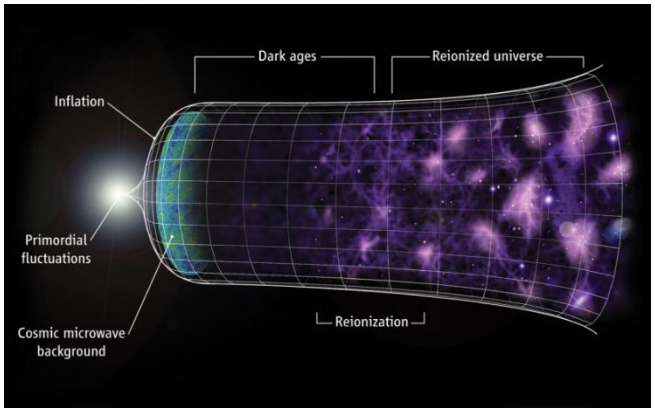
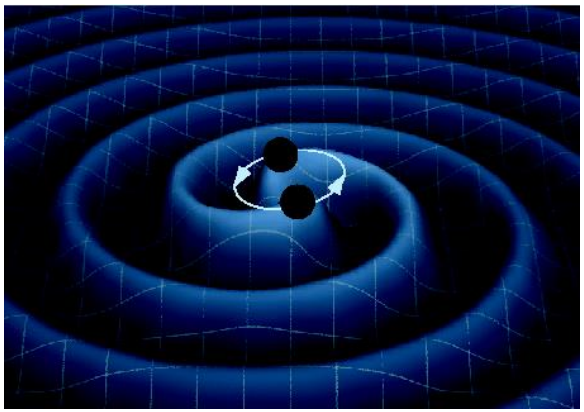
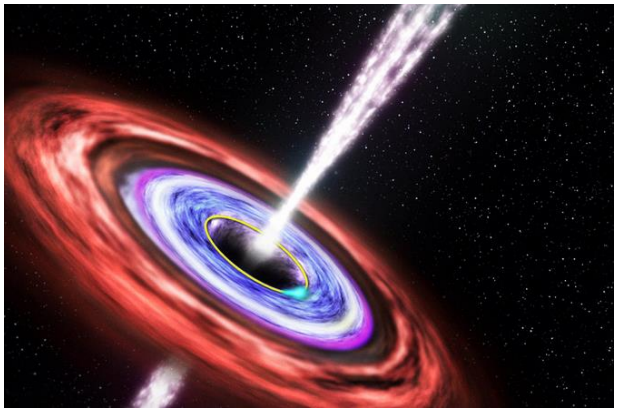
Physics of the Cosmos Program Analysis Group Report







John W. Conklin
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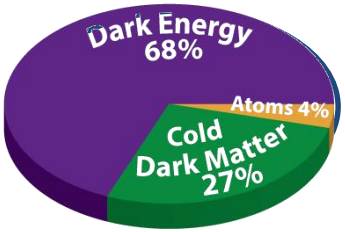
Chair, Physics of the Cosmos Program Analysis Group

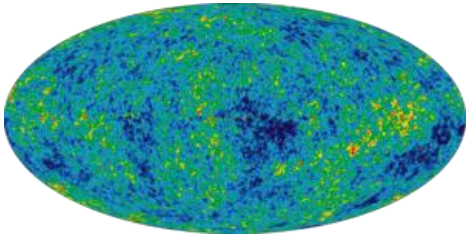
28 October 2019

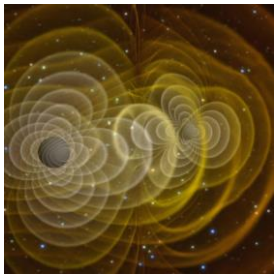
Outline

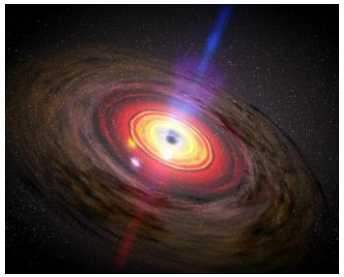
- Introduction to PhysPAG (reminder)
- SIG Highlights and Activities
- Multimessenger Astrophysics SAG
- Input for the technology gap process
- Past and Future Meetings

Physics of the Cosmos Science Objectives









- **Increase our knowledge of dark energy**
- **Precisely measure cosmological parameters governing evolution of the universe and test inflation hypothesis of Big Bang**
- **Test validity of Einstein's General Theory of Relativity and investigate nature of spacetime**
- **Understand formation and growth of massive black holes and their role in evolution of galaxies**
- **Explore behavior of matter and energy in its most extreme environments**

PhysPAG EC Membership

Name	Affiliation	Area of Expertise	Term Ends
John Conklin (Chair)	Univ. of Florida	GW SIG	Dec 2019
Jim Beatty	Ohio State Univ.	CR SIG	Dec 2019
Sylvain Guiriec	George Washington Univ.	Gamma-Ray SIG	Dec 2019
Kelly Holley-Bockelmann	Vanderbilt Univ.	GW SIG	Dec 2019
John Tomsick	UC Berkeley	Gamma-Ray SIG / X-Ray SIG	Dec 2019
Kevin Huffenberger	Florida State Univ.	CoSSIG/IP SIG	Dec 2020
James Rhoads	GSFC	CoSSIG	Dec 2020
Graça Rocha (Vice Chair)	JPL	IP SIG/CoSSIG	Dec 2020
Abigail Vieregg	Univ. of Chicago	IP SIG / CR SIG	Dec 2020
Nicolas Yunes	Montana State Univ.	GW SIG	Dec 2020
Ryan Hickox	Dartmouth College	XR SIG	Dec 2021
Marcos Santander	Univ. of Alabama	CR SIG	Dec 2021

Highlights & SIG Updates (1/4)

- **Great Observatories SAG - R. Kraft (PhysPAG EC rep)**
  - Key findings of SAG10:
    - Strategic goal of maintaining broad multi-wavelength coverage maximizes science return
    - Panchromatic coverage can be achieved with a higher launch rate and mix of mission sizes
    - Mission lifetime of a decade or more required to maintain broad wavelength coverage
    - Planning required to set mission sizes, ensure international participation, understand opportunity cost of losing capabilities

Highlights & SIG Updates (2/4)

- **CR SIG**
  - Hosted a mini-symposium at 2019 April APS meeting in Denver on direct and indirect cosmic-ray measurements and ultra-high-energy neutrinos
  - ~16 Science White Papers submitted to Astro2020 on cosmic rays, either addressing questions of origin, composition, spectrum, or their multi-messenger connections
  - SIG chairs encouraged the community to contact them with questions and suggestions on activities or topics they would like to see the group address

- **Gamma-ray SIG**
  - Coordinated sessions at AAS in Seattle, HEAD meeting in Monterey, and upcoming AAS in Honolulu
  - Produced webpage to coordinate relevant Science White Papers for Astro2020. Held workshops and telecons to organize community in writing of white papers.
    - 74 Science White Papers mentioned gamma-rays in the title or abstract.
  - Contributed a paragraph to the May 2019 newsletter on the status of Gamma-ray missions (Transient Astrophysics Observatory (ISS-TAO), Compton Spectrometer and Imager (COSI-X), Glowbug, BurstCube)

Highlights & SIG Updates (3/4)

- **GW SIG**
  - Helped organize the community regarding thee APC white papers for Astro2020:
    - LISA mission APC, building the WG field, GW Astronomy Beyond LISA
  - Helped organize the community regarding four Voyage2050 white papers
    - Improved sensitivity in LISA band, Low frequencies, Mid-band frequencies, Improved sky localization
  - Organizing GW SIG session at January AAS in Honolulu
  - Continued interactions with the LISA Consortium regarding development of LISA
- **IP SIG**
  - Main activity of community over summer has been production of 8 APC whitepapers for Astro2020 decadal:
    - Three related explicitly to space-based projects: PICO, LiteBIRD, and description of a program for CMB spectral distortions
    - Others related to technological development or ground-based projects (Ground-based efforts highly complementary to space based efforts)
    - One paper, “The need of better tools to design future CMB experiments”, has a sub-section dedicated to space vs ground complementarity
      - Summary of the report from the KISS workshop (Rocha et al., 2019) ‘Designing future CMB experiments’, held on March 19–23, 2018, Caltech

Highlights & SIG Updates (4/4)

- **X-Ray SIG**
  - Coordinated sessions at AAS in Seattle, HEAD meeting in Monterey, and upcoming AAS in Honolulu
  - Produced webpage coordinating community Astro2020 Science White Papers
    - >50 Science White Papers relevant to X-ray astronomy, covering very wide range of science, including supermassive black holes and AGN, galaxies, groups, clusters, and the circumgalactic medium, star formation, the interstellar medium, exoplanets, supernovae and supernova remnants, stellar-mass black holes, and neutron stars
    - XRSIG highlighted science in these White Papers at AAS and HEAD sessions.
  - Will provide a similar overview of Astro2020 APC papers for Honolulu AAS
  - Provided updates to the community on US involvement in Athena, and the progress of the NASA concept study for the Lynx Observatory.
  - Major recent milestones in X-ray astronomy:
    - Successful launch in July of Spectrum X-Gamma S/C with eROSITA & ART-XC telescopes. Update on mission will be given in Honolulu X-Ray SIG session.

Goals of the MMA SAG

1. **Identify science goals that could be achieved by combining different astrophysical messengers measured by current and future ground- and space-based observatories**

2. **Identify measurements that can be made by existing, currently approved, and future planned ground- and space-based observatories that could contribute to MMA in 2020's, early 2030's**

3. **Determine how these enhanced or new science goals align with NASA Astrophysics Division's scientific priorities.**

4. **Identify the key qualitative technical drivers that are needed to achieve these science goals (e.g. wavelength, sensitivity, sky localization, latency, …)**
   - If feasible, determine desirable performance levels for each

What is the MMA SAG?

- **Community-driven; community-owned; open to all**
- **MMA SAG consists of astrophysicists from multiple disciplines within the PhysPAG and COPAG**
- **While inspired by GW BNS observation, MMA SAG is not necessarily GW-specific**
- **Chair, John W. Conklin, University of Florida**
  PhysPAG Co-chair, John Tomsick, UC Berkeley
  COPAG Co-chair, Suvi Gezari, University of Maryland

MMA SAG Source Teams

- **Organized around astrophysical sources (not λ or spectrum)**
  - Goal: form teams with people interested in the same sources but observing via different messengers
  - Asked for volunteers to lead/co-lead the source teams.
  1. **AGN, SMBH binaries, EMRIs**
     - Sarah Burke-Spolaor & Bindu Rani, co-leads
  2. **NS+NS, NS+BH, WD-WD binaries, GRBs**
     - Eric Burns, Colleen Wilson-Hodge, co-leads
  3. **Stellar mass BH-BH binaries**
     - Peter Shawhan, Saavik Ford*, co-leads
  4. **FRBs, SNe Ia, SN remnants**
     - Geoff Clayton, lead
- **~bi-weekly Source Team telecons & ~monthly full telecons**

Progress of the MMA SAG

- **10 community science white papers organized by MMA SAG, including one overarching paper, submitted to Astro2020 decadal**
- **Draft final report circulating via overleaf that includes:**
  - Summary of MMA SAG charter and goals
  - Summary of overarching paper and other SWP submitted
  - Additional work that occurred after the SWP deadline:
    - Section on Fast Radio Bursts
    - Section on Extreme Mass Ratio Inspirals (EMRI)
    - Communications/interactions across MMA observatories
    - Update to cosmic ray section on studying the galactic magnetic field
    - Impact of aLIGO/Virgo O3 run
- **Plan to complete near-final report before end of 2019 CY**
  - Will present outcomes at Jan AAS & solicit feedback from community
  - Final will be report submitted to APAC before Spring meeting

PhysPAG Input to Technology Gap Assessment

- **Technology gaps sent to PhysPAG EC in early June**
  - EC reviewed gaps independently for ~2 weeks
  - Held PhysPAG EC telecon on 17 June 2019 to discuss/formalize our response
- **PhysPAG EC report submitted to Thai Pham on 9 July**
  - 7 gaps were recommended to keep as-is
  - 1 gap found to be redundant
  - 1 gap required further clarification
- **Point of discussion about the process:**
  - 1-2 gaps did not have sufficient/complete information
  - EC was asked to fill in any missing information as needed
  - However, EC in some cases did not know the intent of the submitter and did not want to misrepresent the intent or concept of the submitter

PhysPAG/SIG Meetings and Activities

- **Winter AAS meeting, January 2020, Honolulu**
  - PhysPAG and SIG sessions now solidified
  - For PhysPAG session: Planning Multimission/MMA theme
    - Inviting abstracts for lightning talks from the broad community
- **April APS, April 2020, Washington, DC**
  - Planning has not begun yet, but will likely have SIG sessions
- **AAS HEAD, September 2020**
  - Planning has not begun yet, but will likely have X-Ray and Gamma-Ray SIG sessions
- **DCL for new PhysPAG members**
  - EC advertised, reached out to encourage community to apply
  - Expecting new members, including new Vice-Chair announcement in November