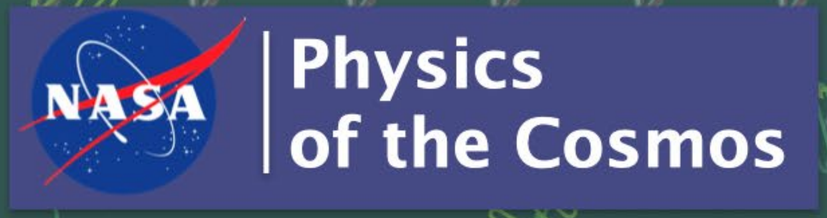

Recent Discussions in Gamma-ray Planning

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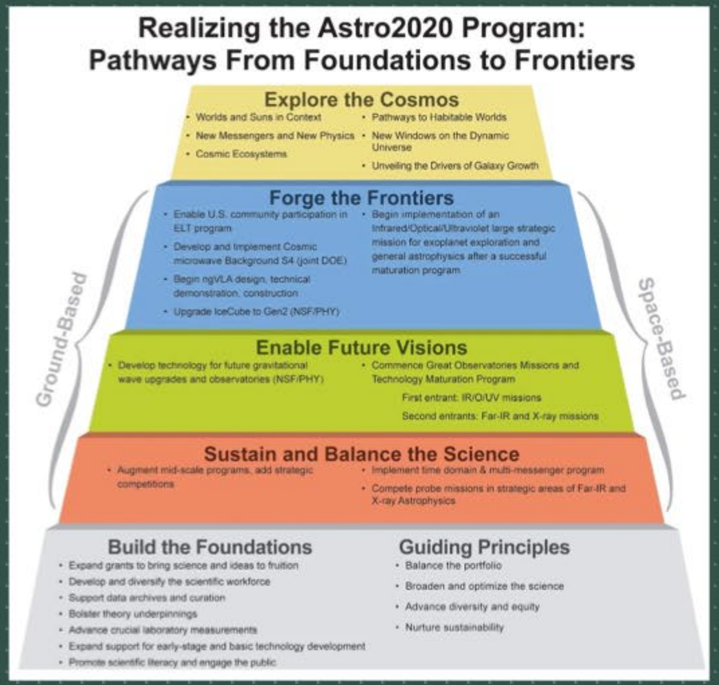
Highlights from 2020 Astrophysics Decadal

- Probe class missions for Far-IR & X-ray Astrophysics
- Mature technology for GW missions and IR - X-ray Great Observatory candidates
- Support for collaborations with NSF & DOE on ground-based observatories: ELT, CMB-S4, ngVLA, IceCube
- A time domain & multimessenger program
- Augment mid-scale programs



Credit: Astro2020 Decadal

Gamma Rays as a Decadal Topic

- The 2020 Decadal in particular covers gamma-ray astronomy in the multimessenger astrophysics, which the community believed was of obvious importance and Decadal committees documented.
- When NASA HQ receives a Decadal, they consider the recommendations, but may not immediately have the infrastructure to address them, or simply decline to for strategic or budgetary reasons.
- NASA's reaction at that stage is partially dependent on whether they have received prior reports from Science Analysis Groups (SAGs) that present similar findings.
- So, there is a community-lead step in the process of NASA considering future strategic investments outside of, and prior to a Decadal.

Highlights from Snowmass 2021

- Snowmass is the particle physics community planning exercise
- The Cosmic Frontier was one of 10 and gamma-ray astrophysics fell into “CF7: Cosmic Probes of Fundamental Physics”
- CF7 invited about a dozen white papers, with one in Multimessenger, and one in Gamma-ray Astrophysics.
- The CF Report acknowledged a strategic gap in MeV and GeV gamma-rays, but emphasized ground-based facilities.

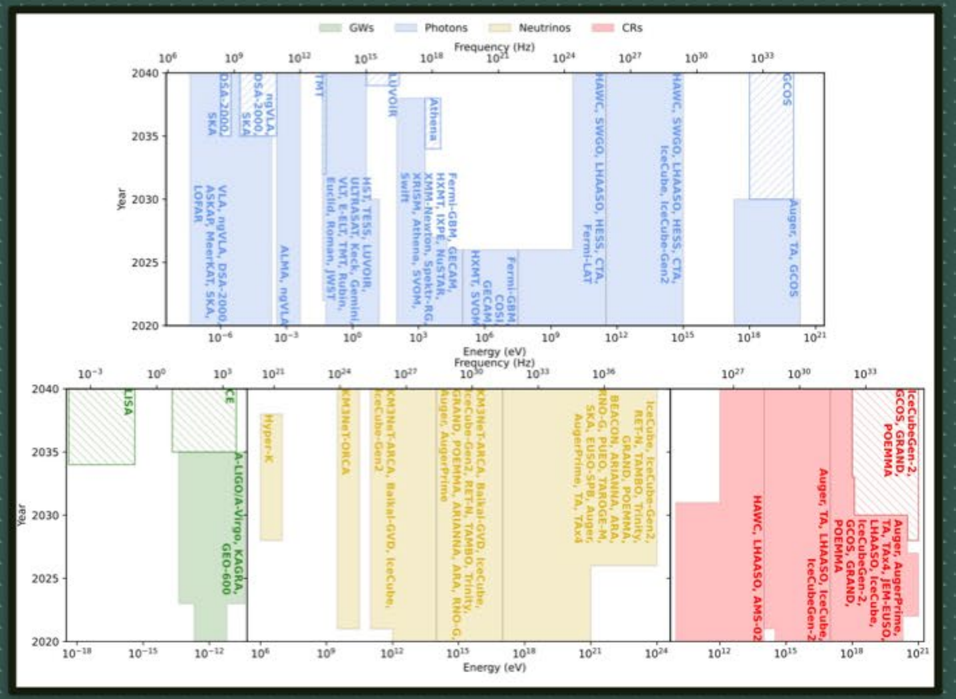


Image Credit: Marco Muzio; in “Advancing the Landscape of Multimessenger Science in the Next Decade”arXiv:2203.10074

Outcomes from P5

- The Particle Physics Project Prioritization Panel (P5) provides recommendations to DOE and NSF-Physics, informed by Snowmass Frontier Reports.
- The high-level recommended facilities were, CMB-S4, Rubin, DUNE, Offshore Higgs, G3, and IceCube-Gen2.
- They also echoed the Decadal in emphasizing improved balance between project sizes, and support for theoretical, computational, and technological developments.
- P5 made additional recommendations in support of ground-based gamma-ray facilities.

Gamma Rays as a Snowmass/P5 Topic

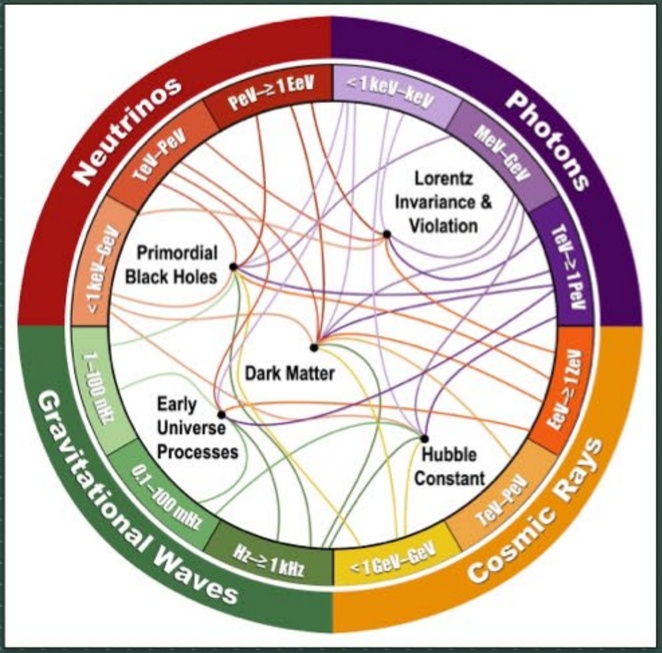
- DOE's Office of Science limits its Cosmic Frontier spending to facilities primarily engaged in Dark Matter, Dark Energy or Cosmology studies.
- NSF-Physics supports work in Dark Matter, Dark Energy, Cosmology, and Particle Astrophysics
- Both NSF and DOE limit their support to ground-based facilities and consider all space-based facilities the domain of NASA (which is not formally informed by either Snowmass or P5).
- While there was astroparticle physics community support for space-based gamma-ray technology and facilities expressed in the Snowmass white papers and reports, P5 specifically omitted reference to space-based gamma rays.

A Home for Space-based Gamma Rays

- The 2020 Decadal process was ahead of the 2021 Snowmass process, and advised NASA & NSF-Astronomy on primarily topics within the purview of both, which notably excludes gamma-rays.
- The P5 advised DOE and NSF-Physics advised DOE and NSF-Physics on topics within the purview of either, but which notably excludes space-based facilities and technology.
- Space-based gamma-ray facilities must be accounted for in the Decadal AND in groundwork for it as reported by SAGs.
- SAG Reports should cover a range of topics that include scientific justifications, technology gaps, and sensitivity/timing requirements that trace to specific science cases.

Ongoing Discussions in Multimessenger Astrophysics

- GW/GRB170817 was co-discovered by Fermi and LIGO
- TXS 0506+056 was co-observed by Fermi and IceCube
- GeV gamma-rays in particular have been the cornerstone of the modern multimessenger era.
- The framing of TDAMM reflects that excitement and and anticipates the development of a new fleet of Great Observatories balanced across messengers
- There is also an emphasis on transient events in particular as a driver for mission requirements around timing.



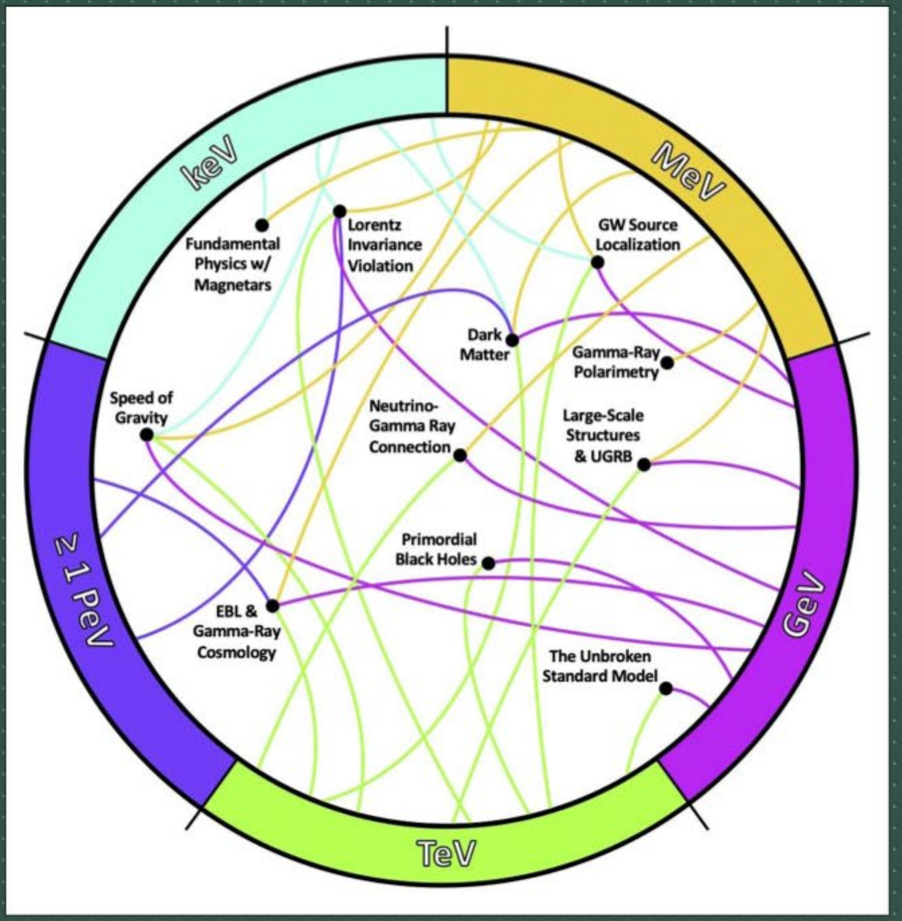
Credit: Tiffany Lewis; Multimessenger WP

Defining Gamma Rays as Complementary

- Since the Decadal, a lot of conversations about the future of gamma rays have been defined as one leg of a 3-4 legged stool - Multimessenger Astrophysics - the future of the field.
- We've also described the role of gamma rays in multiwavelength studies and the cruical nature of maintaining spectral coverage, as originally envisioned by the Great Observatories program that launched Hubble and CGRO.
- Complementary capabilities across wavelengths and messengers (and locations/coverage areas) do provide a value-add-bonus that NASA should care deeply about for both economic and scientific efficiency.

Defining the Gamma-ray Community Intrinsically

- There are great science cases for gamma-ray astronomy, great technology development justifications in gamma-ray science, and great opportunities in the form of science and technology gaps.
- There are even great communicators in the gamma-ray community who can and do explain all of these things.
- What we need, and over the past year GR SIG has made great strides in addressing is the community infrastructure to focus that effort through official channels continuously.



Credit: Kristi Engel; Gamma Ray WP

A Path Forward with Community Input

- **FIG SAG would like to begin a conversation about**
  - What are today and tomorrow's big topics that can only be studied with significant participation from space-based gamma-ray missions?
  - Which gamma-ray objects and events could advance our understanding of fundamental physics and the universe?
  - What investments need to be made in order to achieve that science?
- **In order to answer these questions, we intend to**
  - Start conversations at meetings of gamma-ray astrophysicists
  - Host ~monthly zoom meetings that focus on key aspects or questions
  - Arrange an in-person meeting
  - Maintain email and slack communication with the community

FIG SAG

Future Innovations in Gamma Rays

We will explore gamma-ray science priorities, necessary capabilities, new technologies, and theory needs to inspire work toward 2040.

Get involved and stay informed:

https://forms.gle/VBijBgapMRwJm9dU6

Chairs:

Chris Fryer & Michelle Hui, Paolo Coppi, Milena Crnogorčević, Tiffany Lewis, Marcos Santander, and Zorawar Wadiasingh

Questions?