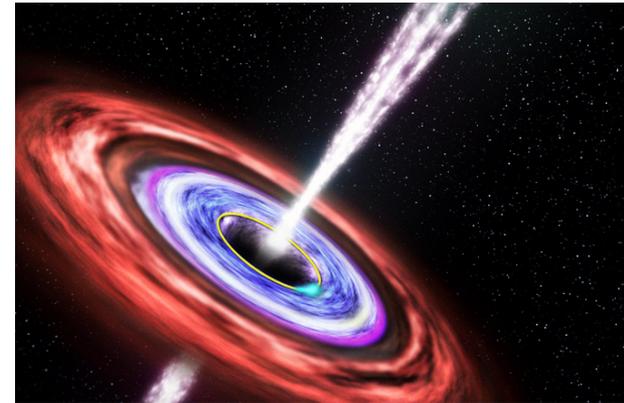
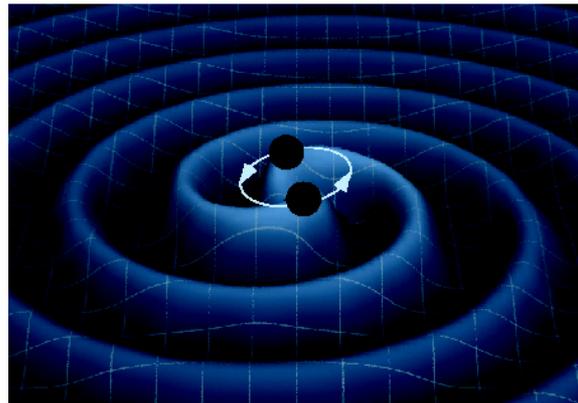
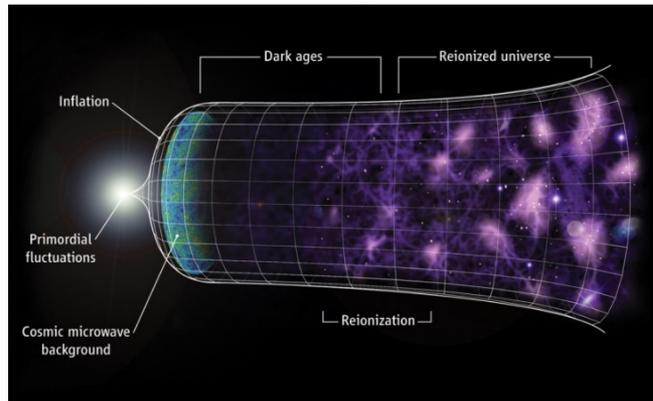


# Physics of the Cosmos Program Analysis Group Activities



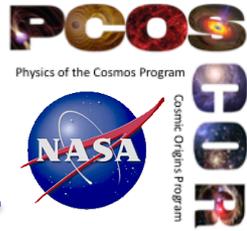
**Graça Rocha**

Jet Propulsion Laboratory/Caltech  
*Chair, Physics of the Cosmos Program Analysis Group*  
[graca.m.rocha@jpl.nasa.gov](mailto:graca.m.rocha@jpl.nasa.gov); [graca@caltech.edu](mailto:graca@caltech.edu)

*AAS, 4 January 2020*

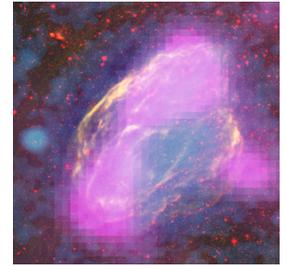
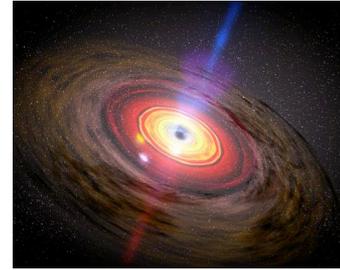
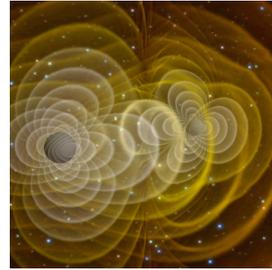
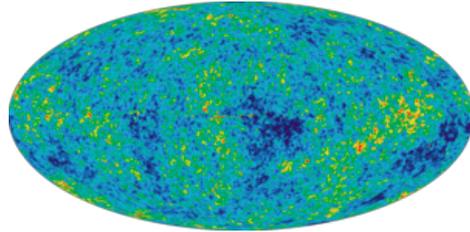
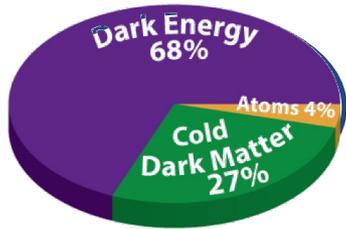
# Outline

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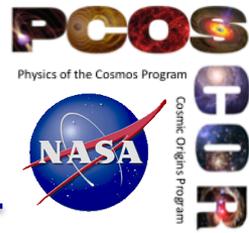
- **Introduction to PhysPAG (reminder)**
- **SIG Highlights and Activities**
- **Multimessenger Astrophysics SAG**
- **Input for the technology gap process**
- **RFI for Research That Falls in the Gaps**
- **Past and Future Meetings**

# Physics of the Cosmos Science Objectives

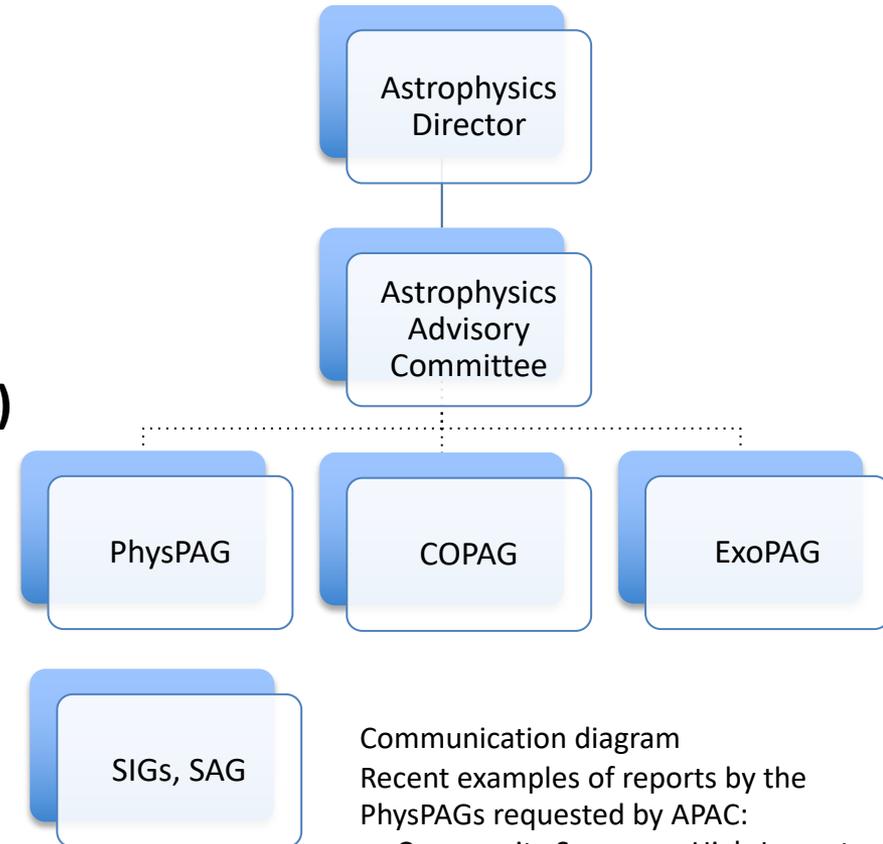


- Increase our knowledge of dark energy
- Precisely measure cosmological parameters governing evolution of the universe and test inflation hypothesis of Big Bang
- Test validity of Einstein's General Theory of Relativity and investigate nature of spacetime
- Understand formation and growth of massive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

# Communicating with NASA Astrophysics via the Program Analysis Groups (PAGs)



- The Physics of the Cosmos Program Analysis Group (**PhysPAG**) coordinates input and analysis from the scientific community in support of the PCOS program objectives.
- Study Analysis Groups (**SAGs**) **conduct specific analyses. PCOS started a SAG on Multi Messenger Astrophysics (MMASAG)**
- Science Interest Groups (SIGs) are longer-standing discipline fora.
  - IPSIG
  - GWSIG
  - XRSIG
  - GammaSIG
  - CRSIG
  - CoSSIG



Communication diagram  
Recent examples of reports by the PhysPAGs requested by APAC:

- Community Survey on High-Impact Research Science
- Community Survey on Possible Delay in 2020 Decadal Survey

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Science Mission  
Directorate

Astrophysics  
Division

Exoplanets

Physics  
Of the  
Cosmos

Cosmic  
Origins

SIGs, SAGs

## Science Analysis Groups (SAGs)

- **Multimessenger Astrophysics** (MMA SAG) (Chairs: John Conklin, John Tomsick, and Suvi Gezari): Analyze the potential scientific benefits of multimessenger observations made possible by NASA observatories in the 2020 decade and beyond, working in conjunction with each other or with other ground and space-based instruments.

## Science Interest Groups (SIGs)

- **Inflation Probe** (Chairs: Kevin Huffenberger, Graça Rocha, and Abigail Vieregg): Coordinate community activities and preparations for a future cosmic microwave background polarization mission.
- **Gravitational Waves** (Chairs: John Conklin, Kelly Holley-Bockelmann, and Nicolas Yunes): Coordinate community activities and preparations for a future gravitational wave mission.
- **X-rays** (Chairs: Ralph Kraft and John Tomsick): Coordinate community activities and preparations for a future X-ray astronomy mission.
- **Gamma Rays** (Chairs: Sylvain Guiriec, Henric Krawczynski, and John Tomsick): Coordinate community activities and preparations for a future gamma ray astronomy mission.
- **Cosmic Rays** (Chairs: Igor Moskalenko, Jim Beatty, and Abigail Vieregg): Coordinate community activities and preparations for a future cosmic ray astronomy mission.
- **Cosmic Structure** (Chairs: Kevin Huffenberger, James Rhoads, and Graça Rocha): Coordinate community activities for future space activities concerning the nature of dark energy, dark matter, neutrinos, and tests of inflation, as well as astrophysical galaxy evolution.

# PhysPAG EC Membership

Name	Affiliation	Area of Expertise	Term Ends
John Conklin (Chair Emeritus)	Univ. of Florida	GW SIG	Dec 2020
Graça Rocha (Chair)	JPL/Caltech	IP SIG/CoS SIG	Dec 2020
Sylvain Guiriec	George Washington Univ.	GR SIG	Dec 2020
Kevin Huffenberger	Florida State Univ.	CoS SIG/IP SIG	Dec 2020
James Rhoads	GSFC	CoS SIG	Dec 2020
Abigail Vieregg	Univ. of Chicago	IP SIG / CR SIG	Dec 2020
Nicolas Yunes	Montana State Univ.	GW SIG	Dec 2020
Ryan Hickox (Vice Chair)	Dartmouth College	XR SIG	Dec 2021
Marcos Santander	Univ. of Alabama	CR SIG	Dec 2021
Jillian Bellovary	Queensborough Comm Coll.	GW SIG / XR SIG	Dec 2022
Sean McWilliams	WVU	GW SIG	Dec 2022
Bindu Rani	SURA, GSFC	GR SIG	Dec 2022
Grant Tremblay	SAO	XR SIG	Dec 2022

We thank the members rotating off in December 2019 for their service:

[Jim Beatty](#), [Kelly Holley-Bockelmann](#), and [John Tomsick](#).

# Highlights & SIG Updates (1/7)

- **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

## Agenda

9:30–9:50 A.M. <b>Introduction to Great Observatories SAG</b>	Lee Armus
9:50–10:05 A.M. <b>Origin of Life and Planets</b>	Michael Meyer
10:05–10:20 A.M. <b>Galactic Processes</b>	Massimo Marengo
10:20–10:35 A.M. <b>Galaxy Evolution</b>	Lee Armus
10:35–10:50 A.M. <b>Fundamental Physics</b>	Ralph Kraft & Suvi Gezari
10:50–11:10 A.M. <b>Capabilities, Facilities and Options</b>	StephanMcCandliss & Martin Elvis
11:10–11:30 A.M. <b>Questions</b>	
<b>WebEx</b>	
<b>Great Observatories SAG</b>	
Sunday, 5 January 2020	
9:30 A.M.   Hawaii Time (Honolulu, GMT-10:00)   2 hrs	
<b>Meeting number (access code):</b> 907 669 117	
<b>Meeting password:</b> Aas2020!	
When it's time, <a href="#">join the meeting</a> .	

SAG10 Session at this AAS meeting

# Highlights & SIG Updates (2/7)

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- **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 this meeting 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 (3/7)

## Gamma-Ray SIG Session

Wednesday, 8 January 2020

1:15 P.M.–2:45 P.M., Room: : 303A

## Agenda

### Welcome

1:15–1:25 P.M. **Fermi Result Highlights**

1:25–1:35 P.M. **COSI Result Highlights**

1:35–1:45 P.M. **Status of Glowbug**

1:45–1:55 P.M. **AMEGO**

1:55–2:05 P.M. **GRAMS**

2:05–2:15 P.M. **ETCC/SMILE**

2:15–2:25 P.M. **MoonBEAM**

2:25–2:35 P.M. **TAP**

2:35–2:45 P.M. **Gamow**

**Open Discussion if time permits**

Sylvain Guiriec

Liz Hays

Carolyn Kierans

Eric Grove

Julie McEnery

Tsuguo Aramaki

Toru Tanimori

Michelle Hui

Judy Racusin

Nick White

### WebEx

#### Gamma-Ray SIG Session

Wednesday, 8 January 2020

1:00 P.M. | Hawaii Time (Honolulu, GMT-10:00) | 2 hrs

**Meeting number (access code):** 905 835 799

**Meeting password:** Aas2020!

When it's time, [join the meeting](#).

# Highlights & SIG Updates (4/7)

- **GW SIG**
  - Helped organize the community regarding **3** 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
  - Continued interactions with the LISA Consortium regarding development of LISA
  - Organized GW SIG session at this AAS meeting in Honolulu

## **Gravitational Wave SIG Session**

Tuesday, 7 January 2020  
9:45 A.M.–11:15 A.M., Room: 303A

### **Agenda**

TBA

### **WebEx**

#### **Gravitational Wave SIG Session**

Tuesday, 7 January 2020

9:30 A.M. | Hawaii Time (Honolulu, GMT-10:00) | 2 hrs

**Meeting number (access code):** 905 332 883

**Meeting password:** Aas2020!

When it's time, [join the meeting](#).

# Highlights & SIG Updates (5/7)

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- **IP SIG**

- Main activity of community was production of **~20** Science whitepapers and **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
- For information on the SWP please take a look at the IP SIG webpage

# Highlights & SIG Updates (6/7)

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- **X-Ray SIG**
  - Coordinated sessions at AAS in Seattle, HEAD meeting in Monterey, and this AAS meeting 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 this AAS meeting
  - 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 here in the X-Ray SIG session.

# Highlights & SIG Updates (7/7)

## X-ray SIG Session

Wednesday, 8 January 2020  
 9:15 A.M.–10:45 A.M., Room: 303A

## Agenda

9:15–9:30 A.M.	<b>Debrief on Astro 2020 APC white papers and new opportunities</b>	XRSIG Co-chairs
9:30–9:55 A.M.	<b>Update on eROSITA / Spectrum-X-Gamma</b>	Mara Salvato
9:55–10:20 A.M.	<b>Update on XRISM</b>	Rob Petre
10:20–10:45 A.M.	<b>Diffraction Limited X-ray Telescope</b>	Herman Marshall

### WebEx

#### X-ray SIG Session

Wednesday, 8 January 2020  
 9:00 A.M. | Hawaii Time (Honolulu, GMT-10:00) | 2 hrs  
**Meeting number (access code):** 904 139 544  
**Meeting password:** Aas2020!  
 When it's time, [join the meeting](#).

# MMA SAG: Goals

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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?

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- 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 Session at this meeting

## MMA SAG Session

Tuesday, 7 January 2020

1:15 P.M.–2:45 P.M., Room: 303A

## Agenda

**Session Chair:** Suvi Gezari

1:15–1:25 P.M.	<b>MMA SAG Goals and Activities</b>	J. Conklin
1:25–1:37 P.M.	<b>Summary of MMA Opportunities</b>	E. Burns, TBC
1:37–1:49 P.M.	<b>Black Hole Mergers</b>	John Tomsick
1:49–2:01 P.M.	<b>Neutron Star Mergers</b>	C. W-H
2:01–2:13 P.M.	<b>Supernovae</b>	Chris Fryer
2:13–2:25 P.M.	<b>GW as probes of AGN</b>	Saavik Ford, TBC
2:25–2:37 P.M.	<b>Communications across MMA observatories</b>	Aaron Tohuvavohu
2:37–2:45 P.M.	<b>Discussion</b>	All

## WebEx

### MMA SAG Session

Tuesday, 7 January 2020

1:00 P.M. | Hawaii Time (Honolulu, GMT-10:00) | 2 hrs

**Meeting number (access code):** 902 690 780

**Meeting password:** Aas2020!

When it's time, [join the meeting](#).

# PhysPAG Input to Technology Gap Assessment

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- **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

# RFI for Research That Falls in the Gaps

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- **Request for Information: Research That Falls in a Gap between current SMD**

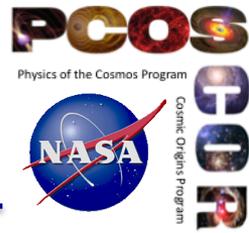
Does your research not fit well into one of NASA's regular funding mechanisms?

- Check out the request for information (RFI) from NASA's Science Mission Directorate for research that falls in the gaps:

<https://nspires.nasaprs.com/external/solicitations/summary.do?solId=%7BD82B2B9A-5F6D-B0C6-741A-6950D1D6F0E1%7D&path=&method=init>

**Send a response by January 31!**

# PhysPAG/SIG Meetings and Activities: Winter AAS meeting, January 2020, Honolulu



## Meeting Schedule [Agenda]

- **Saturday, 4 January 2020**
  - **NASA Joint PAG Session [Agenda]**  
1:15 P.M.–2:45 P.M., Room: Coral Ballroom 1 [Hilton]
  - **NASA PCOS & PhysPAG Session [Agenda]**  
3:15 P.M.–4:45 P.M., Room: Rainbow 2 & 3 [Hilton]
  
- **Sunday, 5 January 2020**
  - **COR Great Observatories SAG Session [Agenda]**  
9:30 A.M.–11:30 A.M., Room: 323A
  
- **Tuesday, 7 January 2020**
  - **Gravitational Wave SIG Session [Agenda]**  
9:45 A.M.–11:15 A.M., Room: 303A
  - **MMA SAG Session [Agenda]**  
1:15 P.M.–2:45 P.M., Room: 303A
  
- **Wednesday, 8 January 2020**
  - **X-ray SIG Session [Agenda]**  
9:15 A.M.–10:45 A.M., Room: 303A
  - **Gamma-Ray SIG Session [Agenda]**  
1:15 P.M.–2:45 P.M., Room: : 303A

[https://pcos.gsfc.nasa.gov/physpag/meetings/AAS\\_Jan2020/AAS2020-agenda.php](https://pcos.gsfc.nasa.gov/physpag/meetings/AAS_Jan2020/AAS2020-agenda.php)

# PhysPAG/SIG Meetings and Activities

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- Winter AAS meeting, January 2020, Honolulu
- **April APS, April 2020, Washington, DC**
  - Planning has begun, but will likely have SIG sessions
- **AAS HEAD, September 2020**
  - Planning has begun and we will have PCOS sessions likely including X-Ray and Gamma-Ray SIG
- **Multimission/MMA theme at Jan AAS & April APS**
  - Invited abstracts for lightning talks to the broad community