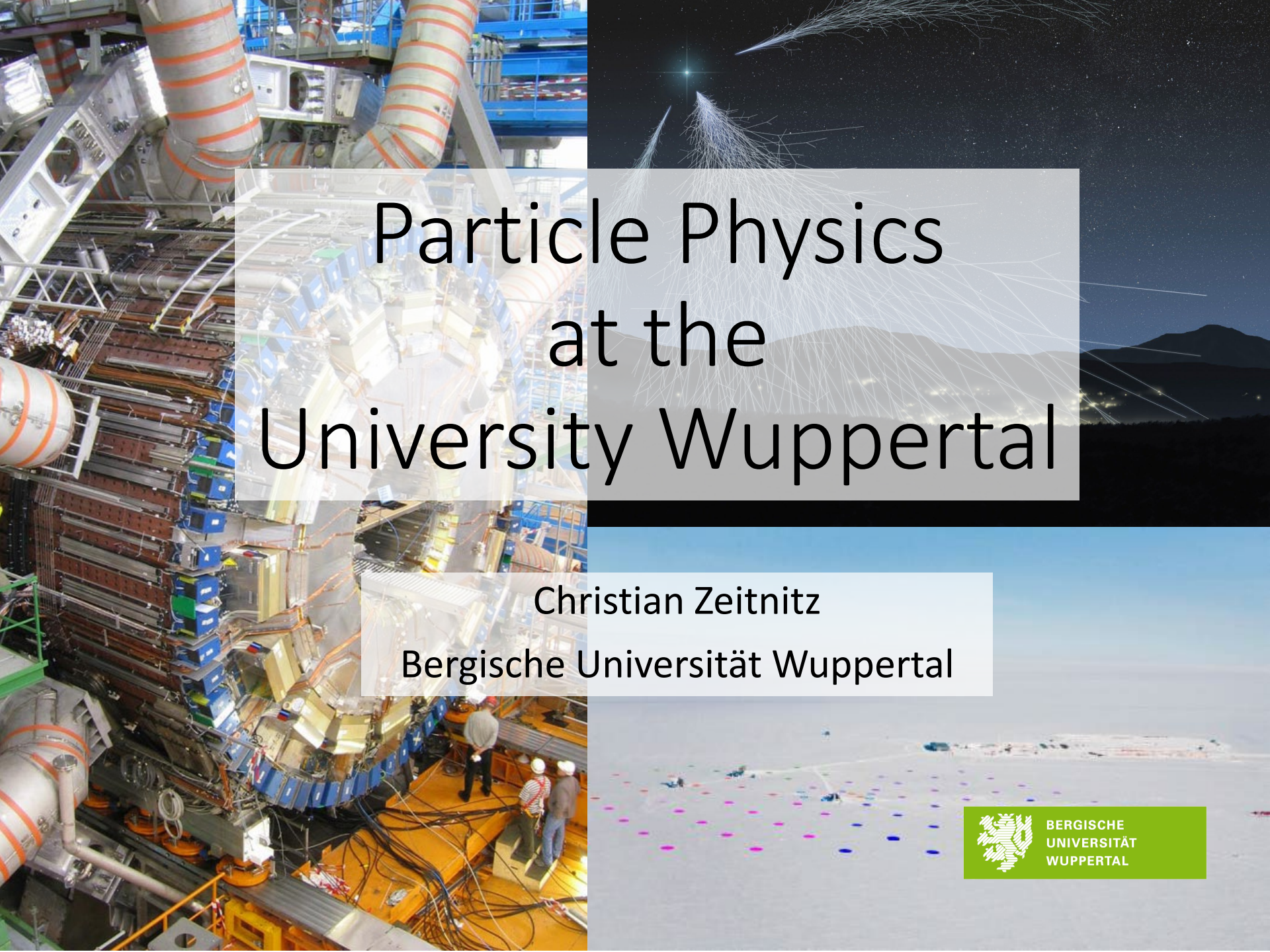


Particle Physics at the University Wuppertal

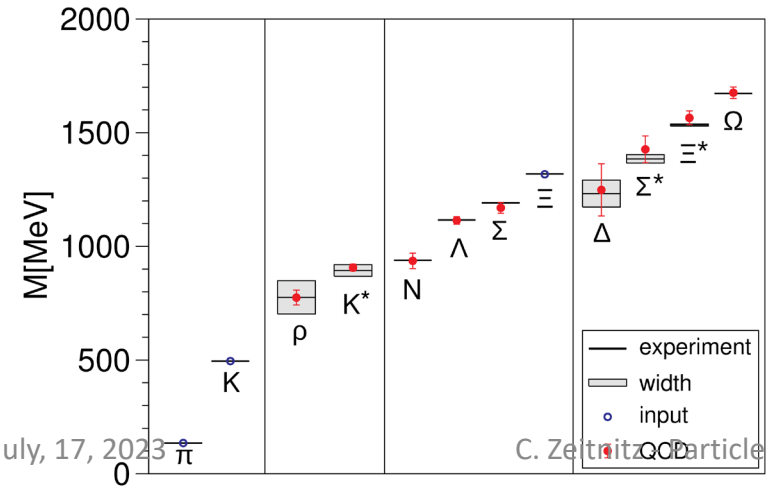
Christian Zeitnitz

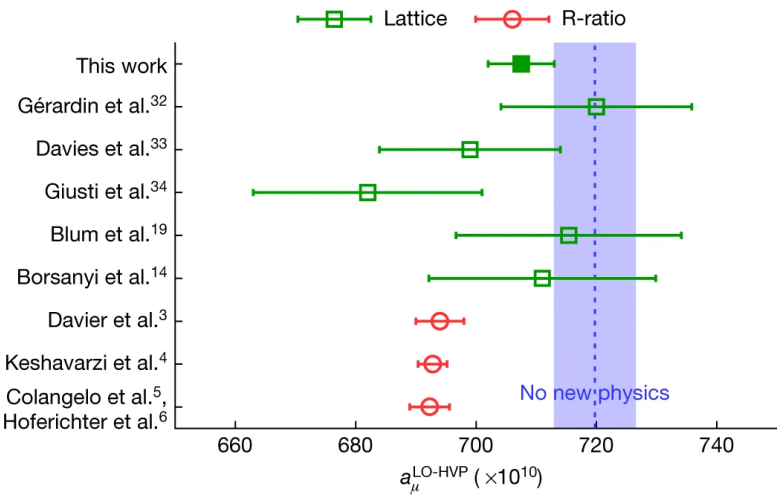
Bergische Universität Wuppertal

BERGISCHE UNIVERSITÄT WUPPERTAL

Activities at the Bergische Universität

- Experimental Particle Physics
  - High Energy Physics (ATLAS, CALICE, EIC)
  - Astroparticle Physics (IceCube, Auger)
  - Hadron Physics (CBM at FAIR)
- Theoretical Particle Physics
  - Strong Lattice Gauge Group
    - Calculation of the light Hadron mass spectrum
    - Hadronic corrections to (g-2) of the Myon



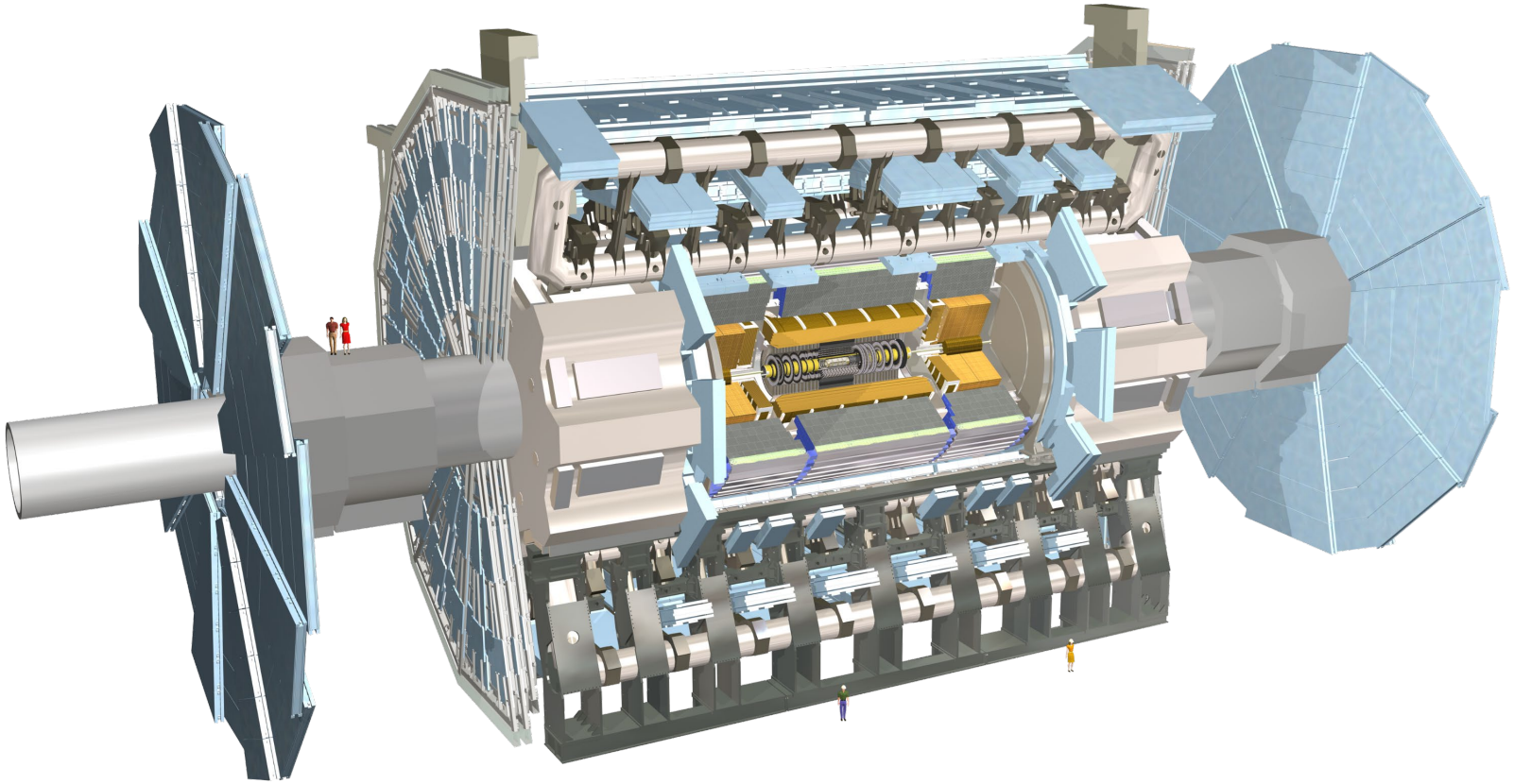


HEP Activities

W. Wagner, C. Zeitnitz

ATLAS-Experiment at the LHC (CERN)

- Proton-Proton collision at 13.6TeV (Run 3)



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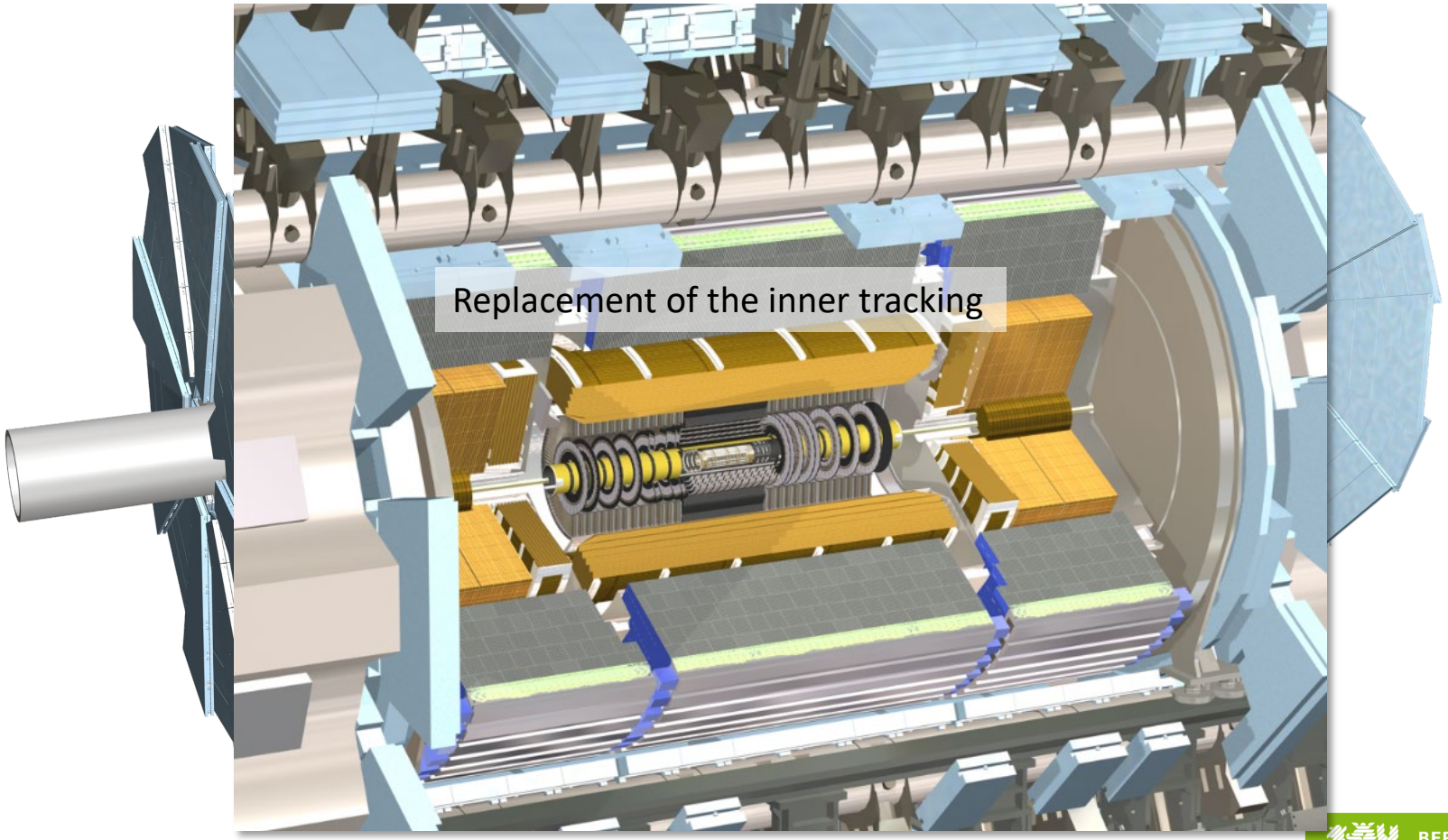
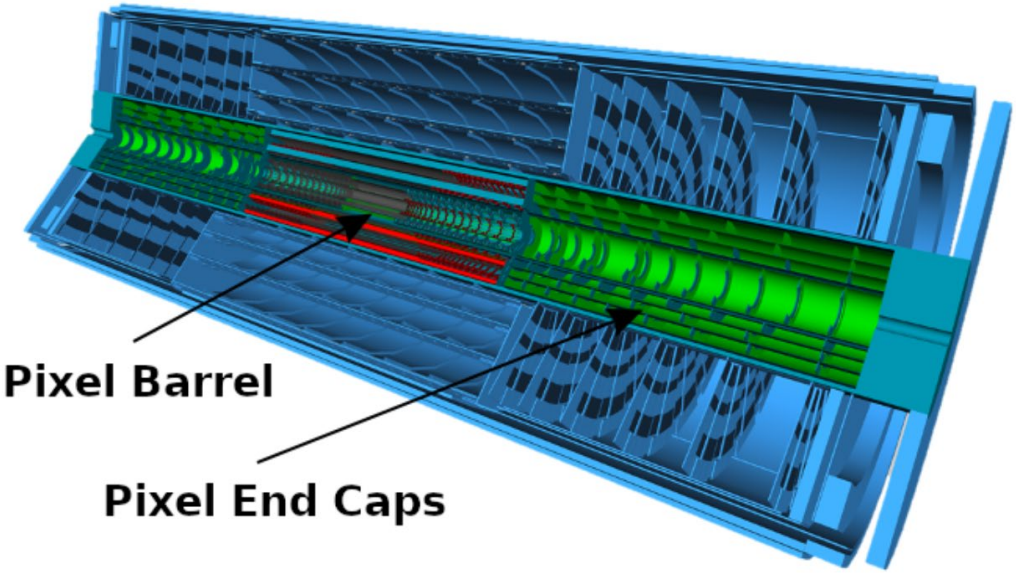
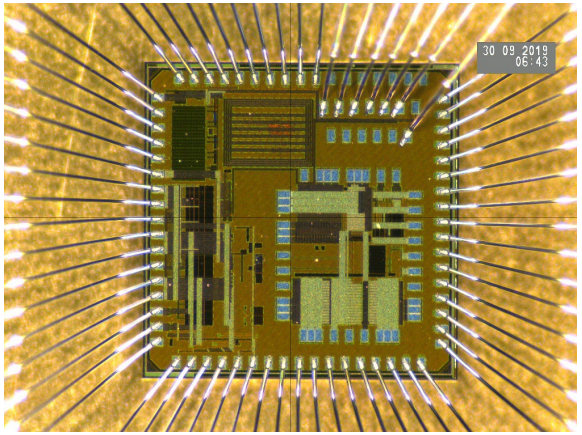


New Inner Tracker of ATLAS (ITk)

- ATLAS all silicon tracking detector
  - 5 layers of Si-Pixels
  - 4 Si-Strip layers
  - Ready for installation 2027



- We work on the Pixel-Detector
  - Front-End Readout
    - Firmware development
  - Radiation hard ASIC for the monitoring of Pixel modules
    - Radiation level up to 500MRad
  - Interlock system of Itk



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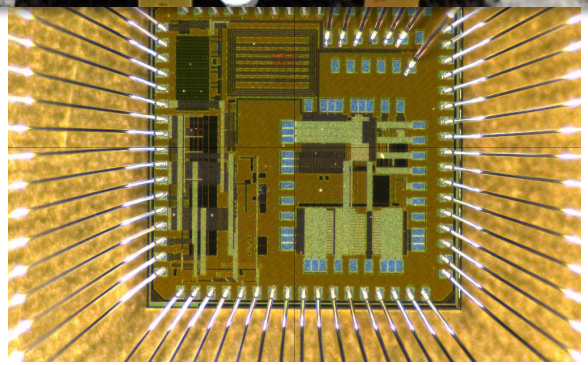

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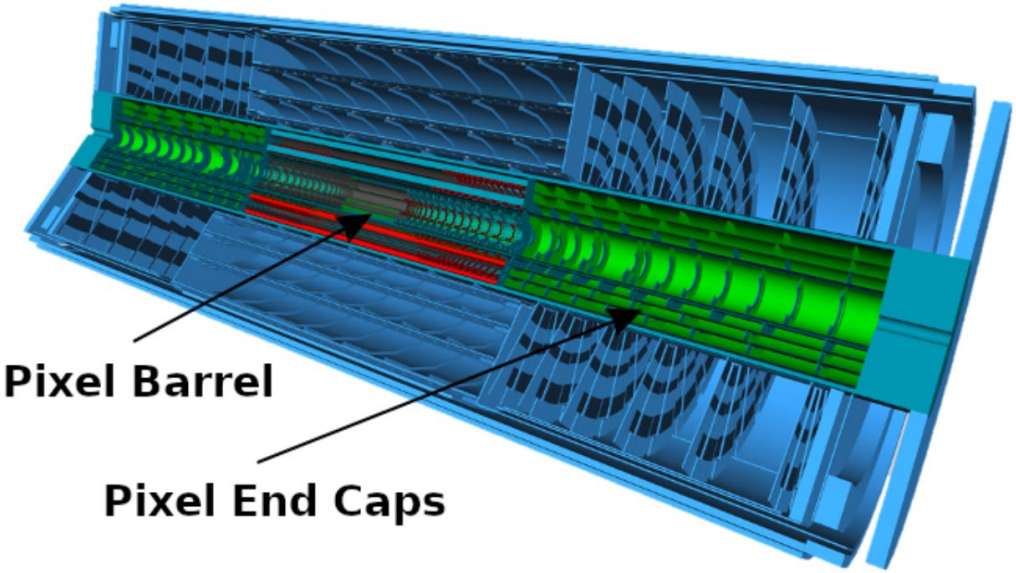

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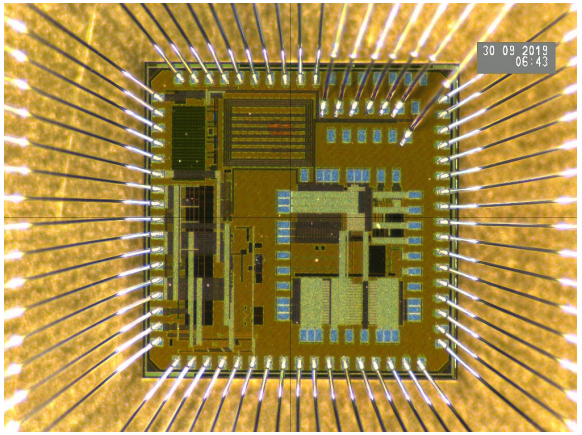
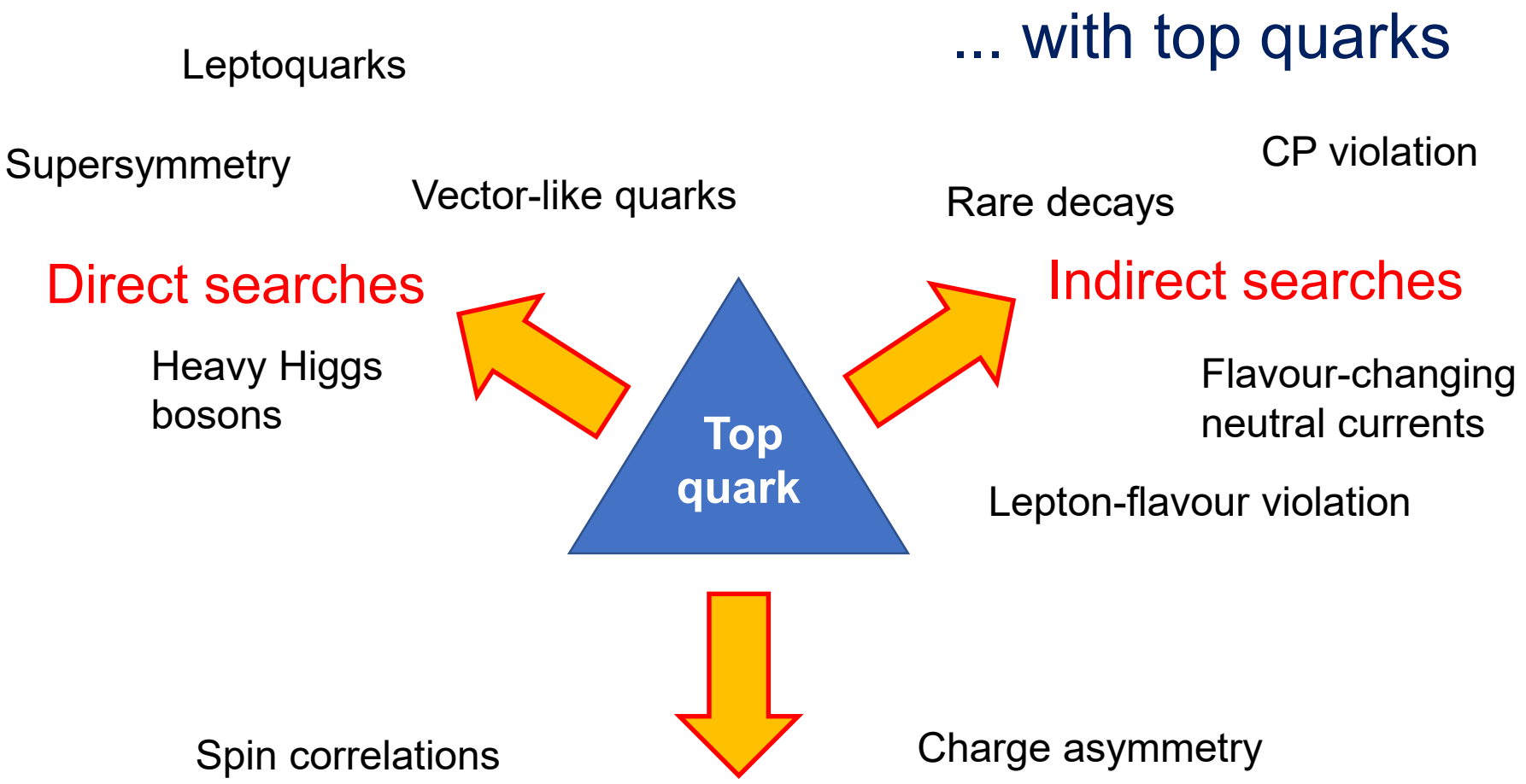
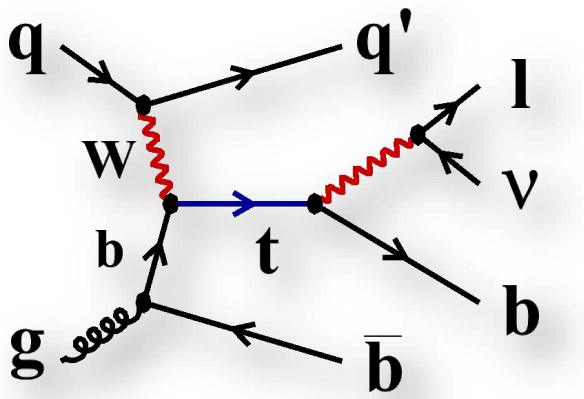


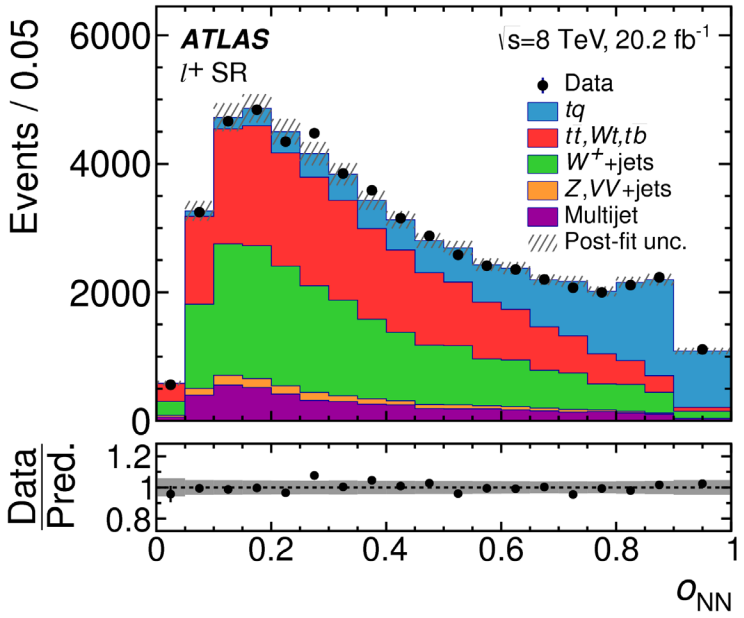
Standard Model and beyond …



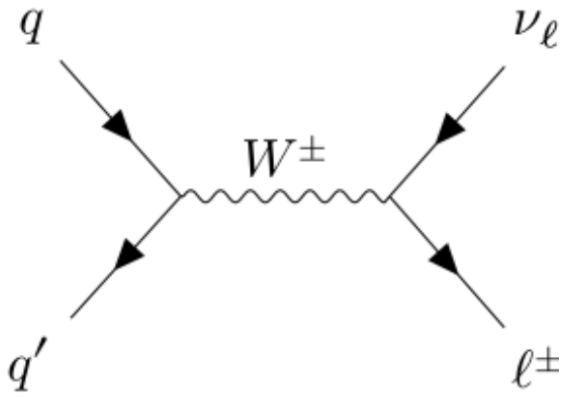
Top Quark Physics

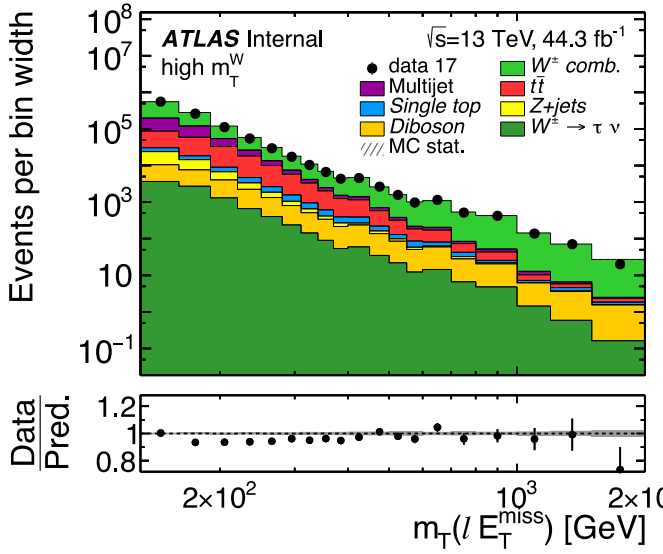


Precision measurement of single Top quark production utilizing Neural Networks



Off-shell W production





… and more

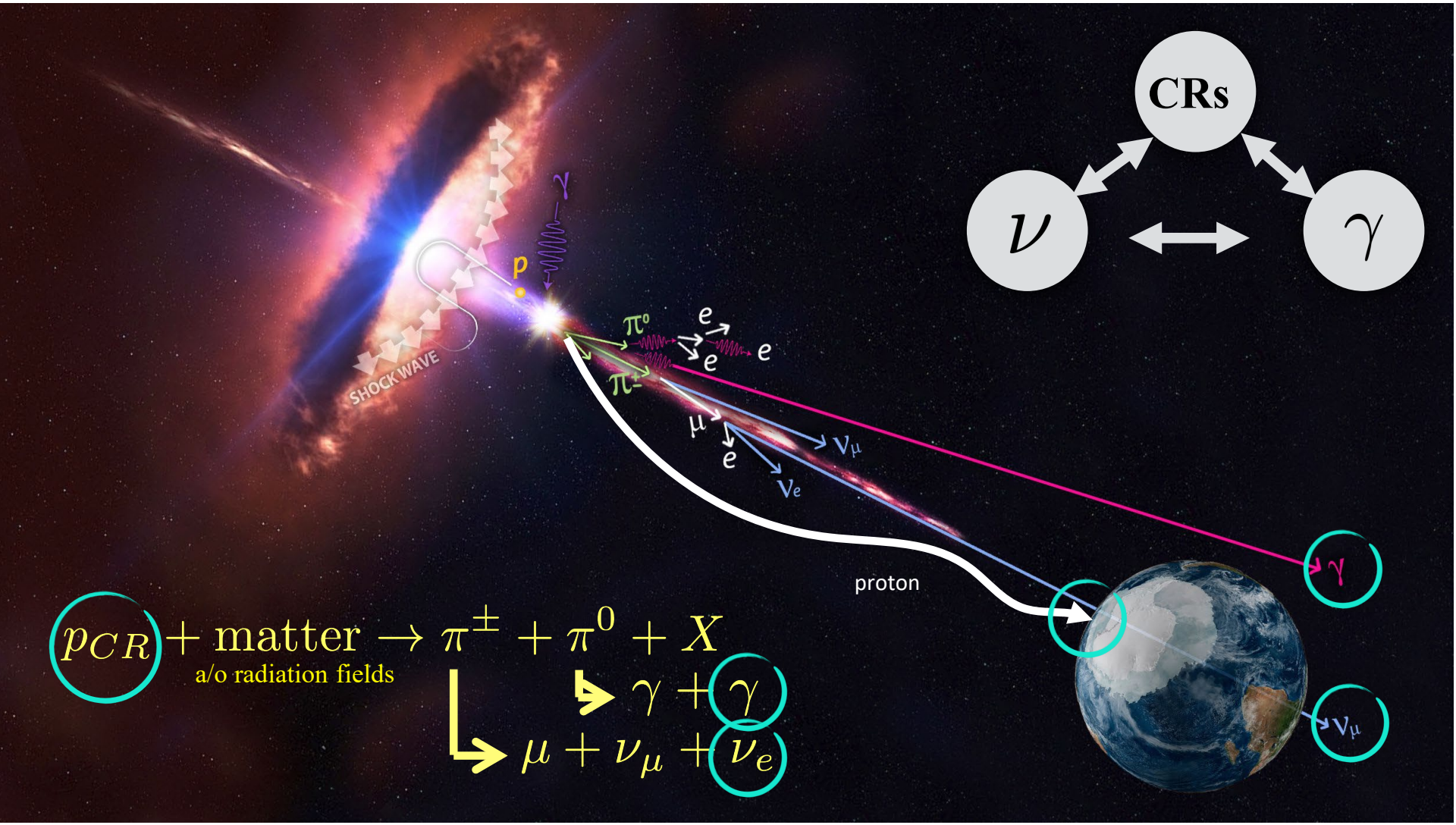
Computing within the Worldwide LHC Computing Grid (WLCG)

- Operate since more than 10 years a Tier-2 center for ATLAS

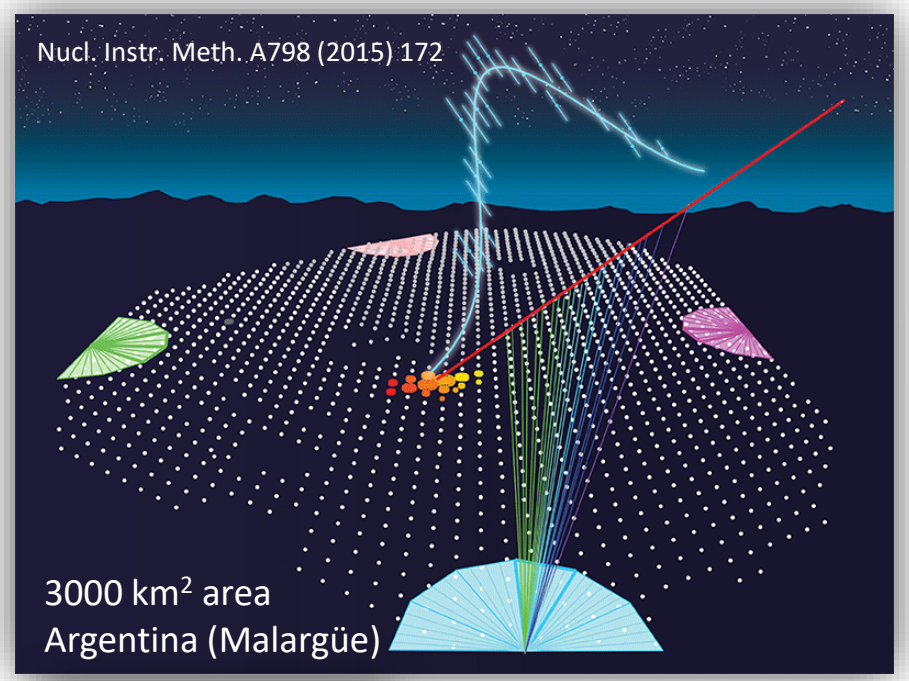
Smaller activities

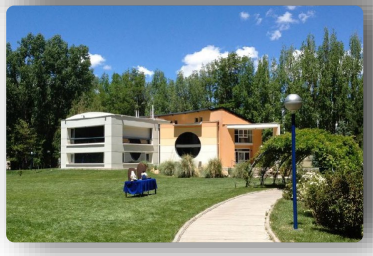
- Started activities at the planned EIC accelerator at BNL
- R&D in direct optical data transmission in the Front End readout
- CALICE collaboration: analog hadronic calorimeter (AHCAL)

Astroparticle Physics
K-H. Kampert



AUGER Experiment



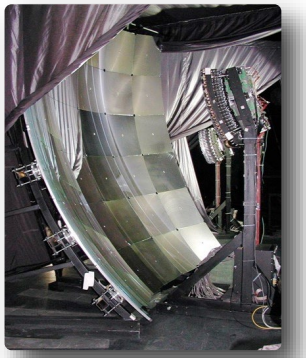


Central campus with visitors center

- 1400 m altitude
- 35° S, 69° W

1

- 27 Telescopes to measure **light trace of EAS** in atmosphere
- integrated light intensity → CR energy
- 13% duty cycle

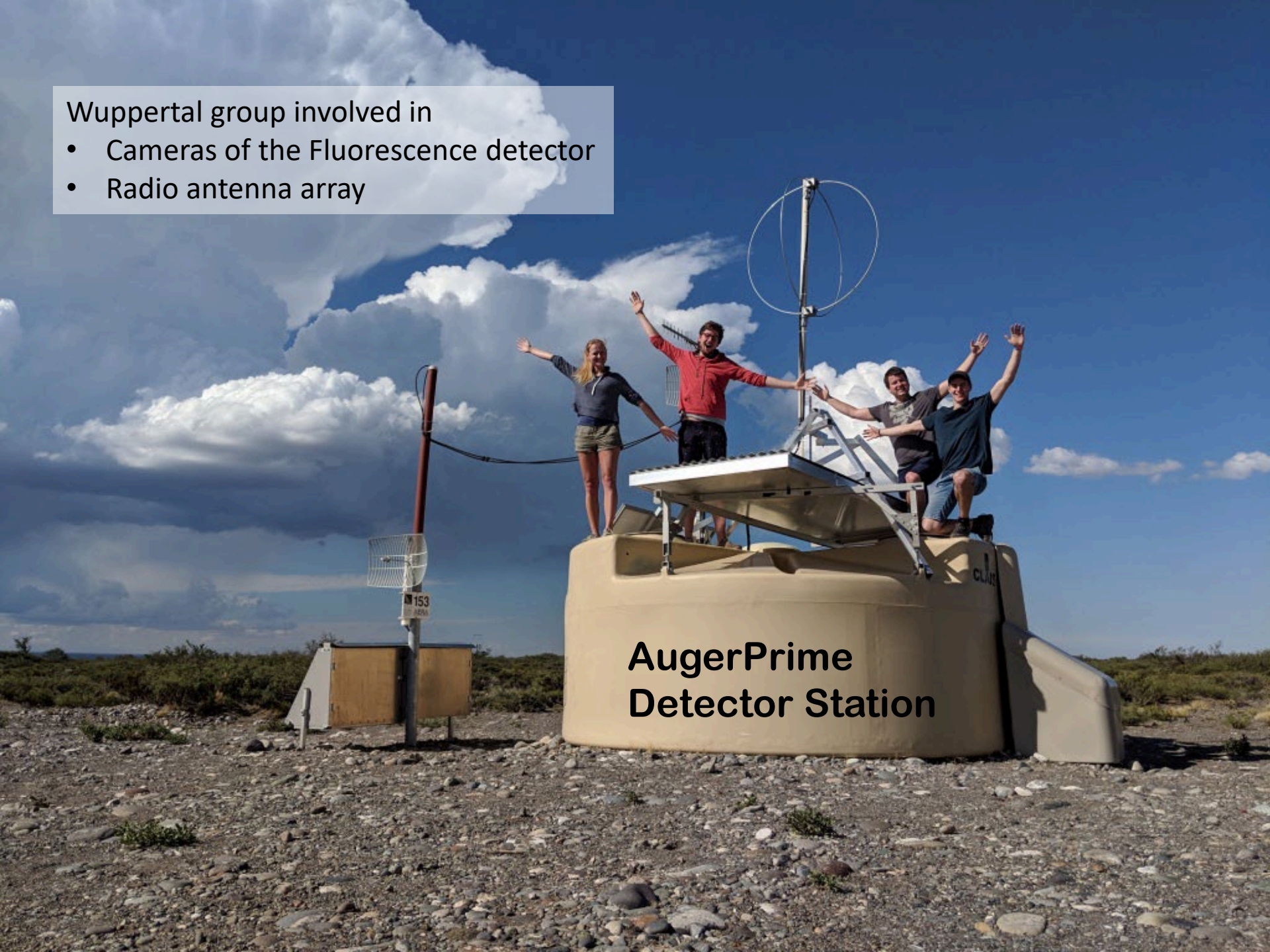


2

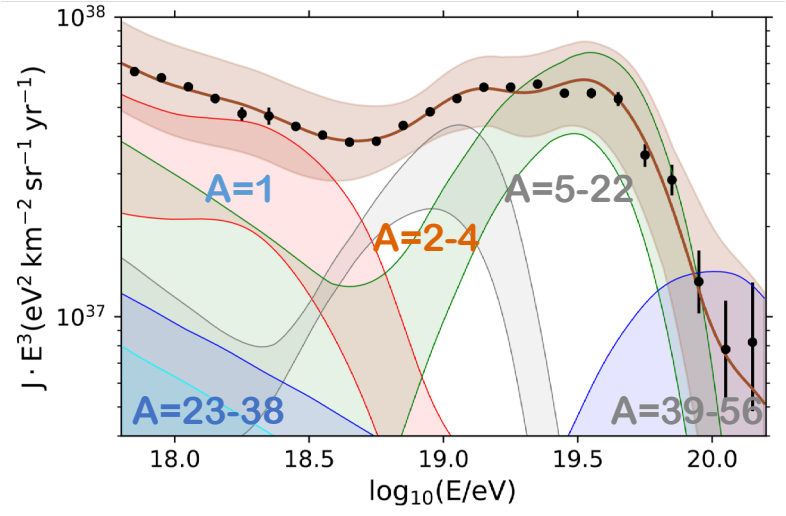
- 1660 Water Cherenkov detectors on 1.5 km grid to measure footprint of **particles at ground**
- 100% duty cycle
- cross calibrated with FD-telescopes with hybrid events

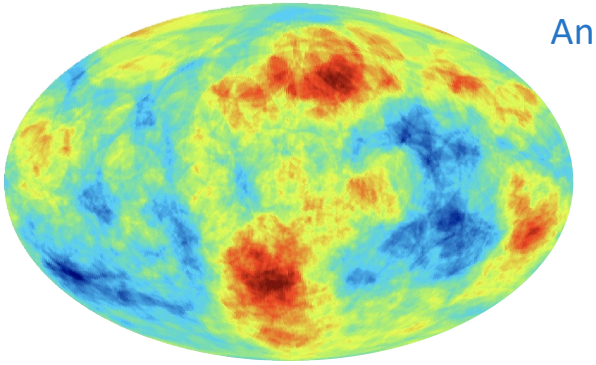
3

- 153 radio antennas for **em-radiated energy**
- 18 km² area
- 100% duty cycle


Wuppertal group involved in
• Cameras of the Fluorescence detector
• Radio antenna array
153
AugerPrime
Detector Station

Physics with AUGER

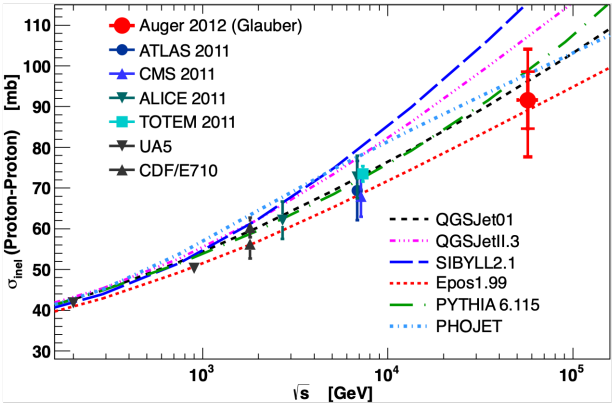




Anisotropies at E>40 EeV

New spectral features in UHECR spectrum

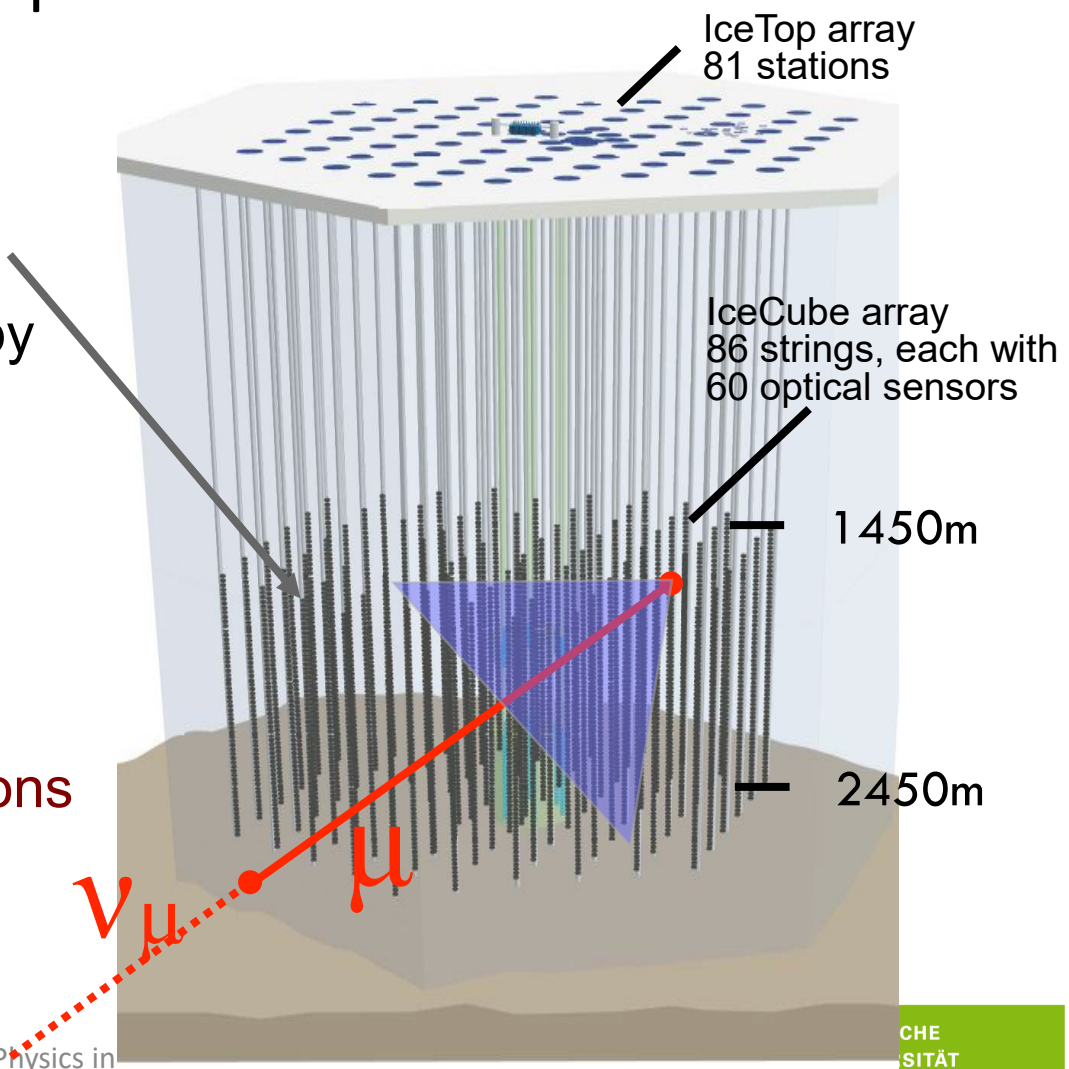
- Increasingly heavy composition
  - → suggests seeing maximum source energies
  - → no cosmogenic neutrinos and photons, yet



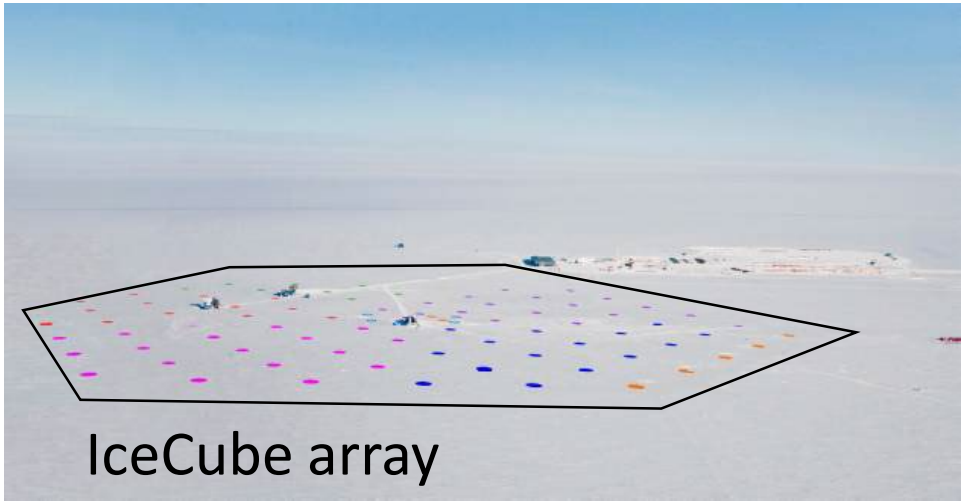
- pp inelastic cross section at $\sqrt{s} \simeq 60$ TeV
- muon deficit in all interaction models, „muon puzzle“

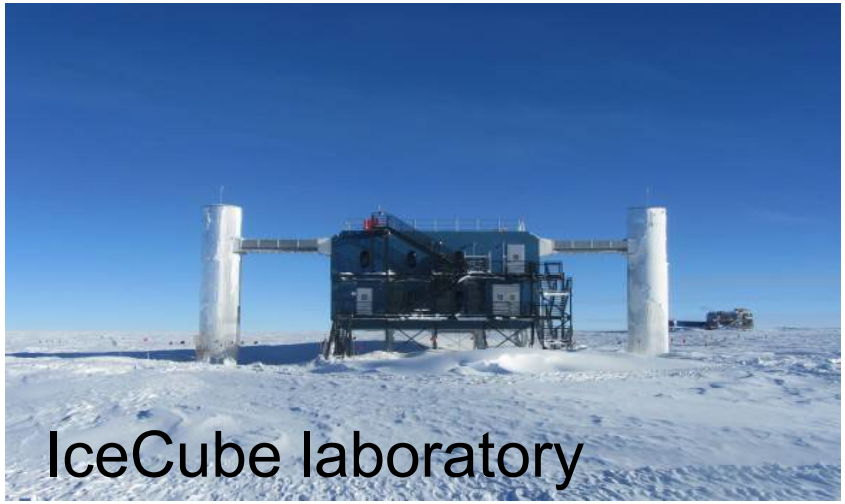
Astroparticle Physics
K. Helbing

- IceCube Neutrino Telescope
  - Particles interact with the deep clear ice
  - Emitted light is detected by sensors
    - Cherenkov Light
    - Bremsstrahlung
    - Pair production
    - Photonuclear interactions
    - Luminescence

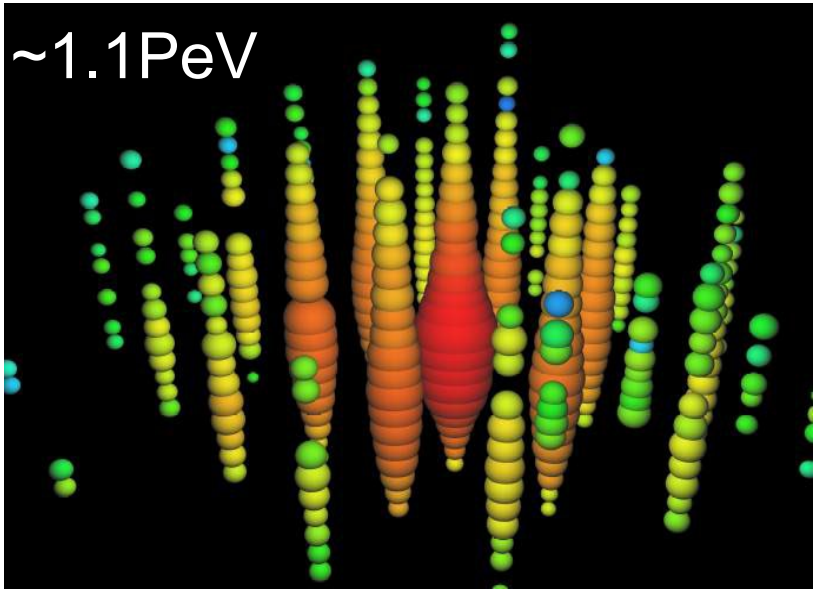


IceCube Neutrino Observatory

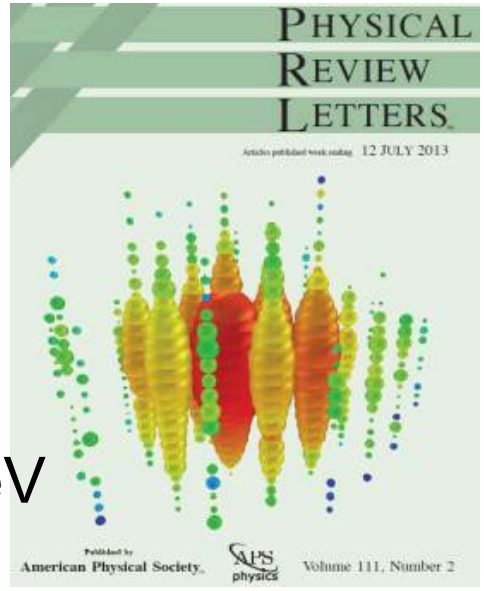




First two astrophysical neutrinos detected on Earth dubbed Ernie & Bert



~1.0 PeV



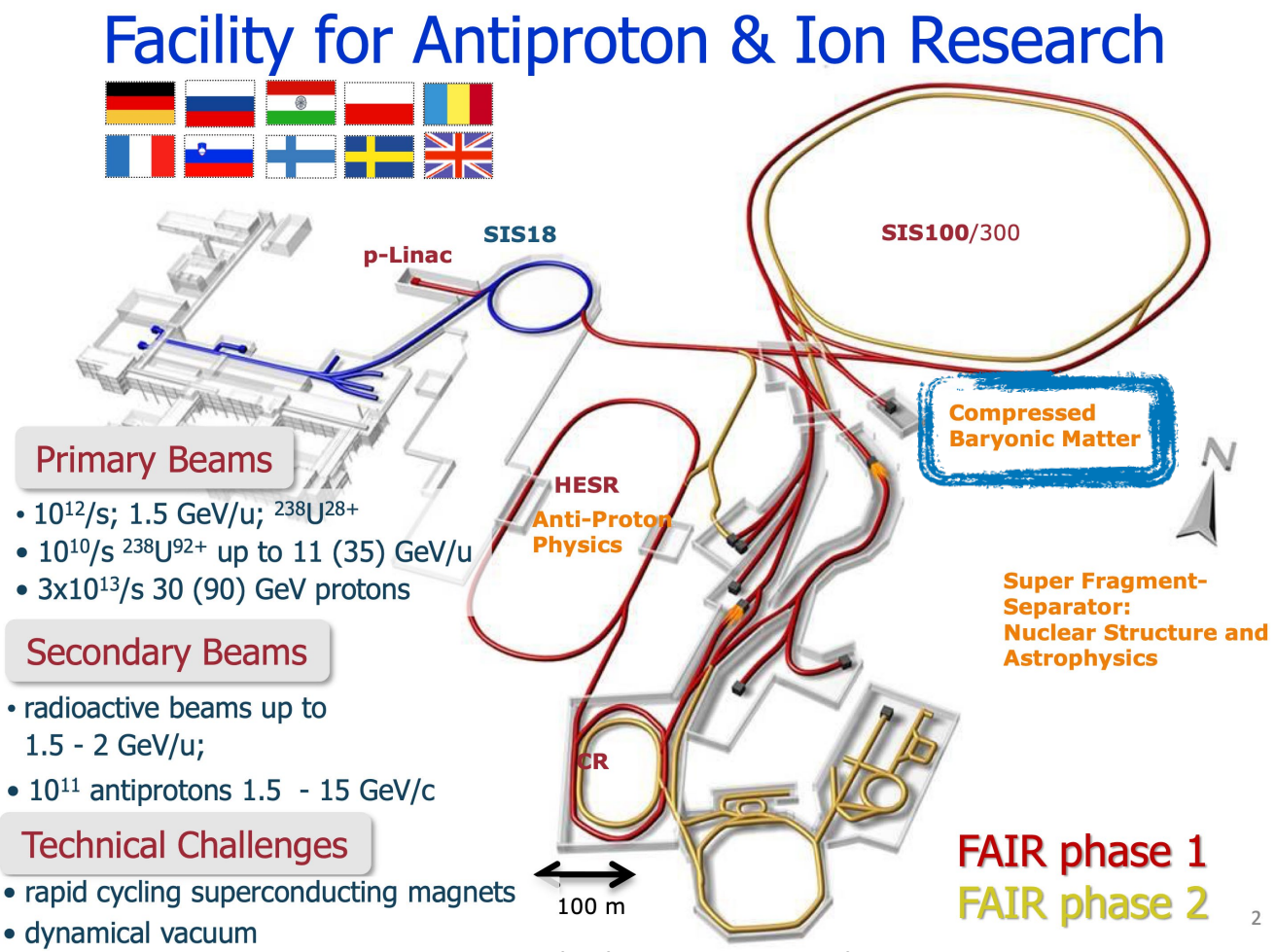
Bert: cover boy

~ 100 times more energy than LHC at CERN can reach

Hadron-Physics
K-H. Kampert

Experiment: Compressed Baryonic Matter (CBM)

- Stuc
  expe
- Den
- Stuc

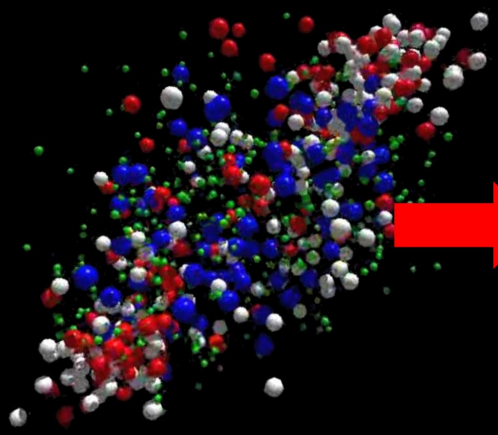


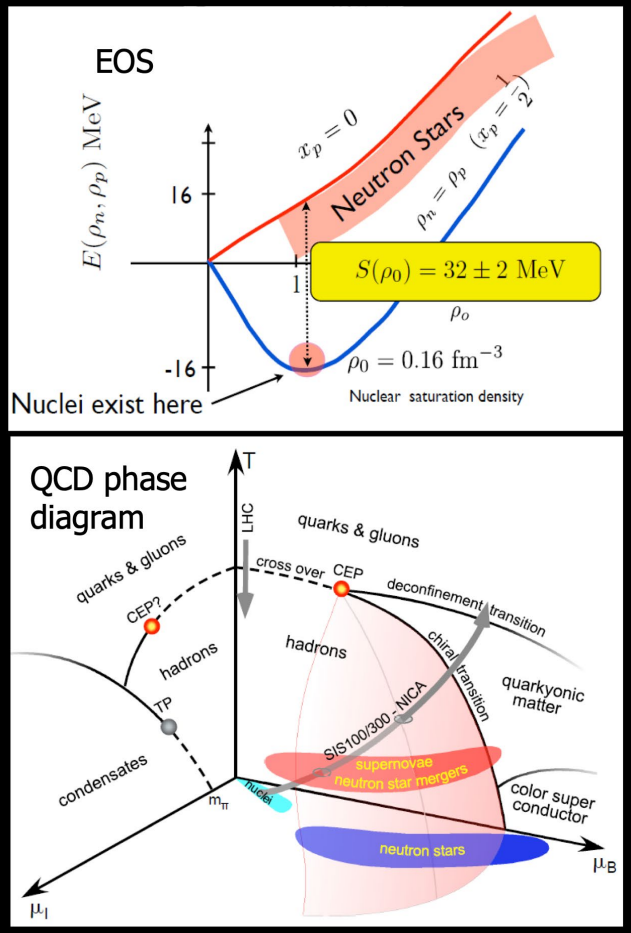
Hadron-Physics
K-H. Kampert

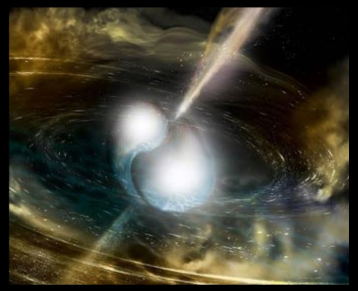
Experiment: Compressed Baryonic Matter (CBM)

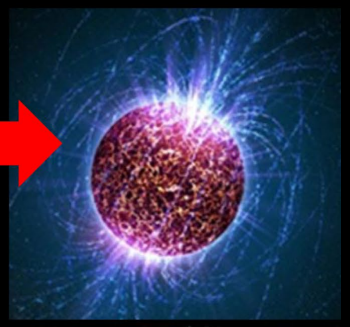
- Study extreme matter densities in a fixed target experiment
- Density comparable to neutron stars
- Study in details the QCD phase diagram

High-density QCD Matter in Lab and Space

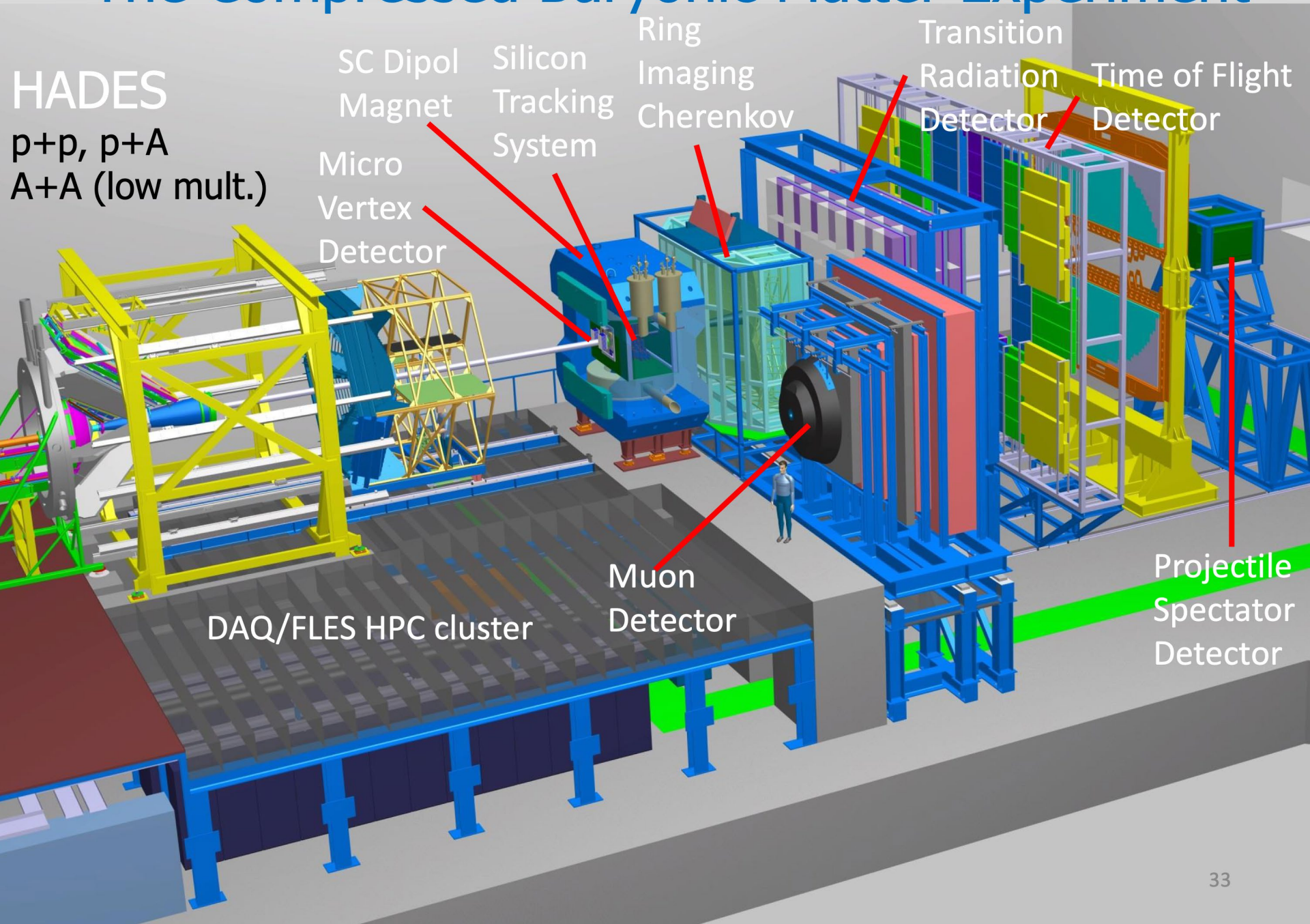








The Compressed Baryonic Matter Experiment



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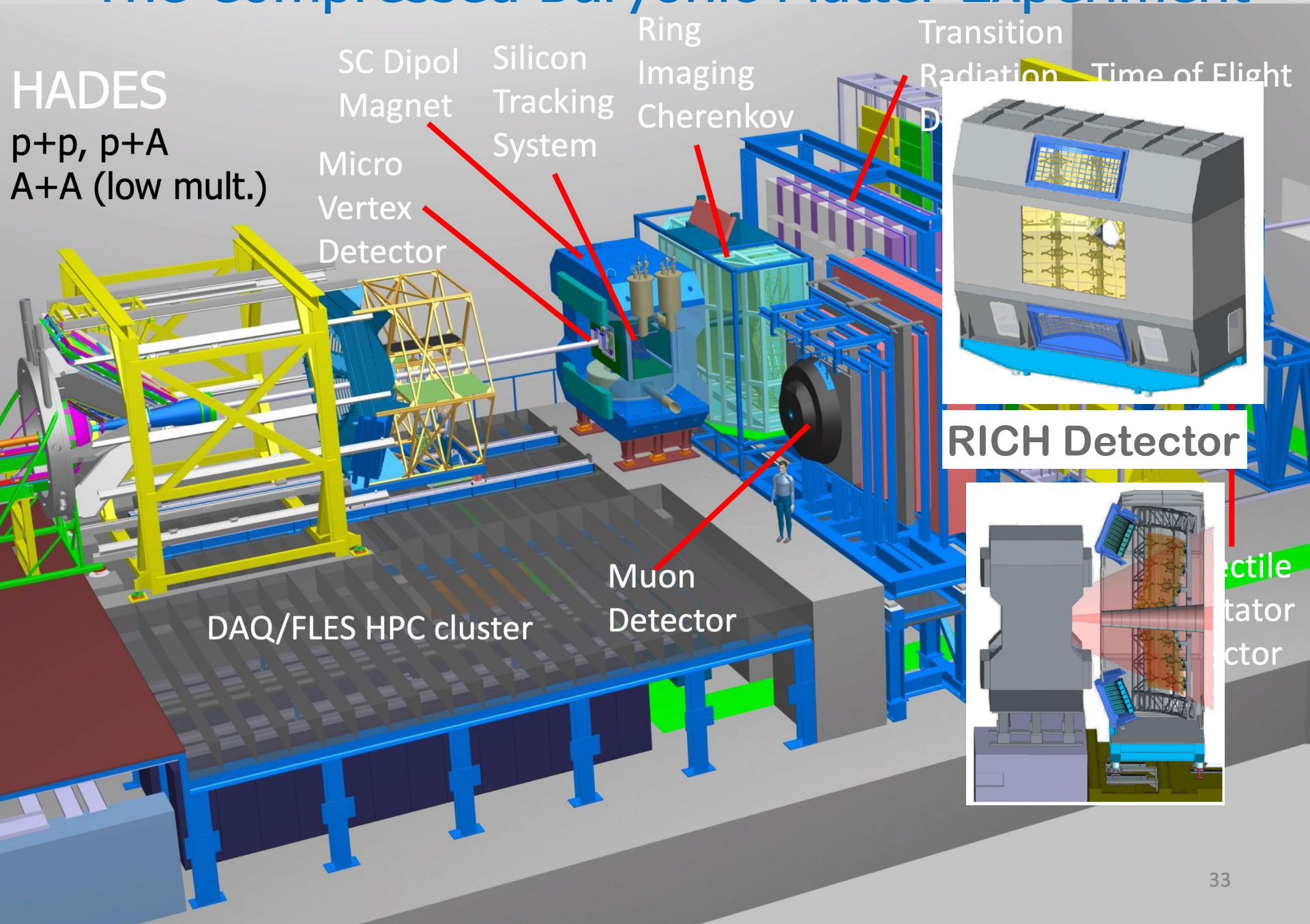

Epistemology of the LHC

- Since more than 10 years a collaboration with philosophers, historians and sociologists exists
- 6 year Research Unit funded by the Deutsche Forschungs Gemeinschaft/Austrian Forschungsfond
  - Topics
    - History of virtual particles
    - Problems of hierarchy, fine-tuning and naruralness
    - LHC and gravitational theory
    - Impact of computer simulation and machine learning on the epistemic status of LHC data
    - Model building and dynamics
    - Producing novelty and securing credibility in LHC experiments