons

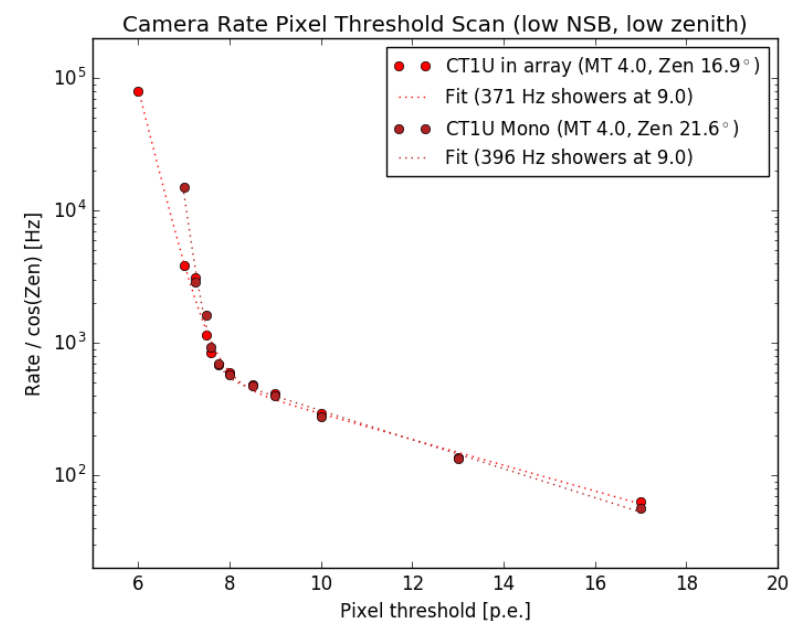


Trigger Scans and Dead Time

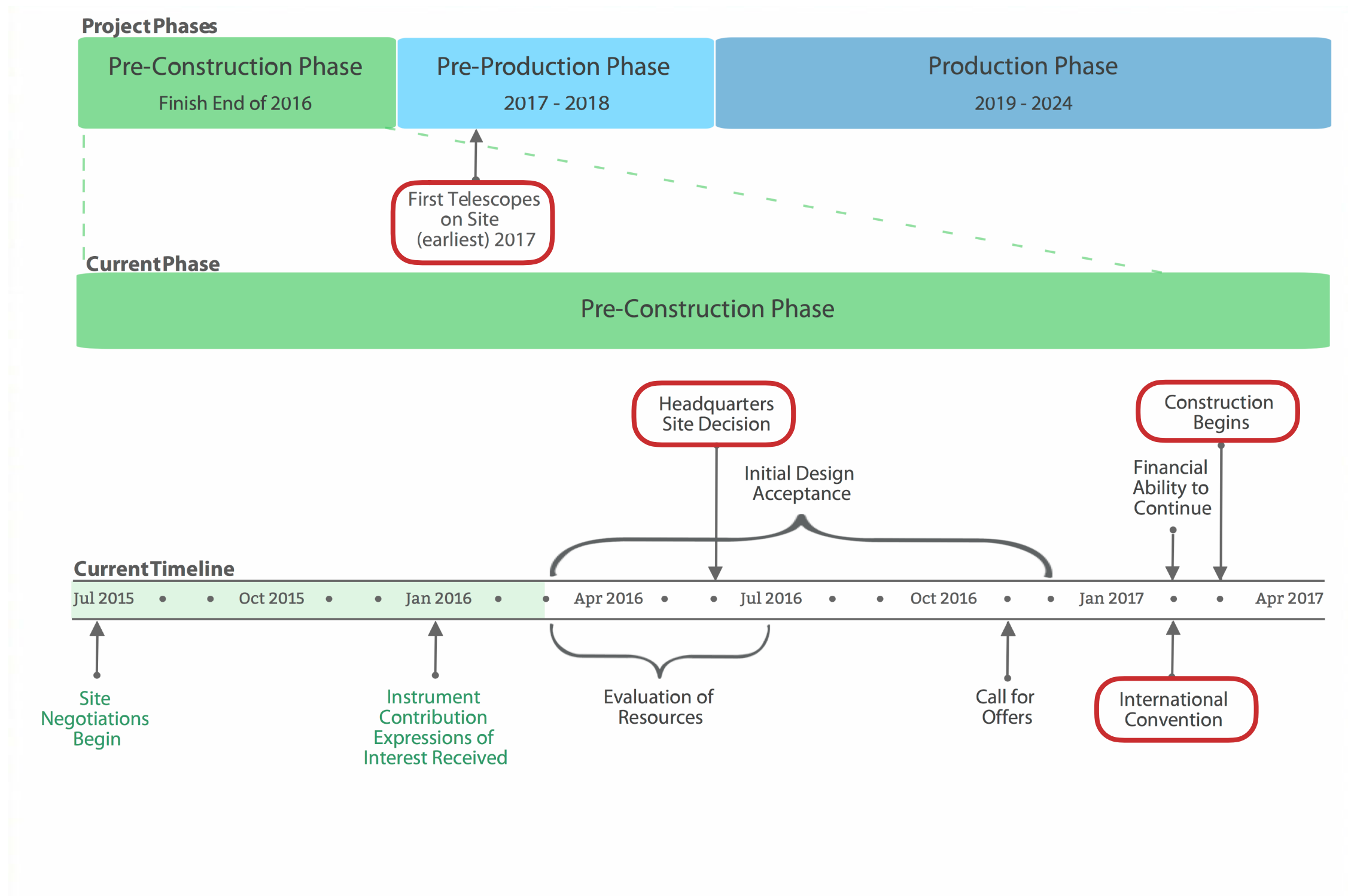
- > Deadtime reduced from 450 μs to $< 6 \mu\text{s}$



- > Trigger system works well →
- > No show stopper, things work
 - Some delay in commissioning, though
 - Took measures to improve workforce situation

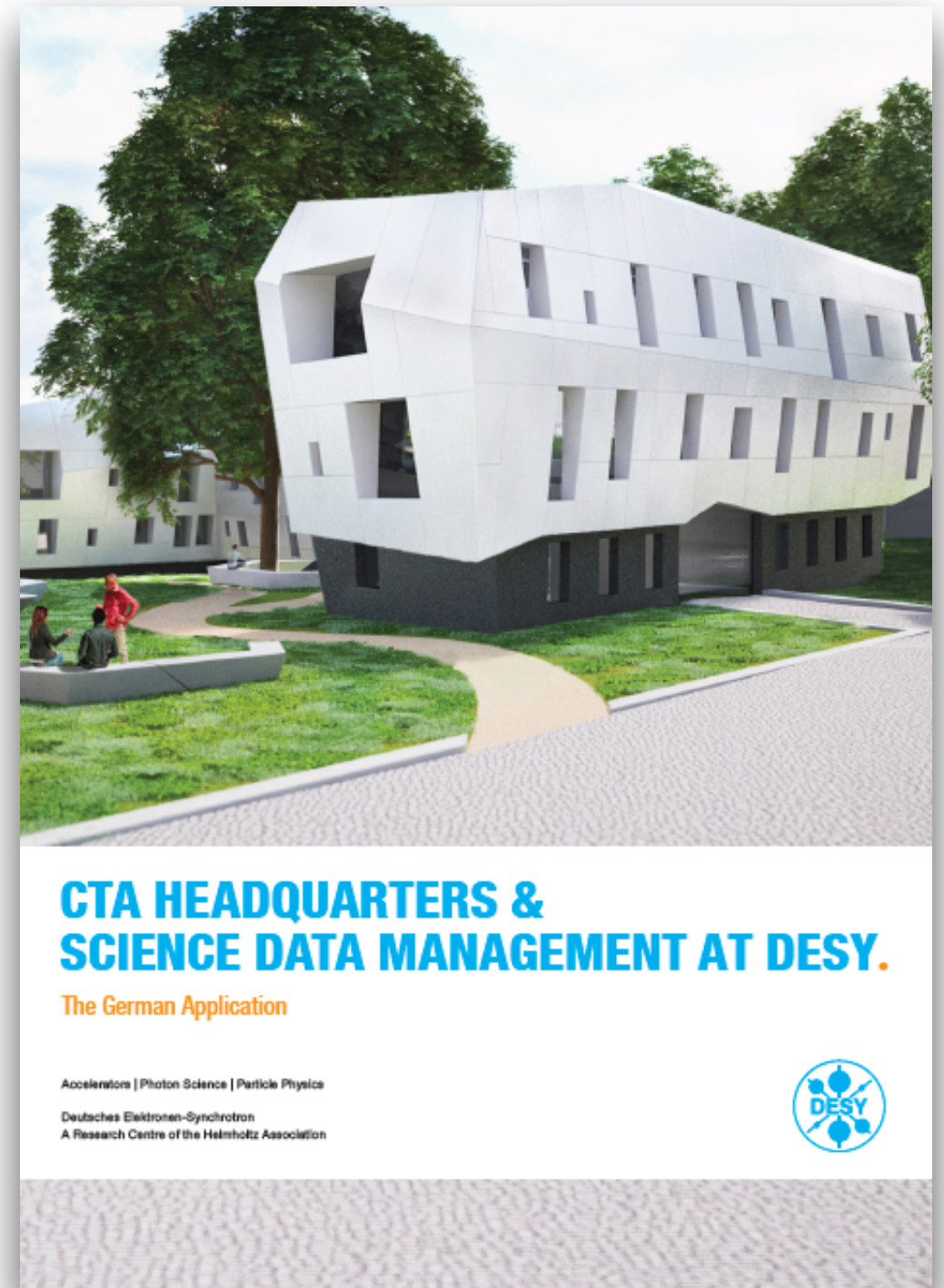


Building Stuff, part II: CTA

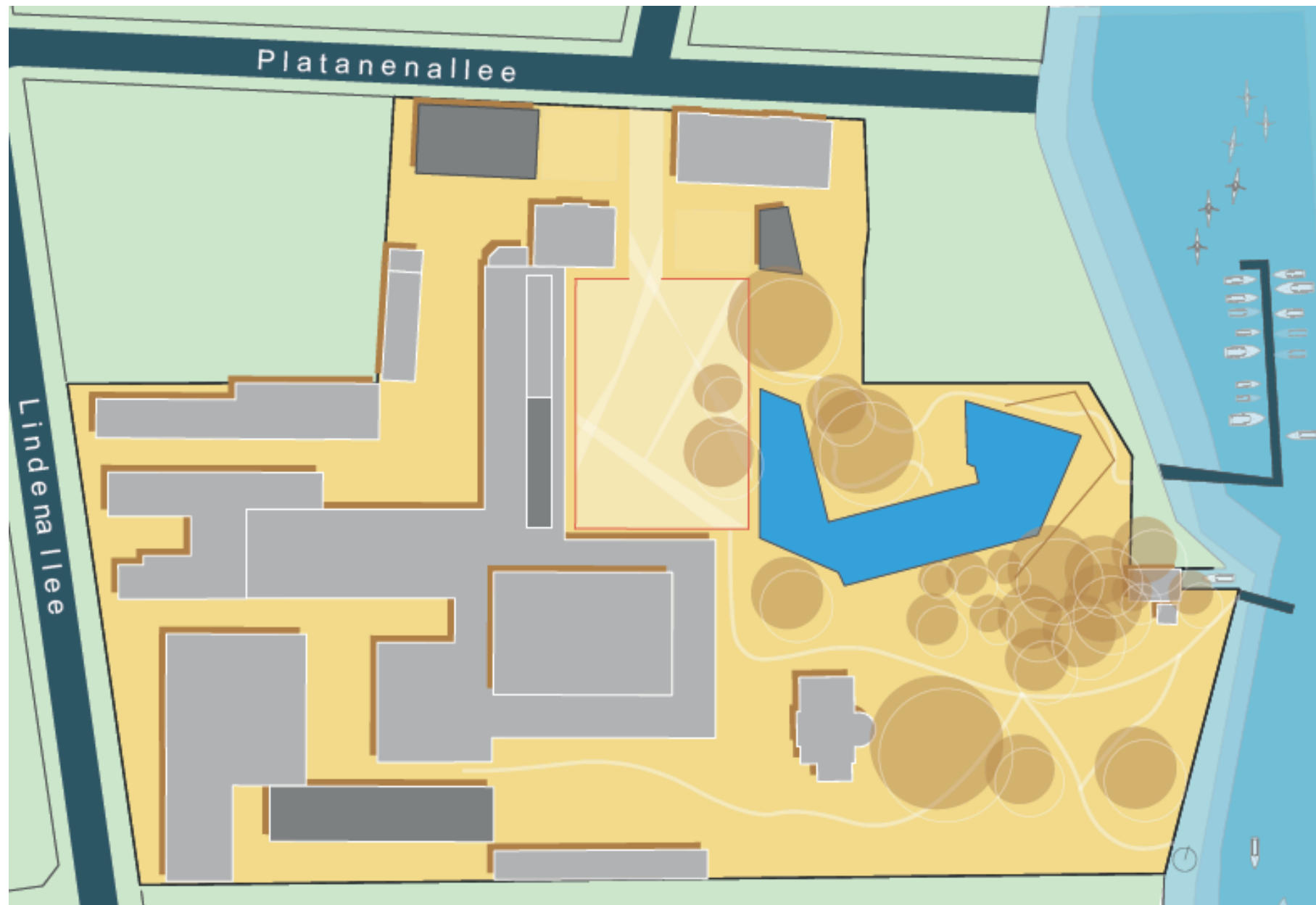


DESY Headquarters Application

- > Headquarters
- > Science Data Management Centre



DESY Headquarters Application



DESY Headquarters Application

> Official endorsements by

- Federal Ministry of Education and Research
- Brandenburg Ministry of Science, Research and Culture
- Helmholtz Association
- Max Planck Society
- University Potsdam
- Humboldt University Berlin

> Expert working group

- First meeting: April 8

> CTAO council

- Decision: mid June



CTA at DESY

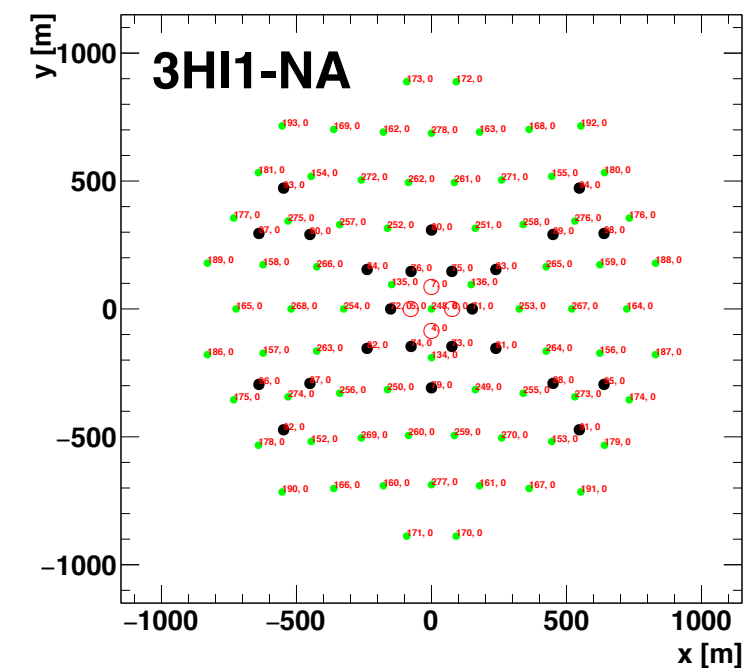
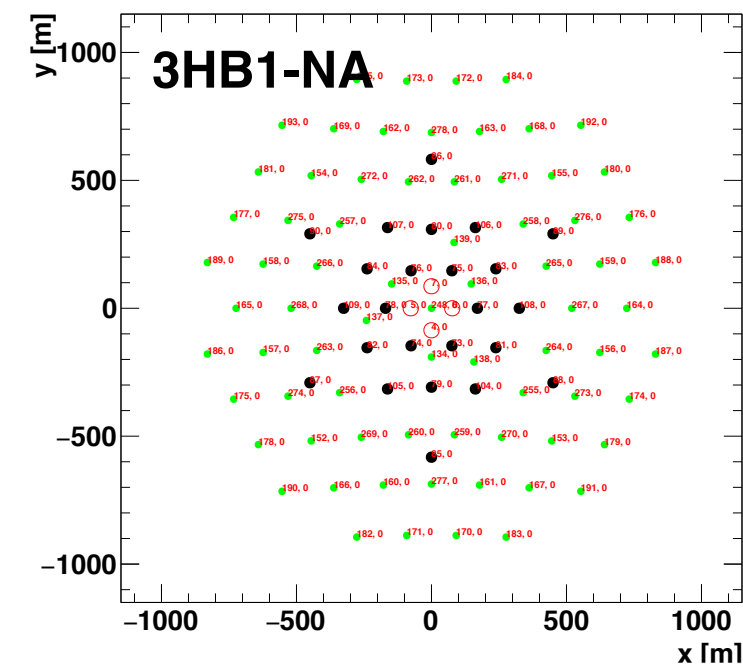
- > Medium-Sized Telescopes
 - From prototype to first telescopes on site
- > Array Control System
 - Software architecture
 - From prototype software to telescope operation
- > Data Pipelines
 - Monte Carlo and reconstruction pipeline
- > CTA array layout



CTA Array Layout

G. Maier, CTA/VERITAS group

- > Huge impact on sensitivity
 - 100 telescopes (Southern Site) and 25 telescopes (Northern Site)
 - Competing physics cases
- > Large computing effort
 - >200 array layouts
 - Task lead by MPIK HD and LUPM (Montpellier)
 - Using GRID and Zeuthen farm resources
 - ~1 PB of simulation files produced
- > Two independent analyses from IFAE (Barcelona) and DESY groups
 - Will provide final array layout until May to CTA consortium and infrastructure teams

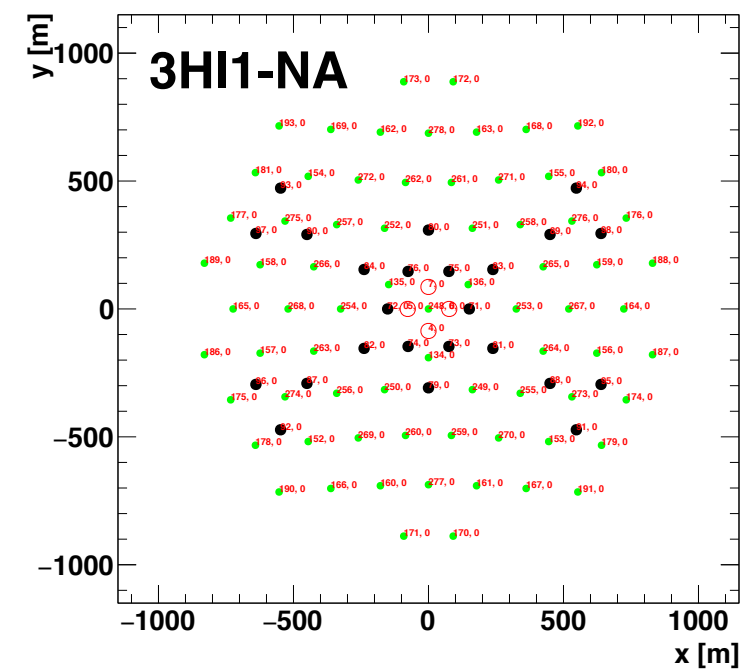
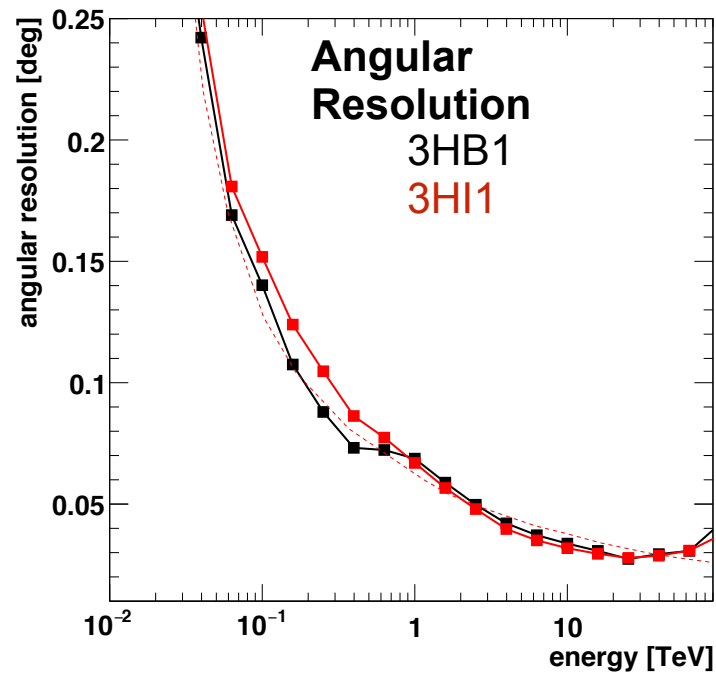
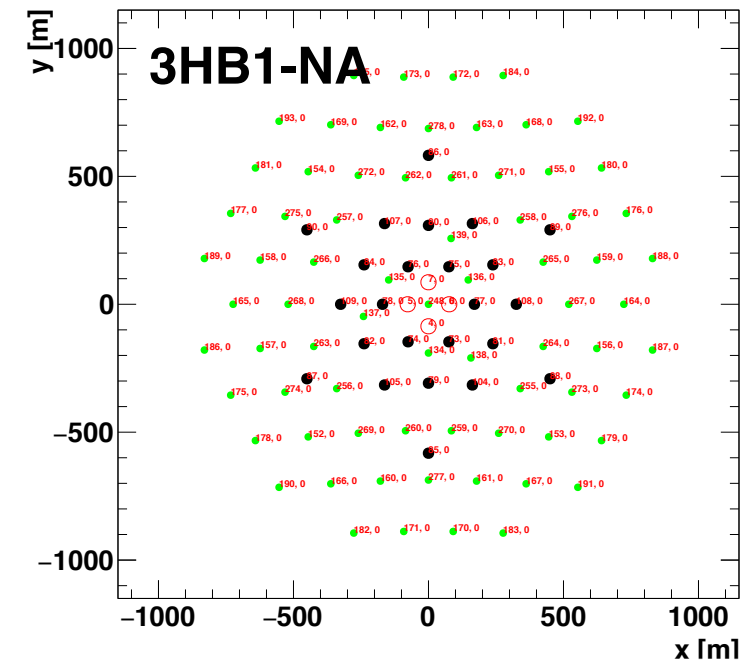
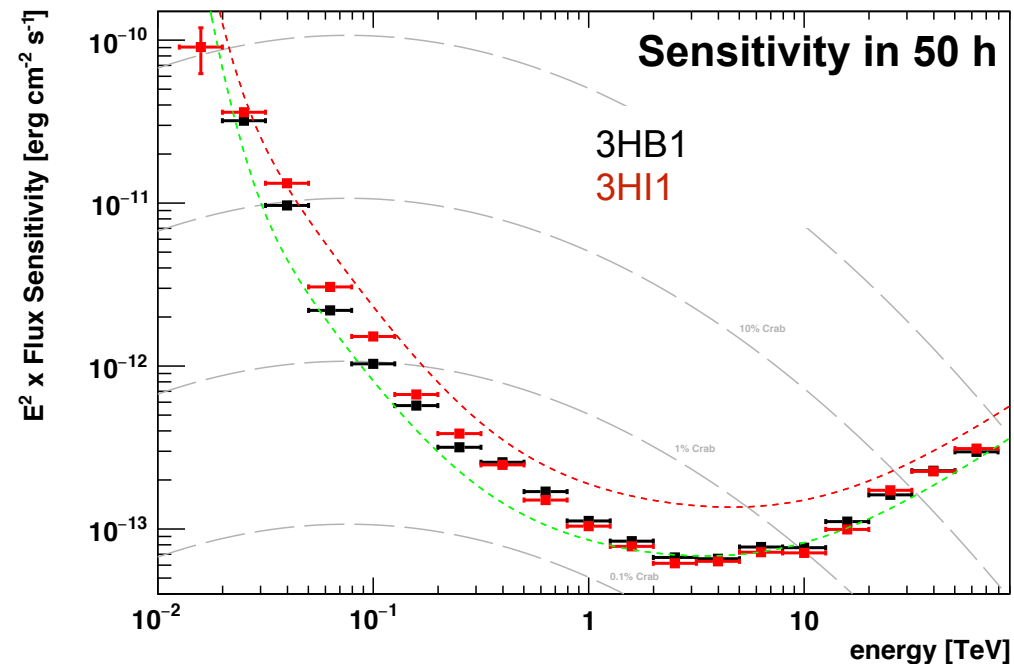


Large-sized telescopes
Mid-sized telescopes
Small-sized telescopes



CTA Array Layout

G. Maier, CTA/VERITAS group



Large-sized telescopes
Mid-sized telescopes
Small-sized telescopes

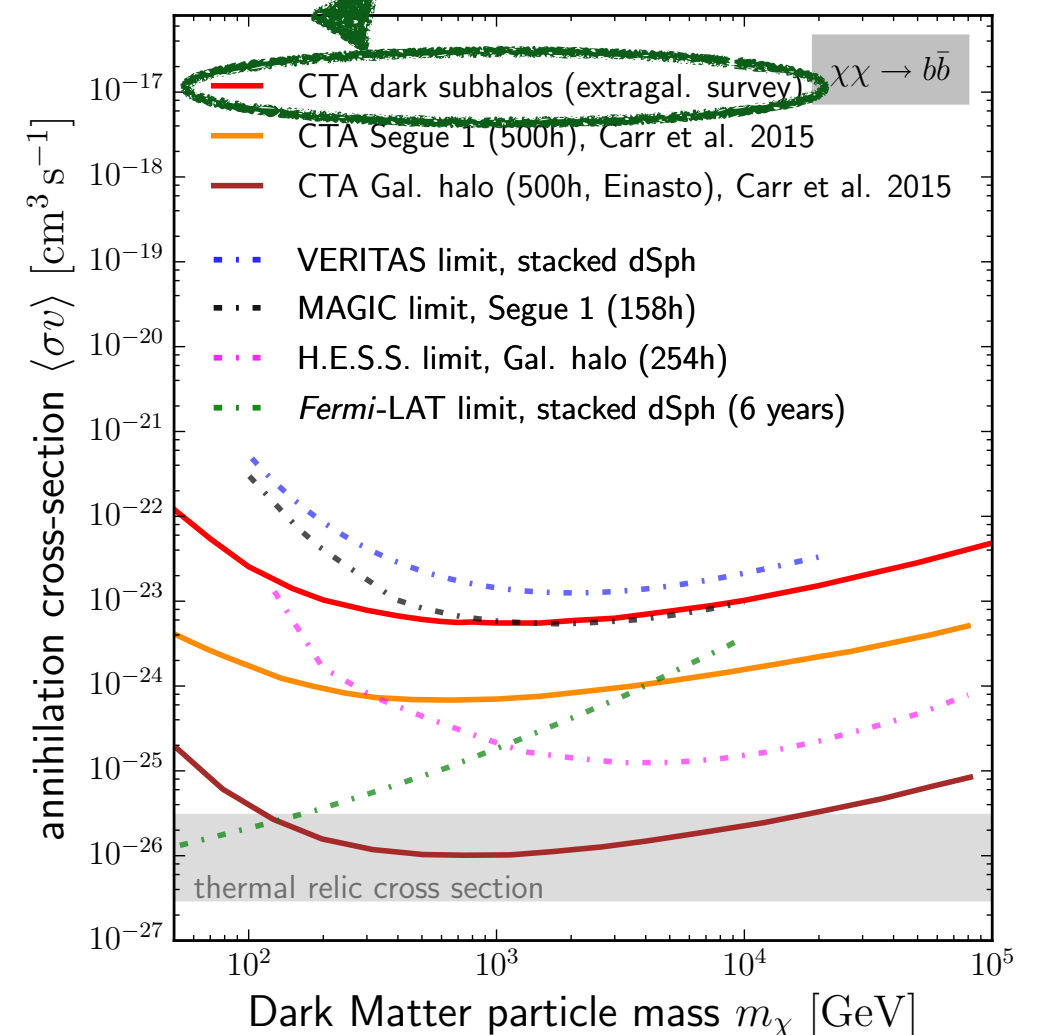
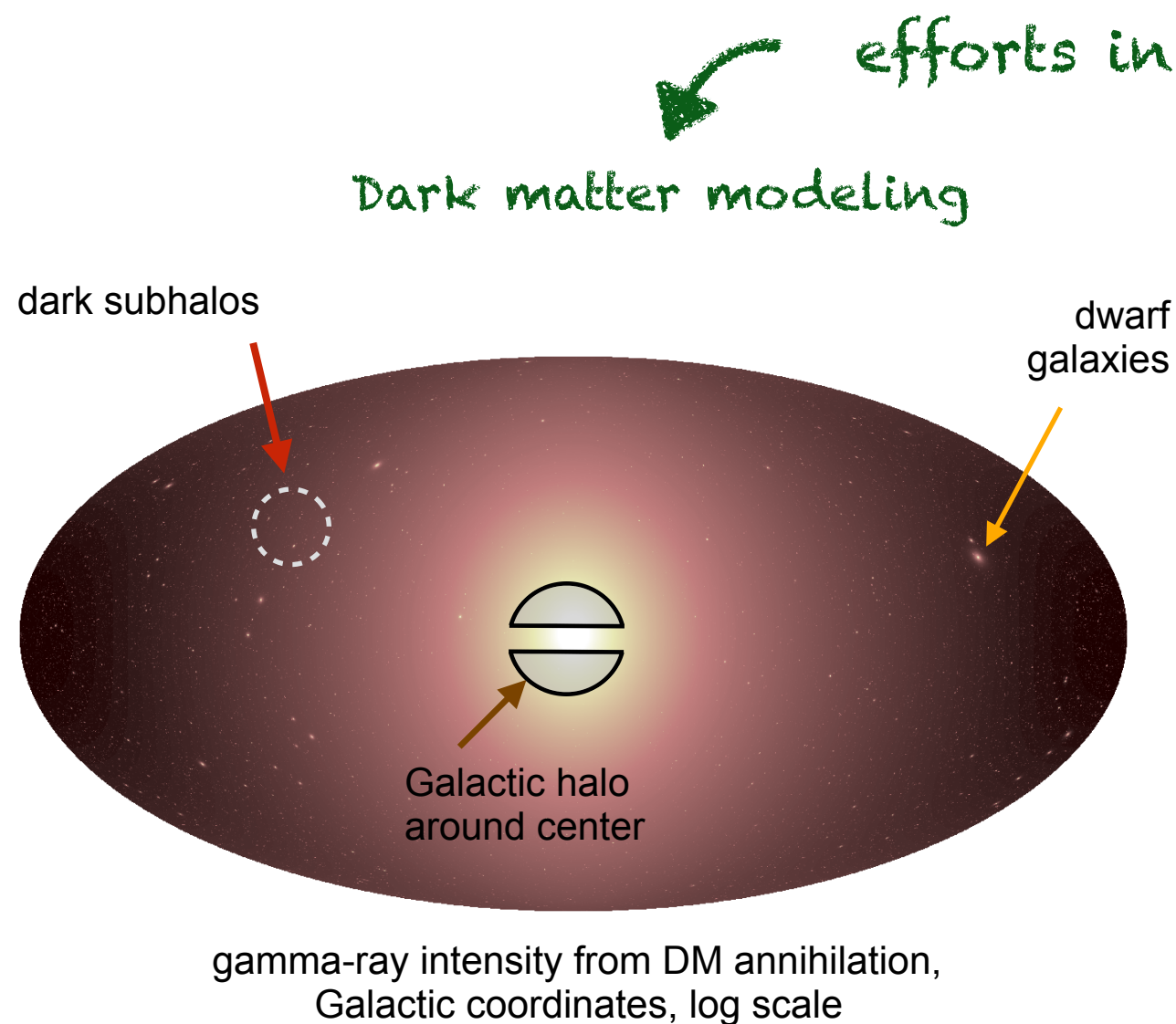


Physics for CTA: Dark Matter Strategies

M. Hütten, CTA/VERITAS group

> Evaluating competing concepts

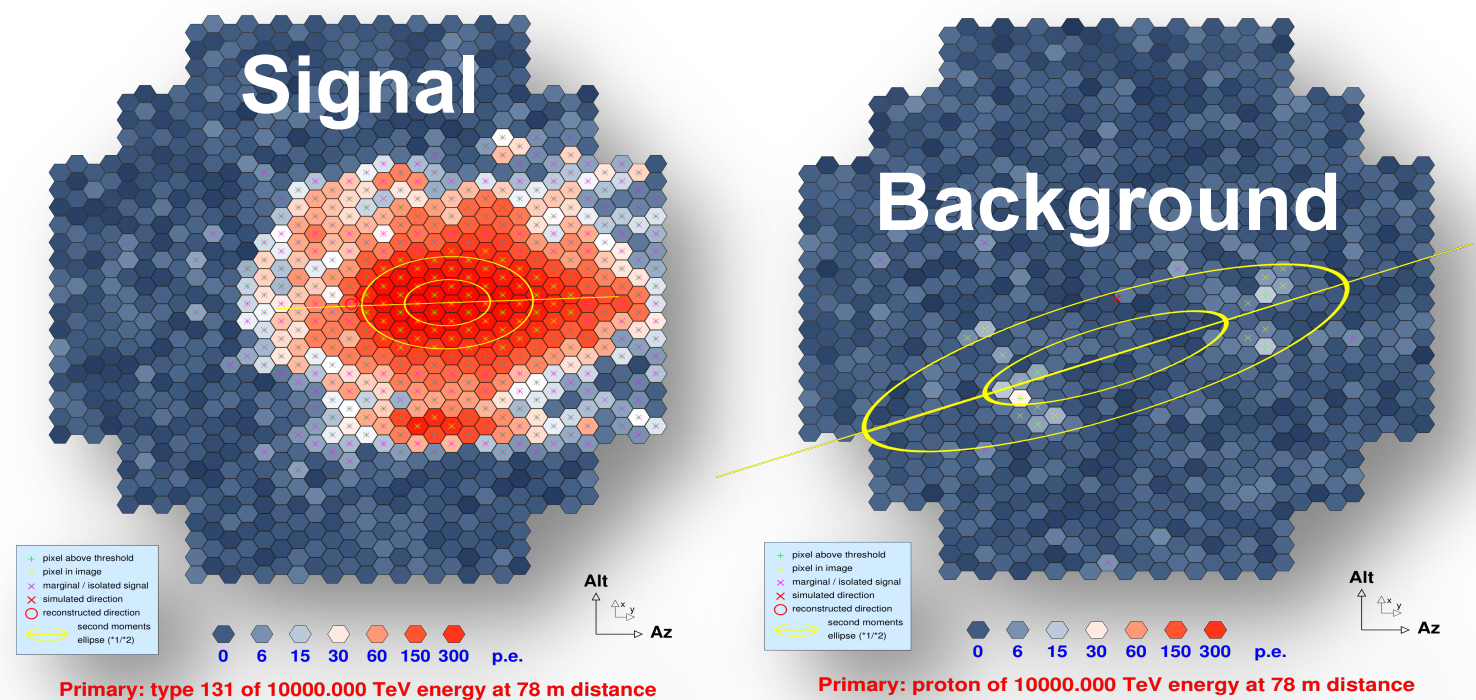
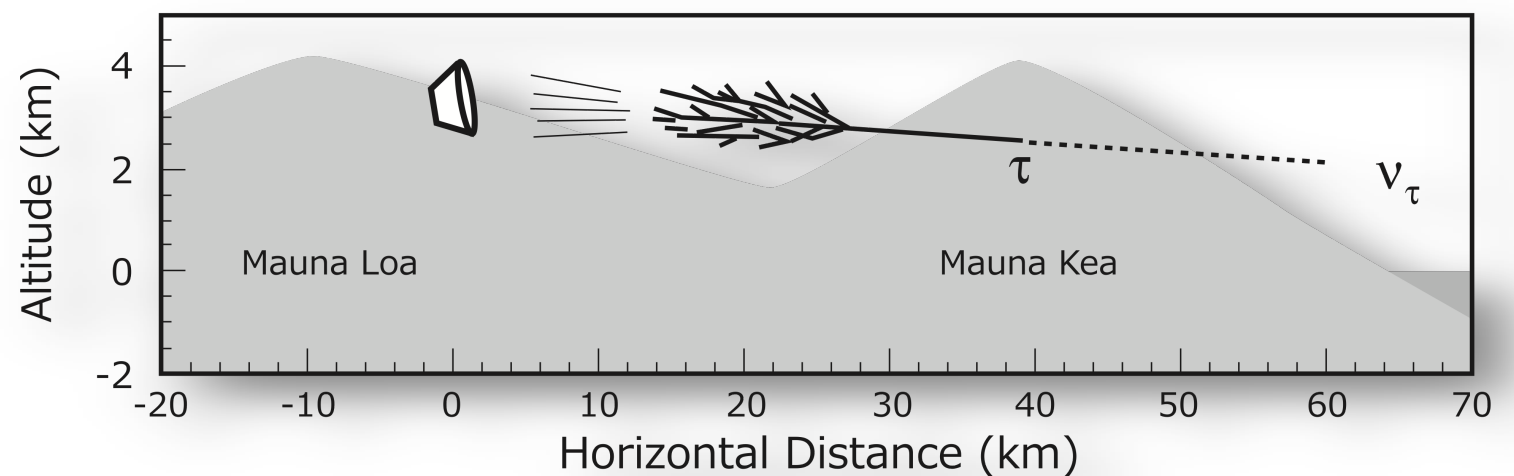
- Best projections for Galactic halo, but large background & modeling uncertainties
- Rely on dwarf galaxies/dark halos as alternative targets



Physics for CTA: Tau Neutrino Astronomy

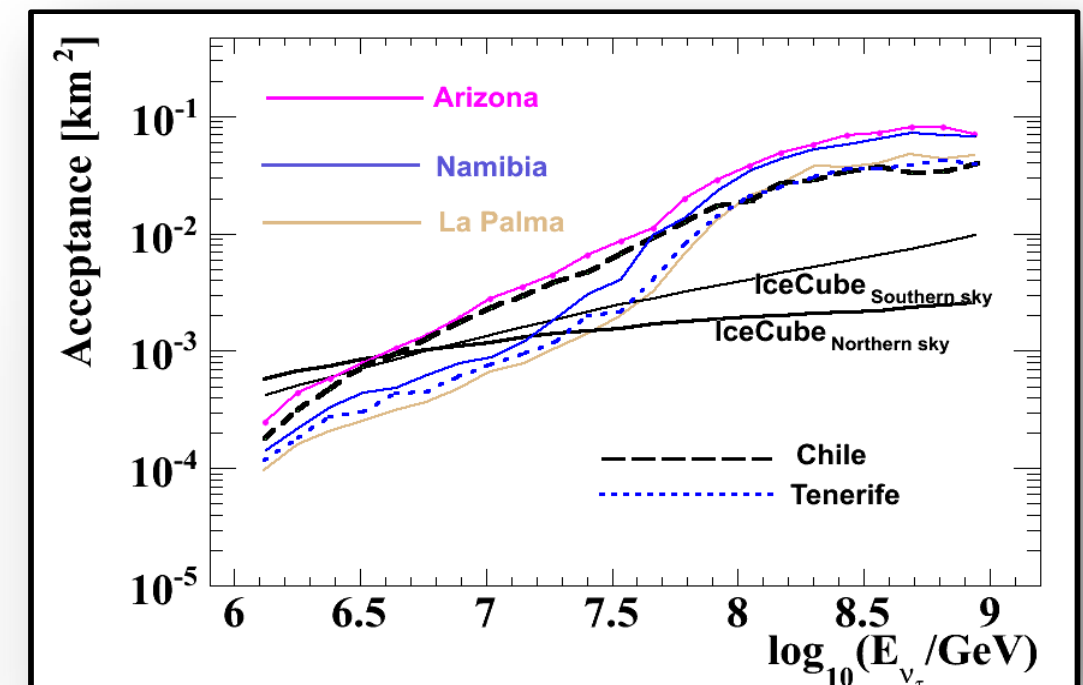
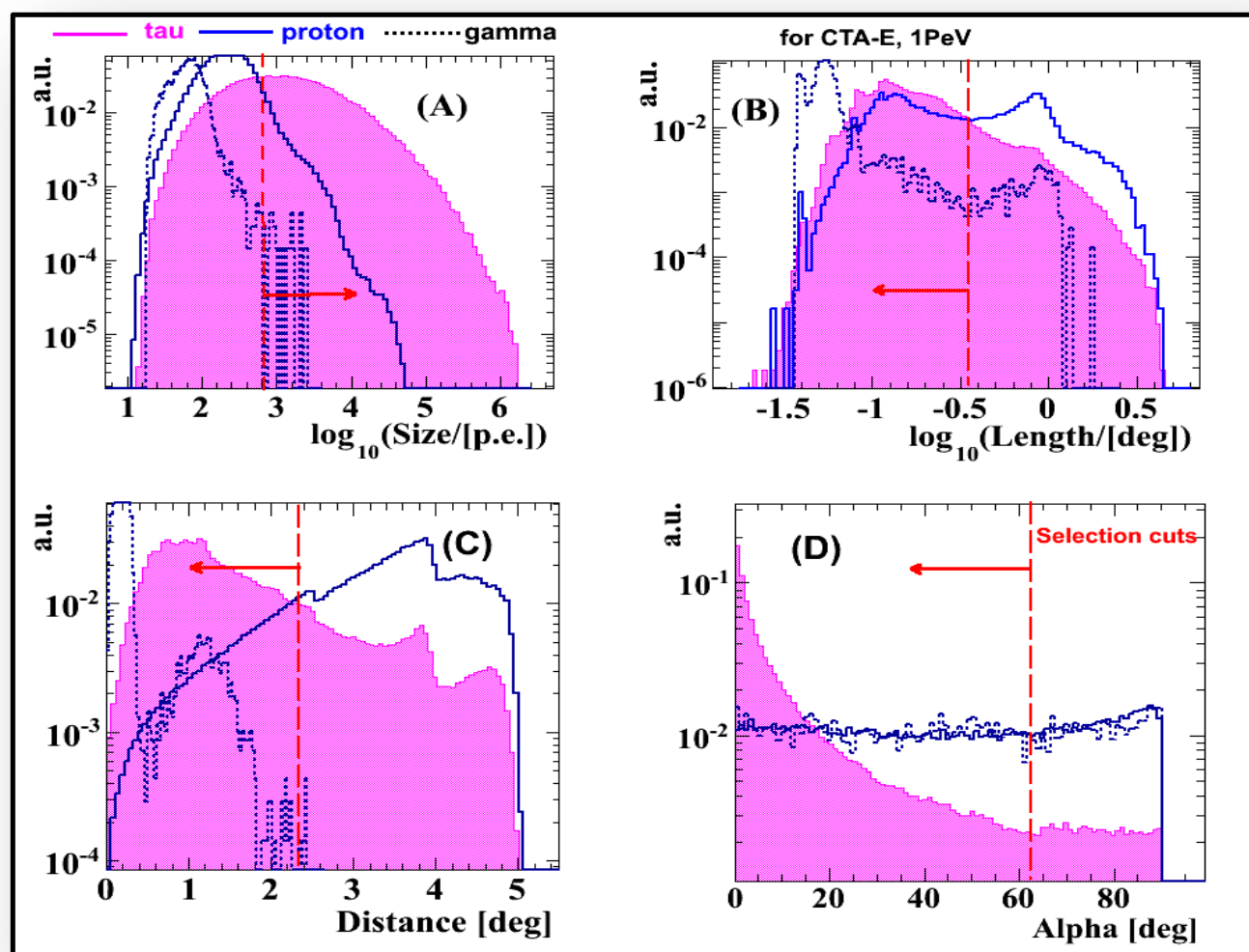
D. Gora, E. Bernardini MAGIC group

- > Use Mountain or Sea as Target material
- > Background: Protons
 - Different signatures (often dominated by muonic shower component)



Physics for CTA: Tau Neutrino Astronomy

- > Separation of Taus is good
- > Acceptance depends on site type
 - Might be sufficient for transient outbursts!



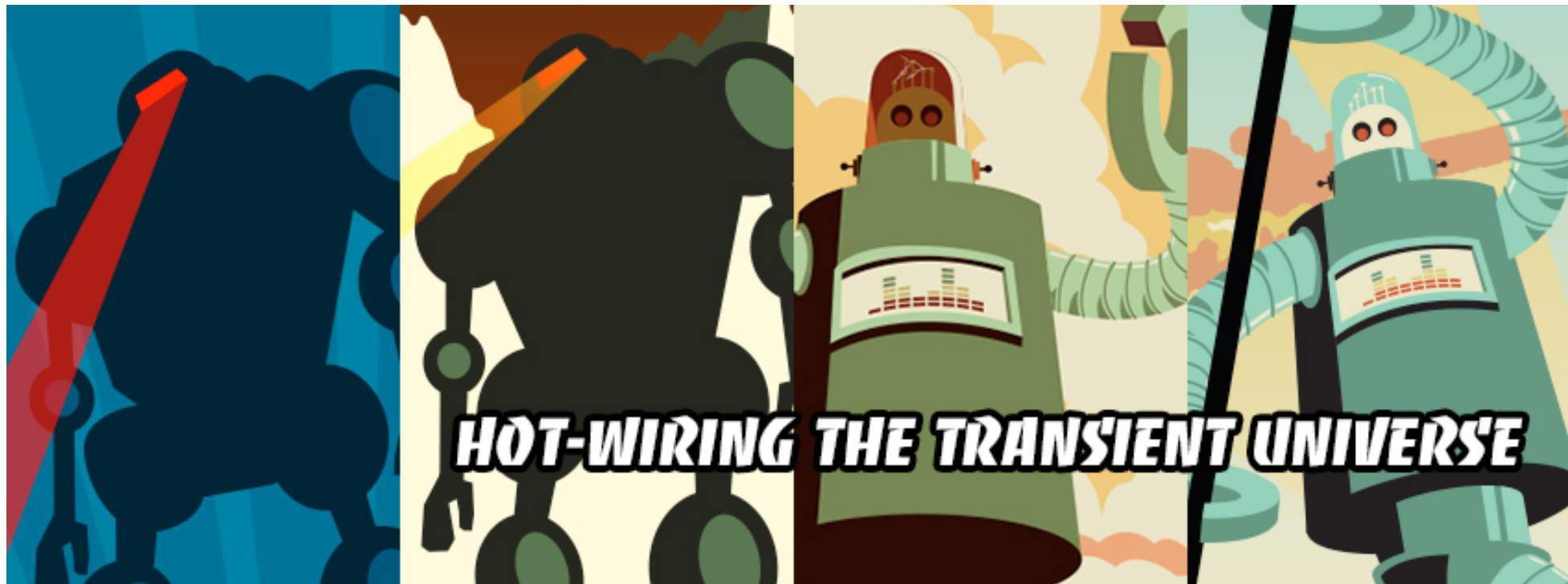
arXiv:1508.02863



DESY Physics Emphasis: Transient Phenomena

all groups

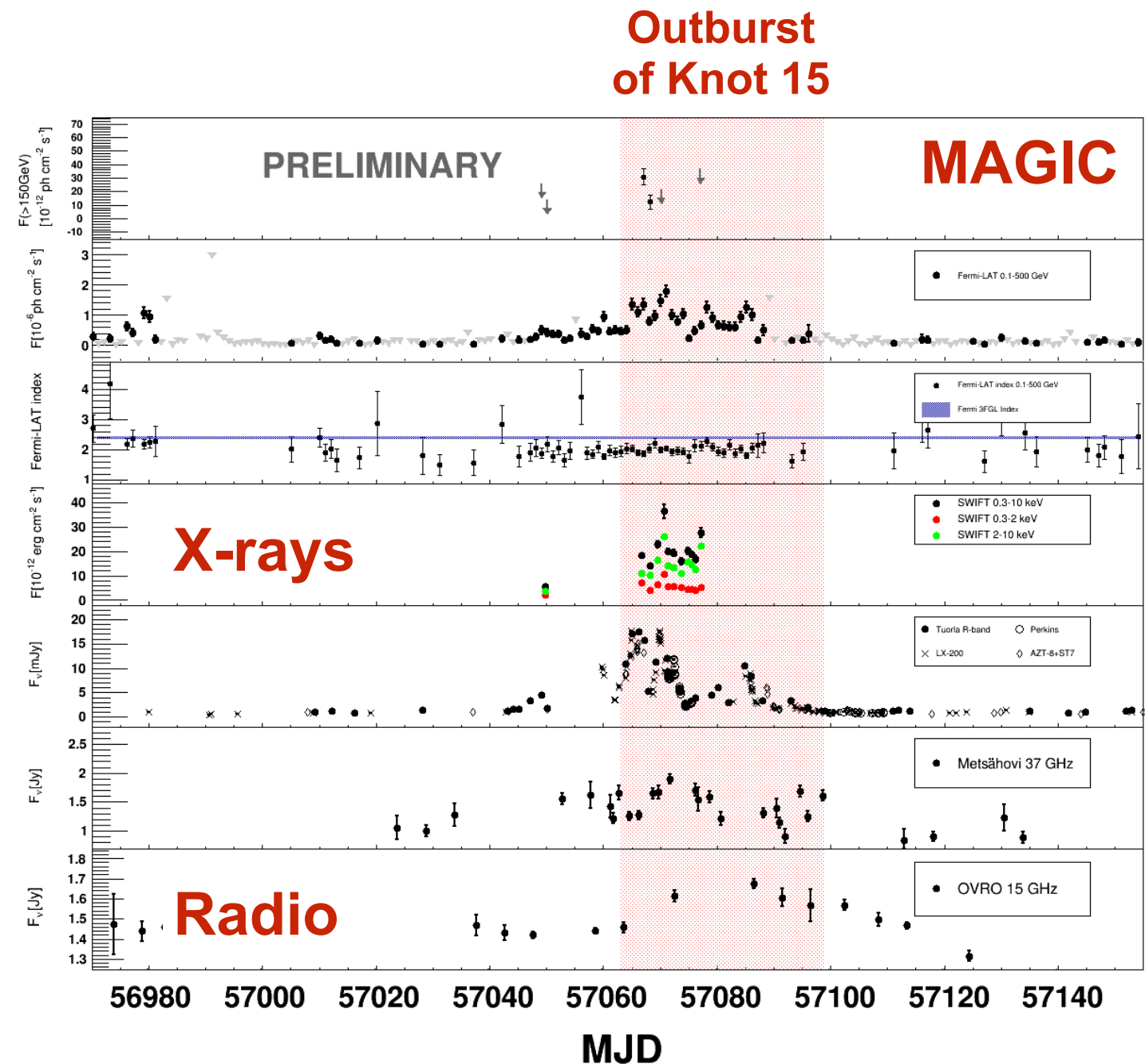
- > Two DESY-internal transients meetings
 - Contributions from CTA, H.E.S.S., VERITAS, MAGIC, IceCube, ZTF/LSST and Fermi groups
 - Exchange of experience and plans
- > New "Interdisciplinary transients group" in H.E.S.S., led by DESY [S. Ohm, H.E.S.S. group](#)
 - Goal: End-to-end optimisation of H.E.S.S. II response to transient phenomena
 - Kick-off Meeting Jan 20-22 in Zeuthen, 19 participants
 - Strong DESY contribution to new alert system



A New VHE Transient with MAGIC: S4 0954+65

G. Pedalletti, MAGIC group

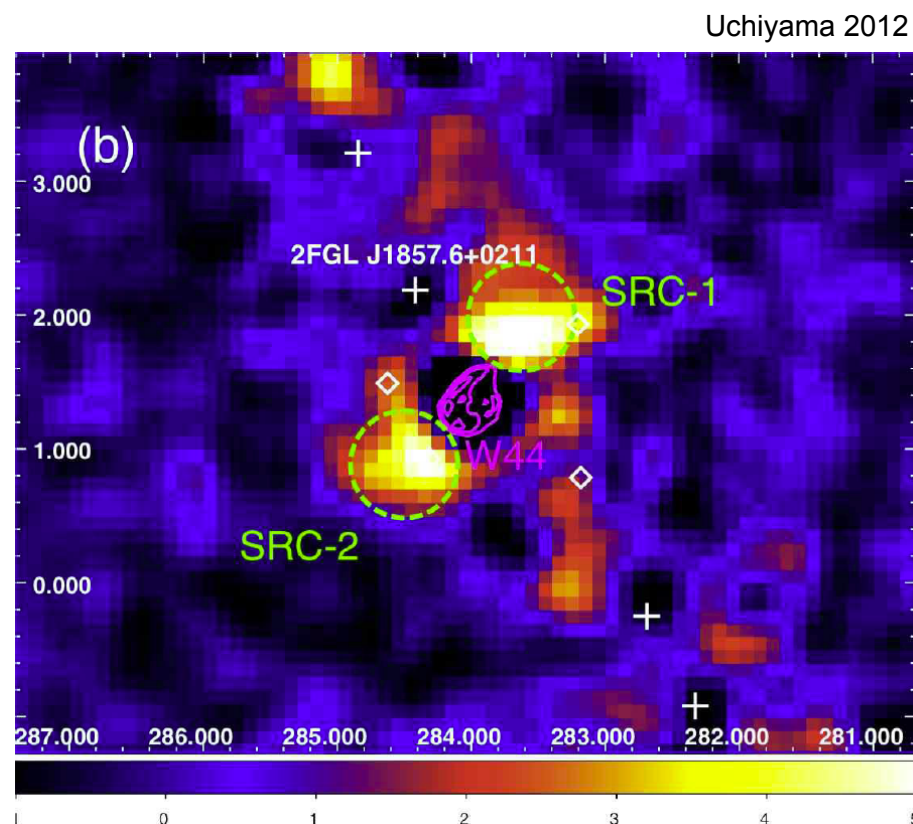
- > TeV detection coincident with a new knot emerging in the jet
 - Change of polarization angle
 - Spiral motion in a helical magnetic field?
- > Delayed peak emission at lower energies (X-ray, radio)
- > MAGIC: The flare factory keeps going
 - ATEL #6999 “MAGIC detects Very High Energy gamma-rays from S5 0716+714”
 - ATEL #7080 “Discovery of Very High Energy Gamma-Ray Emission from the FSRQ S4 0954+65 with the MAGIC telescopes”
 - ATEL #7542 “MAGIC detects an increased activity from PKS 1510-089 at very high energy gamma-rays”



Galactic Physics at DESY: W44 with MAGIC

G. Pedalletti, MAGIC group

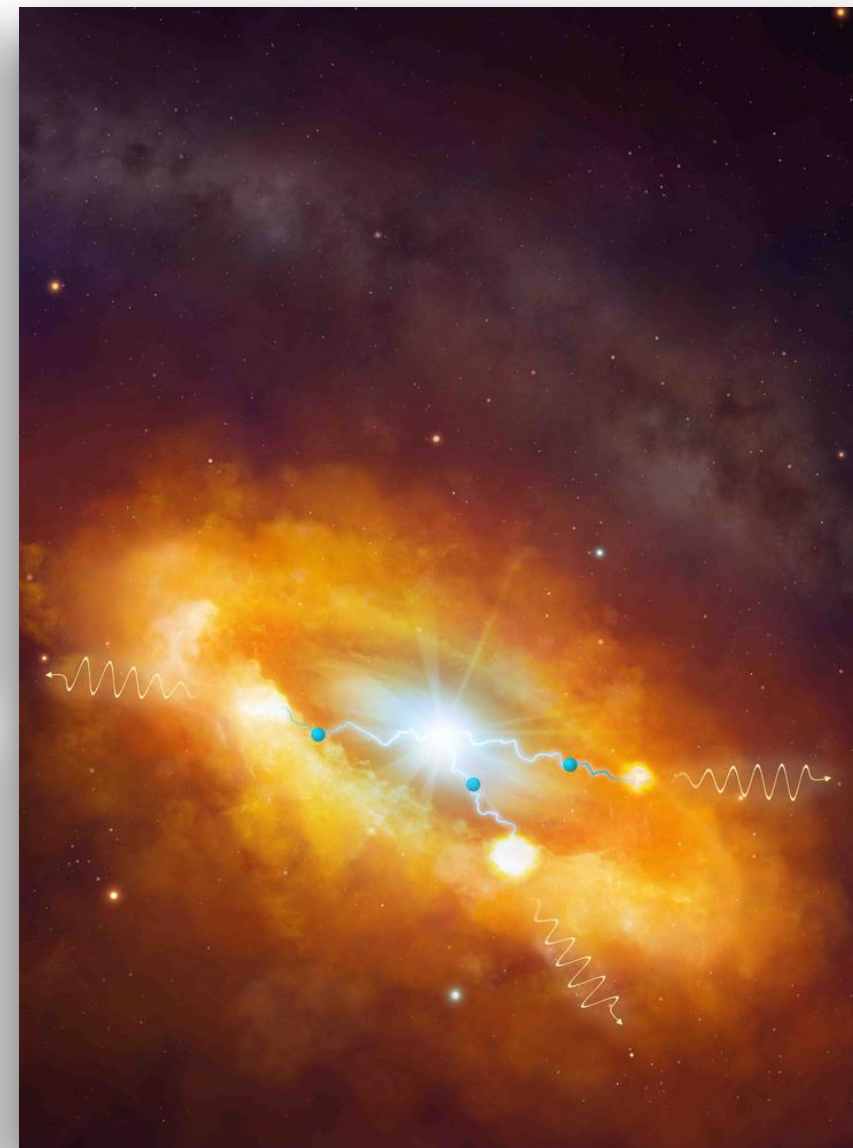
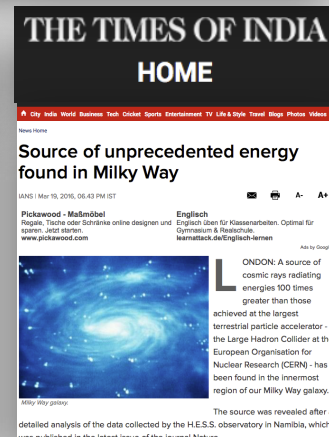
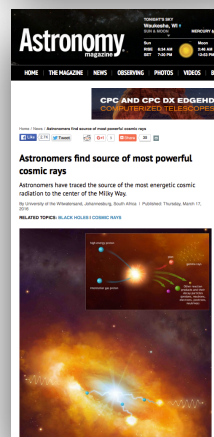
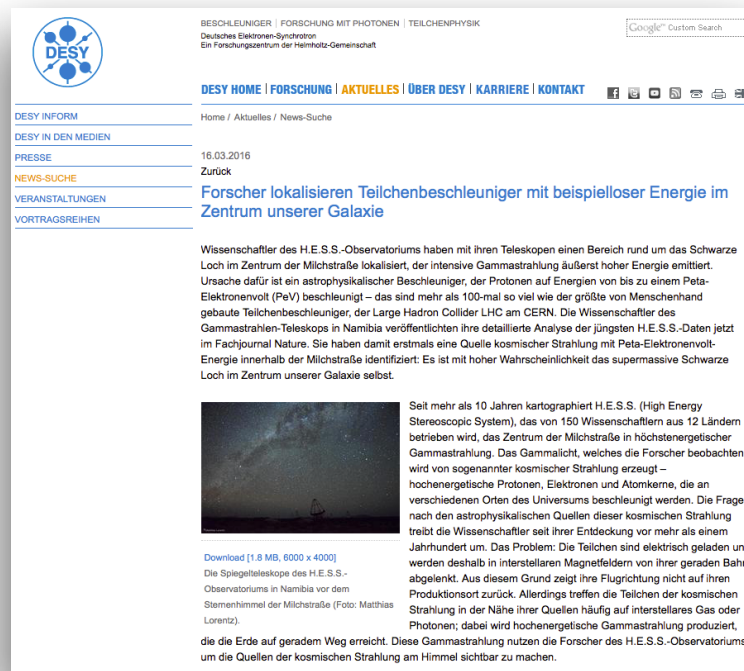
- > W44 is a pion-bump convicted hadronic CR accelerator
- > 100h observations of "SRC-1" near SNR W44, a potential molecular cloud calorimeter of W44's output
- > Deep constraints on VHE emission and potential models



(blinded for all
online purposes)

A Pevatron in the Galactic Centre?

- > Nature paper by H.E.S.S. on diffuse emission in Galactic Centre Ridge region
- > Potential trace of a Pevatron accelerator



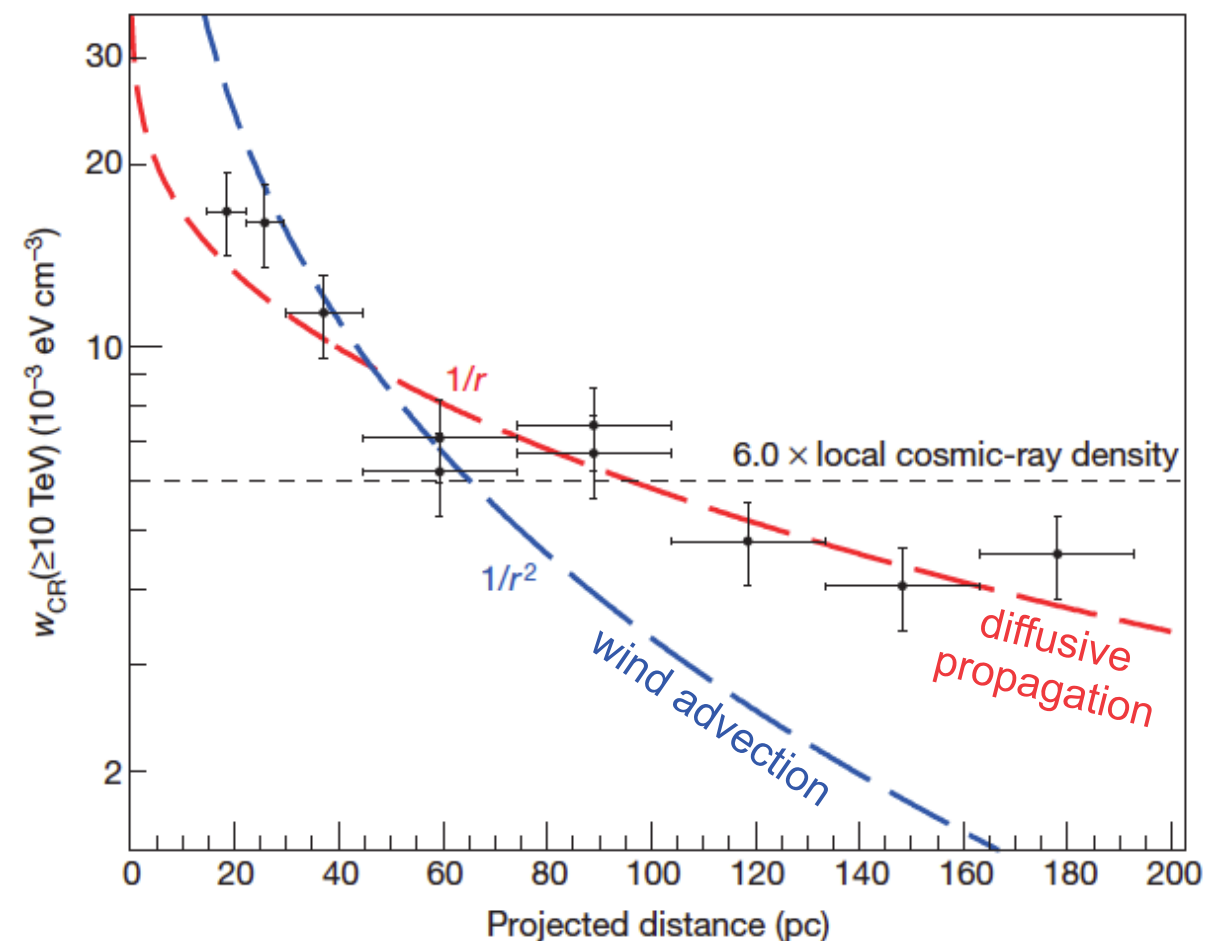
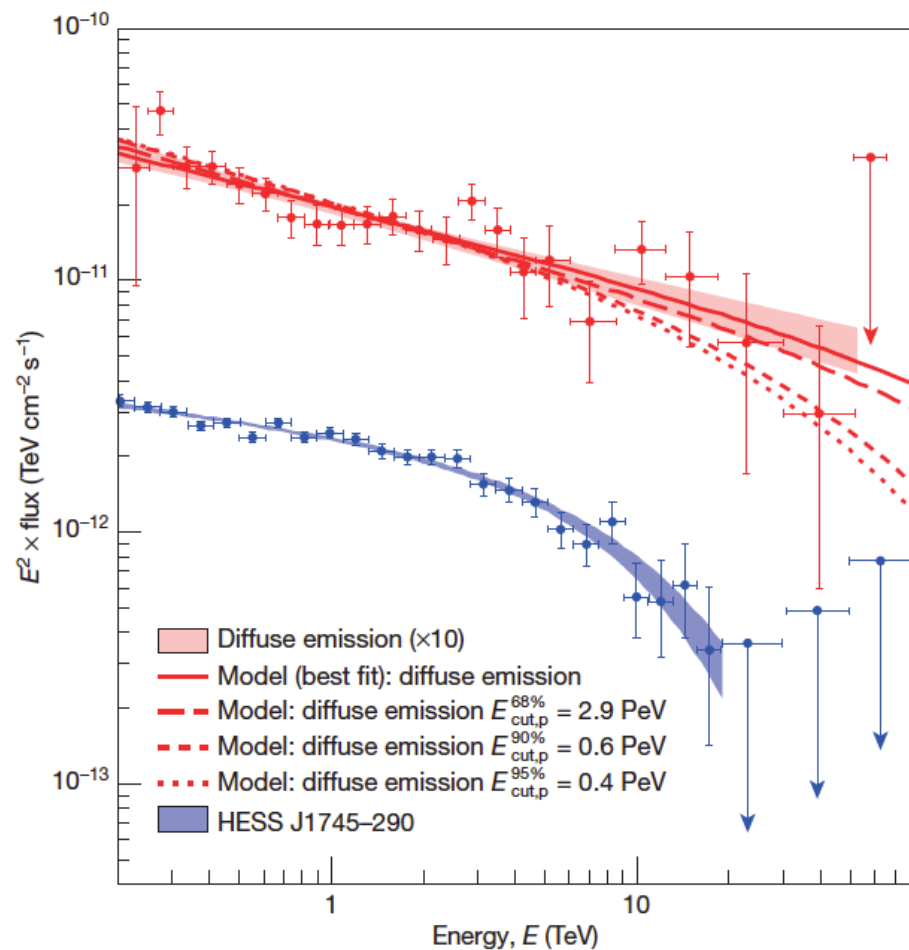
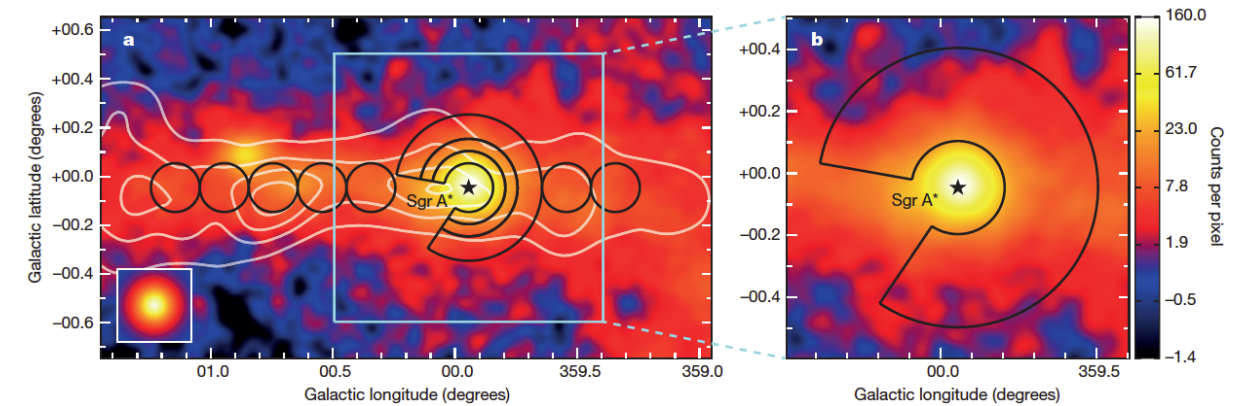
Traced by Morphology and Spectrum

> Cosmic ray density profile

- Calculated using matter densities from molecular line surveys

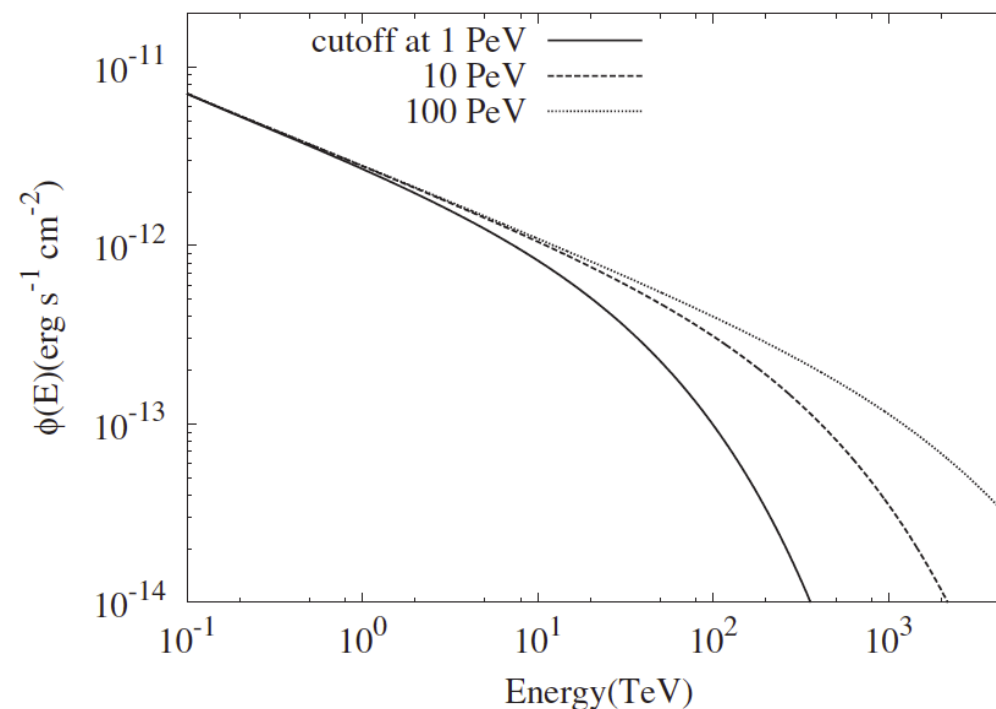
> Very hard emission w/o cutoff

- Untypical for such an extended emission



The Pevatron Scenario

- > There is a Pevatron in the Galactic Centre
- > Constant injection over at least 1000 years
- > Current luminosity of GC source does not suffice
 - But the source may be variable
- > On speculative grounds, the Pevatron might even be a relevant contributor to the total galactic cosmic rays
- > Neutrinos to be expected from the diffuse CRs
 - Might be detectable by IceCube after several years of observation



Summary

- > Major hardware and software activities dominate the lives of many gamma-ray DESYaners now
- > Physics prospects for CTA are being mapped out and look brilliant
- > CTA HQ and data centre application might substantially upgrade the Zeuthen campus
- > A transients physics emphasis is being built up at DESY
- > Physics results mostly come out of long-term observations or programs now