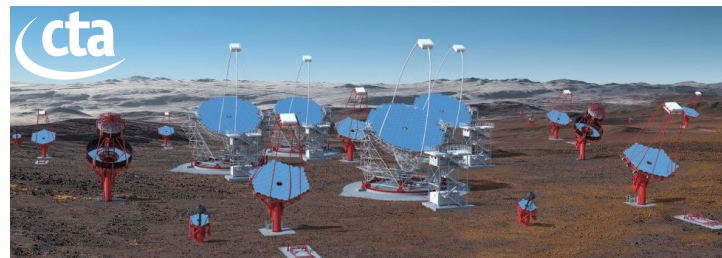# Equipe RCMN - Rayonnement Cosmique

H.E.S.S., CTA, GRAND

Equipe RCMN - Rayonnement Cosmique
H.E.S.S., CTA, GRAND

H.E.S.S., recent activites and news

- Extension of activity for H.E.S.S. for 2025-2028 on good track
- We continue slowly ramping down our responsabilities
  —> we stopped our technical activites end of 2023
- Main results of the team in the last 2 years:
  - Study of PKS 1510-089 points towards different —>
    emission zones
  - Lorentz Invariance Violation: proof of concept
    for combined analysis using Monte Carlo simulations

Bolmont et al. (2022, *ApJ*)


H.E.S.S. collaboration (2023, *ApJ*)
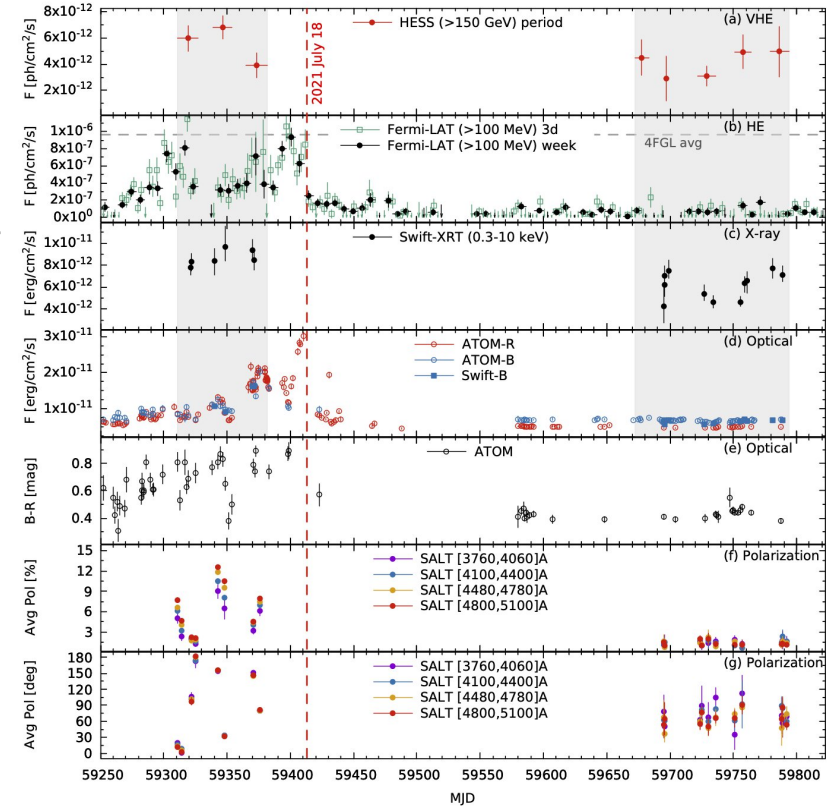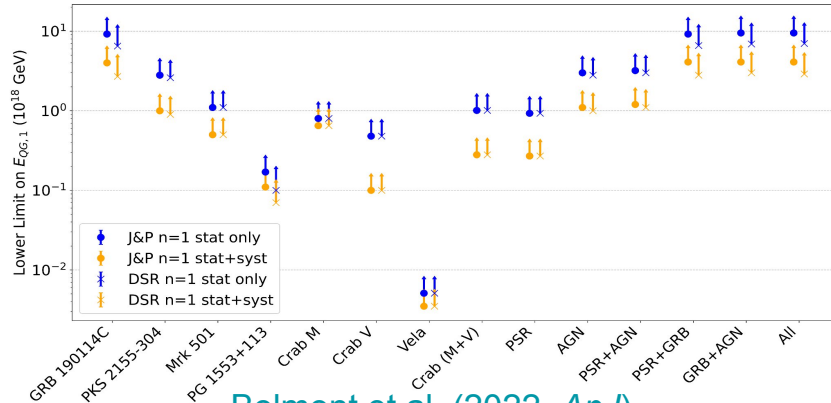
H.E.S.S., the next years

- Extension of activity for H.E.S.S. for 2025-2028 on good track, our planned contributions:
  - We still keep minimal service tasks in the form of:
    - Shifts
    - Monte Carlo simulations for the production of Instrument Response Functions
      —> particularly important for the production of the H.E.S.S. legacy dataset
  - Continue the scientific exploitation as long as possible:
    - AGN studies, including variability and modelisation of source intrinsic time delays
      - Includes alert generation and follow-up
    - Lorentz Invariance Violation (LIV)
      - Combined analysis of multi-sources and multi-instrument real data
      - Including potential source intrinsic time delays when possible   cf. poster U. Pensec: LIV with H.E.S.S.
      - Within the existing working group between H.E.S.S./MAGIC/VERITAS/LST-1
    - Indirect dark matter search
      - Combined analysis of multi-sources and multi-instrument real data
      - Including gamma rays and neutrinos, working with people from ANTARES, KM3NeT, IceCube
   - Also in contact with M. Cirelli (LPTHE) and M. White (GAMBIT)

CTA, recent activites and news

- NectarCAM CDMR (Critical Design & Manufacturing Readiness) review started in February 2021 and declared passed & closed by CTAO in June 2023
- @LPNHE:
  - Front-end board (FEB) for NectarCAM:
    - FEB card: 12 layers, designed, prototyped & tested at LPNHE, ongoing production with Ouestronic (Rennes): 2560 cards for 9 cameras.
    - FEB v6: "ping-pong" mode → reduced dead-time (7.2 μs → 400 ns)
      cf. poster J.-L. Meunier: FEB for NectarCAM
  - Software development for calibration and validation
- On the analysis and simulations side:
  - Development of ctaagnvar, a pipeline for the study of AGN variability   cf. poster G. Grolleron: ctaagnvar
  - Prepare follow-up observations of neutrino events in the IceCube-gen2/KM3Net era
  - Prepare LIV observations with CTA, including potential source intrinsic effects
    cf. poster A. Rosales de León: LIV with CTA
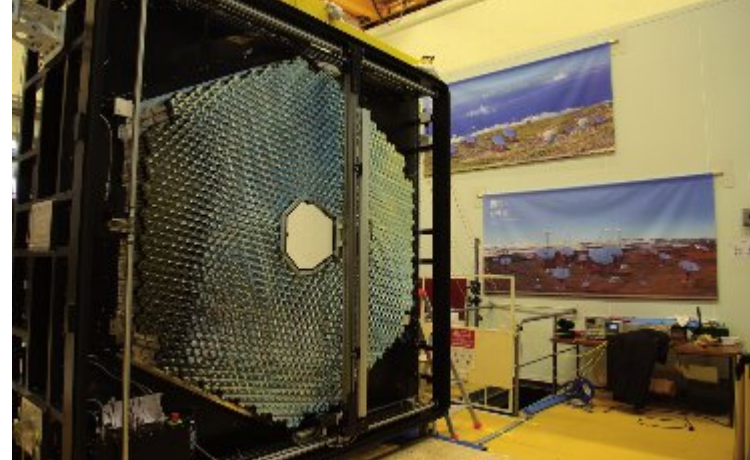
CTA, the next years

- On the construction/production side:
  - Produce 8 more NectarCAM in the next 4-5 years
    - Many parts already produced or being produced
    - Integration of the second camera to start in the next weeks, then 1 camera every ~6 months
  - @LPNHE
    - Finish the FEB production —> end of 2025
    - Finalize the control software of the camera —> 2026?
    - Continue software development for calibration and validation

- On the analysis side:
  - Continue on AGN Key Science Project (population, flares & long-term monitoring program)
  - Continue involvement in the Science Data Challenge
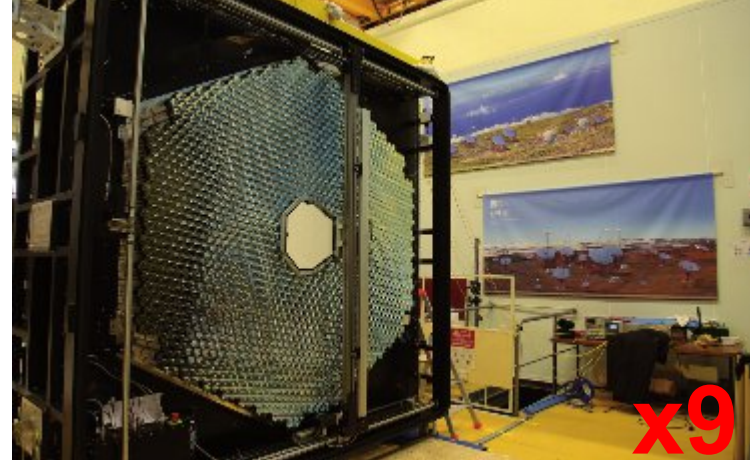
CTA, the next years

- On the CTA north site of La Palma:
  - Commissioning of LST-2, LST-3 and LST-4 —> 2025 and 2026
    - First stereo data of CTA
    - Most important part of the CTA array for transient events —> AGN flares, GRBs, LIV
  - Commissioning of 1st MST (with a NectarCAM) —> start planned for fall 2025

Credit: J. Herrera IAC

GRAND, recent activites and news

- Deployment of antennas on 3 sites:
    - GRAND@Nançay (October 2022)
        - 4 antennas in Nançay radio observatory (France)
        - Used for trigger tests (LPNHE)

    - GRANDProto300 (February 2023) in Xiao Dushan (China)
        - First 13 antennas deployed for design validation
            - Thermal regulation
            - Control of radio self-emission

    - GRAND@Auger (August 2023)
        - 10 antennas on the Auger site in Malargüe (Argentina)
        - Used for cross-calibration tests with Auger

Equipe RCMN - Rayons Cosmiques

GRAND, the next years (short term)

- Main goal in the next years:
  - Detection of very inclined cosmic rays with autonomous trigger on radio signals
- Deployment of 70 more antennas this autumn 2024 (approved 2 weeks ago!) in Xiao Dushan (China)
  - Total of 83 antennas, targeting autonomous detection of large number of very inclined cosmic rays
- @LPNHE:
  - Finalization of NUTRIG (ANR project)   cf. poster P. Correa: trigger for GRAND
  - Setup and manage data format, database and data flow
    - CC-IN2P3 main repository for data storage
  - Development of data analysis pipeline   cf. posters M. Guelfand: particle content of inclined showers
                                              A. Ferrière: analytical plane wave reconstruction
    - Using classical methods
    - Using machine learning methods

GRAND, the next years (long term)

Cosmic ray spectrum — *SNOWMASS review 2022, arXiv:2205.05845*

- Validation of GRAND detection principle
  —> 2025-2026
  - ~300 antennas by the end of 2025
    - Improved design adjusted for GRAND10k
  - Build pipeline for data selection and reconstruction
  - Measure detection efficiency, background rejection efficiency
  - Build energy spectrum for cosmic rays for E = 10^16.5 - 2.10^18 eV

- Physics run —> 2026++
  - Test various design for future giant arrays
- @LPNHE:
  - Analysis of GRANDProto300 data
  - Prospective for the GRAND10k trigger