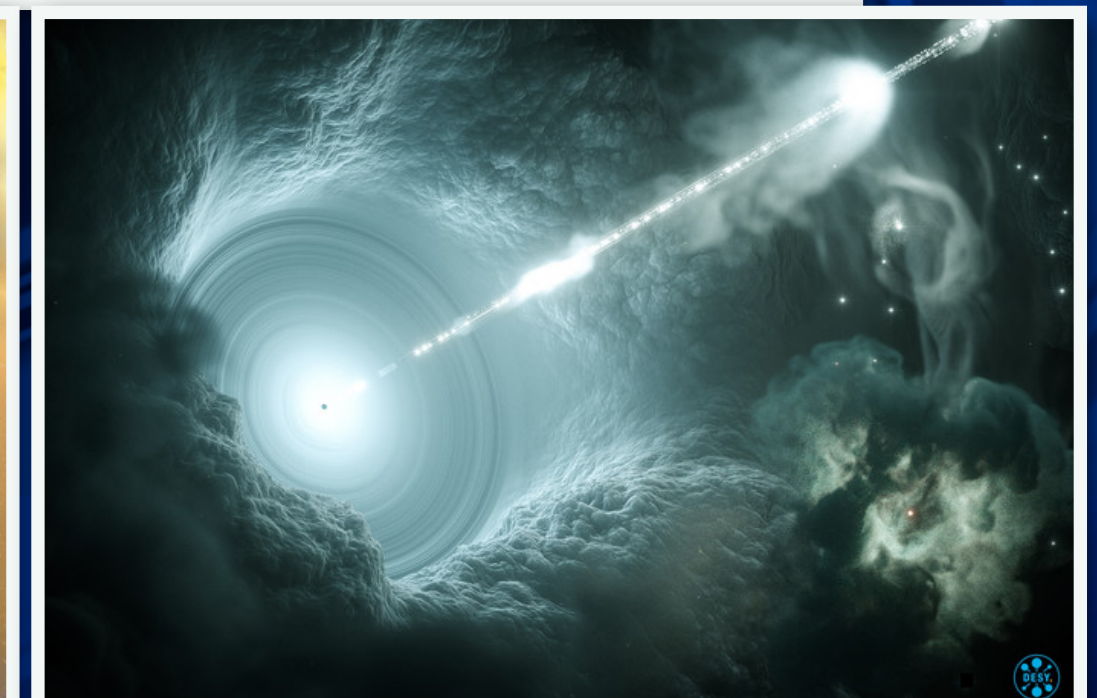
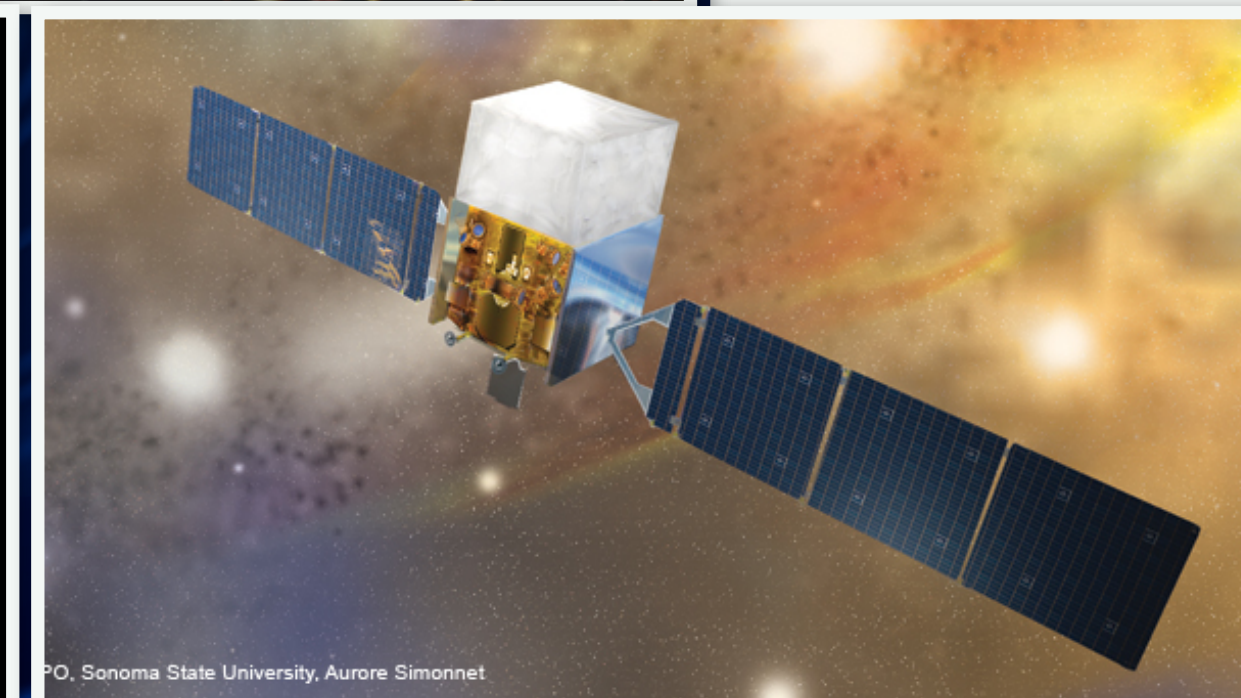
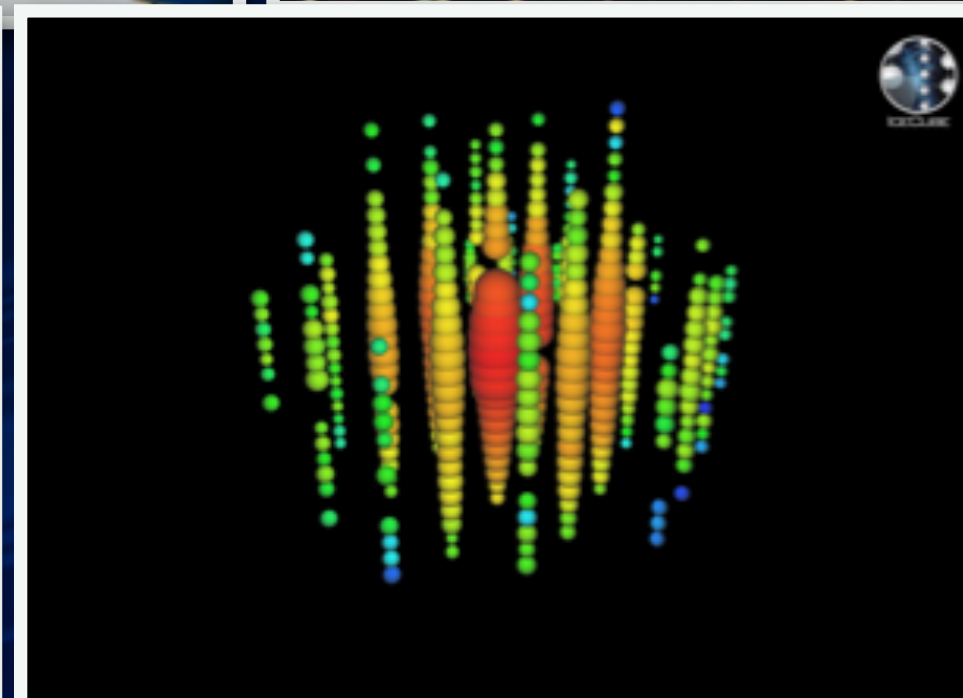
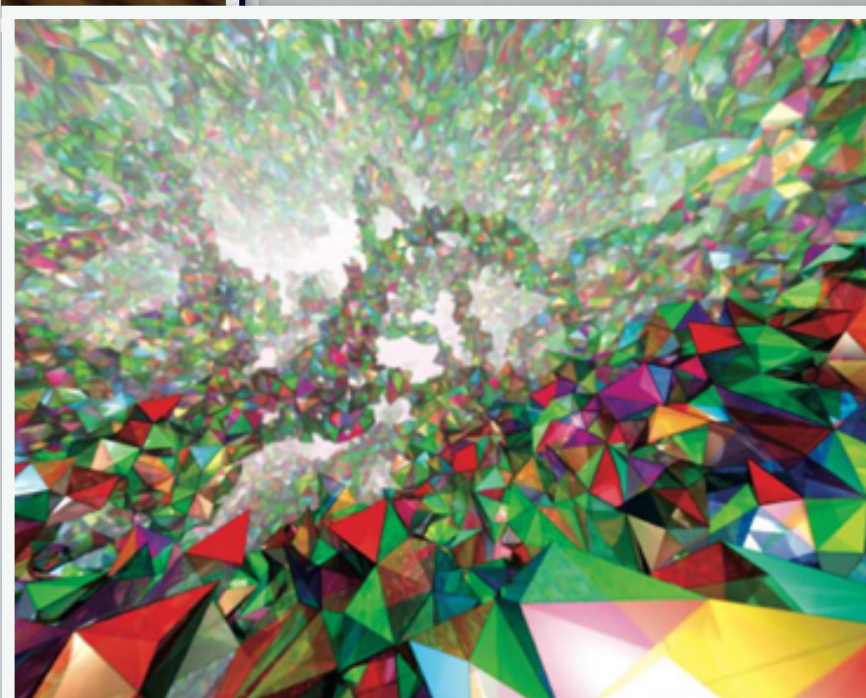
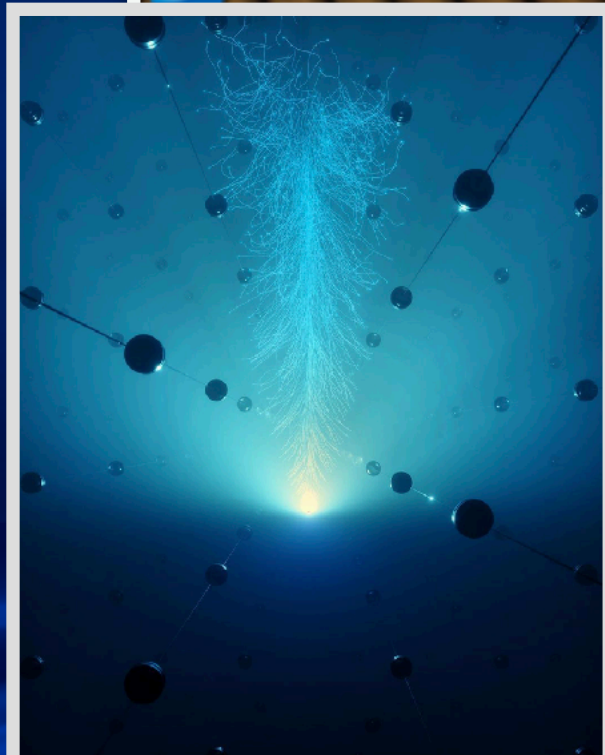
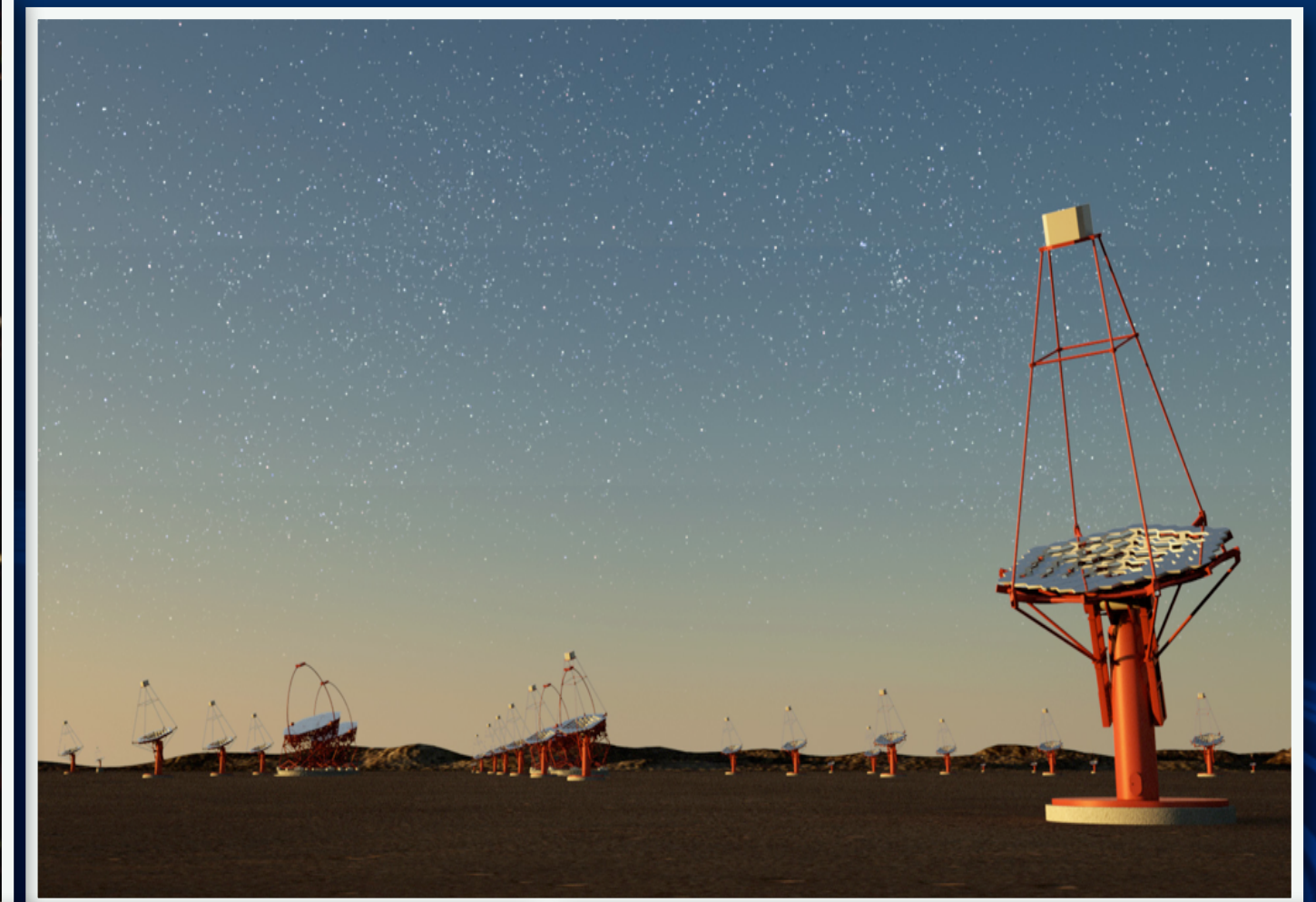
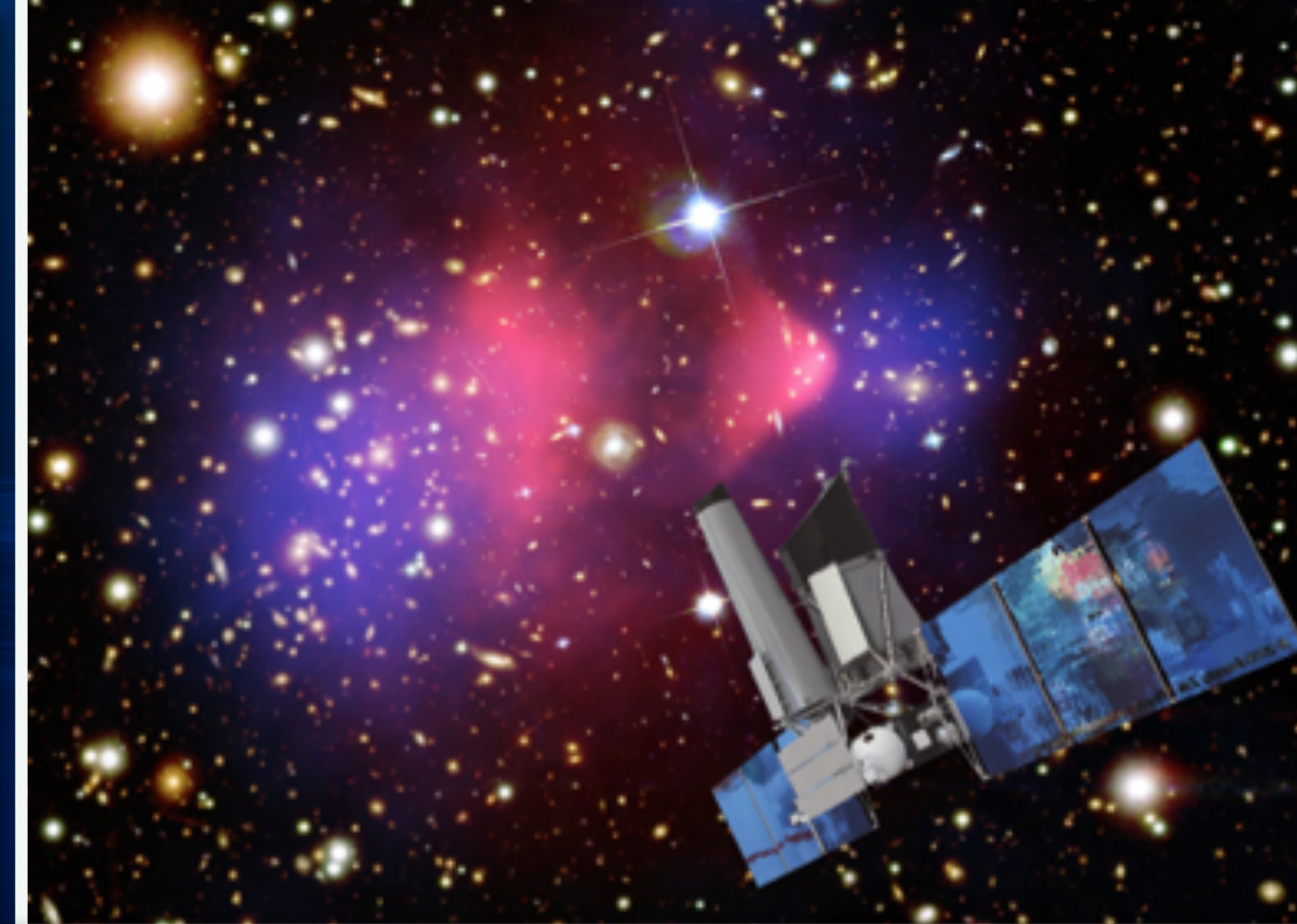
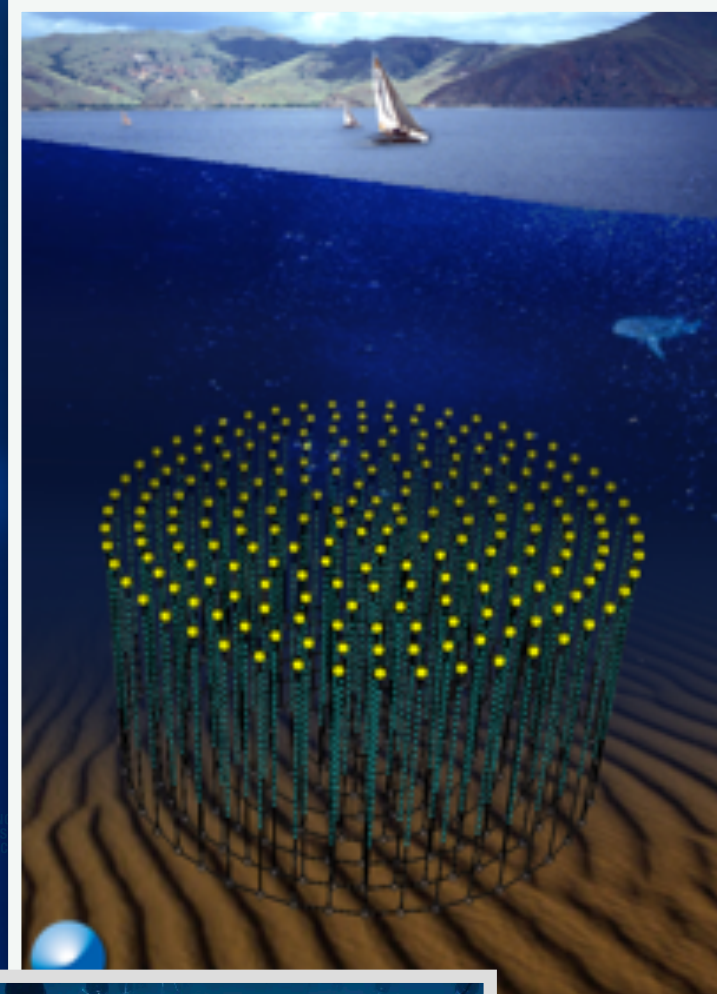


Erlangen Centre for Astroparticle Physics (ECAP)

Stefan Funk



THE ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS – ECAP – A UNIQUE CENTER

- 5 experimental professors (Anton, van Eldik, Funk, Katz, Nelles jointly w. DESY Zeuthen)
- 4 theoretical professors (Giesel, Mecke, Sahlmann, Thiemann)
- 3 professors at Remeis-Observatory in Bamberg (Heber, Sasaki, Wilms)
- Nordbayerischer Forschungscluster “Astroparticle Physics” with University Würzburg



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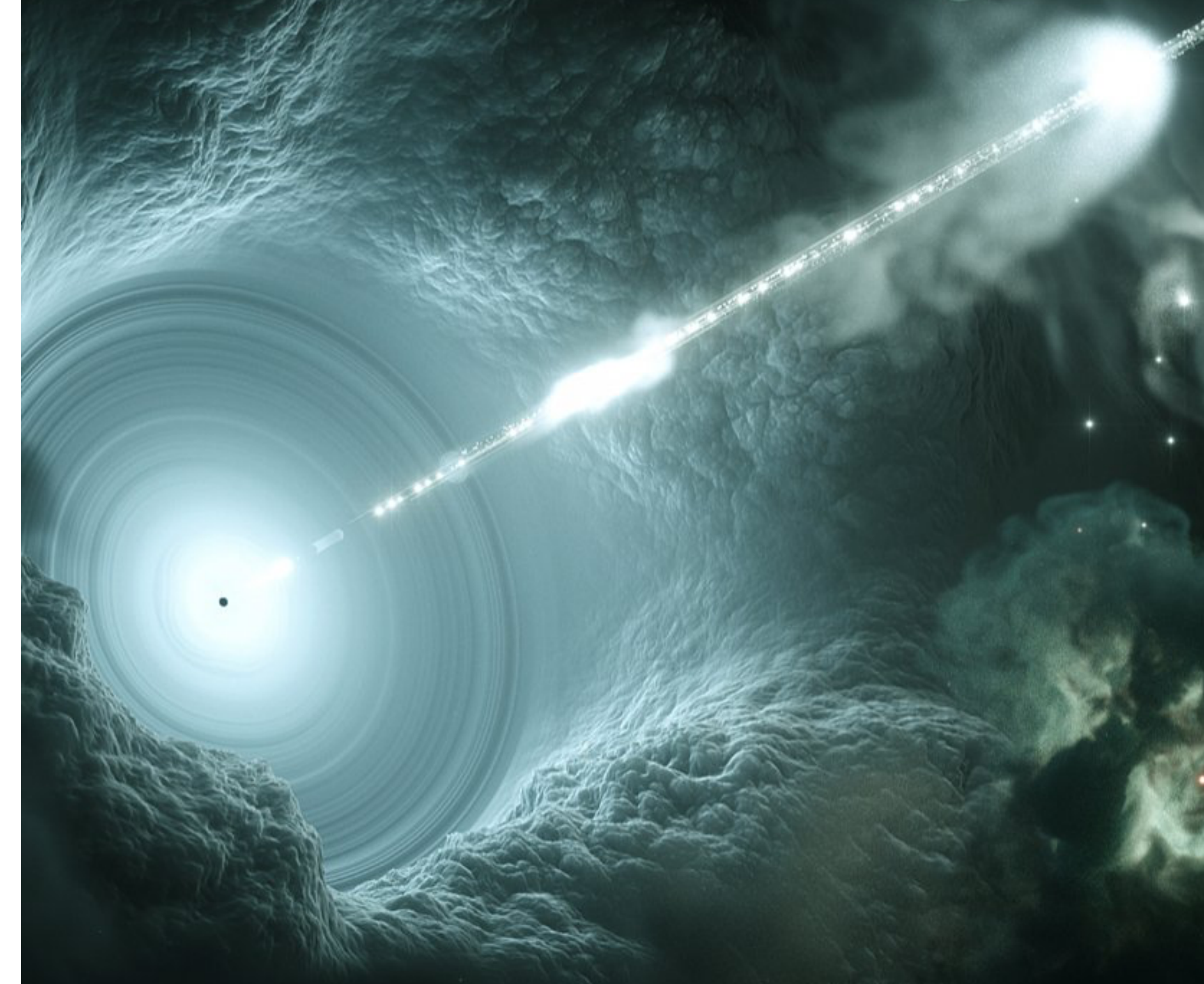
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THE MAIN SCIENCE TOPICS IN ECAP

- High-energy Astroparticle physics
 - The origin of cosmic rays
 - Black holes, neutron stars, supernova explosions
 - Multi-messenger astronomy with light, neutrinos (and gravitational waves)
- Fundamental theory connecting gravity and quantum mechanics and the early Universe
- Big data science, detector development, and technology transfer to medical applications

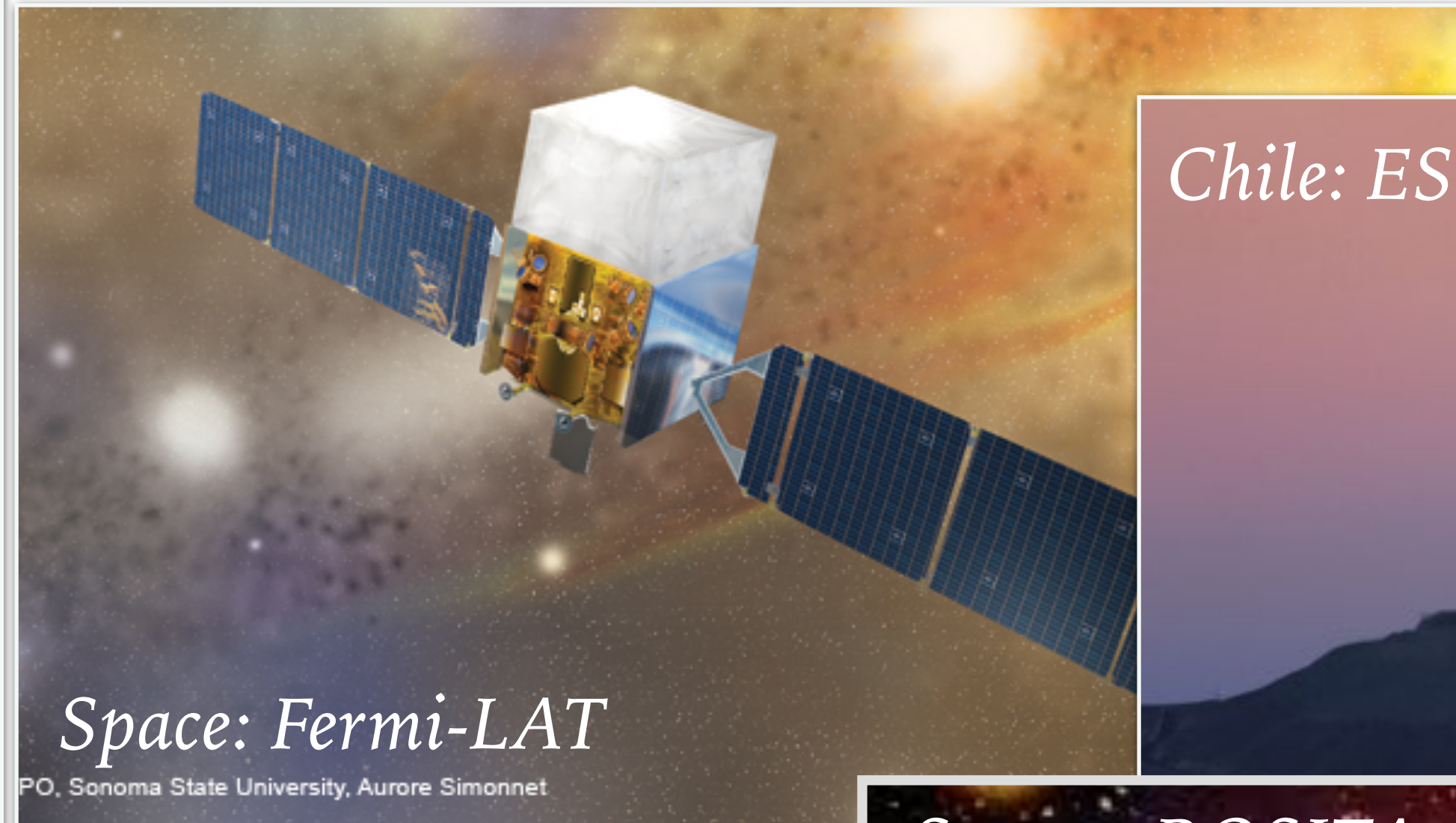
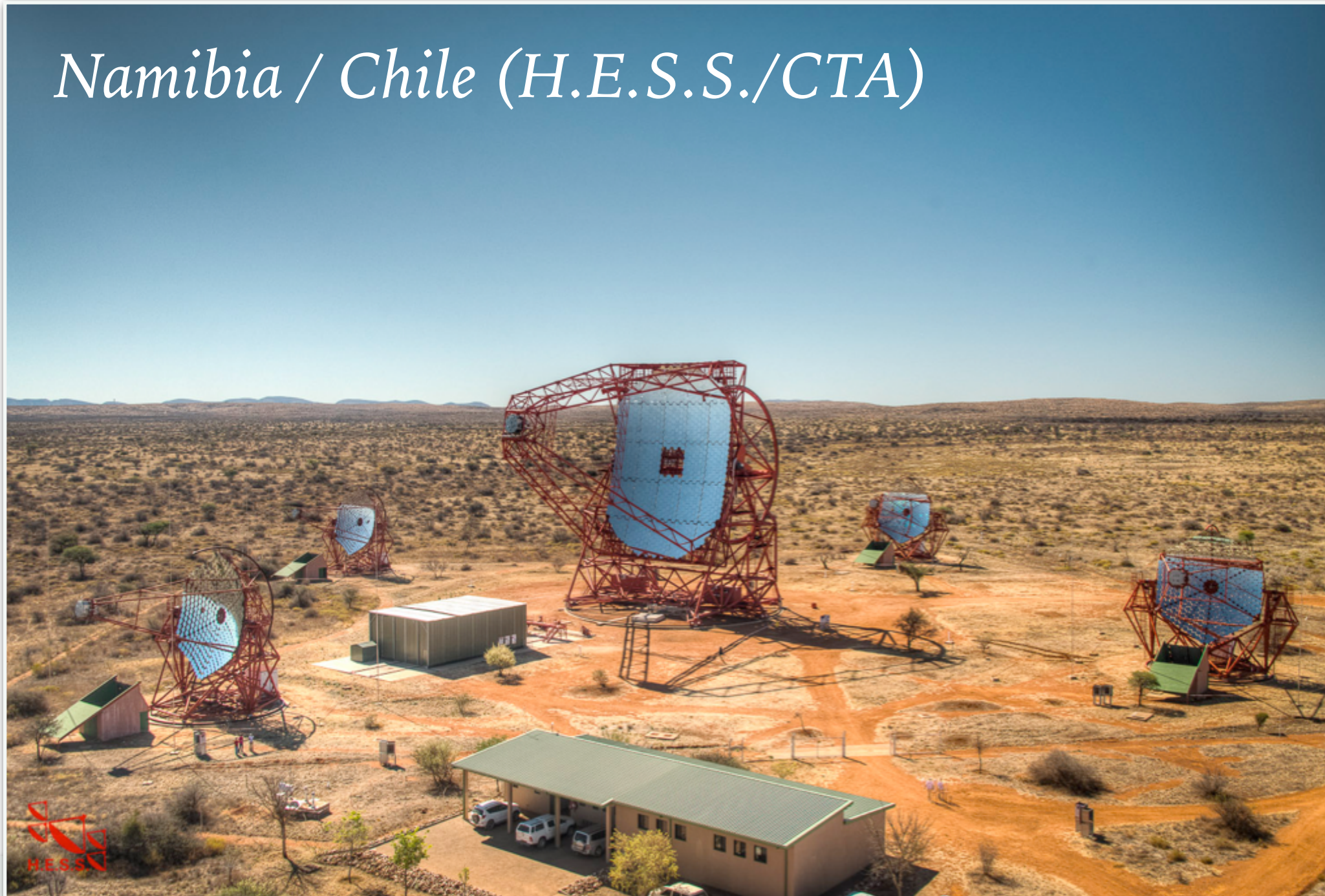
nature
astronomy



Neutrinos from a blazar flare

A LARGE PART OF OUR EFFORT INTO DEVELOPING/BUILDING OUR TELESCOPES

Namibia / Chile (H.E.S.S./CTA)



Space: Fermi-LAT

PO, Sonoma State University, Aurore Simonnet

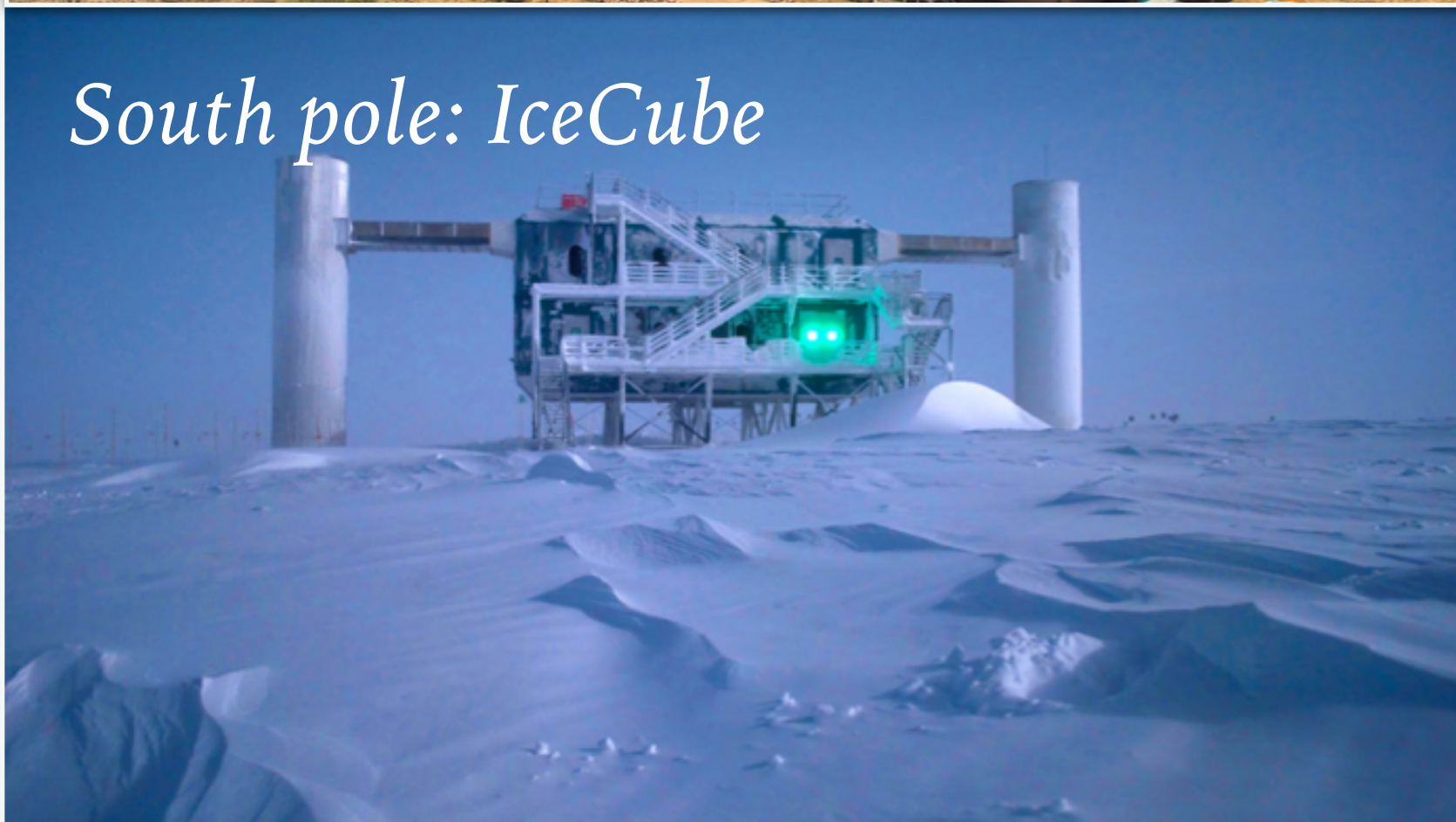
Chile: ESO VLT



Space: eROSITA



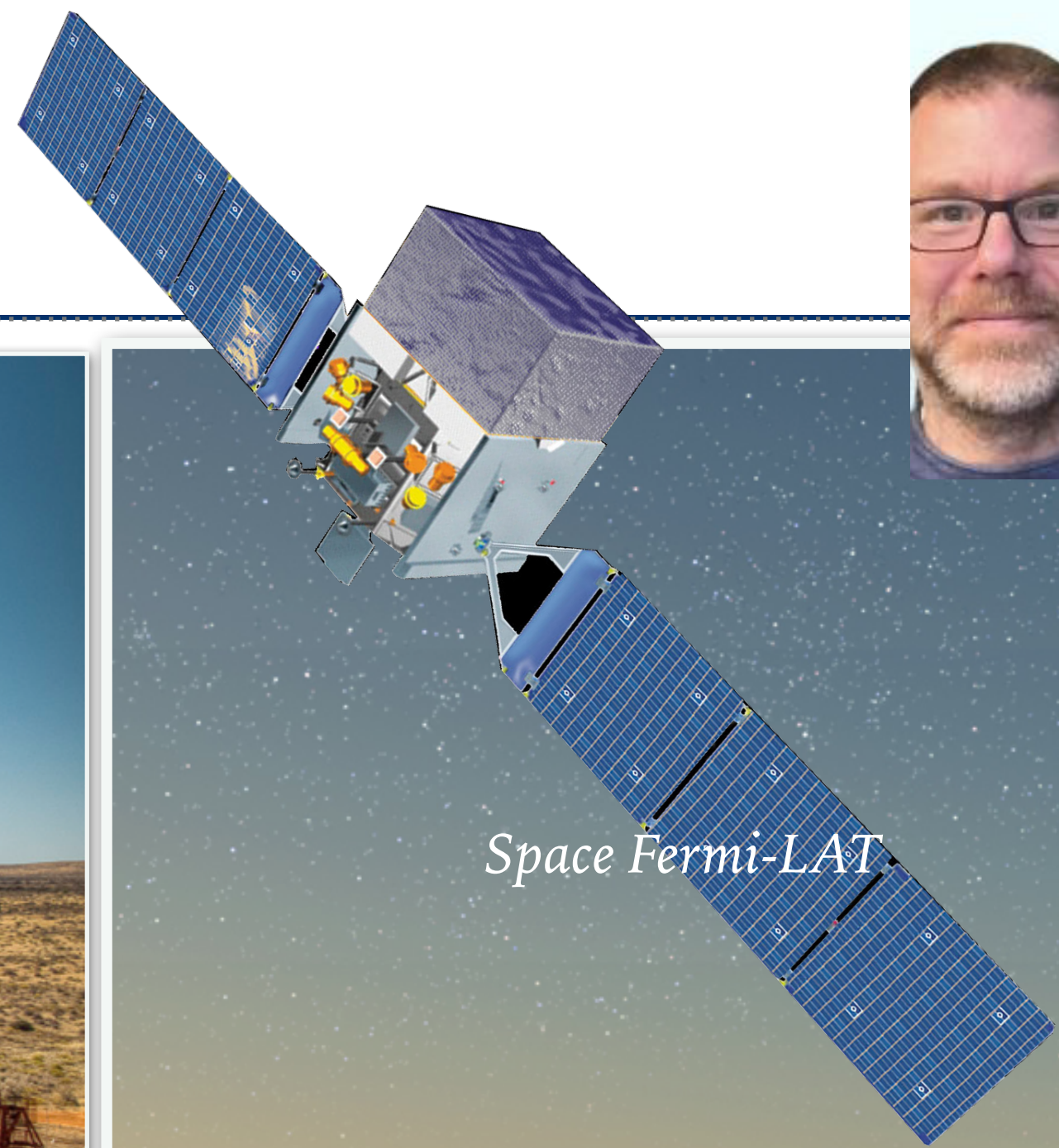
South pole: IceCube



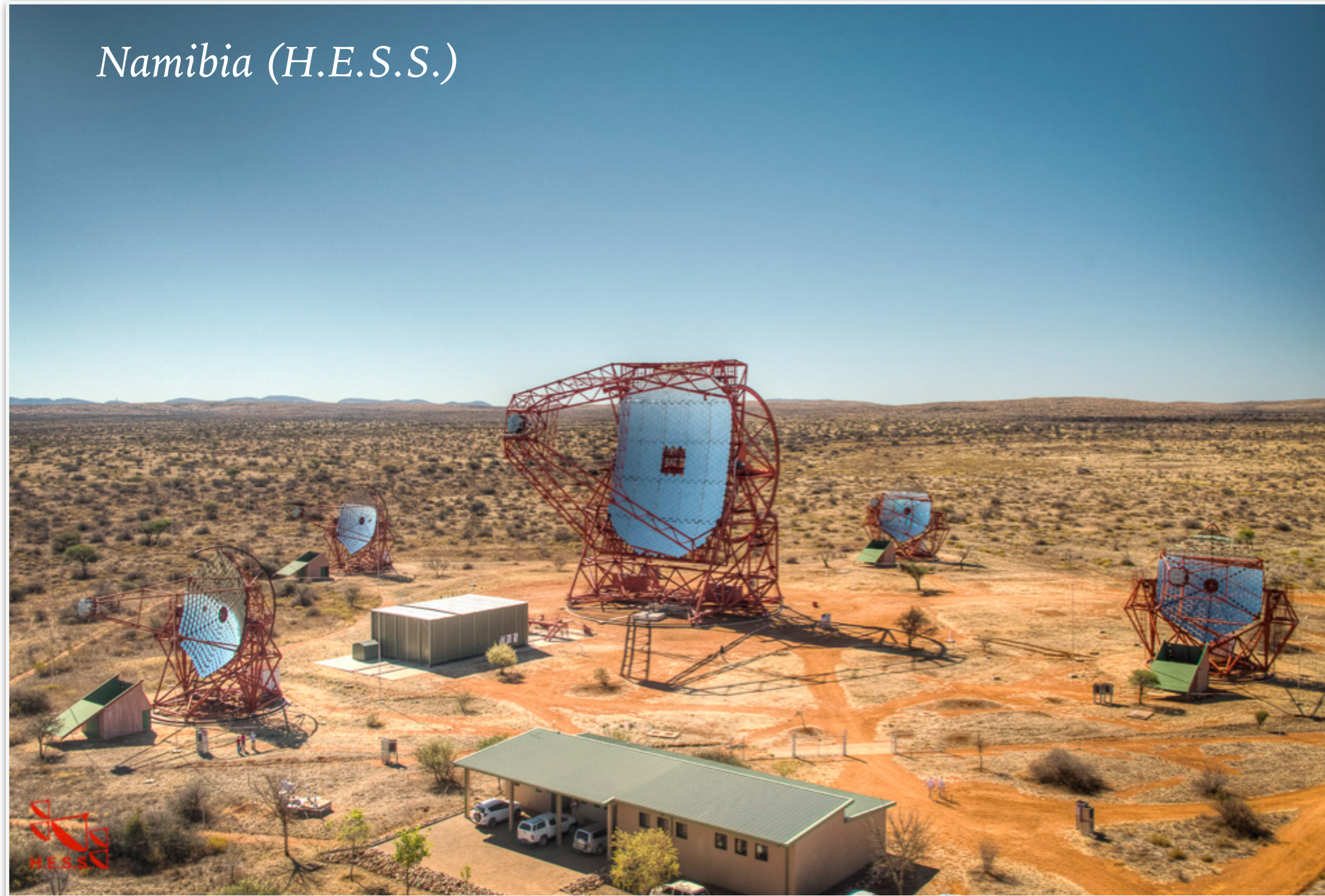
*Mediterranean sea:
ANTARES/KM3NeT*



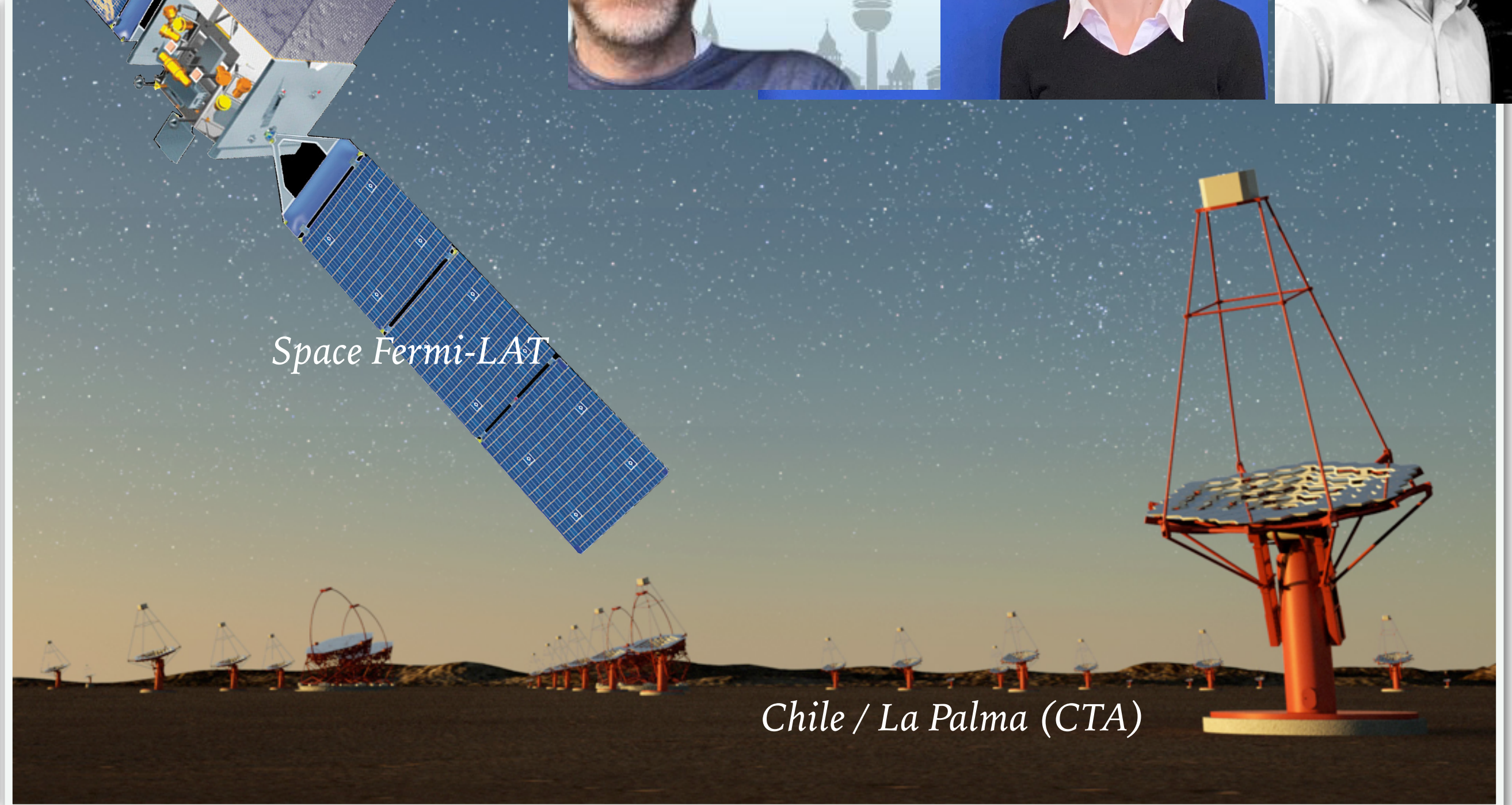
GAMMA-RAY ASTRONOMY



Namibia (H.E.S.S.)



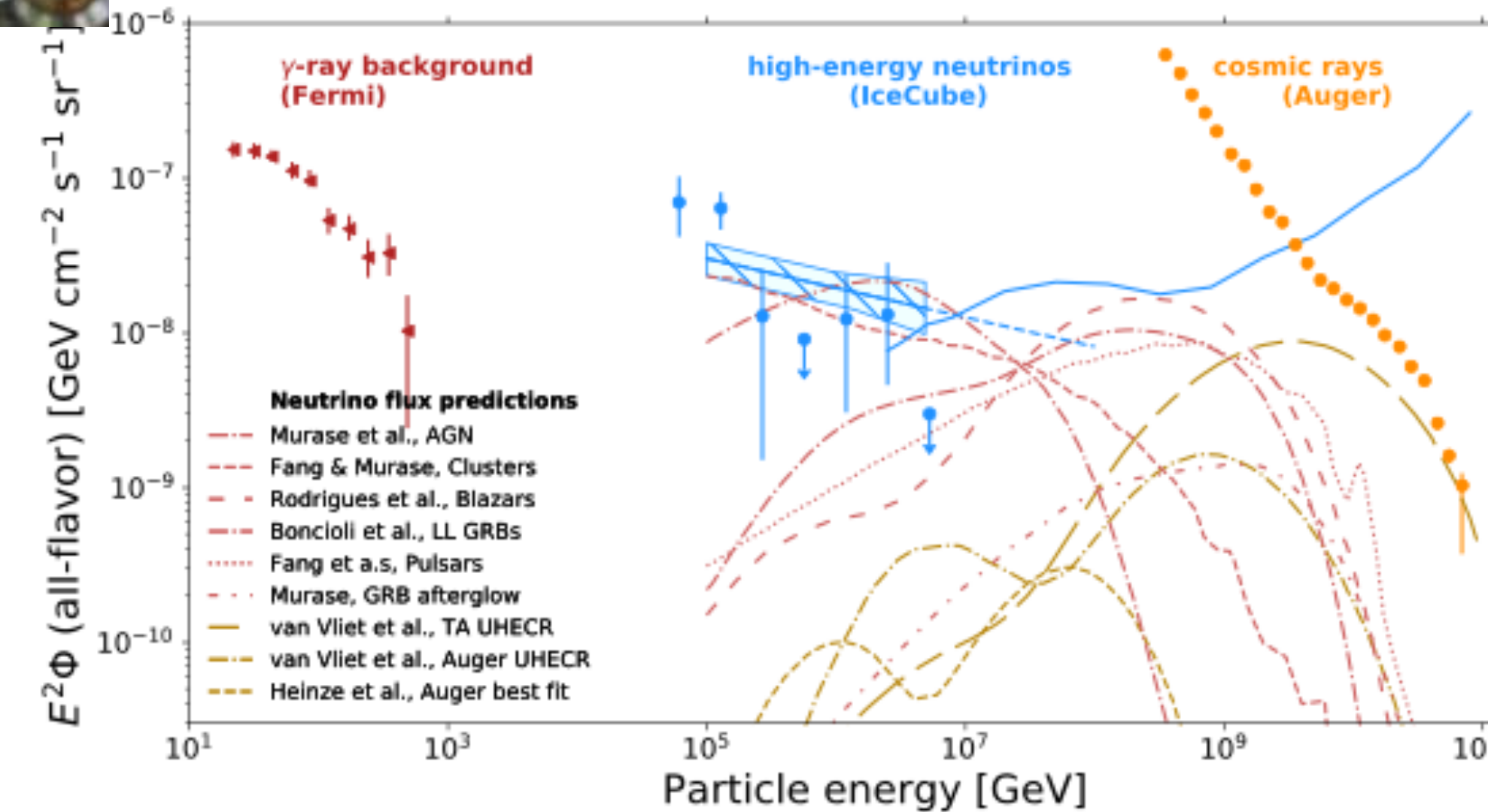
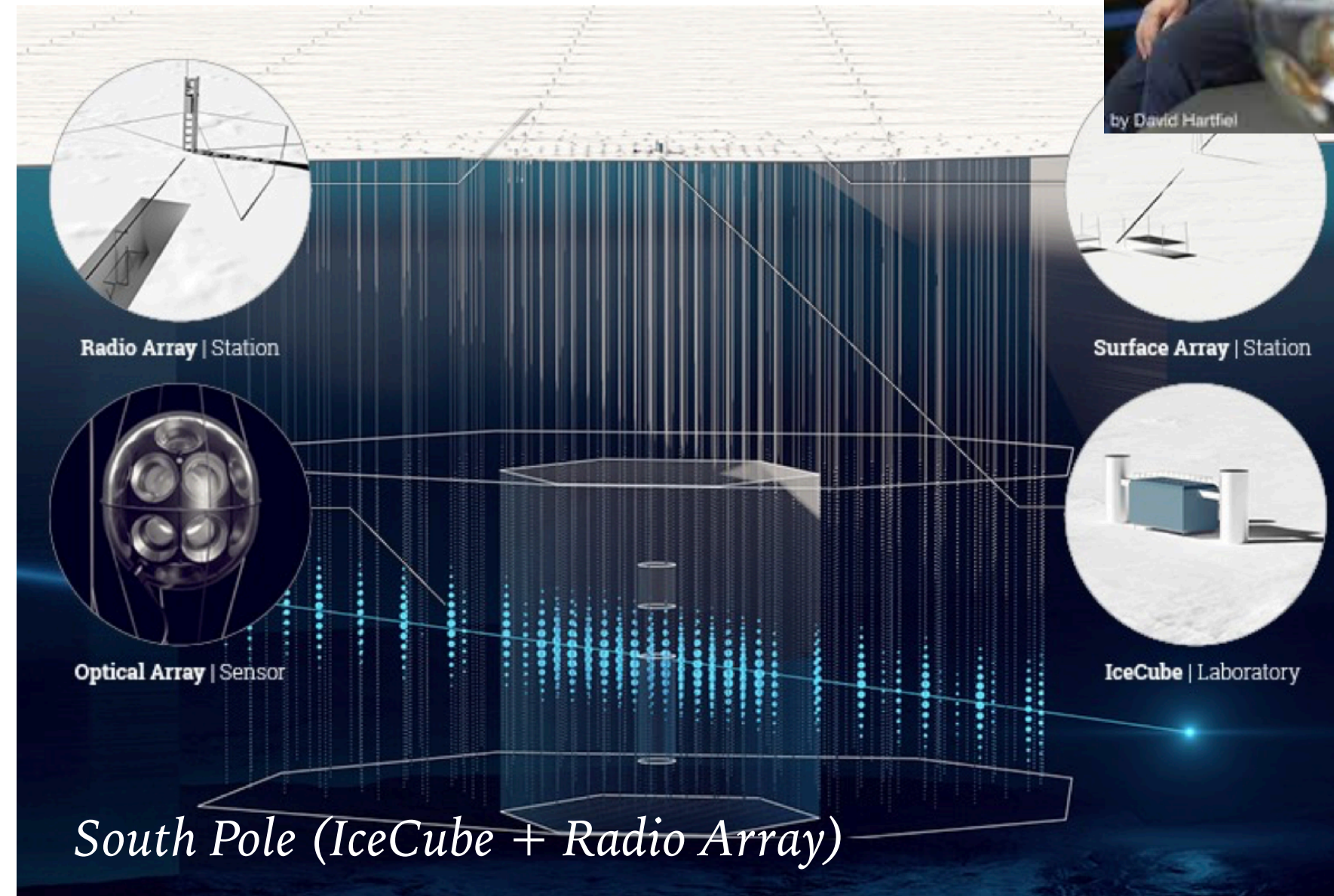
Space Fermi-LAT



Chile / La Palma (CTA)

- Substantial efforts in H.E.S.S., Fermi-LAT, CTA and SWGO
- Hardware development (e.g. camera electronics), software development (multi-instrument high-level science tools for CTA) and data analysis and interpretation (for Fermi-LAT, H.E.S.S.)

NEUTRINO ASTRONOMY

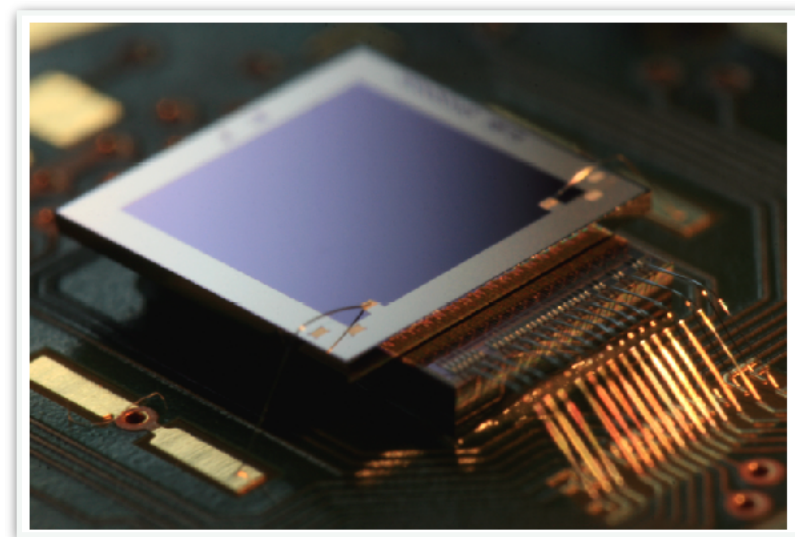


- Only institute in Germany with involvement in all major current (ANTARES, IceCube) and upcoming neutrino observatories (KM3NeT, IceCube-Gen2, RNO-G)
- Covering huge range in neutrino energies
- See talk by U. Katz

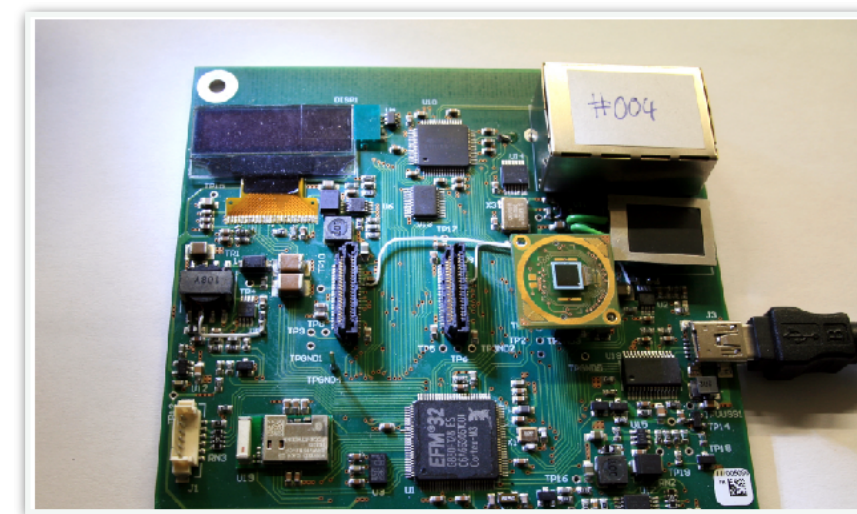
TECHNOLOGY TRANSFER AND MEDICAL APPLICATIONS



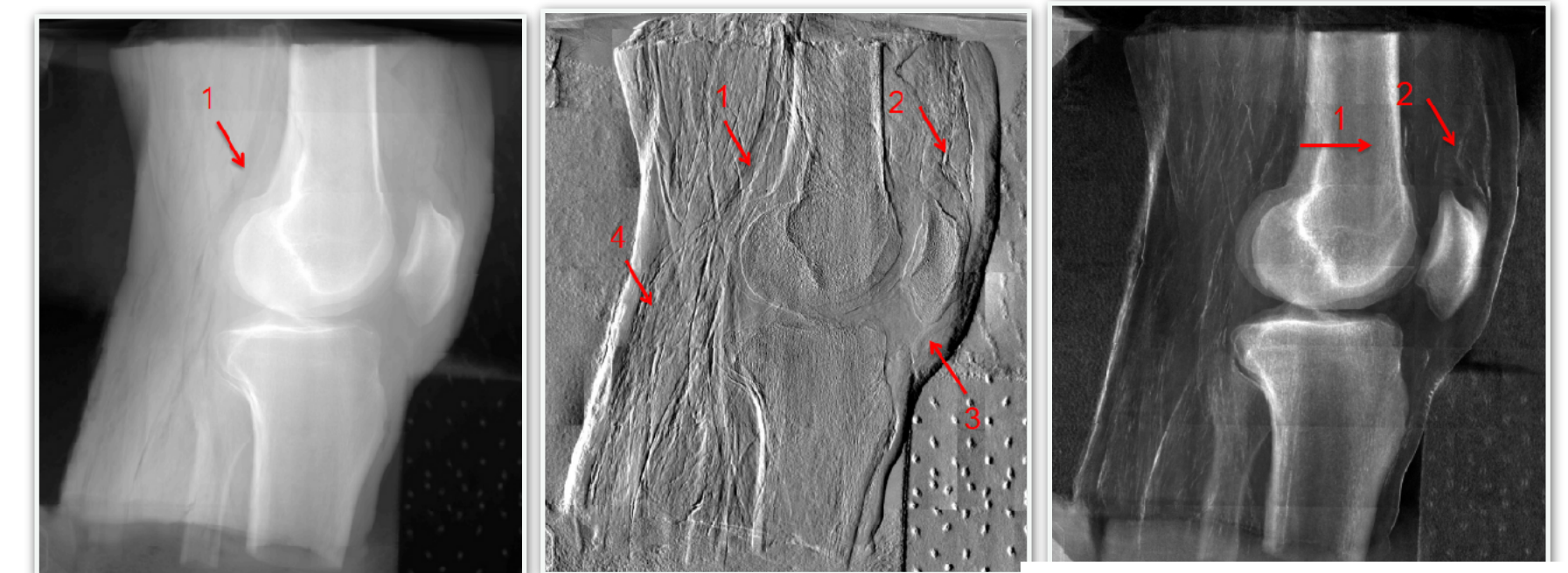
Detector development



Devices and methods for gamma dosimetry

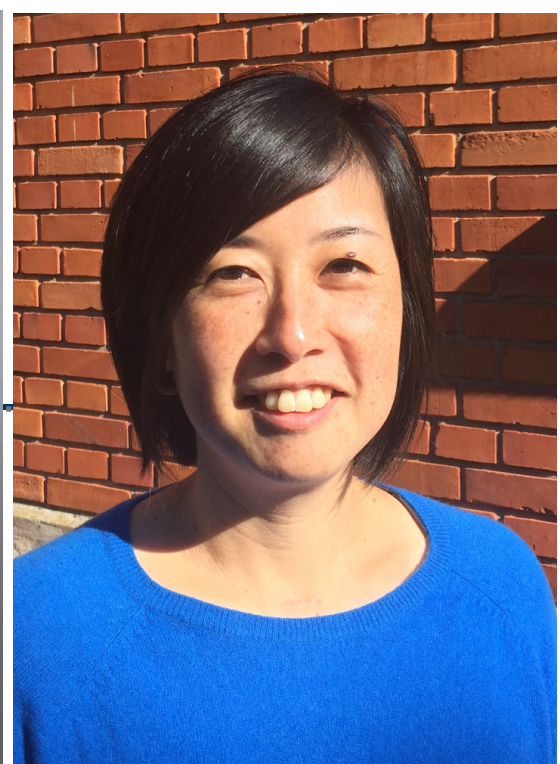
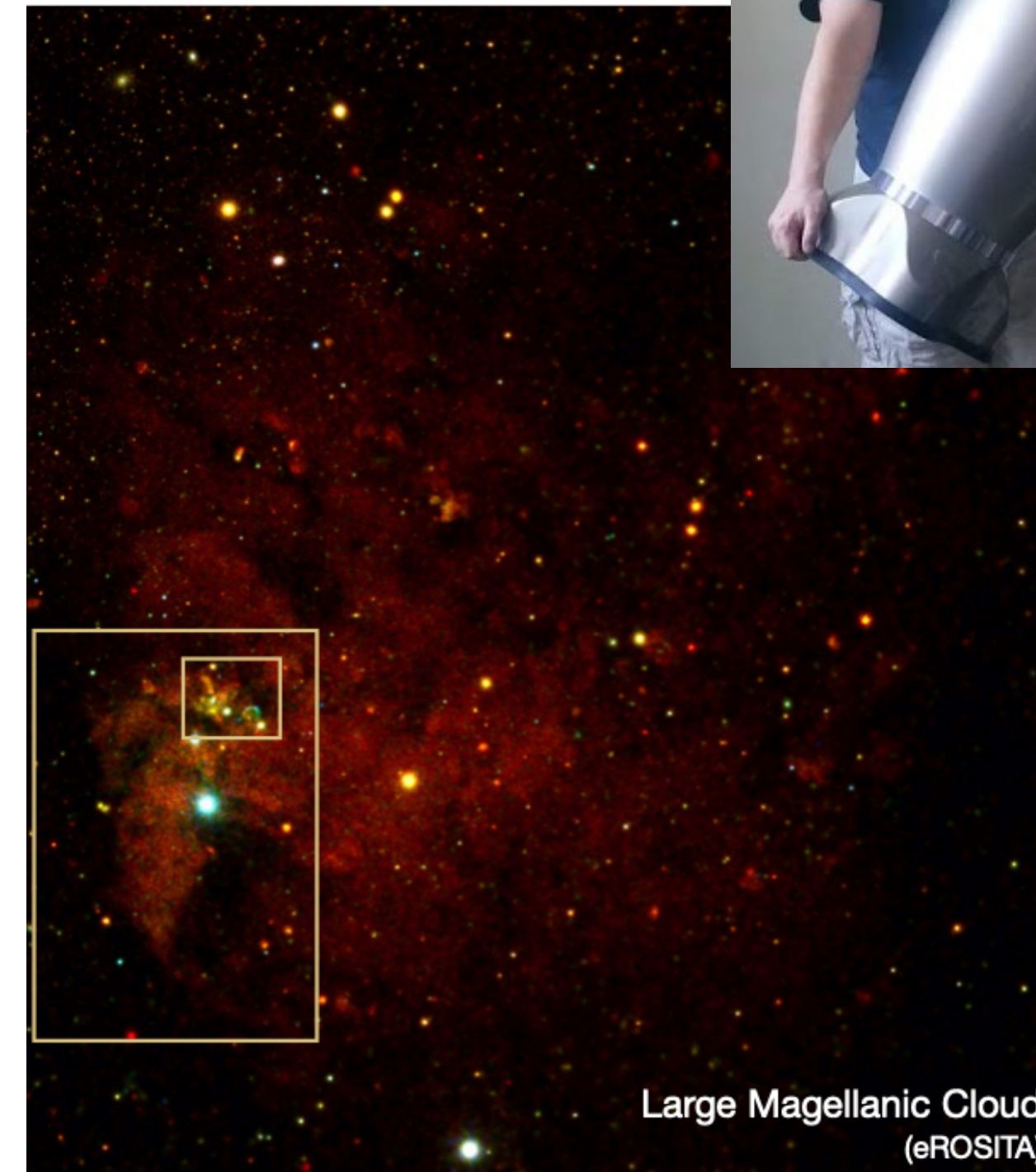
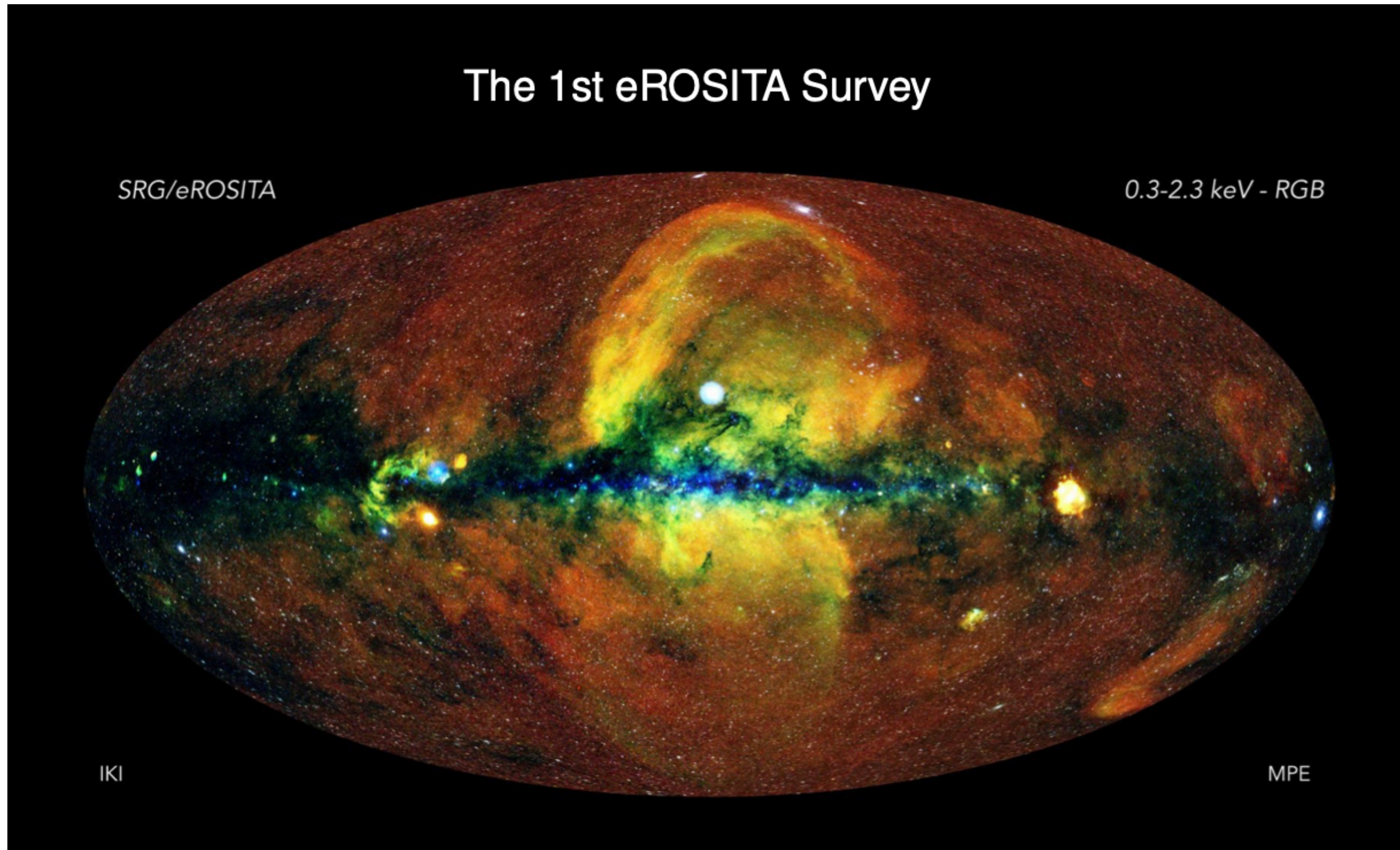


Phase-contrast x-ray imaging for medicine and non-destructive testing



- Long-standing effort to transfer methods and technologies from our field into medical applications (amongst others), based on our detector development expertise

X-RAY ASTRONOMY AT LANDESSTERNWARTE BAMBERG

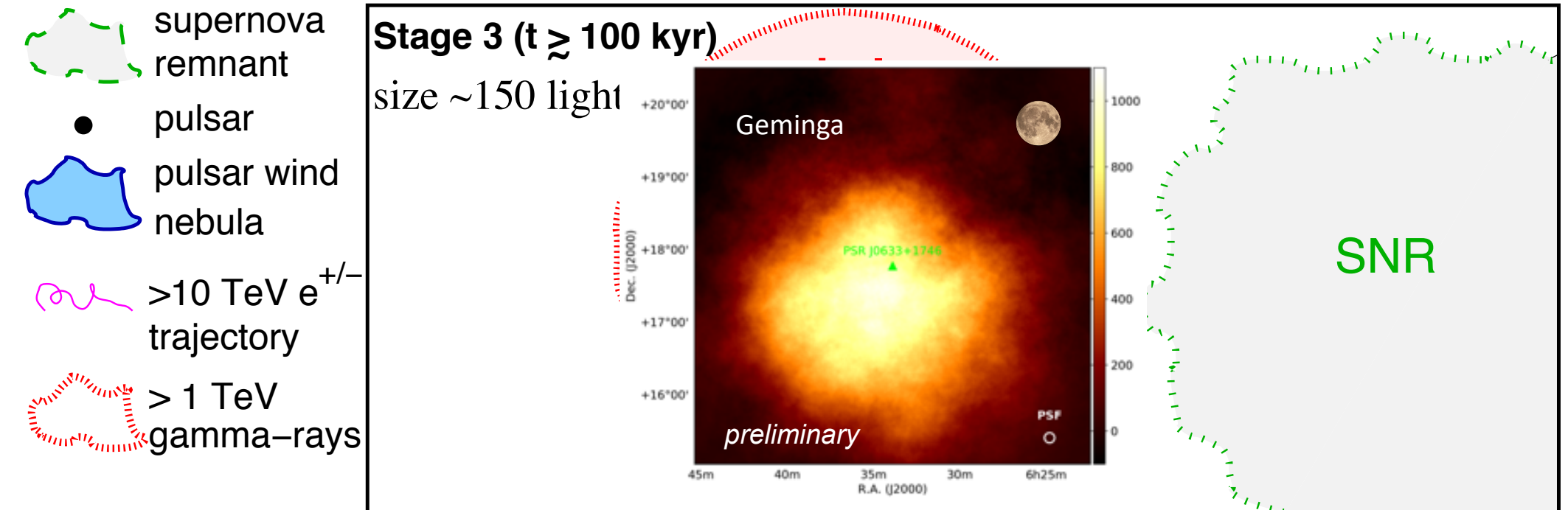
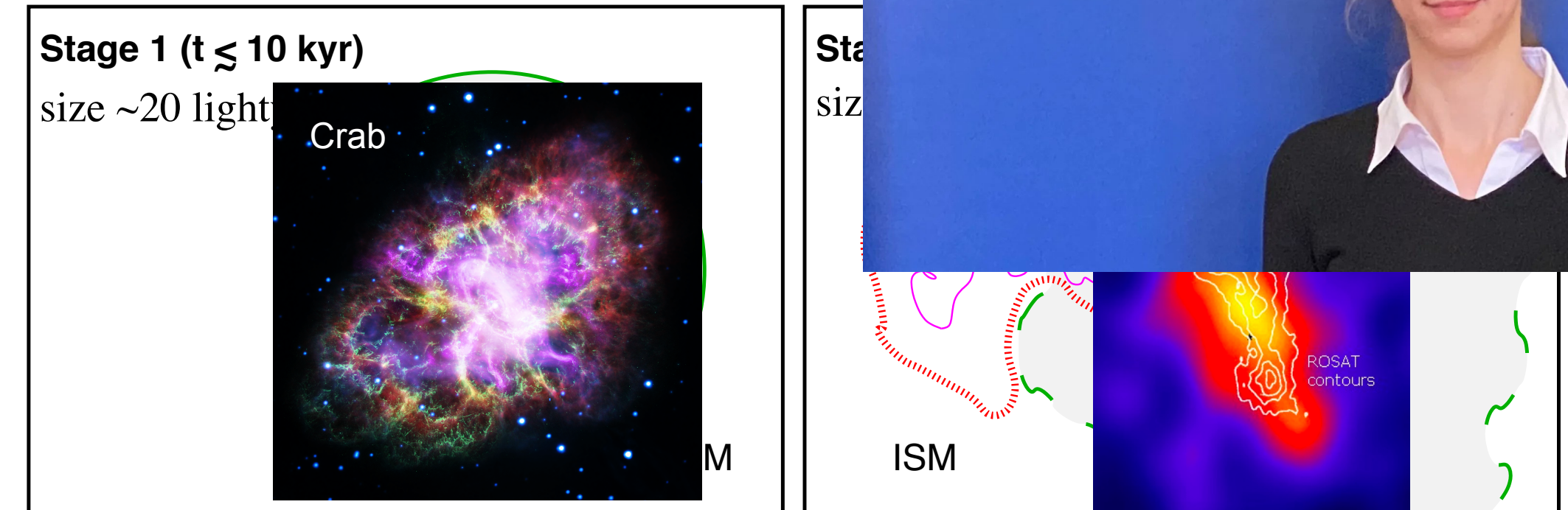


- Experience with most current high energy missions, participation in many future missions
- See talk by J. Wilms

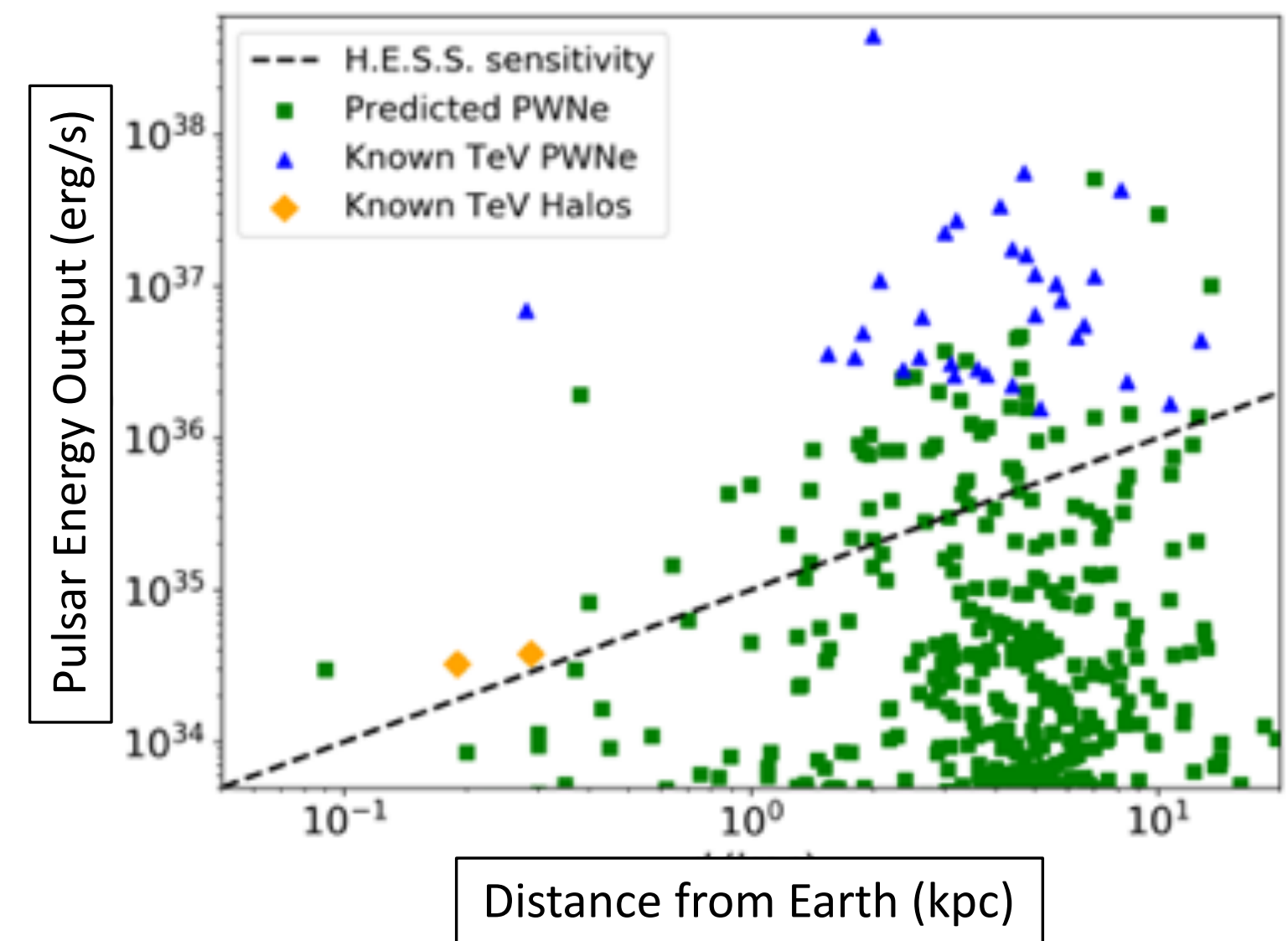
PULSAR ENVIRONMENTS & GALACTIC COSMIC RAYS



- DFG Emmy Noether group — start Oct. 2021
- Key questions:
 - Nature of energetic particles?
 - Transport through the cosmos?
 - Pulsar evolution and population?



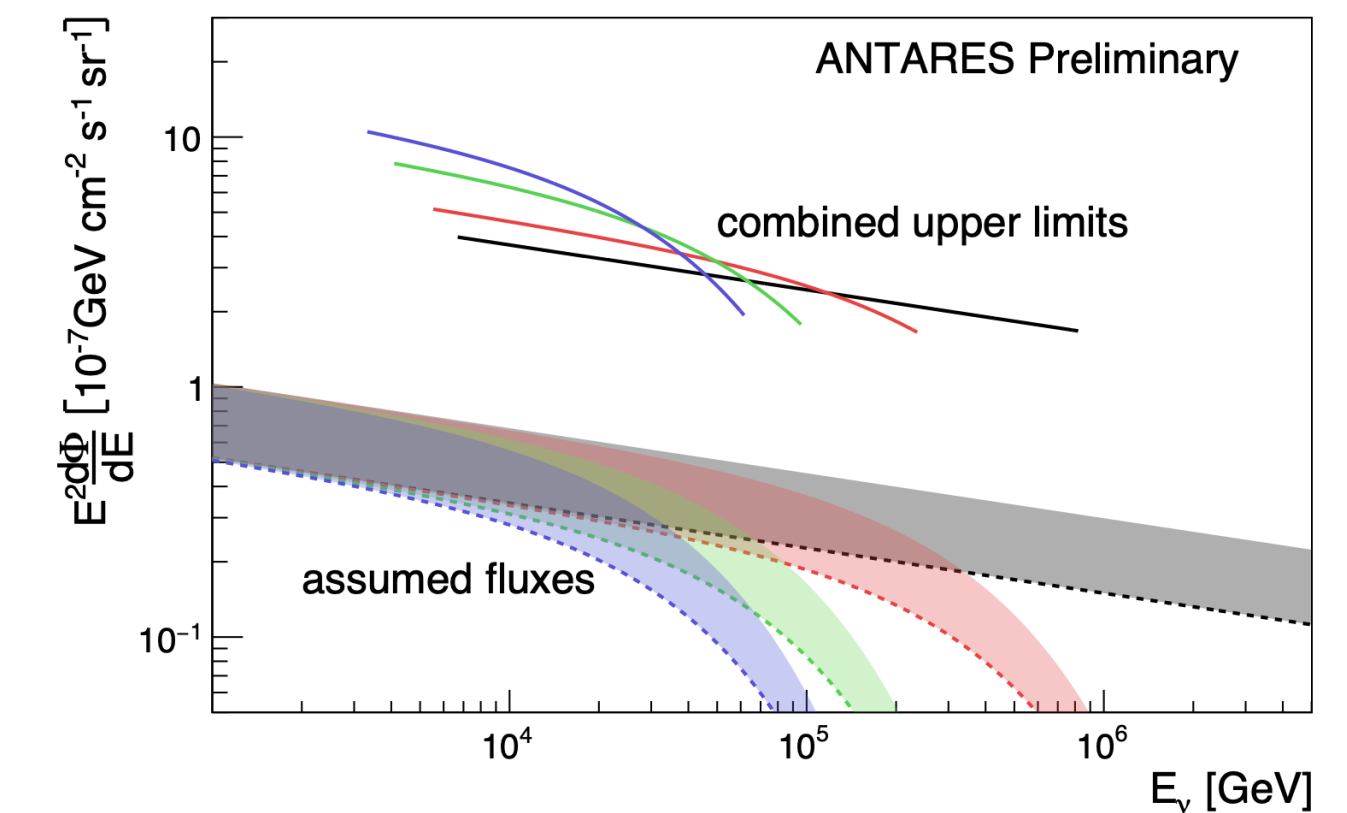
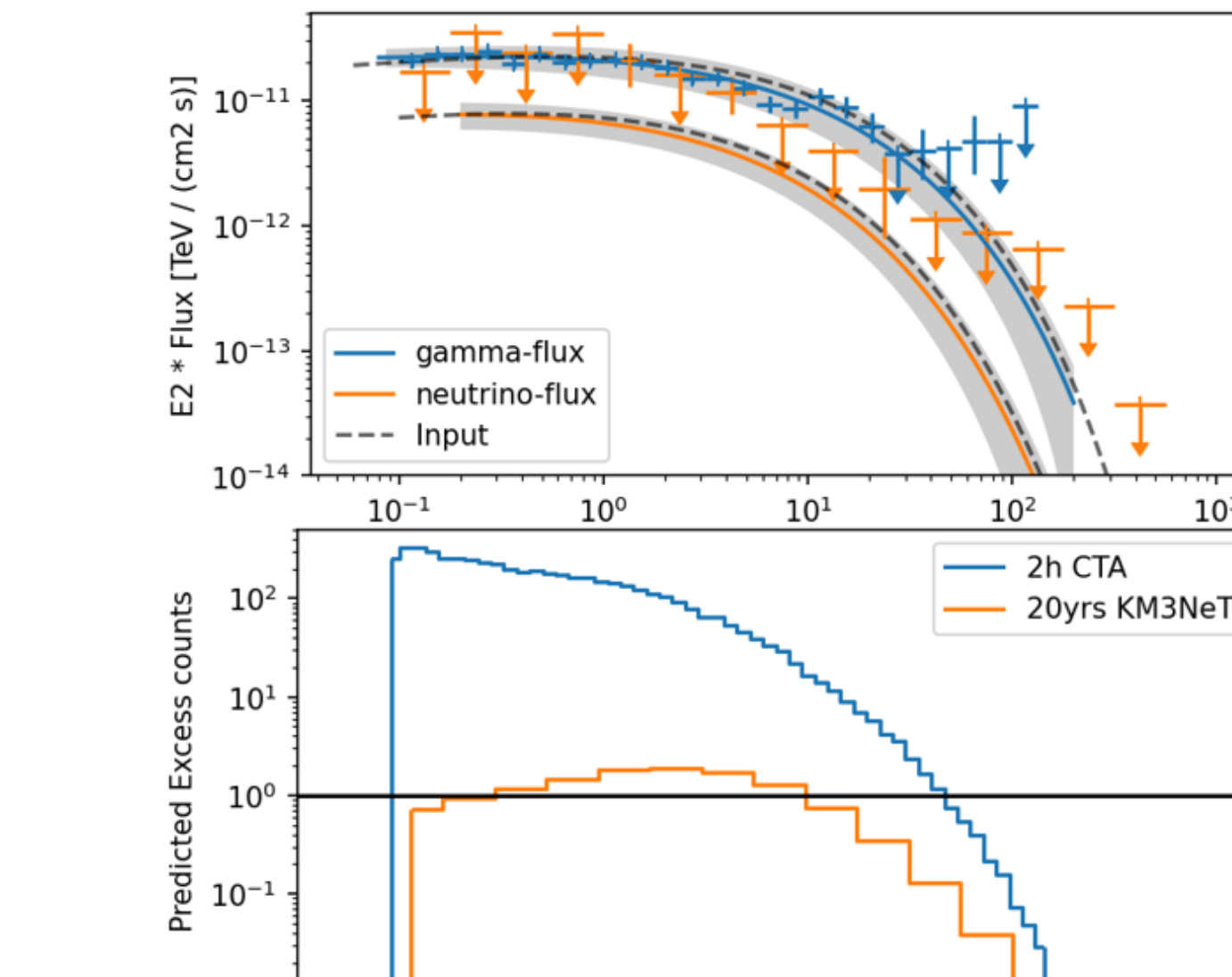
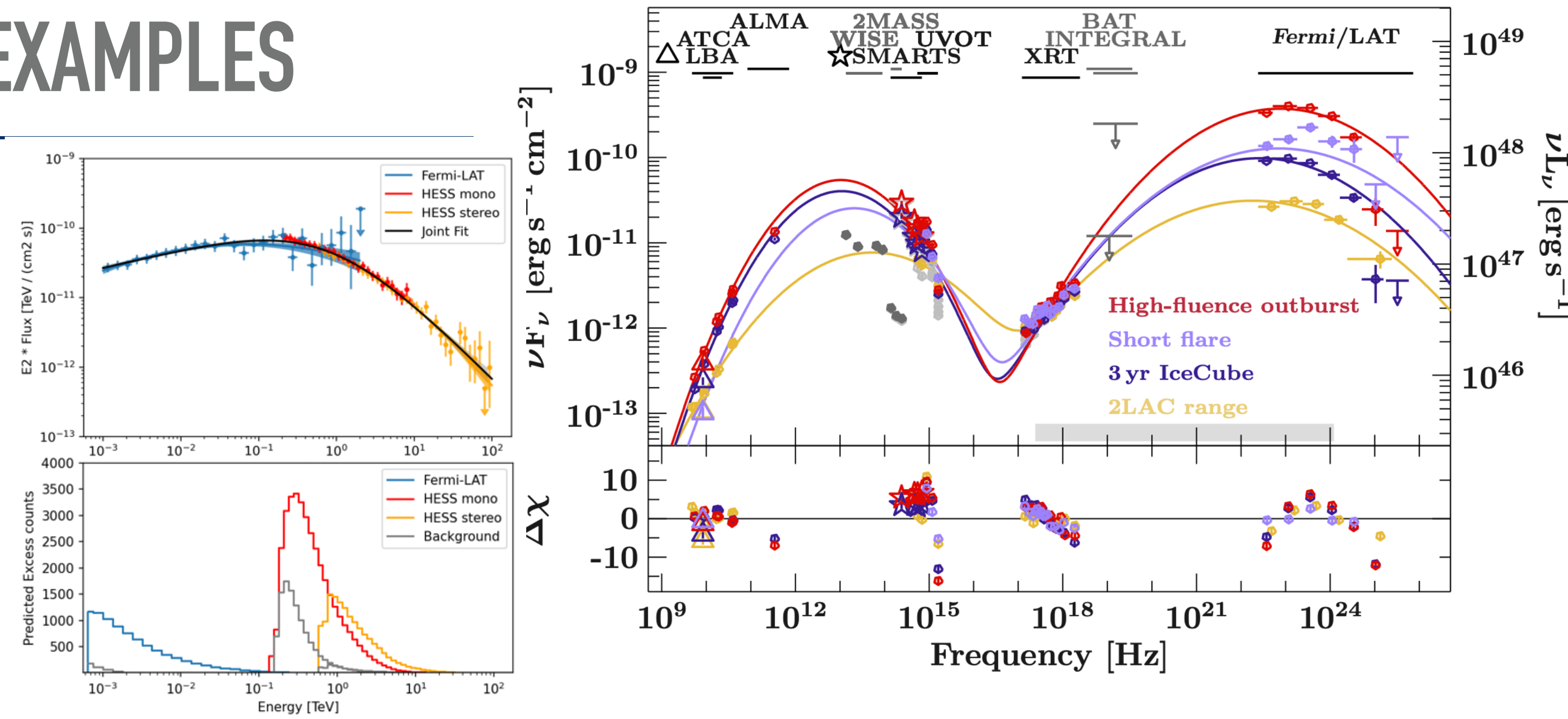
- supernova remnant
- pulsar
- pulsar wind nebula
- >10 TeV e^{+/-} trajectory
- > 1 TeV gamma-rays



- New members starting in April / May 2022
Postdoc, PhD student, Bachelor/Masters

MULTI-MESSENGER ASTRONOMY EXAMPLES

- e.g. Radio (TANAMI) and Fermi-LAT observation of candidate AGNs for IceCube events
- e.g. joint fitting of gamma-ray and neutrino data for Galactic supernova remnants
- e.g. event-wise multi-instrument fitting of Crab Nebula

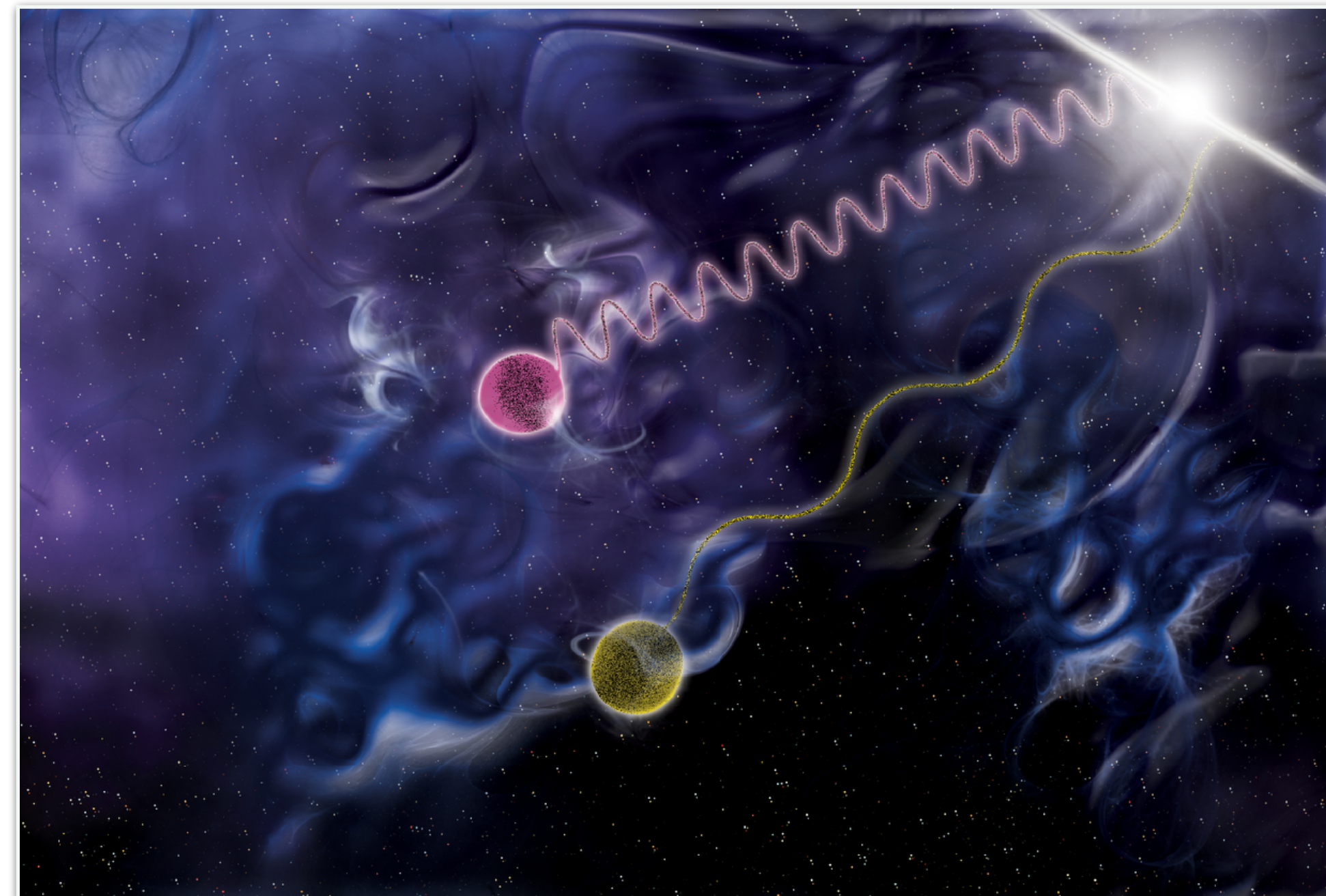
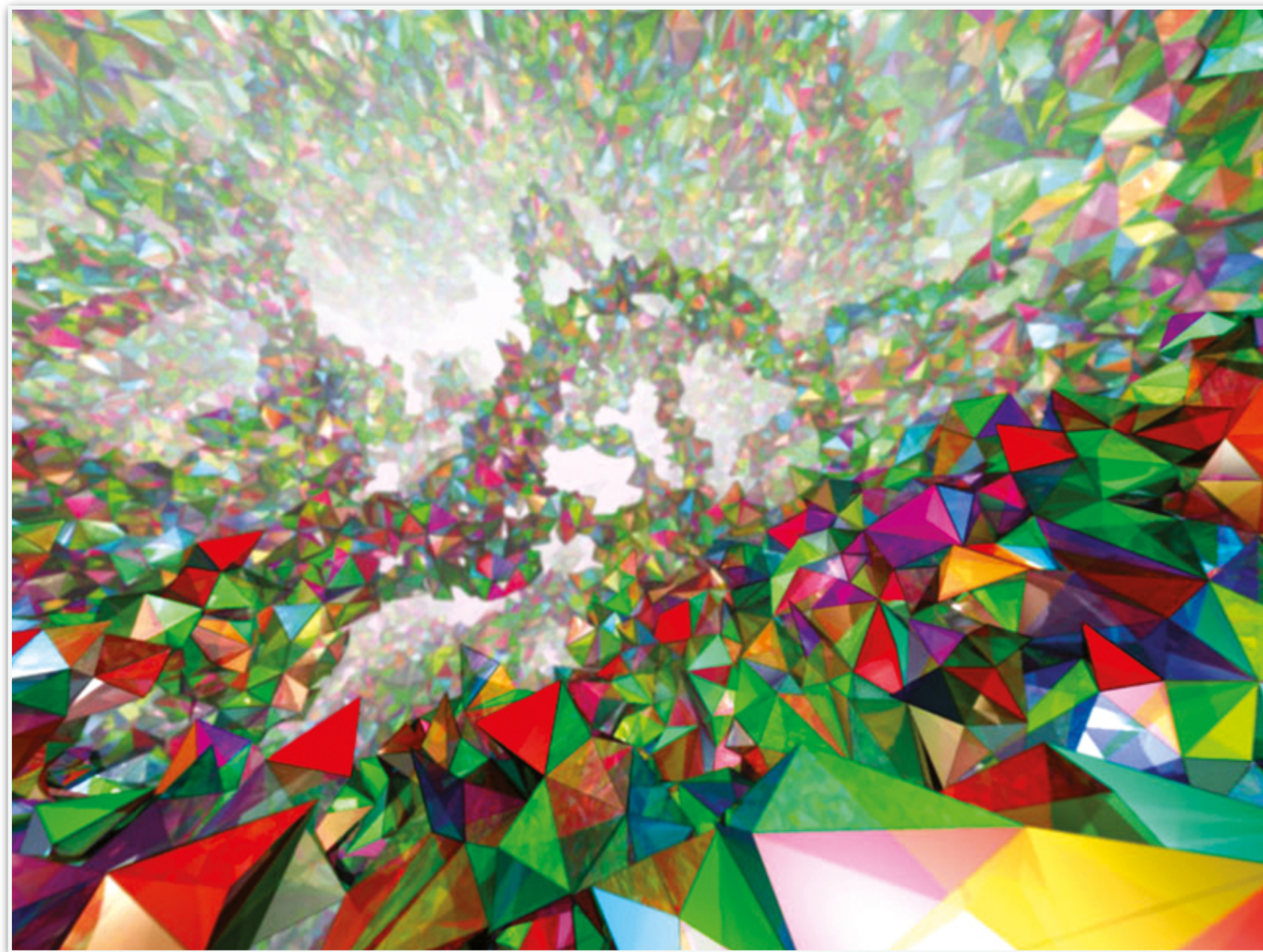


Unbehaun PhD thesis

Hallmann PhD thesis

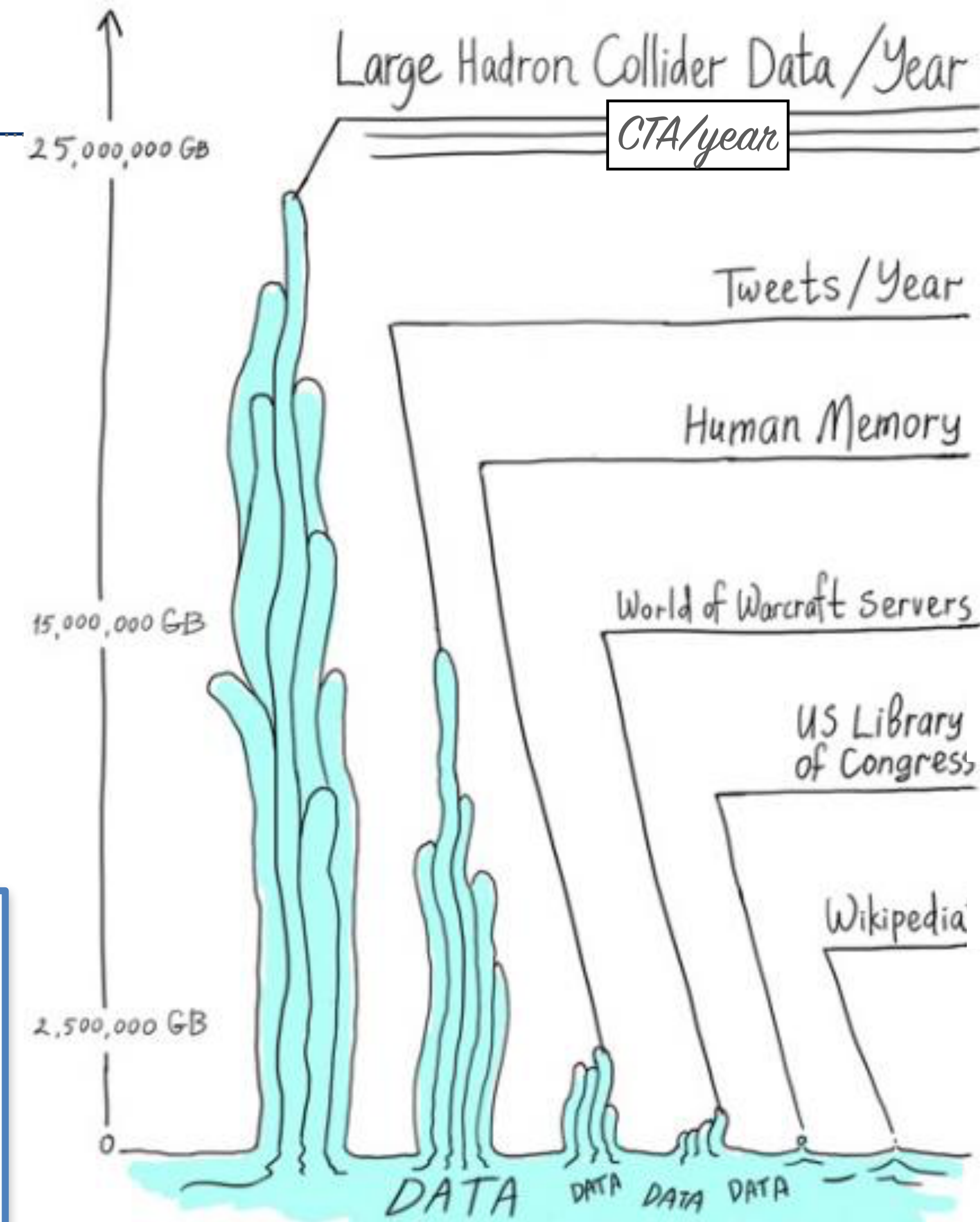
CLOSE COLLABORATION WITH THEORY

- Physics shortly after the big bang (the Planck scale)
- Experimentally measurable effects of physics on the Planck scale (e.g. on cosmic microwave background, on gravitational waves or on the energy-dependence of the speed of light)
- Search for a mathematical consistent theory of space - time - matter



BIG DATA SCIENCE AND MACHINE LEARNING

- *Big data* traditionally key topic (LHC@CERN, ...). E.g: CTA 25 PB/year (public) data.
- Method development and applications in data handling (grid computing) deep learning, pattern recognition, image analysis, open data, NFDI, ErUM-Data



All numbers approximate.

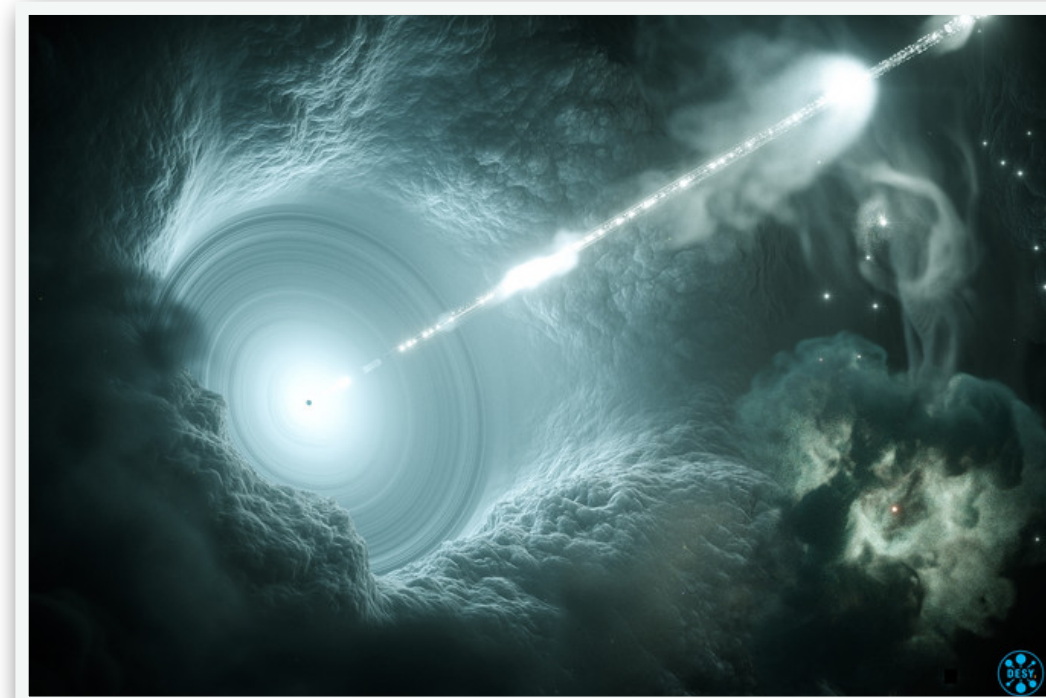
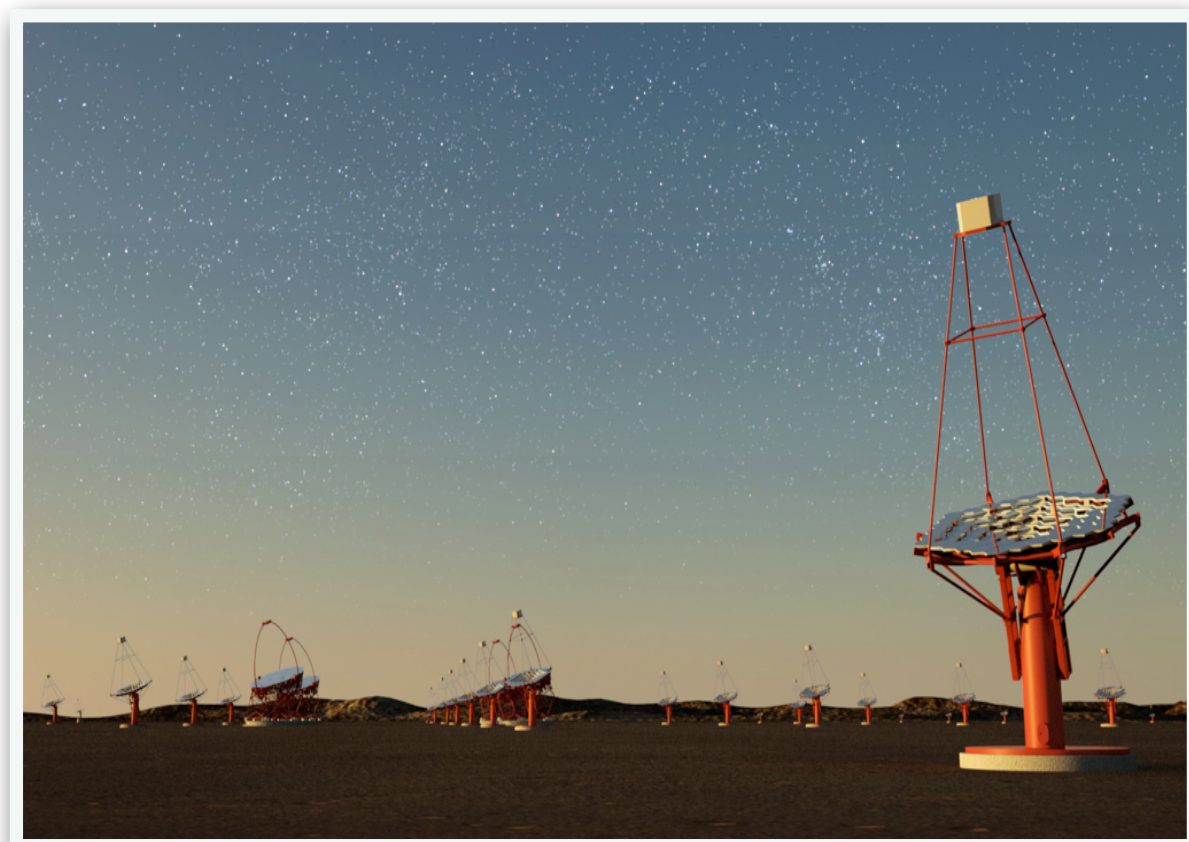
FORSCHUNGSBAU ECAP LABORATORY

- To support developing and building components for telescopes, technology transfer, data monitoring of large experiments
- Funding according to §91b (50% federal, 50% state funding)
- 3500 sqm of high-tech modern laboratories, offices and an assembly hall
- Will move in August 2022



SUMMARY

- ECAP established at FAU 15 years ago, highly visible internationally, one of the largest centres in the field in Europe. Long-standing close ties with partner institution in Würzburg.
- Core activities: physics of the high-energy Universe, combination of gravity and quantum dynamics (Loop quantum gravity), detector development, technology transfer
- Large-scale international projects
- Forschungsbau ECAP Laboratory will provide a unique infrastructure



Astronomy and Astroparticle Physics Cluster Northern Bavaria

The Friedrich-Alexander Universität Erlangen-Nürnberg and the Julius-Maximilians-Universität Würzburg cordially welcome *ESO Director General Xavier Barons* to the occasion of his visit of the north Bavarian research cluster involving the following institutions:

Erlangen Center for Astroparticle Physics and Dr.-Remeis-Observatory Bamberg of FAU,
Chair of Astronomy and Astrophysics of JMU.

Programme:

April 4th: Erlangen and Bamberg

12:15 Arrival at ECAP
12:30 Welcome words President FAU
12:40 Introduction: Director ECAP
13:00 Coffee
13:30 The European Southern Observatory (Barcons)
14:00 Gamma ray astronomy at ECAP (van Eldik, Funk, Mitchell)
14:20 Neutrino astronomy at ECAP (Katz, Nelles)
14:40 X-ray astronomy at ECAP (Wilms/Sasaki)
15:00 Technology transfer at ECAP (Michel)
15:20 Coffee
15:50 Tour ECAP Laboratories
16:30 Depart for Bamberg
17:30 Tour Sternwarte Bamberg
19:30 Dinner in Bamberg

Tuesday April 5th: Würzburg

09:45 Venue at Röntgen Lecture Hall, Campus Hubland Nord, JMU Würzburg
10:00 Welcome words President JMU (Pauli)
10:15 Welcome words Vice-Dean of Faculty Physics & Astronomy (Pflaum)
10:30 Theoretical Astrophysics: Chair of Astronomy and Astrophysics (Mannheim)
11:00 Coffee
11:30 EHT Black Hole Imaging (Christian Fromm)
12:00 Radio astronomy in the context of astroparticle physics (Kadler)
12:30 Multi-Messenger Astronomy (Buson)
13:00 ESO opportunities for University cooperations and concluding discussions
13:30 Lunch
15:00 Laboratory visit: Landwehr-Lab (Sebastian Klemmt)
16:00 Meet the president and farewell