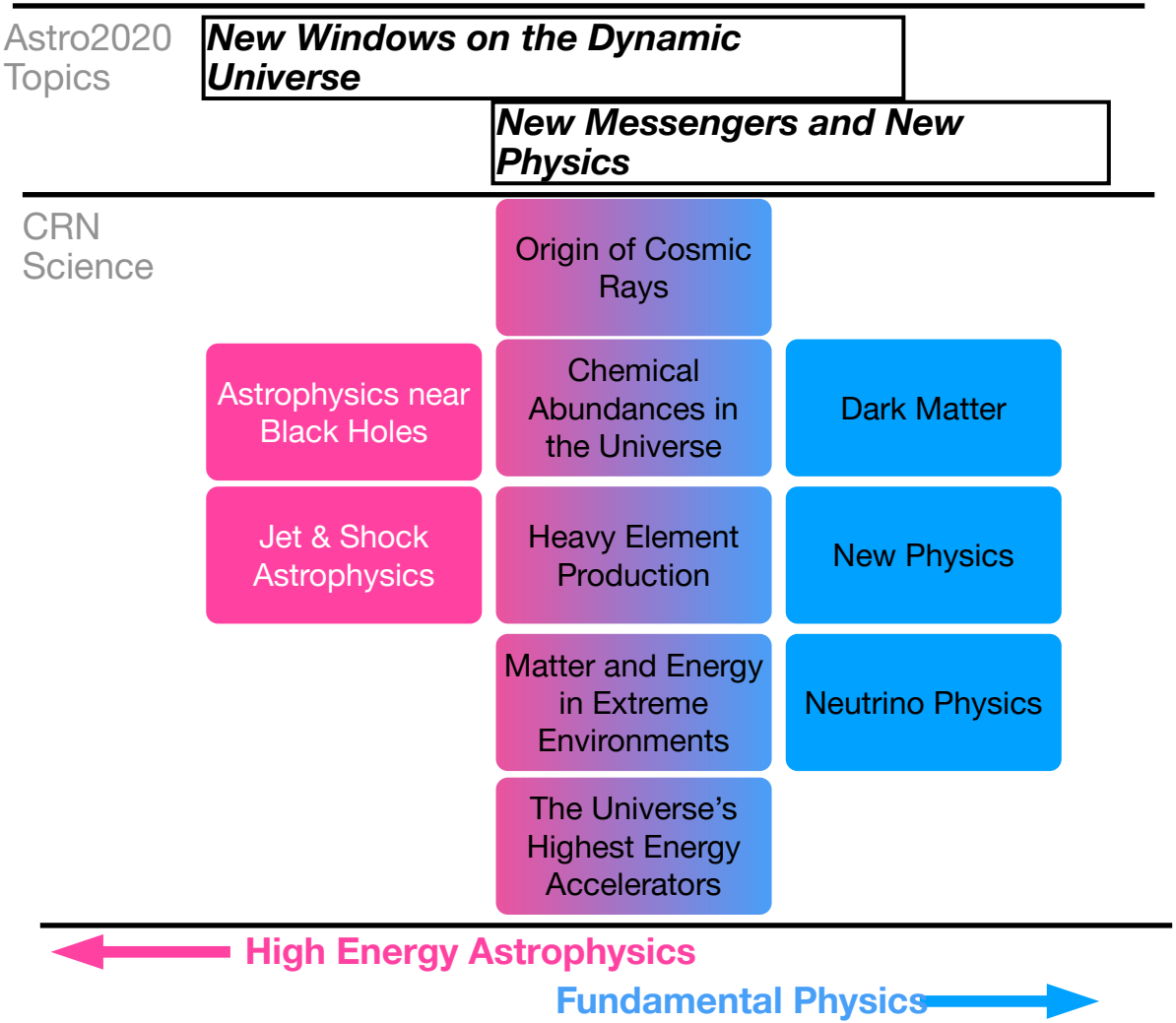
CRNSIG within NASA's Physics of the Cosmos

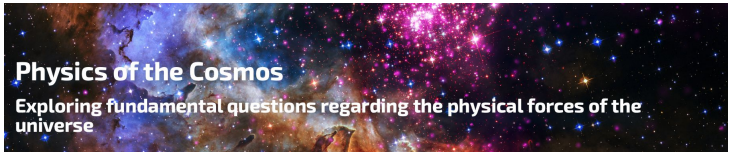
Austin Cummings Penn State, for CRNSIG within PhysCOS APS Global Summit 2026

The Big Picture

- High Energy Astrophysics: What objects in the universe accelerate particles to the highest energies? What mechanisms are at play? How and when are cosmic rays and neutrinos produced at these sites?
- Fundamental Physics: Exploring physics at high energies, over long baselines produced in cosmic accelerators



Cosmic Ray and Neutrino Science Interest Group (CRNSIG)



- Community-led forum to address open science questions related to the Physics of the Cosmos and Cosmic Rays and Neutrinos
- **Goals:**
  - Provide quantitative metrics and assessments to NASA of current and future needs of the cosmic-ray and neutrino astrophysics community
  - Assess science gaps and technology gaps related to CRs and Neutrinos
  - Provide input from the science community to the Physics of the Cosmos Program

Join! Send email to CosmicSAG-join@lists.nasa.gov with Subject="join"

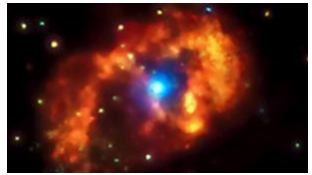


Image: Superstar Eta Carinae Shoots Cosmic Rays. Credit: NASA Goddard Space Flight Center

Image: Jelly Fish Nebula (IC 443) source of cosmic rays. Credit: NASA / DOE / Fermi LAT Collaboration, NOAO / AURA / NSF, JPL-Caltech/UCLA

CRN SIG Activities

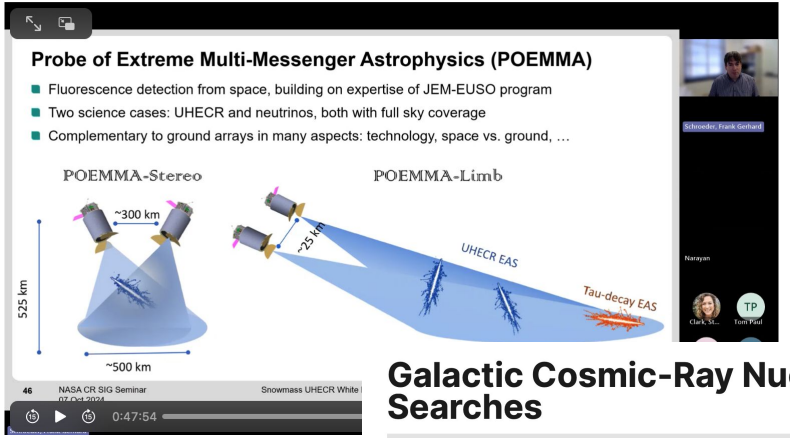
Community Forum for Cosmic Rays & Neutrinos within NASA

- Assess cosmic ray and neutrino science topics within NASA's portfolio
  - Identify Science Drivers, Tech Gaps & Connections
  - Connect CRN to strategic goals (such as TDAMM)
  - Understand the unique role that space-based observatories play, particularly when working within the landscape of the broader cosmic ray, neutrino, and multimessenger observatories
  - Community planning for future missions and science drivers
- Regular webinars on CRN Science topics
- Conferences and community engagement (ICRC, APS, AAS)

CRNSIG Webinars

Recent Topics

- Ultrahigh Energy Cosmic Rays and the Snowmass Study
- Ultrahigh Energy Neutrinos with Balloon-Borne Missions
- Indirect dark matter searches with cosmic antinuclei
- Galactic cosmic rays



Galactic Cosmic-Ray Nuclei Searches

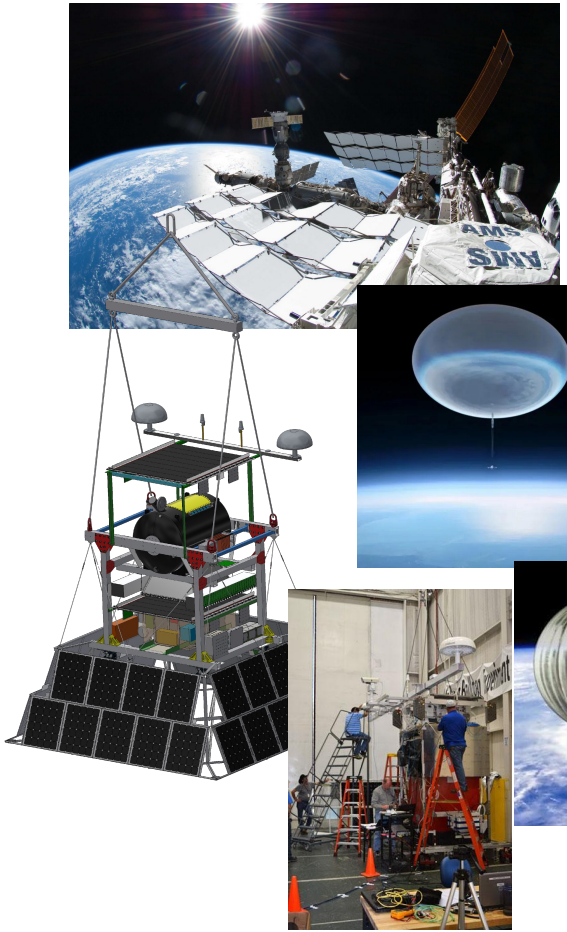
Time	Topic	Speaker
14:00 - 14:05	Brief Introduction	CRN SIG Co-Chairs
14:05 -14:25	Recent Advances in Astrophysics of Cosmic Rays	Igor Moskalenko (Stanford University)
14:25 -14:45	Recreating on Earth: GCR Interactions with the Interstellar Medium	Priya Ghosh (NASA GSFC)
14:45 -15:05	Features in the Spectra of GCR Nuclei as Measured by the Calorimetric Electron Telescope (CALET) on the ISS	Nick Cannady (NASA GSFC)
15:05 -15:25	Measuring the Abundances of Heaviest Elements with SuperTIGER and TIGERISS	Wolfgang Zober (WUSTL)
15:25 -15:45	The Status and Future Plan for HELIX	Nahee Park (Queen's University)
15:45 -16:00	Open Discussion	

https://science.nasa.gov/astrophysics/programs/physics-of-the-cosmos/community/crn-sig/

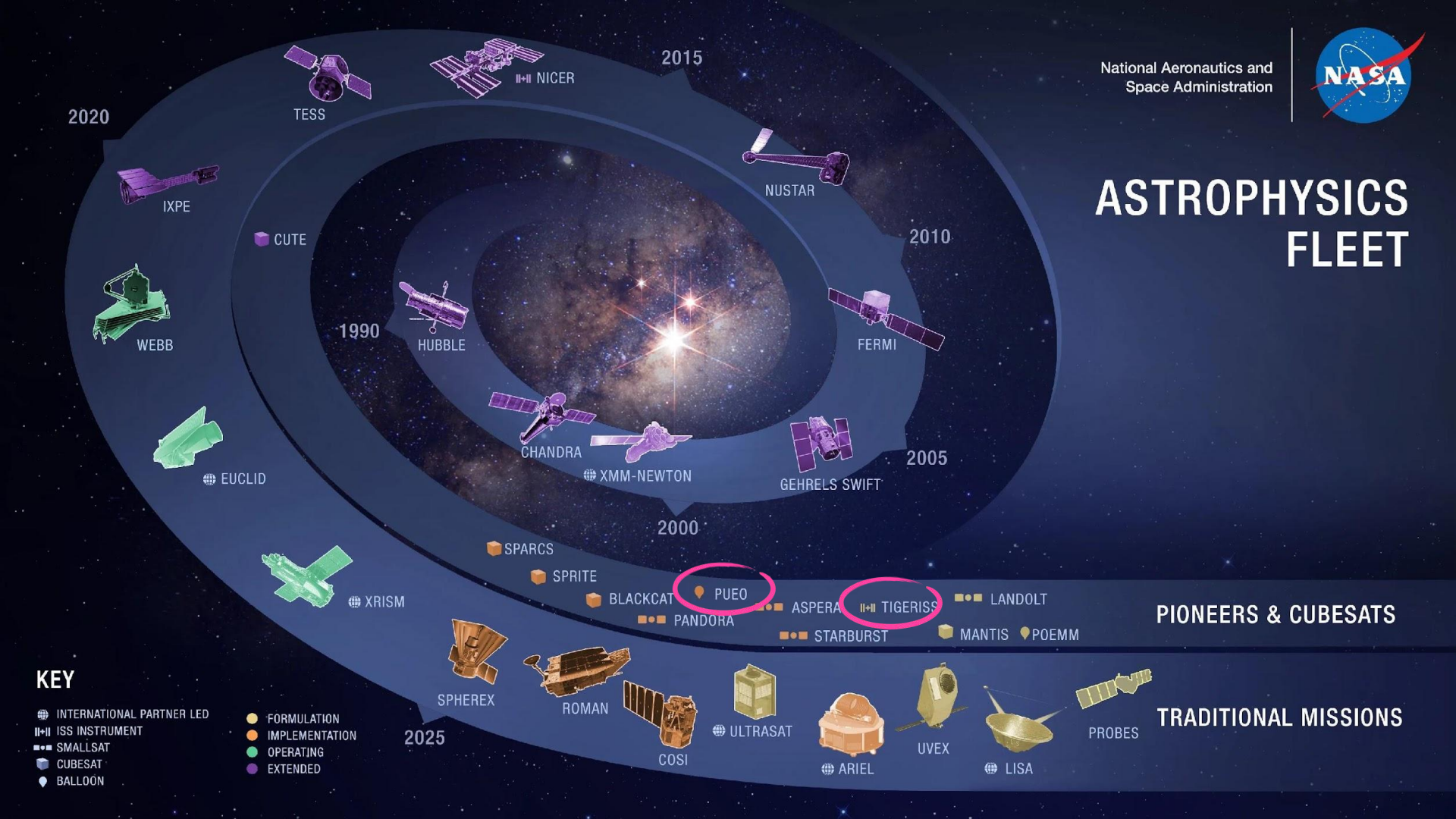
NASA Platforms

relevant for Cosmic Rays & Neutrinos

- Cosmic ray and neutrino observatories have been very successful with space-based instruments with a variety of platforms
  - Balloons: long-duration, superpressure
  - International Space Station (planned to be decommissioned)
  - Larger (Pioneers) missions: balloons, cubesats, & ISS
  - ***New!***: Lunar orbiter, lander capabilities
- CRN experiments can be standalone small missions or stepping stones to larger probe class missions
- Maintaining and strengthening small missions (balloons, APRA missions, Pioneers) is ***vital*** to our SIG



Example study from Scientific Balloon Roadmap Program Analysis Group (Balloon Roadmap PAG): A Roadmap For Scientific Ballooning 2020-2030 arXiv:2210.01198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LANDOLT
PANDORA
STARBURST
MANTIS
POEMM
PIONEERS & CUBESATS
SPHEREX
ROMAN
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TRADITIONAL MISSIONS
KEY
INTERNATIONAL PARTNER LED
ISS INSTRUMENT
SMALLSAT
CUBESAT
BALLOON
FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED

Cosmic Ray & Neutrino NASA Missions

Recent & Ongoing

- Balloons:
  - EUSO-SPB
  - HELIX
  - GAPS
  - PUEO*
- ISS:
  - AMS-02

Upcoming

- Balloons:
  - PBR*
  - GRAMS
  - ADAPT
- ISS:
  - TIGRESS*

Planned

- Satellites:
  - POEMMA

*Contributions at the APS Global Summit!

Goals: Provide a community forum for CRN projects across missions, platforms. Plan for the future. And provide feedback to NASA via decadal survey process, science & tech gaps.

Upcoming Activities

CRNSIG 2026-2027

- Regular meetings to plan for decadal survey, tech gaps, & science gaps
- Identify possible Science Analysis Groups within CRNSIG to provide report to NASA Astrophysics Division
- Meetings on cross-section measurements at AAS
- Webinar topics:
  - March 25: TDAMM and its connection to neutrinos and cosmic rays
  - CRN platforms and future missions [balloons, lunar, cubesats, flaglets]
- ***Encourage members*** to attend the Innovation for Astrophysics Missions Workshop May 27-28 2026 to start planning for Astro2030

Summary

CRN SIG

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- Welcoming community forum related to CRNSIG missions within PhysPAG
  - Webinars, conferences, discussions offer opportunity to inform NASA of broad interest in the science community in cosmic ray and neutrino science
- Community Organization for the next Decadal Survey:
  - Advocate for the importance of Cosmic Ray and Neutrino science in NASA's portfolio
  - Consider all possible platforms (balloons, lunar, satellites, …)
  - Vital role of small missions: Many of our CRN missions are small, but play an important role in advancing the science.
  - Science and technology gaps serve as important mechanisms for the community to motivate future missions