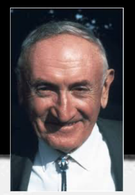
Why CTA matters in Switzerland

What do we bring and share

CTA computing challenges

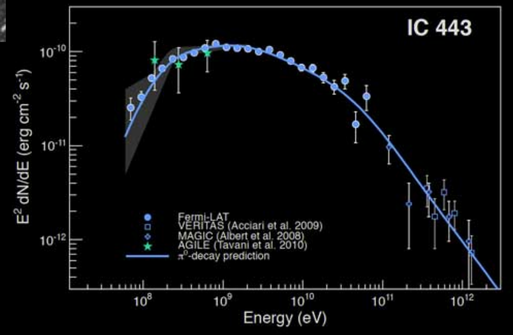
PROBING HADRONIC ACCELERATION



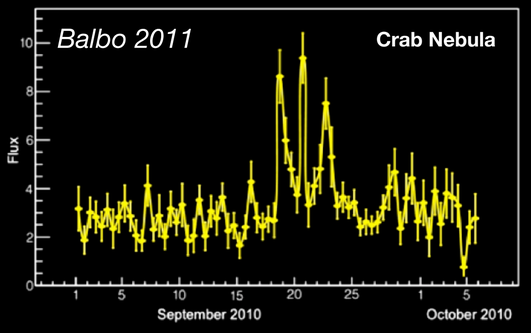
Cosmic rays are caused by exploding stars which burn with a fire equal to 100 million suns and then shrivel from ½ million mile diameters to little spheres 14 miles thick, says Prof. Fritz Zwicky, Swiss Physicist

"This, in all modesty, I claim to be one of the most concise triple predictions ever made in science. More than 30 years were to pass before this statement was proved to be true in every respect."

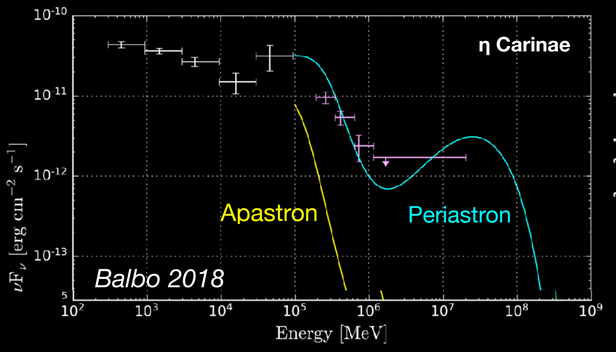
SNRs: GeV cutoff GeV protons ?

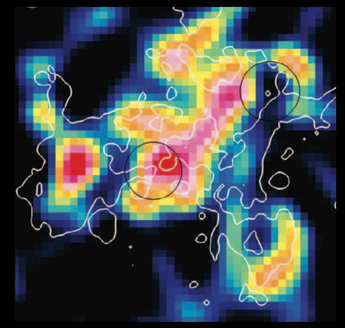


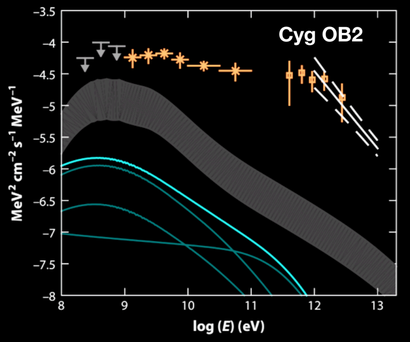
Pulsar Wind Nebula PeV electrons



OB stars: >TeV cutoff PeV protons ?



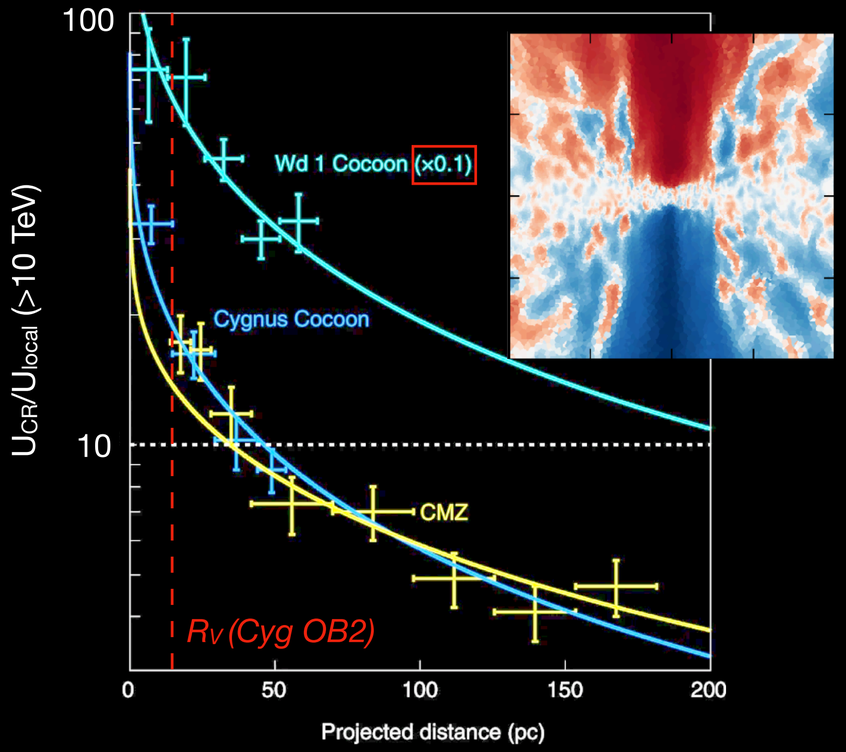




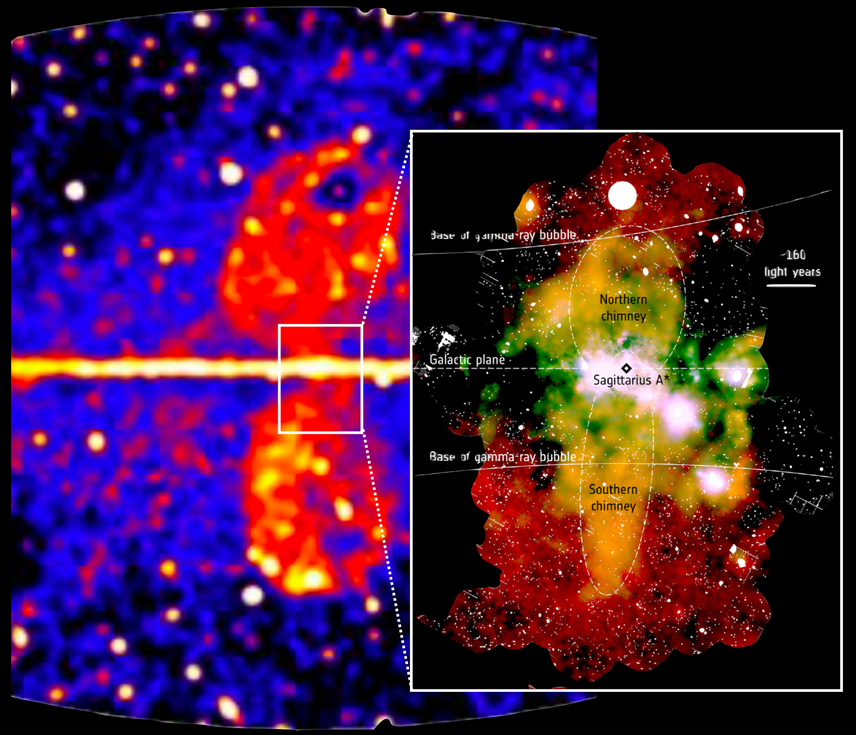
See talk by A. Mitchell

AND ITS RELATION TO FEEDBACK

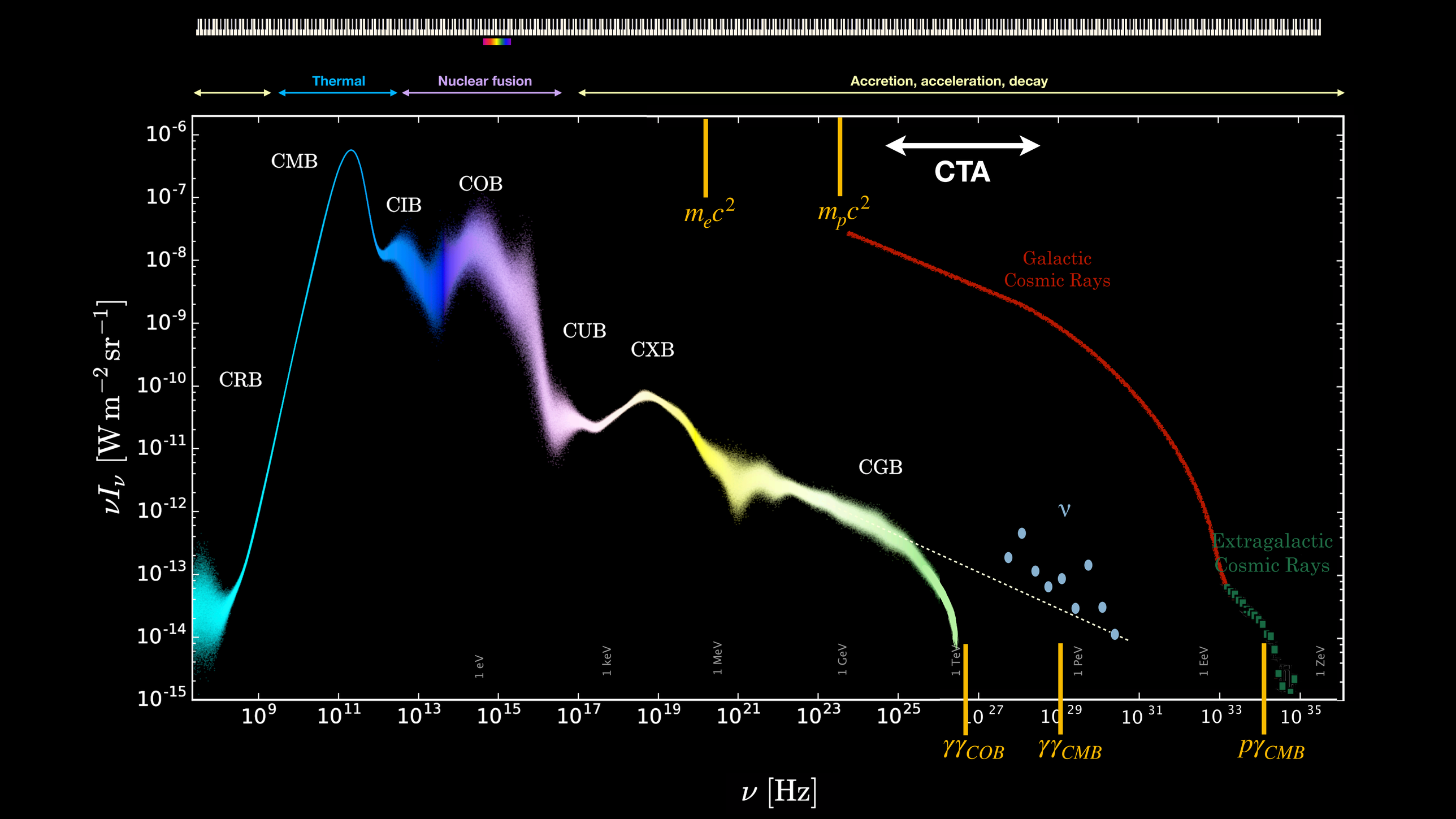
Galactic scale winds



Galactic Centre



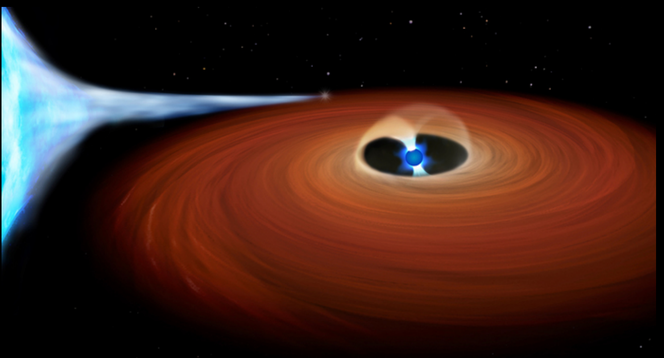
Clusters and the Universe

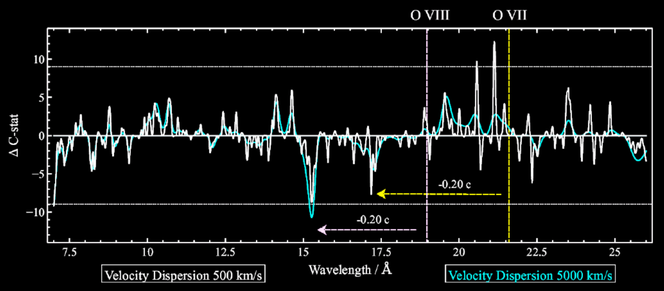

Thermal
Nuclear fusion
Accretion, acceleration, decay
CMB
CIB
COB
CUB
CXB
CGB
CRB
CTA
$m_e c^2$
$m_p c^2$
Galactic
Cosmic Rays
Extragalactic
Cosmic Rays
ν
$\gamma\gamma_{COB}$
$\gamma\gamma_{CMB}$
$p\gamma_{CMB}$
νI_ν [W m^{-2} sr^{-1}]
ν [Hz]
1 eV
1 keV
1 MeV
1 GeV
1 TeV
1 PeV
1 EeV
1 ZeV

SPECTACULAR HIGH-ENERGY SOURCES OF THE 2020s

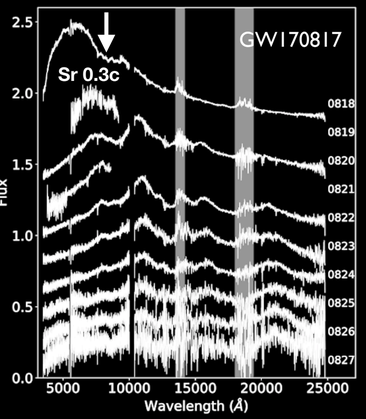
Relativistic outflows, everywhere

Ultra-Luminous Pulsars
$10^{2\text{-}4}\ L_{EDD}$

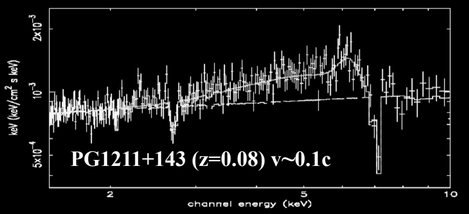


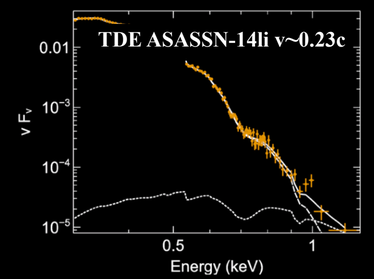


Gamma-Ray Bursts

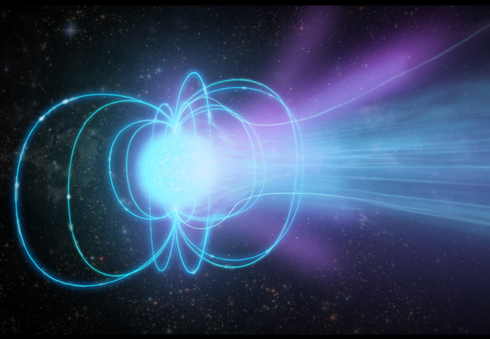


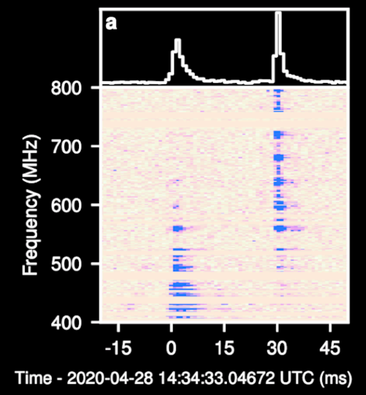
AGN/TDE Outflows





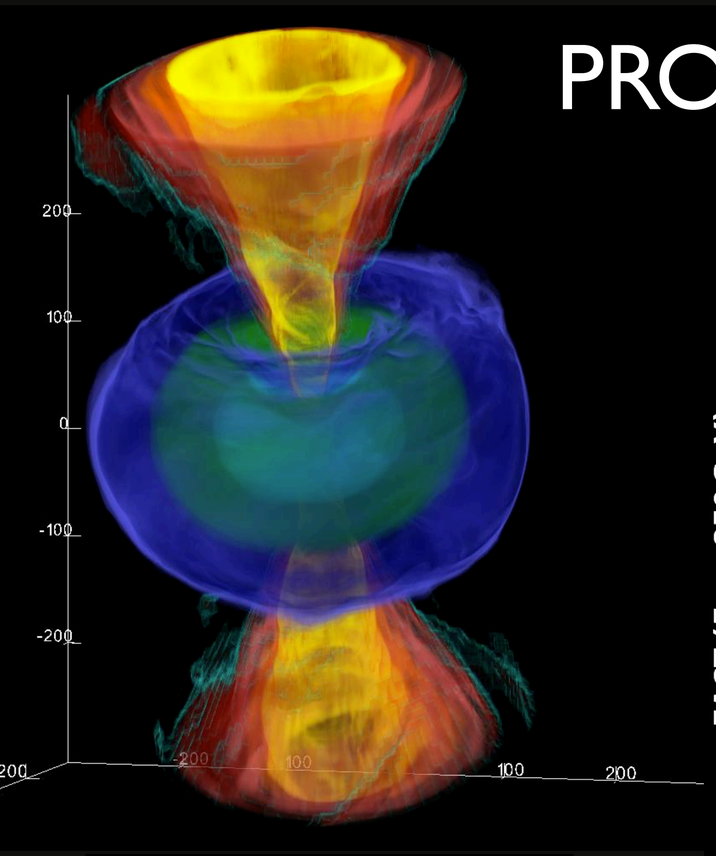
Magnetars/FRBs

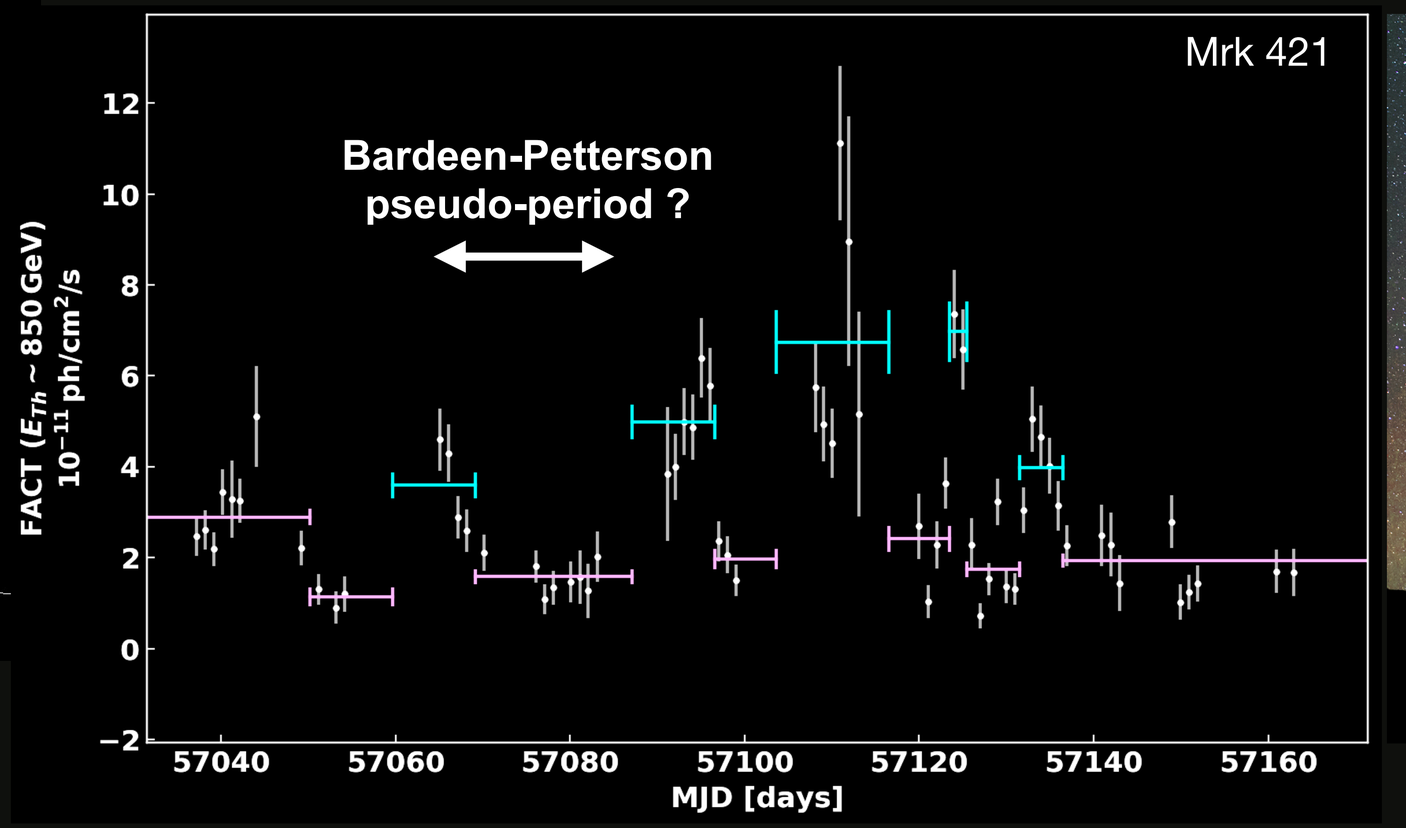


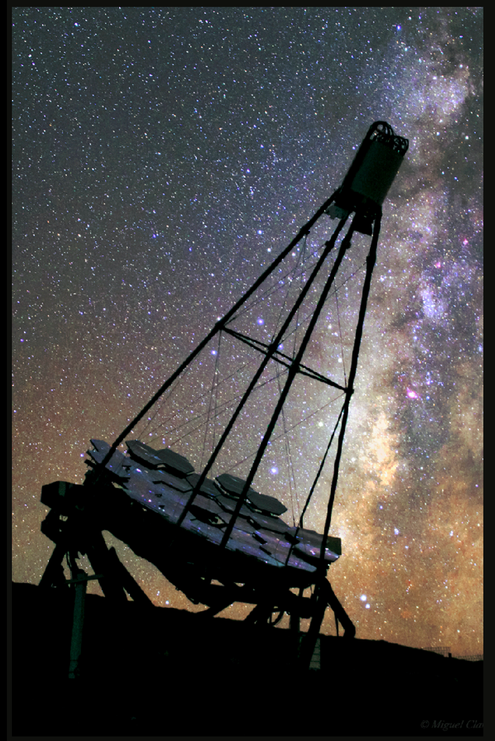


See talk by V. Savchenko

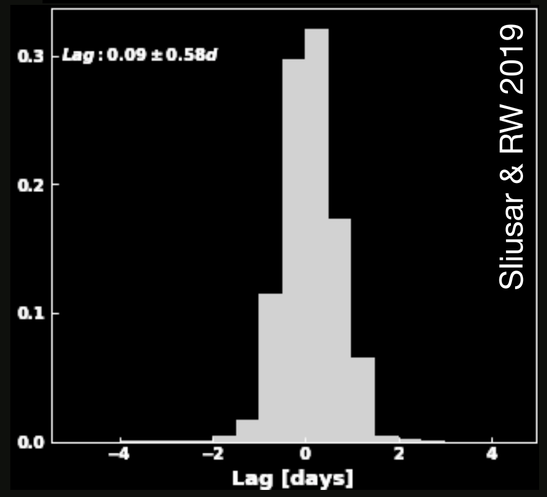
PROBING WHERE FLOWS END AND START







FACT- Swift XRT Lag



→ Inverse Compton emission from PeV electrons
(if driven by shocks)

See talk by A. Tramacere

What we want to share

- DIscoveries & knowledge
- A common goal in a great adventure

} education

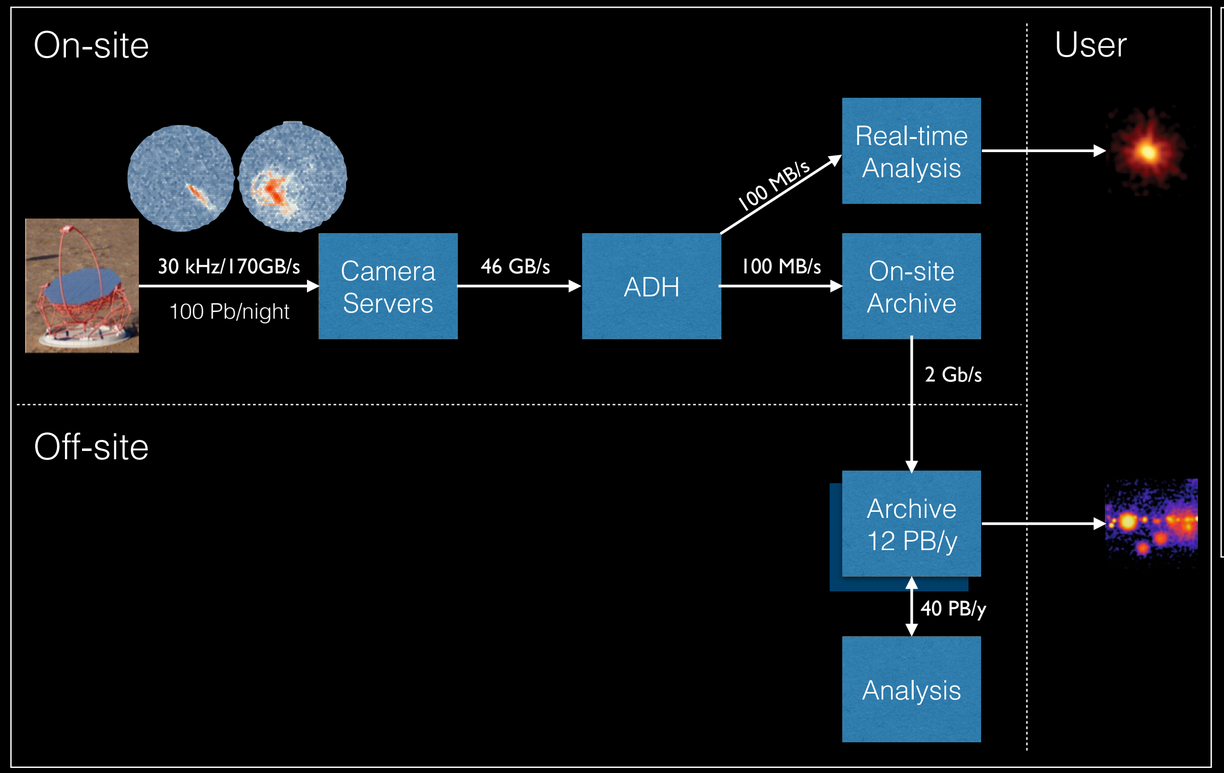
- The need for a complete CTA (hence for ressource optimization)

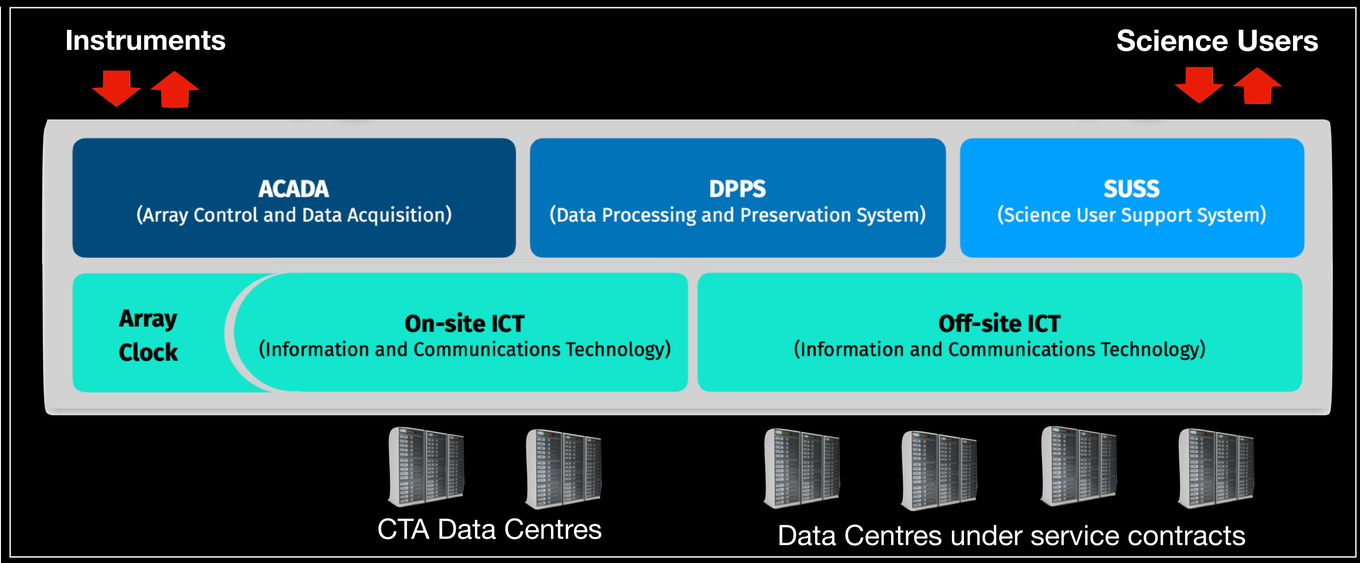
- An open-science culture to serve a broad community (astronomy heritage)
- A solid understanding of long term commitment (30 years long for INTEGRAL)

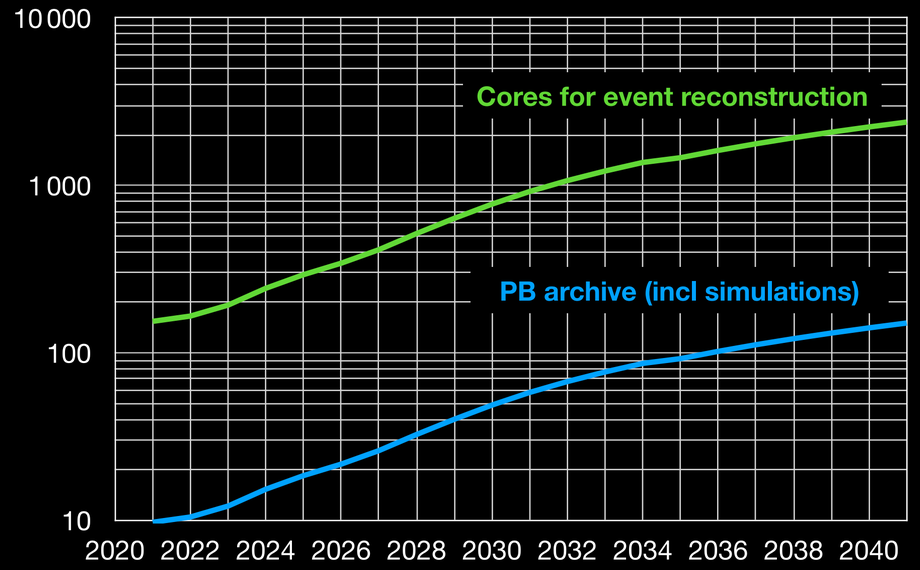
What we want to bring

- The community in Switzerland studying the Universe through radiation and messengers emitted by high energy or decaying particles (about 50 people, 30 years of history) or interested by optical interferometry
- Involvement in experiments complementary to CTA:
  - Astrophysics neutrinos: IceCube
  - PeV cosmic- and gamma-rays: HERD, LHASSO
  - MeV to GeV gamma-rays: POLAR2, HERD
  - X-rays: XRISM, eXTP, ATHENA
- An other Zwicky ? Humm…
- Engineering and project management, for what follows on computing aspects

CTA Computing Challenges



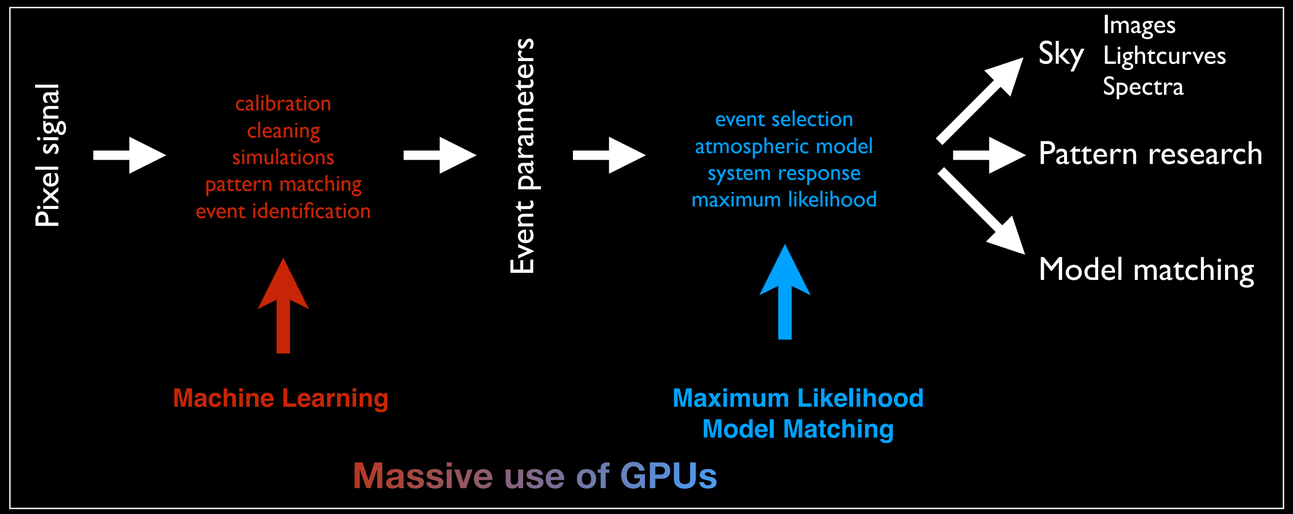


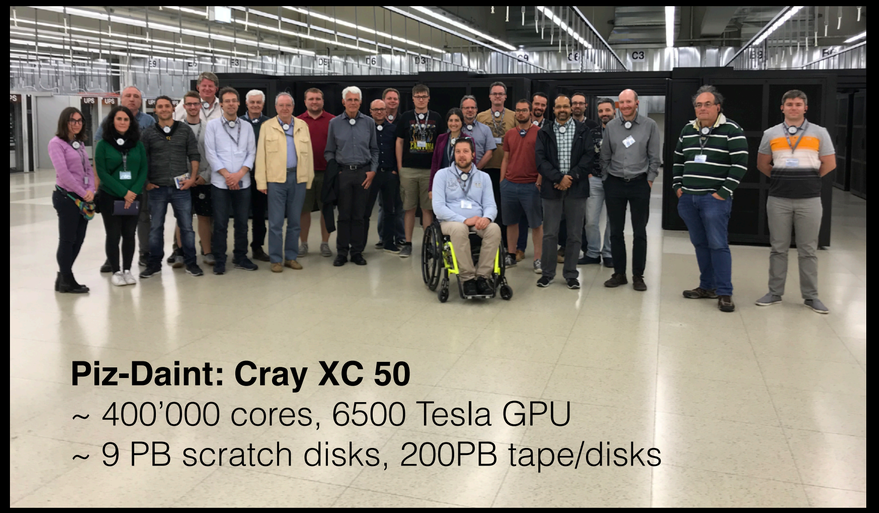


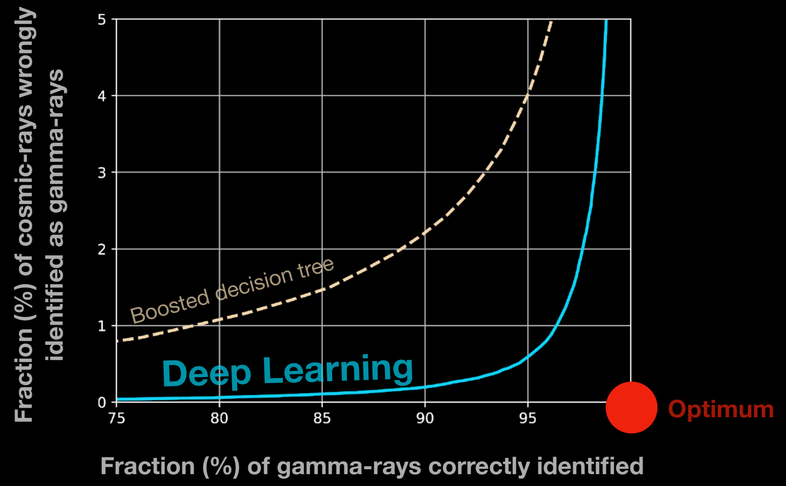
Array Data Handler development:
- proven performance scaling
- 900 cores for CTA-N & S
- compressed fits format for disk
- relies on Google's protocol's buffers

Distributed archive prototype:
- Open Archival Information System implementation
- light weight
- relies on NASA's W3Browse

CTA Computing Challenges







The University of Geneva, EPFL and CSCS (ETHZ) collaborate on computing, on the infrastructure and on software development and optimisation. In particular in view of the need of highly paralleled computing for both CTA and SKA.

CTA Computing Challenges

- Provide the best products and services
- Be fair and open
- Make it usable for 30 years
  - minimise dependencies, in particular for data and analysis software
  - do not develop software technologies, reuse and rely on solid partners
- Take advantage of a worldwide community to distribute the burden and the joy
- Leverage GPU and Machine Learning power to increase the scientific potential

Take Home Messages

- To get a complete CTA matters to Swiss researchers

- We have a culture providing long lasting support to the community through data centre activities

- We have a solid national computing infrastructure available to support CTA

Dark matter was first proposed by Fritz Zwicky in 1933 due to the fact that there is a type of energy in the vacunm that influence the orbit of the planets and the expansion of the universe. Athough he proposed this almost a century ago, dark matter is still a mystery nowadays.