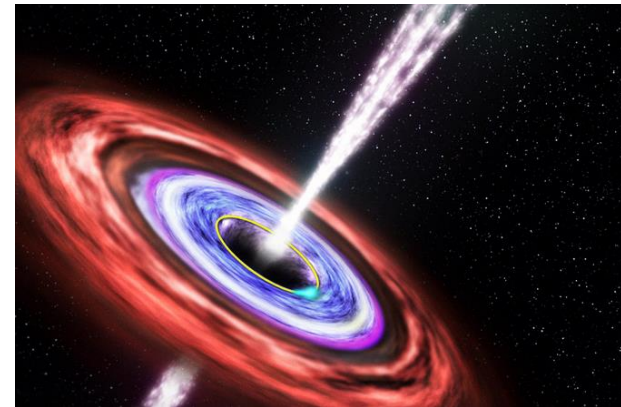
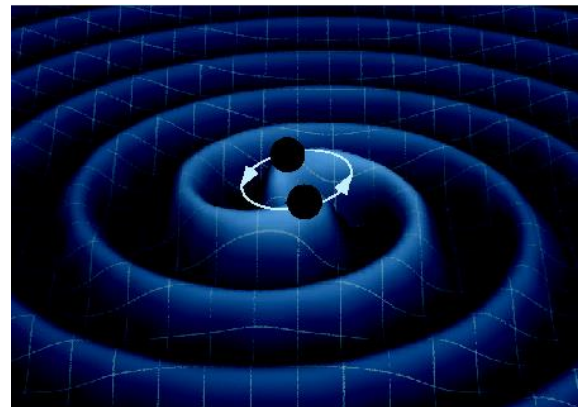
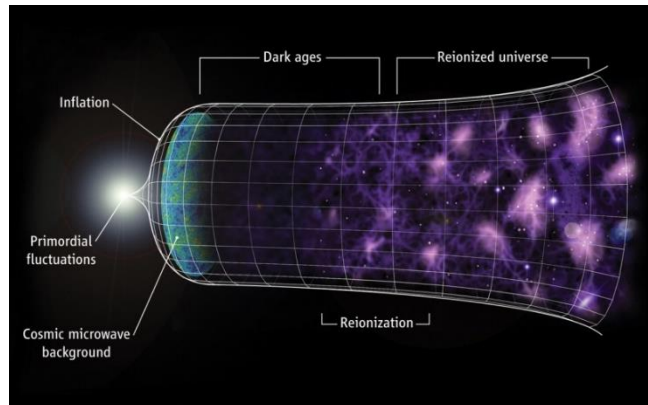


# Physics of the Cosmos Program Analysis Group



**John W. Conklin**

University of Florida (jwconklin@ufl.edu)

*Chair, Physics of the Cosmos Program Analysis Group*

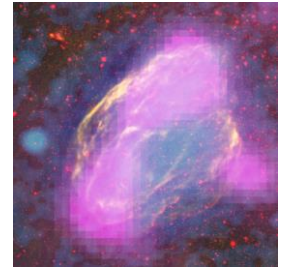
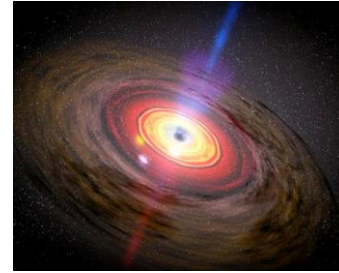
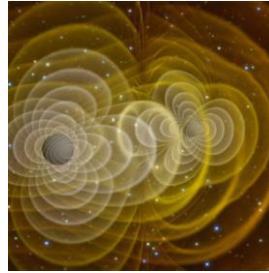
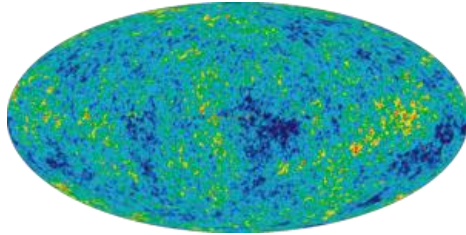
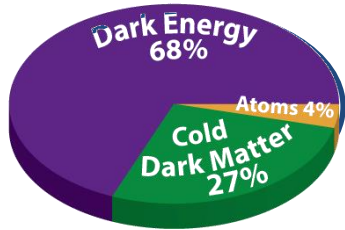
*10 January 2019*

# Outline

---

- **Introduction to PhysPAG (reminder)**
- **New NASA Policy on PAGs and the 2020 Decadal Survey**
- **News from the Physics of the Cosmos Program**
- **Multimessenger Astrophysics SAG**
- **SIG Highlights and Meetings**

# Physics of the Cosmos Science Objectives

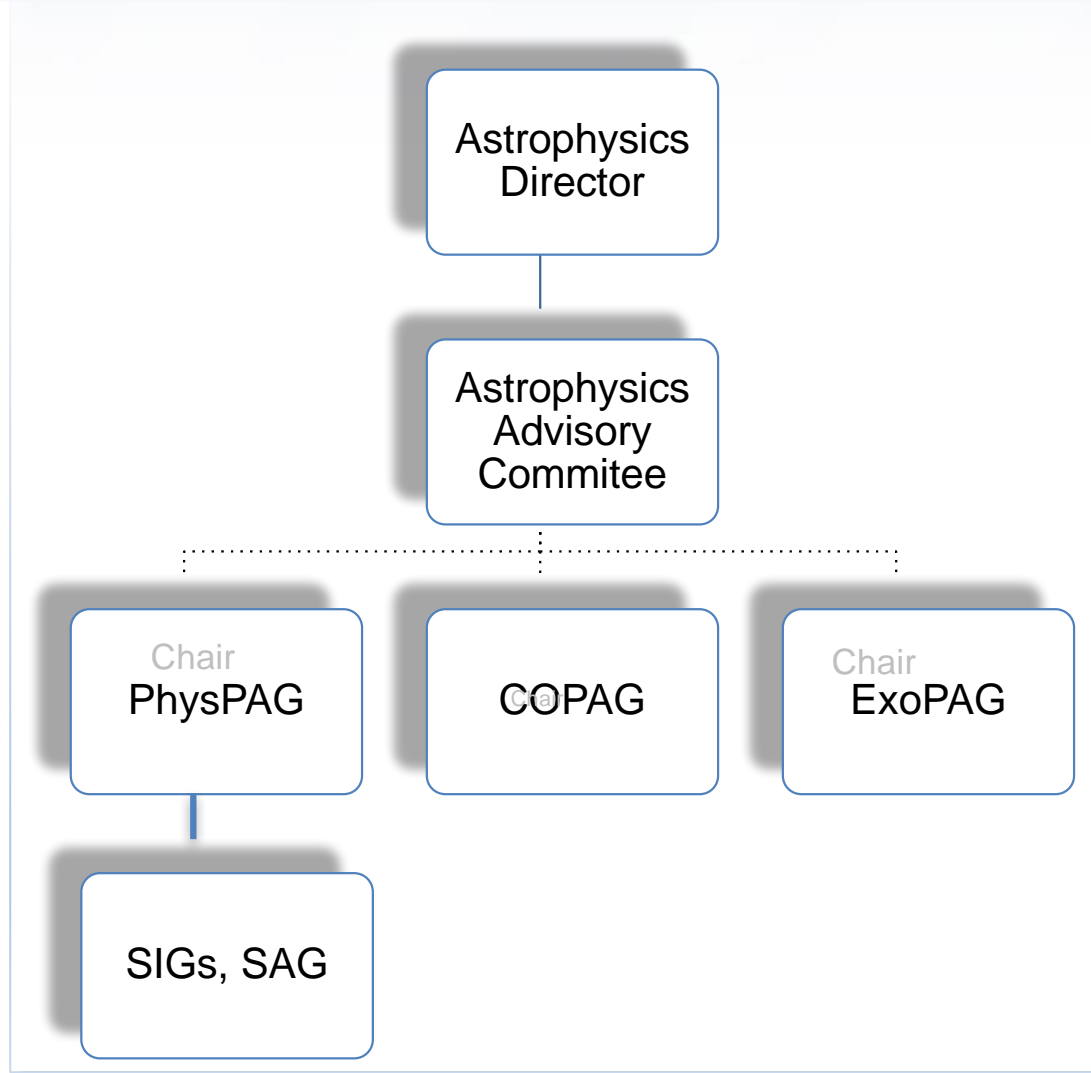


- Increase our knowledge of dark energy
- Precisely measure cosmological parameters governing evolution of the universe and test inflation hypothesis of Big Bang
- Test validity of Einstein's General Theory of Relativity and investigate nature of spacetime
- Understand formation and growth of massive 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
Ralph Kraft	SAO	X-Ray SIG	Dec 2018
Henric Krawczynski	Washington Univ. in St. Louis	Gamma-Ray SIG	Dec 2018
Igor Moskalenko	Stanford Univ.	CR SIG	Dec 2018
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

# Communication Pathways



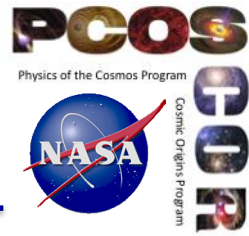
# Outline

---

- Introduction to PhysPAG (reminder)
- **New NASA Policy on PAGs and the 2020 Decadal Survey**
- News from the Physics of the Cosmos Program
- Multimessenger Astrophysics SAG
- SIG Highlights and Meetings

# NASA's Astrophysics Program Analysis Groups and the 2020 Decadal Survey

---



## Approved by Paul Hertz, 30 November 2018

- “the PAGs, including their ECs and sub-groups ..., shall not submit white papers to Astro2020. However the PAGs, including the ECs and their sub-groups, may submit summaries of accepted and publicly available PAG reports”
- “Thus the PAGs, including the ECs and sub-groups, may serve their communities by coordinating the writing of white papers and other input for Astro2020.”
- “The PAGs, including the ECs and sub-groups, may also serve their communities by communicating to Astro2020 the existence of any analysis work done by the PAGs, including the ECs and sub-groups, which has been completed, including approval for public release, and made available publicly.”

# Outline

---

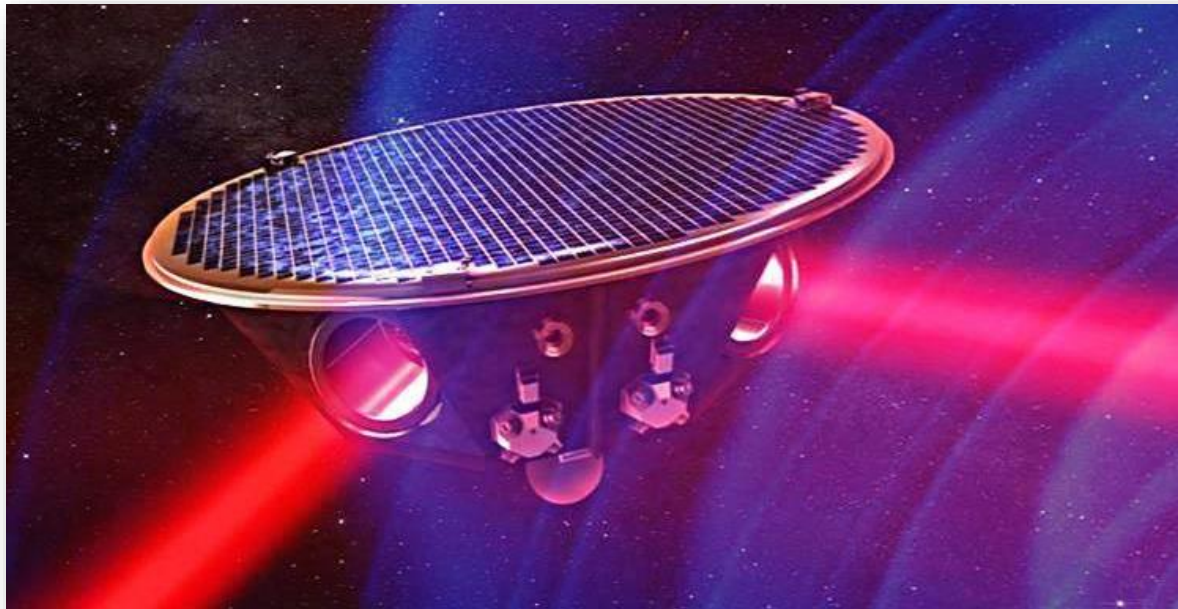
- Introduction to PhysPAG (reminder)
- New NASA Policy on PAGs and the 2020 Decadal Survey
- **News from the Physics of the Cosmos Program**
- Multimessenger Astrophysics SAG
- SIG Highlights and Meetings



# LISA Preparatory Science (LPS) Program

- **Background**

- ROSES element dedicated to LISA science support
- Three-year proposals starting in FY19
- Independent from LISA Study Office
- 30 proposals submitted, 8 selected



# LISA Preparatory Science Selections

Title	PI	Institution
Searching for the Stochastic Gravitational-Wave Background with LISA	Vuk Mandic	U. Minnesota
Electromagnetic and Gravitational Wave Signatures of LISA Massive Black Hole Binaries	Tamara Bogdonovic	Georgia Tech Research Center
Developing global analysis strategies for the LISA gravitational wave observatory	Neil Cornish	Montana State
Multi-messenger Astronomy: Forecasting LISA Events with LIGO Detections and EM counterparts	Smadar Noaz	UCLA
Black Hole Mergers and Gravitational Radiation in the LISA Era	Dierdre Shoemaker	Georgia Tech Research Center
Tools for Modeling Selection Biases and for Advanced Astrophysical Interpretation of LISA Observations	Shane Larson	Northwestern
Simulating the LISA instrument for maximum science return: high fidelity modeling of precision freefall and optical metrology	Peter Wass	U. Florida
Next generation analysis for LISA data analysis	Curt Cutler	JPL
Detection of ISA Verification Binaries and Galactic Ultra-Compact Binaries using the Zwicky Transient Facility	Tom Prince	Caltech

# Updated Astrophysics Implementation Plan

- **Periodic update to NASA Astrophysics Division's plan to implement 2010 Decadal recommendations**
  - Previous update was in 2016
- **2018 AIP can be found here:**  
<https://science.nasa.gov/astrophysics/documents>

National Aeronautics and Space Administration



## Astrophysics Implementation Plan: 2018 Update

# Outline

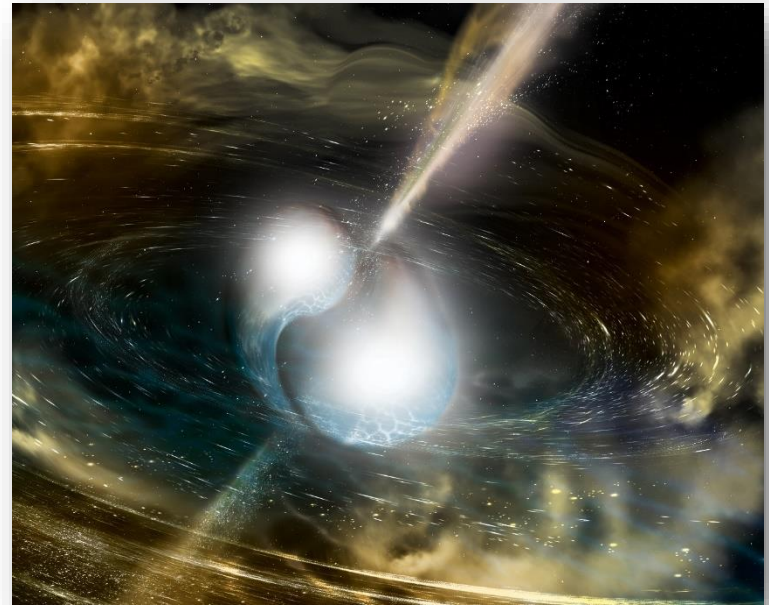
---

- Introduction to PhysPAG (reminder)
- New NASA Policy on PAGs and the 2020 Decadal Survey
- News from the Physics of the Cosmos Program
- **Multimessenger Astrophysics SAG**
- SIG Highlights and Meetings

# Goals of the MMA SAG

---

- 1. Identify science achievable by combining different messengers measured by current & future ground- & space-based observatories**
- 2. Identify measurements that can be made by existing, currently approved, planned ground- & space-based observatories 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**
- **To Join:**
  - Google: MMA SAG PCOS, click on first search result
  - Then subscribe to email list

# MMA SAG Source Teams

---

- **Organized around astrophysical sources (not  $\lambda$  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**

# Outcomes of the MMA SAG

---

- The SAG will document its findings in one or more publically available white papers
  - Delivered to APAC in summer 2019
- These white papers will not advocate for any particular mission, but provide analysis of MMA landscape in 2020's



# MMA SAG White Papers in Progress

---

- **AGN, SMBH binaries, EMRI's**
  1. Extreme Mass Ratio Inspirals
  2. Multi-Messenger science of the growth of supermassive binary black holes
  3. AGN Multi-messenger: Neutrinos
  4. High-energy emission: key challenges
- **NS+NS, NS+BH, WD-WD binaries, CCSNe**
  5. Neutron star mergers
  6. Galactic Binaries
  7. Core Collapse Supernovae
- **Stellar Mass BH-BH binaries**
  8. Multi-Messenger Astrophysics Opportunities with Stellar-Mass Binary Black Hole Merger Events
  9. Multi-Messenger Supermassive Black Hole Binary Statistical Inferences
- **FRBs, SNe Ia, SN Remnants – still in progress**

# Outline

---

- Introduction to PhysPAG (reminder)
- New NASA Policy on PAGs and the 2020 Decadal Survey
- News from the Physics of the Cosmos Program
- Multimessenger Astrophysics SAG
- **SIG Highlights and Meetings**

# Highlights & SIG Updates (1/4)

---

- **Great Observatories SAG - R. Kraft (PhysPAG EC rep)**
  - GO SAG originated in COPAG EC, but significant interest among PhysPAG community, and particularly XRSIG. Roughly 40 participants.
  - Broad charter to address the following questions:
    - What are options for maintaining, in next 10-20 years, multi-wavelength coverage from space?
    - Can anticipated scientific goals be realized with a combination of flagship, smaller missions?
    - Should longevity be key criteria for considering future large missions? What are kinds of science that require simultaneity vs sequential obs. ?
    - What is role of international partnerships in meeting these goals?
    - Are there (non-traditional) technical solutions that are being discussed or should be studied that can help?
    - To what degree can loss of wavelength coverage be partially mitigated through the use of existing NASA archives?
  - Had several telecons and divided into five working groups - four science themes and one for missions and facilities.
  - Each WG will develop one or more white papers

# Highlights & SIG Updates (2/4)

---

- **GW SIG**
  - The GW community organizing space-based GW white papers with NLST
  - Helping organize the LISA Consortium reboot
  - Organizing sessions here at AAS
- **CoSSIG**
  - Organizing community in preparing Science White Papers
- **CR SIG**
  - Held Mini-Symposium at Spring APS meeting in Columbus, OH
    - Featured results from key experiments, including Voyager as exited heliosphere
  - Organizing community in preparing the White Paper process

# Highlights & SIG Updates (3/4)

---

- **X-Ray SIG**

- Organized XR SIG meeting here at Seattle AAS meeting
- Community is gathering information from large mission studies about plans for submitting WP's to Decadal. Will share this info to X-Ray community to ensure full community participation

- **Gamma-ray SIG**

- The gamma-ray community held two workshops, telecons for initiating, continuing drafting science white papers for 2020 Decadal.
  - 1st workshop at the George Washington University, May 23-24, 2018
  - 2nd workshop at the Clemson University, October 1, 2018
  - Organized XR SIG meeting here at Seattle AAS meeting
- Community is drafting five science white papers, which will respond to multiple thematic areas

# Highlights & SIG Updates (4/4)

---

## ■ IP SIG

- The CMB community is working on Science White Papers:
  - Terri Brandt participated in CMB meetings (started with CMB-S4 few months ago)
  - Community is approaching collaborators to review white papers, ensure the whole set of interests are represented, namely:
    - Interests in space and ballooning are well represented
    - Various people reading more than one draft at a time, so that content is rationalized and consistent among groups and between science topics

# PhysPAG/SIG Meetings

---

- **Winter AAS meeting, 6–10 January, 2019, Seattle, WA**
  - Joint-PAG session on Sunday, 6 January
    - **CANCELLED**; Due to the government shutdown
    - Paul Hertz plans to hold web Town Hall after government re-opens.
  - Thursday, 10 January, 1.5-hour sessions each, in order:
    - GW SIG (sorry, you missed it)
    - PhysPAG Session (this one right now)
    - Gamma-Ray SIG (1:15 PM today, Room 310)
    - X-Ray SIG (3:15 PM today, Room 310)
- **AAS/HEAD Meeting, 17-21 March, Monterey, CA**
  - X-Ray SIG session
- **April APS, 13-16 April, Denver, CO**
  - Will have PhysPAG/PCOS and SIG sessions

# How to get involved in PhysPAG

---

- **Visit our NASA website**
  - Google: PCOS GSFC
- **Subscribe to our email list**
  - Google: PCOSnews GSFC
- **Join the Executive Committee**
  - Five members expected to roll off in Dec 2019 (including me)
  - Look for Dear Colleague letter in Oct/Nov 2019



# PhysPAG Impact: 3 recent examples

---

- 1. 2015 – Paul Hertz charge to PAGs to review large mission concepts that could be funded in prep for Astro2020**
  - ⇒ 4 STDTs: HabEx, LUVOIR, Lynx, OST
  - PhysPAG report, Section 2d: Importance of Probe-Class Missions
- 2. 2016 – Paul Hertz Charge to PAGs on Astrophysics Probes**
  - ⇒ 10 PI-led Probe Concept Studies
- 3. 2018 – NASA considered delaying Asto2020 decadal; PAGs issued a survey of Astro community**
  - ⇒ 72% of respondents said delay not needed
  - ⇒ 54% of respondents identified as PCOS
  - ⇒ Today Astro2020 decadal following original schedule