National Aeronautics and Space Administration

Cosmic Origins Program Analysis Group (COPAG)
AAS Splinter
January 11, 12-1:30 pm ET

Dr. Margaret Meixner
Chair,
Cosmic Origins Program Analysis Group Executive Committee

Agenda

12 -12:15 pm: Ingesting the Decadal Survey Results: The role of the COPAG
- -NASA HQ: Kartik Sheth
- -COR Program Office/NASA Goddard: Peter Kurczynski
- -COPAG Executive Committee: Margaret Meixner (USRA/SOFIA)

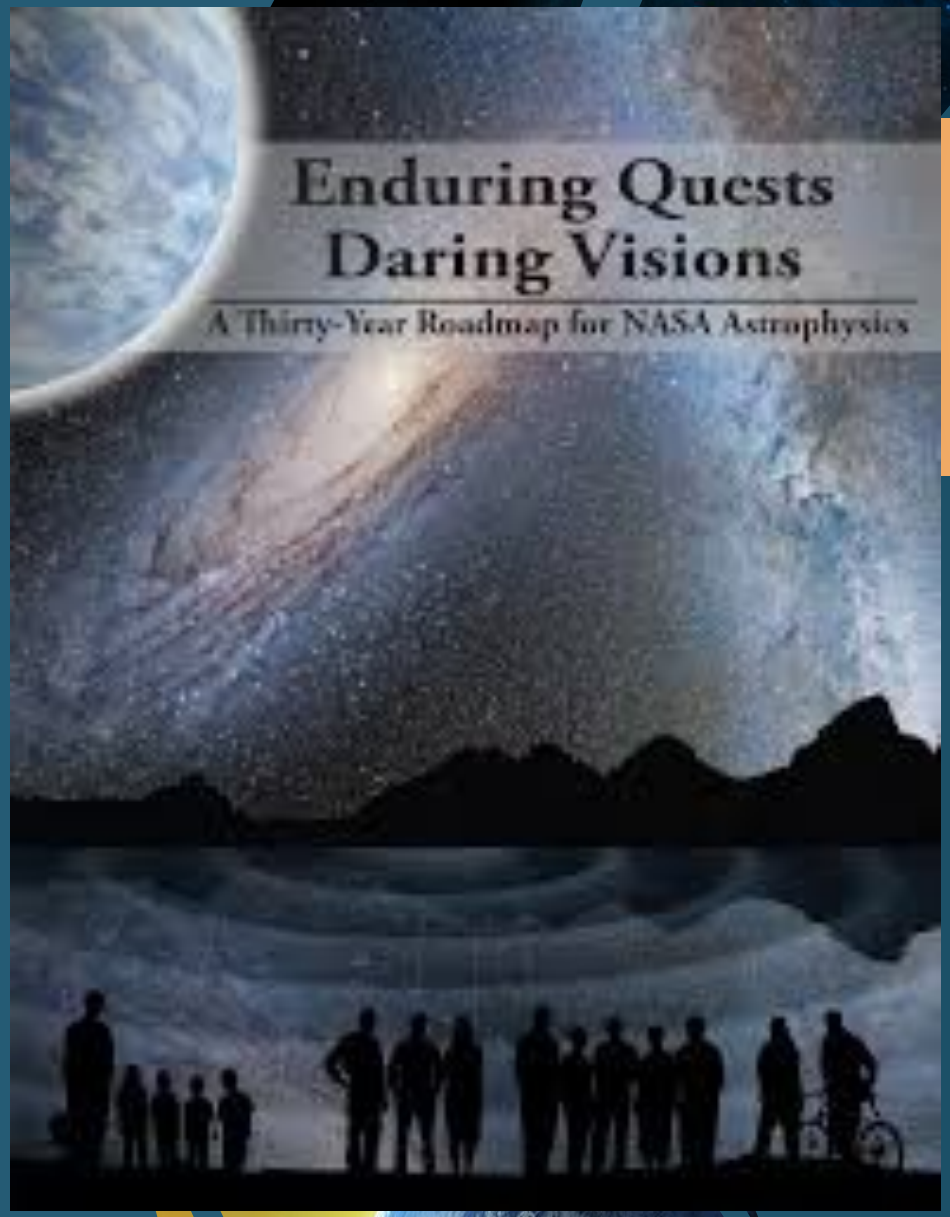
12:15-1 pm: New Science Interest Groups (SIGs) and Science Analysis Groups (SAGs) – chaired by Meixner
- -Laura Lopez (OSU), ISM and planet formation
- -Keith Hawkins (UT Austin), Stars, Sun and Stellar Populations
- -Kartik Sheth (NASA HQ), State of the Profession & Societal Impacts
- -Steven Finkelstein (UT Austin) Cosmic Dawn, Galaxies
- -Jason Tumlinson (STScI/JHU) The Next Great Observatories
- -DISCUSSION

1-1:30 pm: Panel Discussion: What have I done and liked about serving on the COPAG Executive Committee (EC)?
- -Janice Lee, IPAC/CalTech
- -Stephan McCandliss, Johns Hopkins University
- -Alex Pope, University of Massachusetts, Amherst
- -Tom Megeath, University of Toledo
- -DISCUSSION

Kartik Sheth
COR Program Officer

Ingesting the Decadal Survey Results: The role of the COPAG

NASA HQ perspective



https://arxiv.org/abs/1401.3741

The Cosmic Origins Program seeks to answer the enduring question "How did we get here?

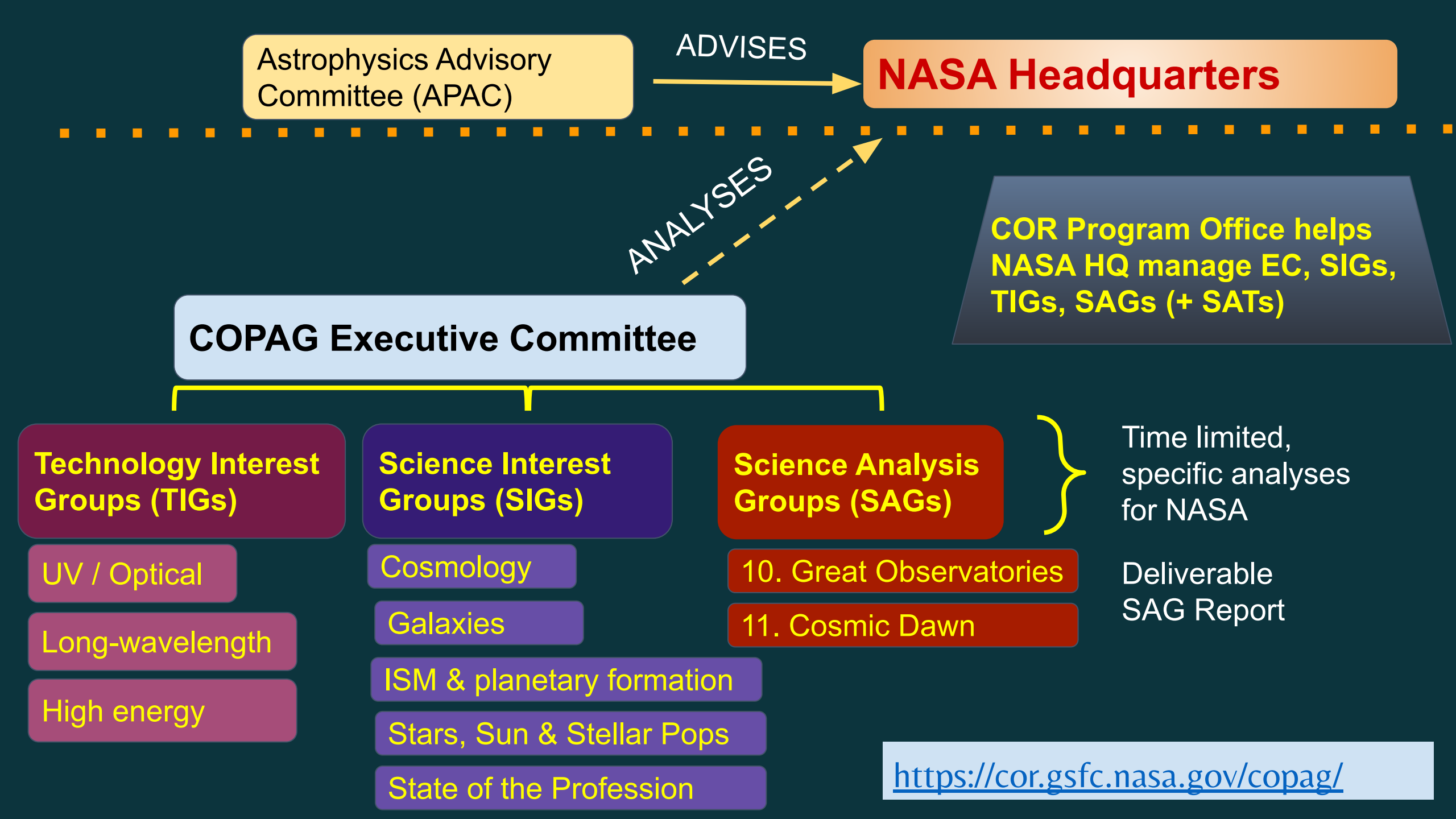
- Our community needs not only an ambitious and daring vision but also smart, strategic solutions to achieve the vision.
- Cosmic Origins Program (COR) via its science and technology interest groups as well as science analysis groups provides expert analysis of the science and technology gaps.
- The Program offers analysis of solutions on how these gaps may be closed to realize the vision for our desired understanding of our Cosmic Origins.

Cosmic Origins & The Decadal Survey

- NASA will seek to implement the recommendations of the Decadal Survey within its programmatic constraints.
- After the Decadal Report is published, COR will be helping NASA analyze the recommendations in concert with
  - Cosmic Origins Program Analysis Group (COPAG) Executive Committee (EC)
    - Science Interest Groups (SIGs)
    - Technology Interest Groups (TIGs)
    - Science Analysis Groups (SAGs)

COME JOIN US!

https://cor.gsfc.nasa.gov/


Astrophysics Advisory Committee (APAC)
ADVISES
NASA Headquarters
ANALYSES
COR Program Office helps NASA HQ manage EC, SIGs, TIGs, SAGs (+ SATs)
COPAG Executive Committee
Technology Interest Groups (TIGs)
Science Interest Groups (SIGs)
Science Analysis Groups (SAGs)
Time limited, specific analyses for NASA
UV / Optical
Long-wavelength
High energy
Cosmology
Galaxies
ISM & planetary formation
Stars, Sun & Stellar Pops
State of the Profession
10. Great Observatories
11. Cosmic Dawn
Deliverable SAG Report
https://cor.gsfc.nasa.gov/copag/

10-12 appointed APAC members (incl. Meixner)

ADVISES

Paul Hertz (Director)
Kartik Sheth (COR PS)
Eric Tollestrup (Dep. COR PS)

ANALYSES

Peter Kurczynski
Deputy Chief Scientist (TBD)

Meixner (Chair) + 10-15 EC members, rolling applications

Leadership opportunities

- UV / Optical
- Long-wavelength
- High energy

Leadership opportunities

- Cosmology
- Galaxies
- ISM & planetary formation
- Stars, Sun & Stellar Pops
- State of the Profession

Leadership opportunities

- 12...
- 13...

Time limited, specific analyses for NASA

Deliverable SAG Report

https://cor.gsfc.nasa.gov/copag/

Fill out the following form (link in the chat):
https://forms.gle/X1qUccRJk9Jy94iN6

Peter Kurczynski
COR Chief Scientist

Ingesting the Decadal Survey Results: The role of the COPAG

COR Program Office perspective

What's happening at AAS?

-Check out the Cosmic Origins AAS web page here:

https://cor.gsfc.nasa.gov/copag/AAS_Jan2021/AAS2021-Meeting.php

NASA Astrophysics Town Hall: Wednesday, 12 - 1:30 pm ET

NASA Exhibit Booth Presentations: M-W, 2:40 - 3:10 pm ET

- TODAY Eliad Peretz, Orbiting Configurable Artificial Star (ORCAS)
- Tuesday Steve Finkelstein, JWST Early Release Science
- Wednesday, Jack Burns, Radio Astrophysics from the Moon

NASA Exhibit Booth Chat Sessions: M-F, 2:40 - 3:10 pm ET

What's happening at AAS?

-Check out the Cosmic Origins AAS web page here:

https://cor.gsfc.nasa.gov/copag/AAS_Jan2021/AAS2021-Meeting.php

Cosmic Origins AAS Splinter Sessions, 12 - 1:30 pm ET

- TODAY (Joint PAG) 6:50 - 8:20 pm. Enhancing Participation of Minority Serving Institutions in Space Science
- Tuesday: Infrared Science Interest Group
- Wednesday: Low Frequency Radio Astronomy for Cosmic Origins
- Thursday: Ultraviolet and Visible Science Interest Group and Technology Interest Group

How can I get more involved in Cosmic Origins?

Consider the benefits

- Create community
- Learn more about how NASA astrophysics works
- Join the adventure!

Sign up for newsletter announcements

Participate in a Science/Technology Interest Group

Help start a new Science Interest Group

Apply to serve on the Executive Committee

Margaret Meixner, Chair of COPAG EC

-Community participation in the Decadal Survey ingest process is critical.

Thank You for your COPAG EC service!

Misty Bentz	*2020*	*Georgia State University*
Tom Megeath	*2020*	*University of Toledo*
Claudia Scarlata	*2020*	*University of Minnesota*
Jason Tumlinson	*2020*	*STScI/JHU*
Sarah Tuttle	*2020*	*University of Washington*

COPAG Executive Committee

Margaret Meixner (Chair)	*2021*	*SOFIA Science Mission Operations/USRA*
Janice Lee (Chair-elect)	*2024*	*Caltech/IPAC*
Christine Chen	*2024*	*Space Telescope Science Institute*
Chris Depree	*2024*	*Agnes Scott College*
Steve Finkelstein	*2021*	*University of Texas, Austin*
Lisseth Gavilan-Marin	*2024*	*NASA/Ames*
Christopher Hayward	*2024*	*Flatiron Institute*
Alina Kiessling	*2023*	*Jet Propulsion Laboratory, Caltech*
Stephan McCandliss	*2021*	*Johns Hopkins University*
Alexandra Pope	*2021*	*University of Massachusetts*
Sabrina Stierwalt	*2024*	*Occidental College*

Still openings for the COPAG EC

COPAG impact in 2020

- Great Observatories Report (Armus & Megeath): Published a multi-PAG Document analyzing the impact of NASA Great Observatories and highlighting the importance of synergistic science they enabled.

- Report on a multi-PAG Survey on COVID-19 impact and ADAP cadence (Lee & Bentz), led APAC to recommend to Astrophysics that ADAP call remain annual (not every other year) and it was immediately implemented.

- Infrared Science Interest Group (IRSIG) kept the pulse on this community's science through webinars, newsletters and surveys thanks to co-chairs: Meredith MacGregor & Michael Zemcov

2021: Ingest of Astro 2020 Decadal Survey Results

- Further analysis by COPAG may be important to the ingest
- COPAG is creating 5 new Science Interest Groups that parallel the Decadal Panels:

Cosmology
Galaxies
ISM and planet formation
Stars, Sun and Stellar Populations
State of the Profession and Societal Impacts (cross-cutting SIG)

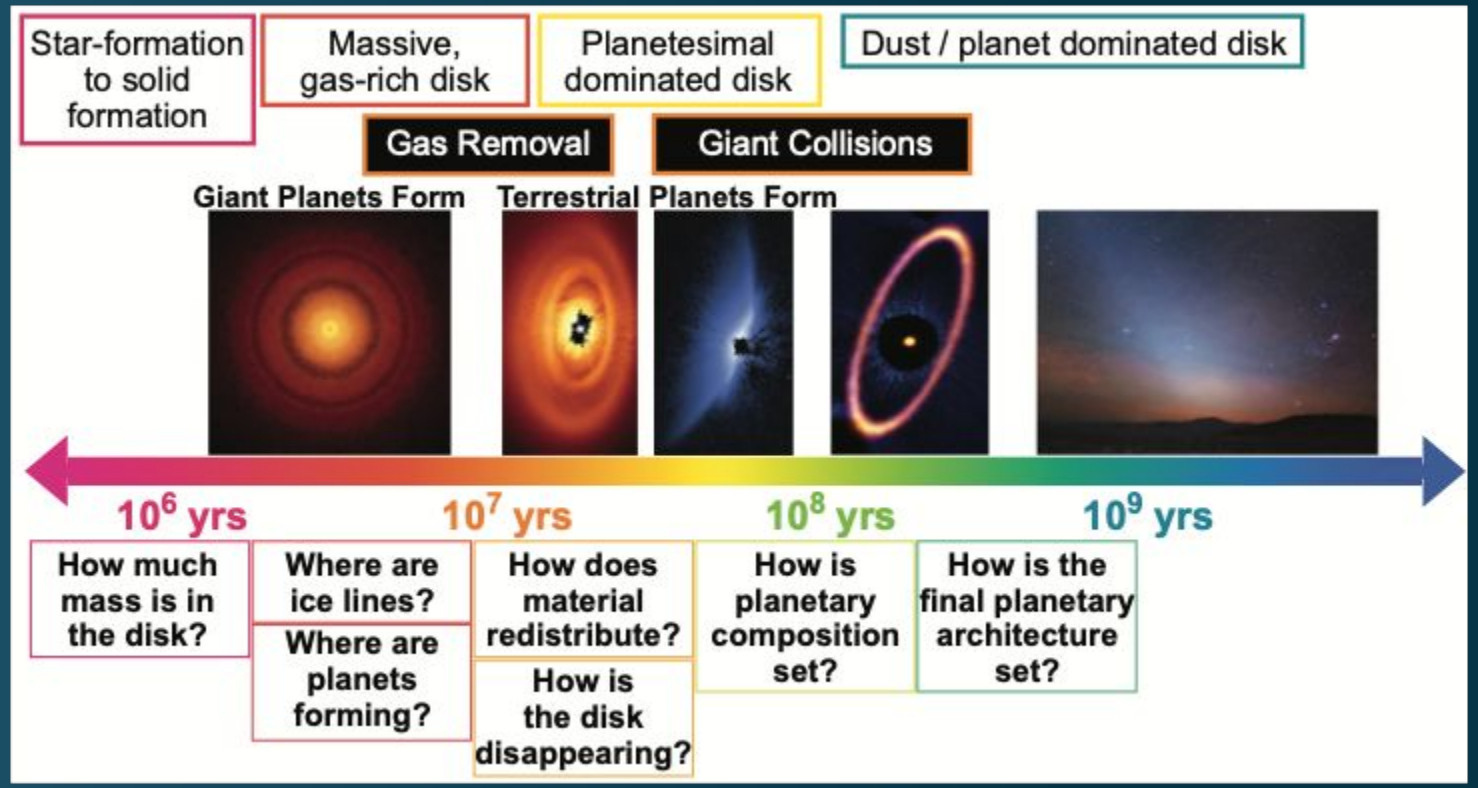
Interested in leading or joining one of these SIGs?

Fill out this form listed in the chat:
https://forms.gle/X1qUccRJk9Jy94iN6
or please contact any of us directly.

Laura A. Lopez
Ohio State University

Next Decade Issues in ISM and Planet Formation

Planet Formation

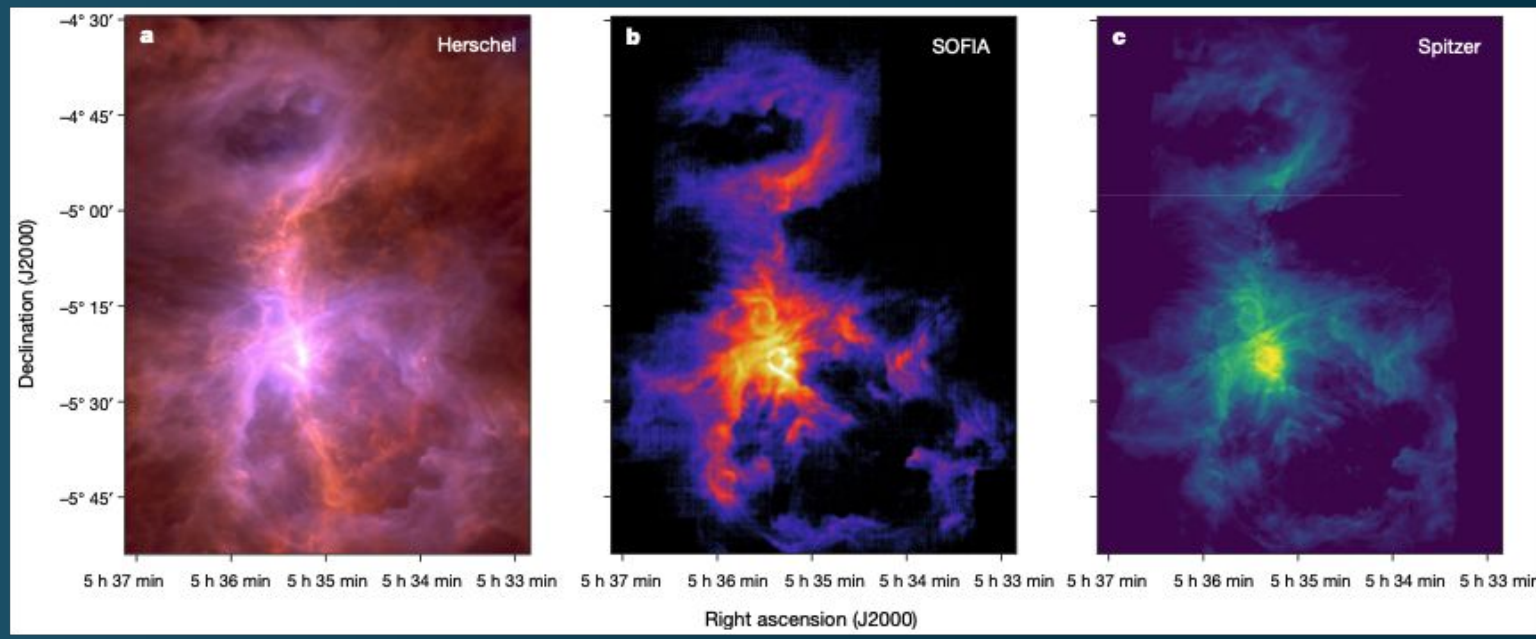


Weinberger, Turner, & Hasegawa 2019

Major outstanding questions:

- What factors determine locations in disks of planet formation?
- How is material transported through the disk and into planets?
- What is the structure of protoplanetary disks (e.g., where are ice lines?), and how do disks evolve?

ISM & Star Formation



Pabst et al. 2019

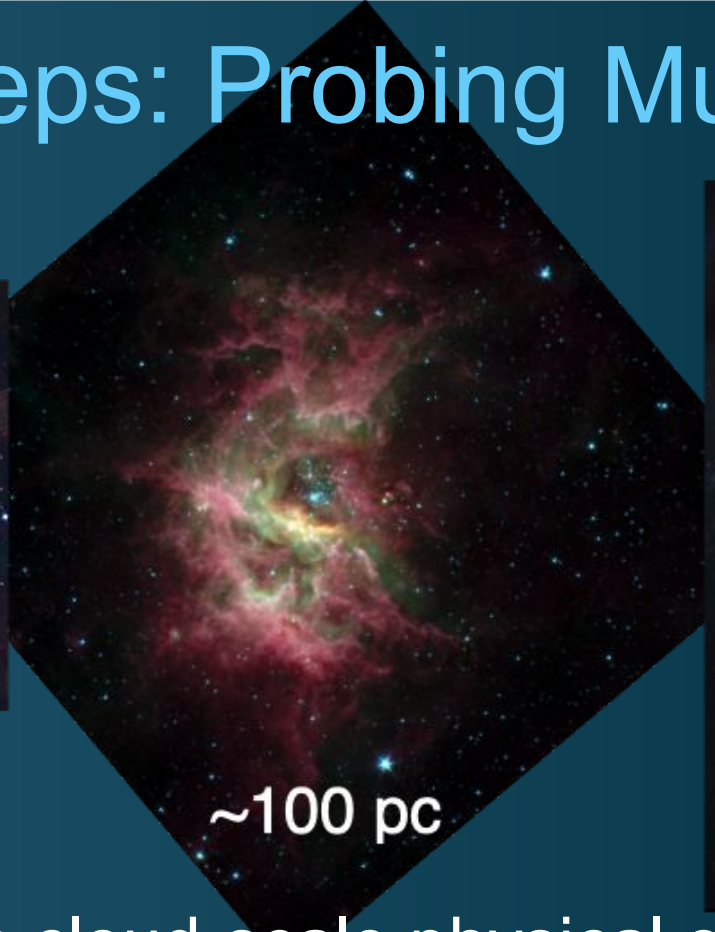
Major outstanding questions:

- What controls the formation of molecular clouds, filaments, and stars, and how does it depend on ISM conditions?
- How does star formation and stellar feedback shape the ISM?
- What is the role of turbulence and B fields?

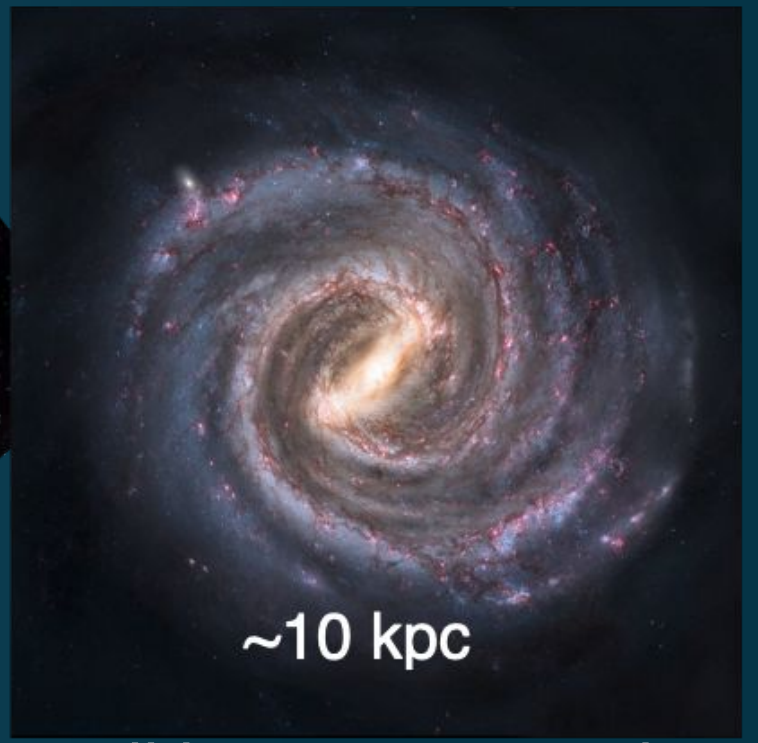
Important to connect theory and observations.

Important Steps: Probing Multiple Scales

~ 1 pc
1 AU ~ 5e-6 pc



~100 pc



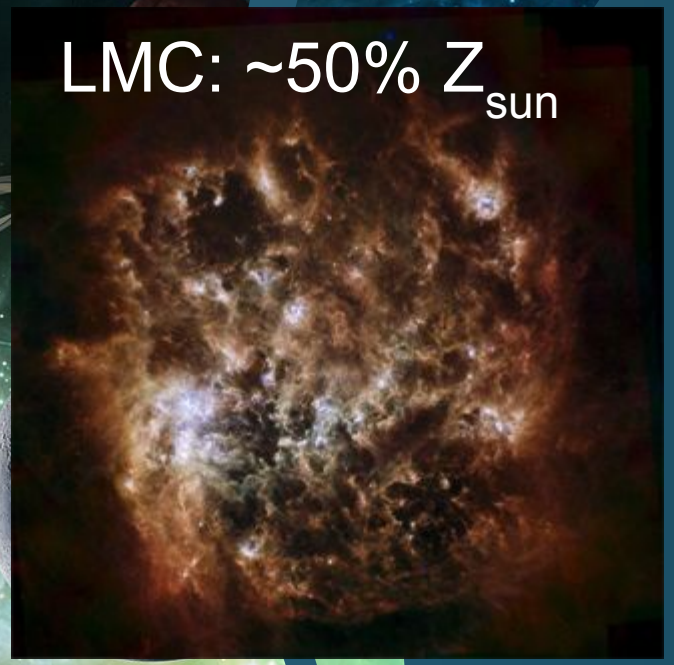
~10 kpc

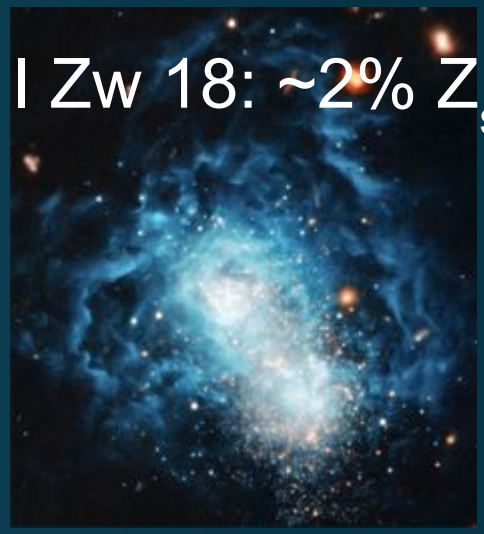
It is especially important to resolve cloud-scale physical conditions to constrain the SF and GMC processes.

This point underscores the need for dynamic range, high spatial resolution, and sensitivity to probe ISM and star formation in Milky Way and in a variety of extragalactic environments.

Important Steps: Exploring Different Environments

Low metallicities:



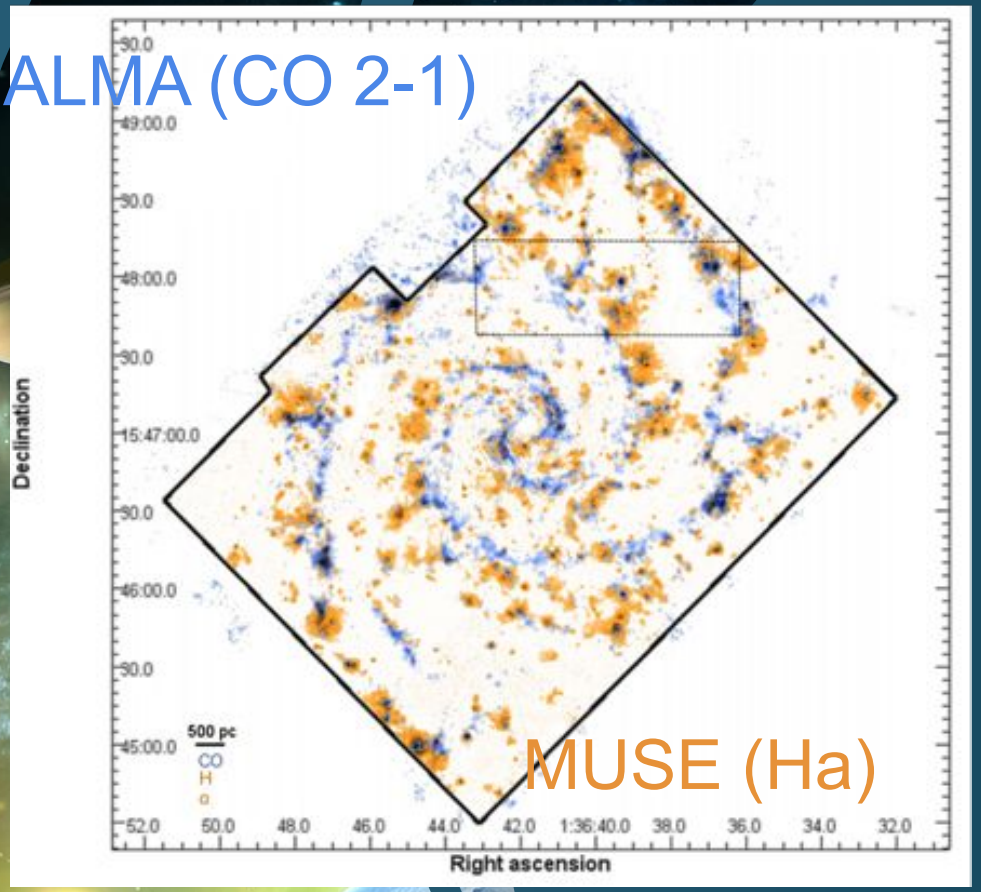


Starbursts & Mergers:

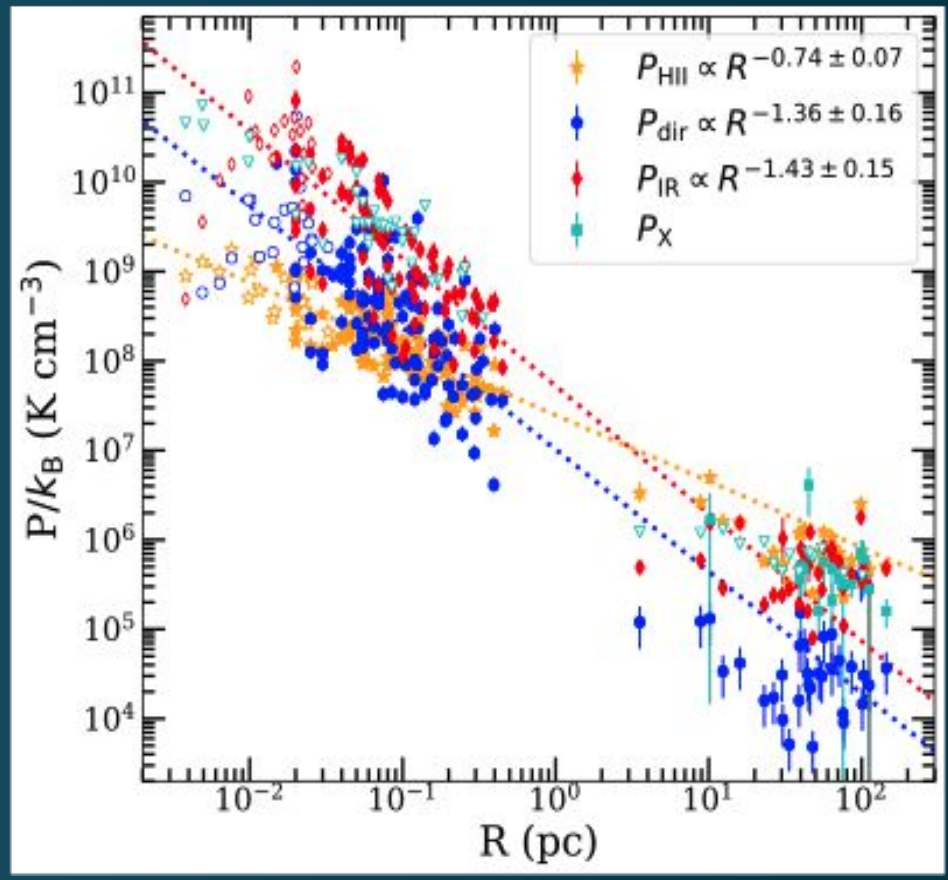
Galactic center:

Meixner et al. 2013; Izotov & Thuan 2004; Hankins et al. 2020; Wilson et al. 2006; Lopez et al. 2020

Important Steps: Panchromatic Observations



Kreckel et al. 2018



Olivier et al. 2021

Multiwavelength observations are crucial to study the multi-phase ISM. They are important to e.g., constrain the cycle of matter in the ISM and the dynamical impact of stellar feedback.

Keith Hawkins
UT Austin

Stars, Sun and Stellar Populations

Stellar, Solar and Galactic Astronomy

How did we get here ? → How did our Sun (and solar system) form ? → How does the Milky Way form?

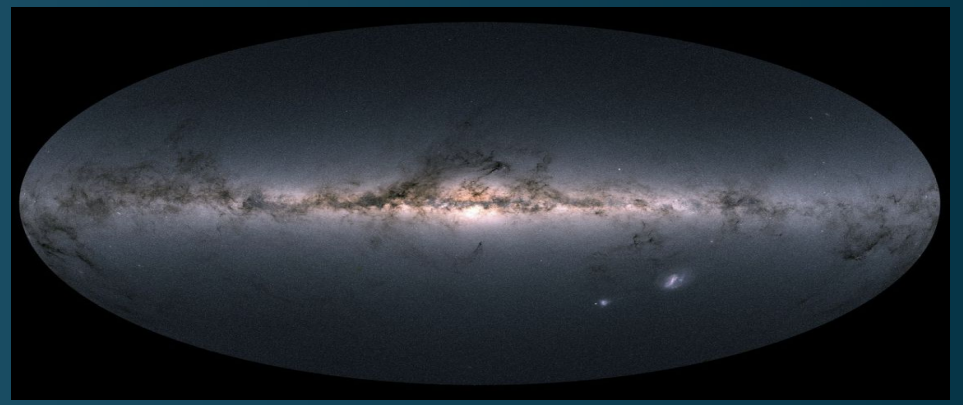
To answer these broad fundamental questions we must:

-- **Map the chemo-dynamics of stars across the Galaxy**

-- **Uncover the fundamental properties and demographic of the stars in the Galaxy**

-- Combine theory and observations from surveys to constrain the physical processes involved

-- All stars are benchmarked to the Sun, so we must also understand the basic properties of the Sun

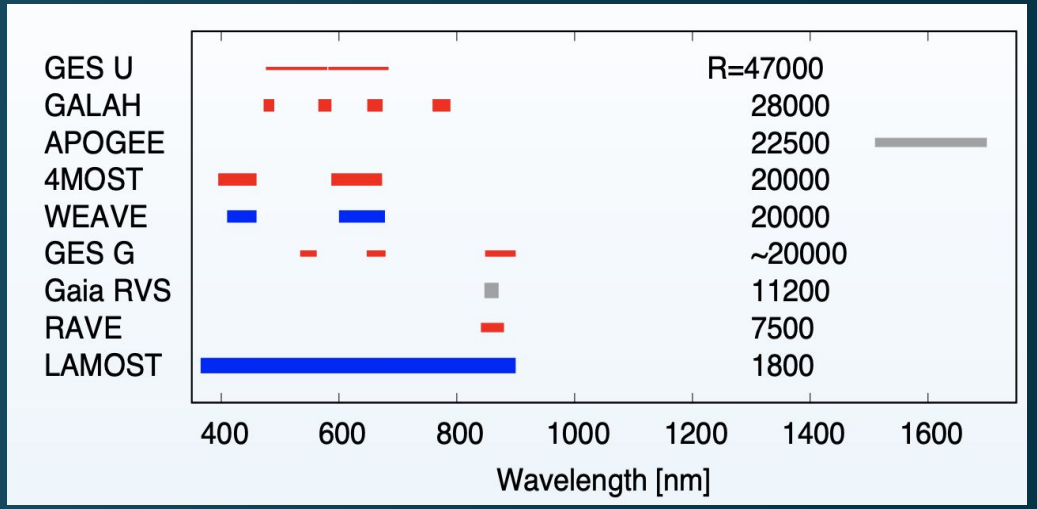


ESA/Gaia/DPAC

Stellar, Solar and Galactic Astronomy in the 2010s-2020

Entered Big Data Era :

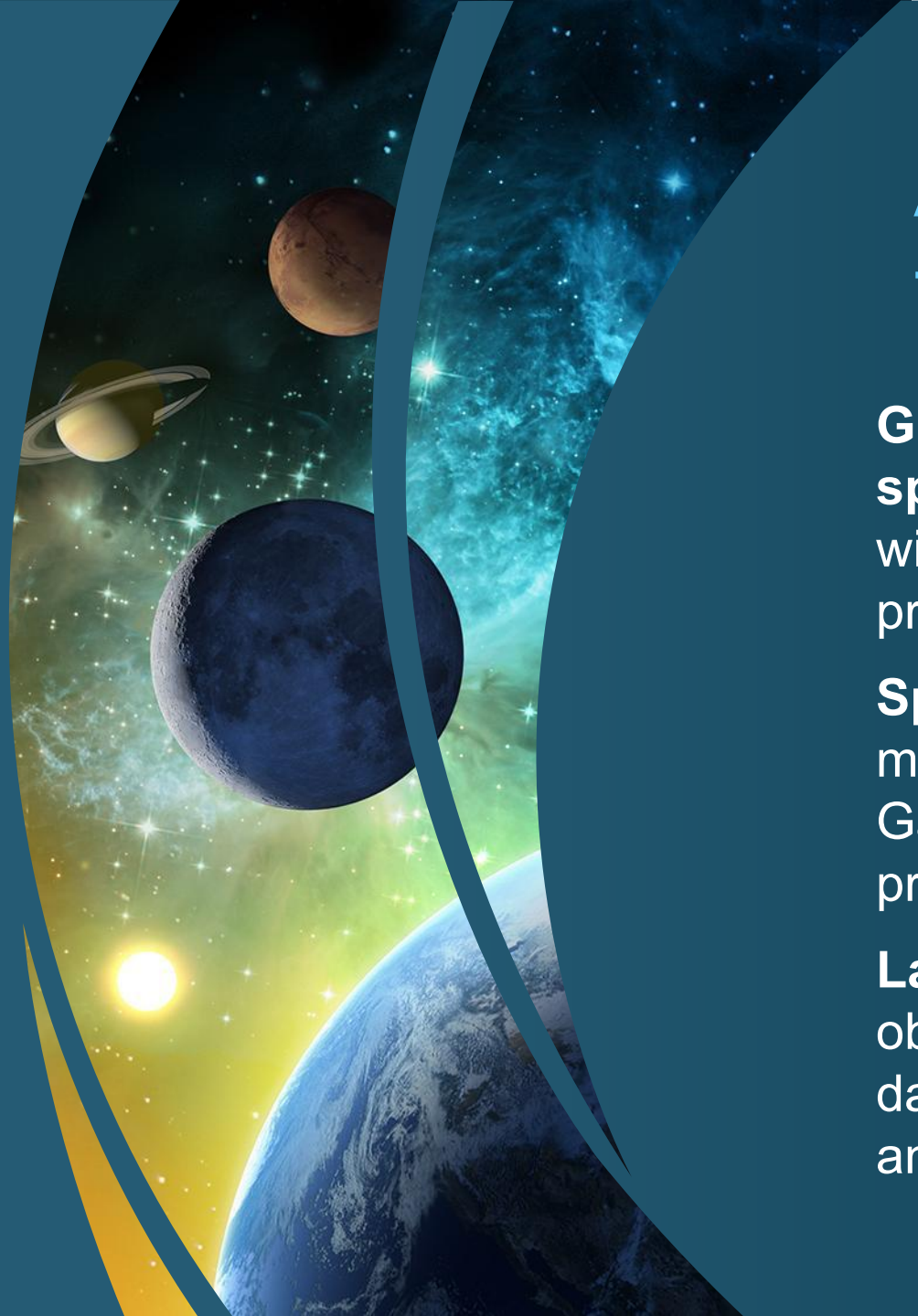
- **Large spectroscopic surveys** (SDSS-IV, LAMOST, RAVE, Gaia-ESO, ...)
- **Gaia (astrometry+)** -- DR1 (2016), DR2 (2018), EDR3 (2020), finish in the mid-to-late 2020s
- **Theoretical Simulations : Cosmologically motivated, large-scale sims** (e.g. Illustris, FIRE, Latte, Anake, …) and **stellar interior sims** (e.g. MESA, …) have been made to compare with observations on solar, stellar, and Galactic scales



Jofre+2018

Industrial Stellar Astronomy over the 2020s

Taken from Ness+2020 white paper; of a famous painting by Jean-Michel Basquiat



Stellar, Solar and Galactic Astronomy in the 2020s : The tools

Ground Based Surveys across the wavelength spectrum (SDSS-V, LAMOST, 4MOST, WEAVE, ...) -- will provide the necessary data to constrain the properties of our Galaxy and stellar evolution

Space Missions (JWST, Roman, etc.) -- will provide much of the follow-up and surveys of key regions (e.g. Galactic bulge, star forming) that will help quantify the properties and demographics of stars across the HRD

Laboratory Astrophysics : Interpreting the data we obtain from the surveys will require high-quality lab data (e.g. opacities, transition probabilities, atomic and molecular data, etc.)

The Big Question & importance in the 2020s+

Big Questions (my take):

1. What are the key physical processes involved in the formation of galaxies like the Milky Way?
2. What are the time-scales involved in these physical mechanisms (often require precise ages of stars)
3. Since stars are key tracers of galaxy formation, what are the properties and demographics of stars across the HRD
4. The Sun as a benchmark (e.g. solving the solar convection zone boundary problem)

Whether one wants to understand the Hubble law, galaxy formation or even exoplanets, stars play a pivotal role! Understanding how stars (our Sun incl.), work, their properties & demographics will be critical in the coming decade to answer the ?s of the Cosmic Origins Program

Kartik Sheth

State of the Profession & Societal Impacts, Cross cutting SIG

NASA Core Values

Inclusion – NASA is committed to a culture of diversity, inclusion, and equity, where all employees feel welcome, respected, and engaged.

To achieve the greatest mission success, NASA embraces hiring, developing, and growing a diverse and inclusive workforce in a positive and safe work environment where individuals can be authentic.

This value will enable NASA to attract the best talent, grow the capabilities of the entire workforce, and empower everyone to fully contribute.

Aligning SMD Activities

- **Strategy 4.1 Increase the diversity of thought and backgrounds represented across the entire SMD portfolio through a more inclusive and accessible environment.**
- In alignment with the NASA core value of Inclusion and SMD Science Plan, we seek to foster a community where everyone feels welcome, included and valued.
- SMD's goals are to develop a workforce and scientific community that reflects the **diversity of the country and to instill a culture of inclusion** across its entire portfolio.

https://science.nasa.gov/about-us/science-strategy

SMD Anti-Racism Action Group (ARAG)

It is the purpose of this Action Group to propose and implement near-term tactical actions to address the lack of equity and inclusion of the Black, Indigenous, and People of Color (BIPOC) community in SMD and its stakeholder communities through anti-racist actions.

Thomas Zurbuchen, Co-Chair, SMD AA
Kartik Sheth, Co-Chair, Astrophysics
Laura Delgado Lopez, Exec Secy, Policy
Gregory L. Robinson, Webb
Peg Luce, Heliophysics
Meagan Thompson, Planetary Science
Benjamin Phillips, Earth Science
Paula Evans , Logistics Management Institute

Gathering SMD Input: How we did it

Attributed & Anonymous Forms: ~40 individuals or groups submissions.

1hr Incubator workshops ~35 participants split into 12 diverse groups generated a wide range of action ideas

Ideas contributed by individuals and groups directly to ARAG via emails and pptx presentations

~200 ideas for actions were submitted

Next Steps for ARAG

EXAMPLES of ACTION IDEAS SUBMITTED

- Collect and publicize demographics of SMD current and past proposers and awardees to establish a current baseline to build upon.
- Add measurable outcomes in performance plans for supervisors for improving inclusion.
- Set up a rotating, diverse SMD engagement group to build new partnerships & strengthen existing ones w/ MSIs, building on experience & lessons learned from the small business unit.
- Identify & provide mechanisms for shadowing + short- & long-term leadership details.
- Use a common code of conduct / rules of the road for a more inclusive environment at reviews
- Set a goal for each division to aim to increase the diversity of its aggregate demographics of reviewers in ROSES panels from the present numbers
- Learning and accountability from regular culture surveys / audits of the environment in SMD.
- Monthly conversation series
- Consider establishing a SMD-wide postdoc fellowships hosted at HBCUs + MSIs
- Consider establishing a regional program for creating STEM cohorts & communities for future STEM leaders + NASA workforce.
- Long term meaningful and growing partnerships with partners who have traditionally not been involved in NASA missions and research - centering on needs + desires of partners and NASA.
- Combining forces with existing successful programs at NASA and other agencies.

Next Steps for ARAG

Examples of ideas submitted by staff for SMD End-States:

- A growth mindset culture always keen to ask "How can we innovate & improve?"
- SMD understands and values non-traditional leadership styles
- Rotations/details across leadership encouraged and designed as opportunities for existing & future leaders, especially from under-represented groups.
- An SMD which reflects the national demographics at all levels from administrative positions to leadership positions over the next xx years.
- In R&A at panels and in the PI pool, demographics reflect the nation at all levels of a project over the next xx years.

Some Other SMD Activities

- Long term inclusion, diversity, equity and accessibility (IDEA) WG established
  - ARAG ideas / end states → IDEA WG.
- Public statements by NASA and SMD leaders on identification of existing exclusion and lack of participation by all communities at NASA and commitment to better inclusion going forwards.
- Working group modifying requirements for AOs to align with NASA's new core value of Inclusion.
- Astrophysics Division has a R&A task force looking into ways to make the R&A process more inclusive and diverse (Scannapieco, Connaughton, Jang Condell, Benford, Hasan, Knezek, Sheth)
- Astrophysics to undergo an audit of its culture and practices - may expand to other parts of SMD in the future.
- Earth Science Division has multiple groups examining all aspects of its portfolio and work from the ROSES solicitations to data initiatives.
- Advisory committees are discussing the state of the profession in nearly every discipline emphasizing the importance of an inclusive environment and diversity of thought and ideas for mission success.

Steve Finkelstein (UT Austin)
SAG11: Cosmic Dawn

Seeking leadership interest in a new Science Analysis Group focused on Cosmic Dawn in the 2030's.

Steve Finkelstein - SAG11: Cosmic Dawn

JWST will revolutionize nearly every area of astrophysics, and “First Light and Reionization” is JWST Science Theme #1.

- However, it doesn’t take long to think about what JWST won’t do, or to envision some JWST discoveries that will need further observations needing another type of observatory.
- A few examples:
  - JWST will not observe the full galaxy population during the EoR. A JWST “UDF” would reach M_{UV} ~ -15.5 (200 hr per filter), a factor of ~10 brighter than the expected turnover of the luminosity function.
  - JWST deep spectroscopic surveys will cover areas less than the expected size of an ionized bubble, leading to biases in Lyman-alpha based reionization studies.
- NGRST will take care of a lot of the “large volume” needs leftover from JWST, but it will not reach z > 10, will not match JWST’s spectroscopic depth capabilities, and it will also only partially overlap with JWST in time, thus JWST followup opportunities will be limited.

Steve Finkelstein - SAG11: Cosmic Dawn

- We formed SAG11 to begin to imagine the post-JWST/NGRST future, identifying five goals:
- #1: Identify questions that will likely remain unanswered after the conclusion of the *JWST* mission. This includes not only those questions which *JWST* is not suited to study, but also an exploration of those questions which might form based on likely *JWST* observations, and complementary observations to the full SKA surveys of the 2030's.
  - Requires: Consideration of a number of scientific areas, creatively exploring what we think will be the pressing questions in ~2030
- #2: Assess the potential for the proposed NASA flagship missions (LUVOIR, Origins, Lynx and HabEx) to answer these questions.
  - Requires: Multiple groups to dig into the technical capabilities of these missions.

Steve Finkelstein - SAG11: Cosmic Dawn

- Goal #3: Identify observational gaps that are not covered by the proposed NASA flagship missions and describe the capabilities that potential probe-class missions would require to close these gaps.
  - Requires: Discussing potential types of other observatories, or modifications to a current proposed mission concept (flagship, probe, or something smaller).
- #4: Examine the potential for panchromatic observations that can be done now with existing telescopes and data archives in support of these ideas.
- #5” Identify the need for coordinated programs between multiple observatories (including ground based), archives and/or numerical simulations.
  - Requires: Consideration of a broad range of potential observations, archival datasets, and/or simulations to assist with the analysis of the science goals.

Steve Finkelstein - SAG11: Cosmic Dawn

We are currently seeking leadership interest from the community. If you are interested in organizing this effort (with the assistance of the COPAG EC), then please email:

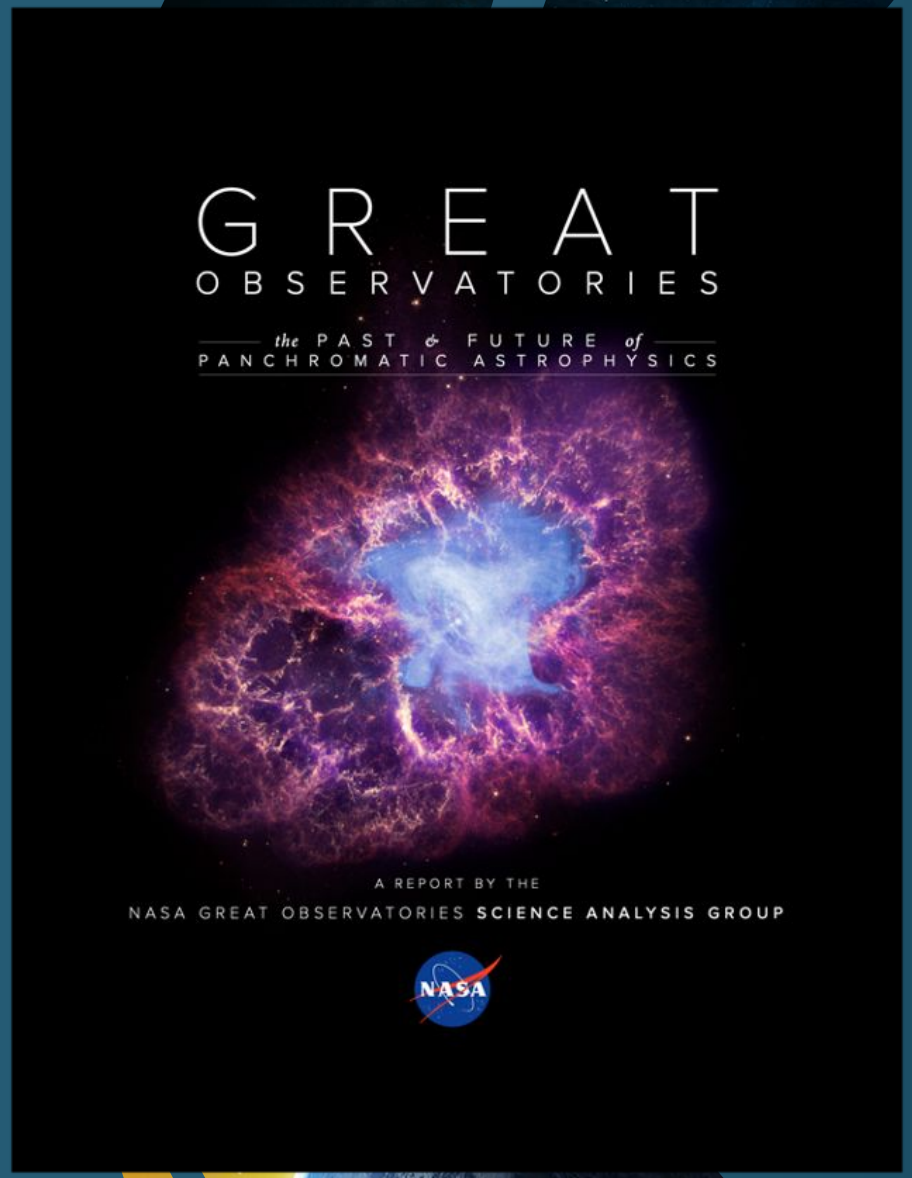
EC Member Steve Finkelstein (stevenf@astro.as.utexas.edu)

EC chair Margaret Meixner (mmeixner@usra.edu)

Jason Tumlinson (STScI/JHU)

The Next Great Observatories:

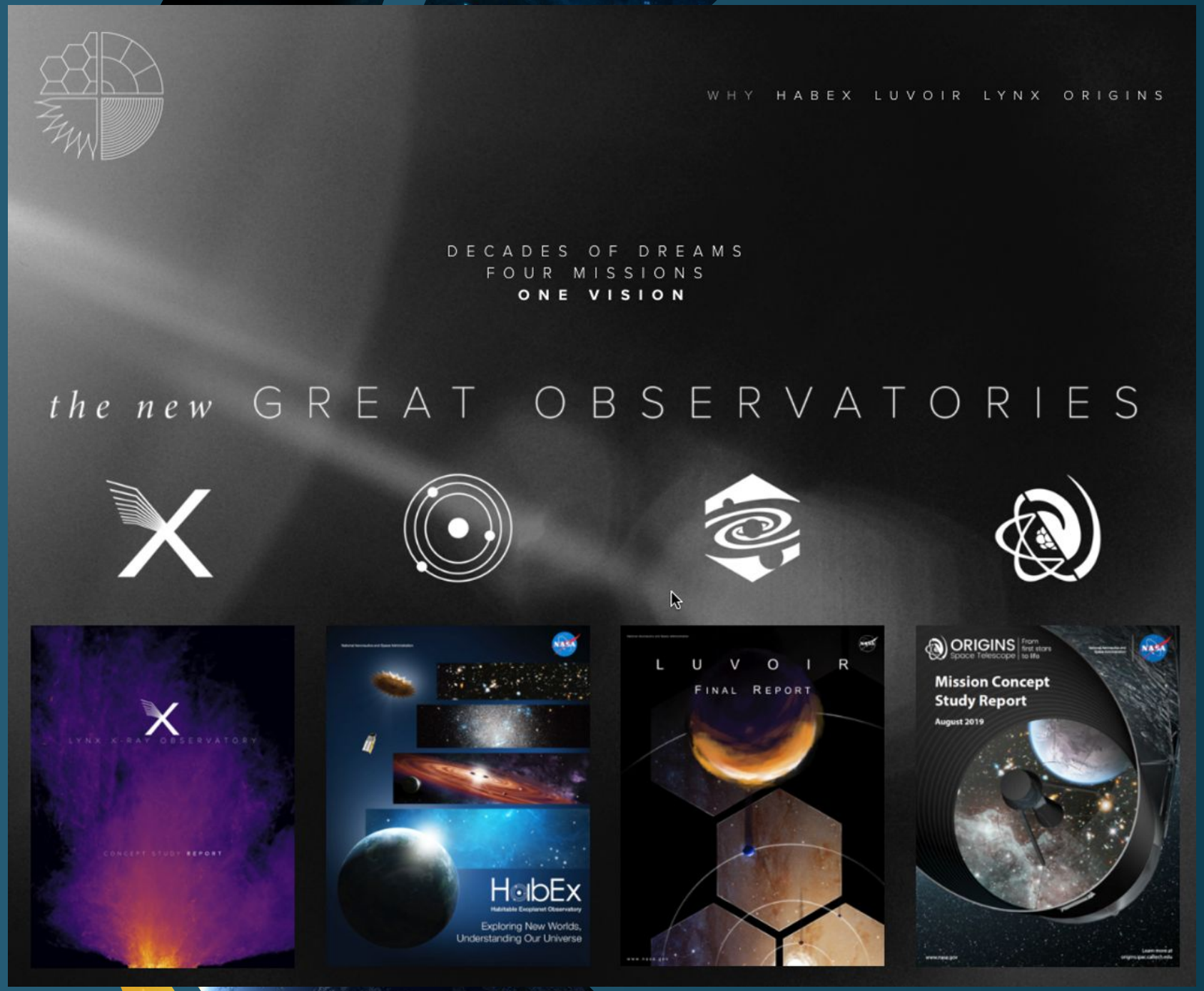
a potential SAG for finding scientific synergies the next decades



In 2018-19, the COPAG's Great Observatories Science Analysis Group (GO-SAG) produced a study of the scientific benefits of cooperating flagship observatories.

Hubble, Spitzer, Chandra, and Compton

"The scientific legacy of the Great Observatories has demonstrated the importance of sensitive, panchromatic observations for progress in astrophysics, as well as the ability of NASA and its partners to provide concurrent and sustained access to a large part of the electromagnetic spectrum from space. The Great Observatories became a deliberate NASA agency program that transcended individual missions and wavelength regimes. **This legacy points the way to a future where panchromatic capabilities are not just maintained but enhanced, and the remarkable growth in our understanding of the Universe continues through the development of the next generation of space observatories that will inspire further giant leaps in astrophysics in the coming decades."**



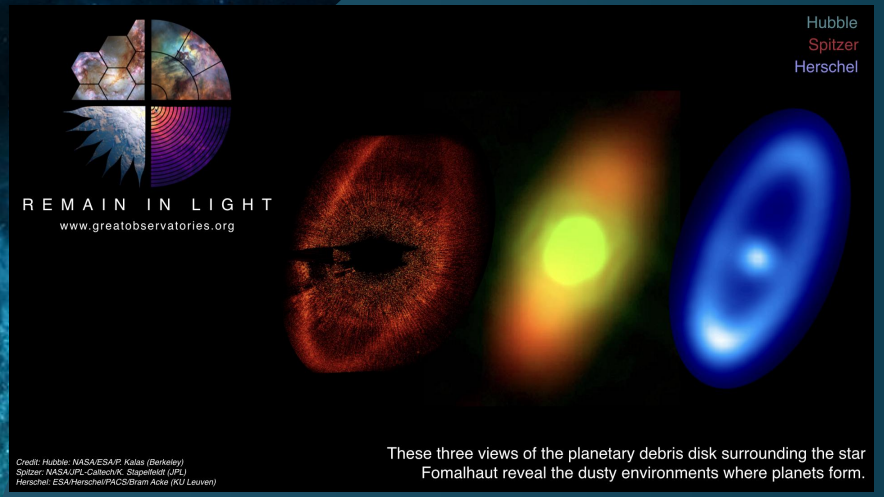
REMAIN IN LIGHT

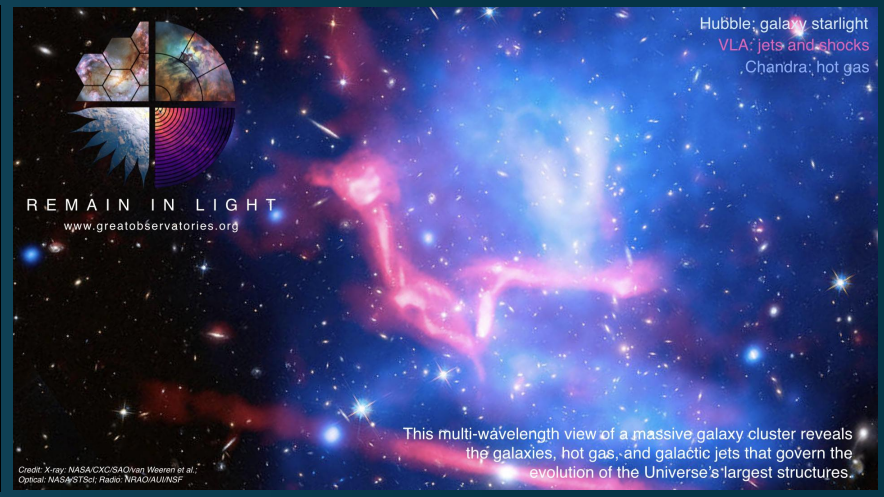
www.greatobservatories.org

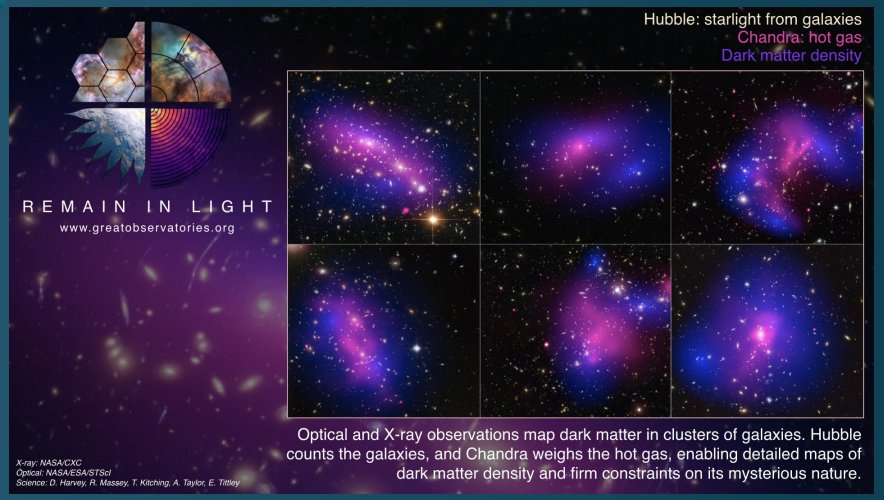
www.greatobservatories.org is a grassroots effort to advocate for the science of and foster a community around a new generation of multi-wavelength flagships for the 21st century.

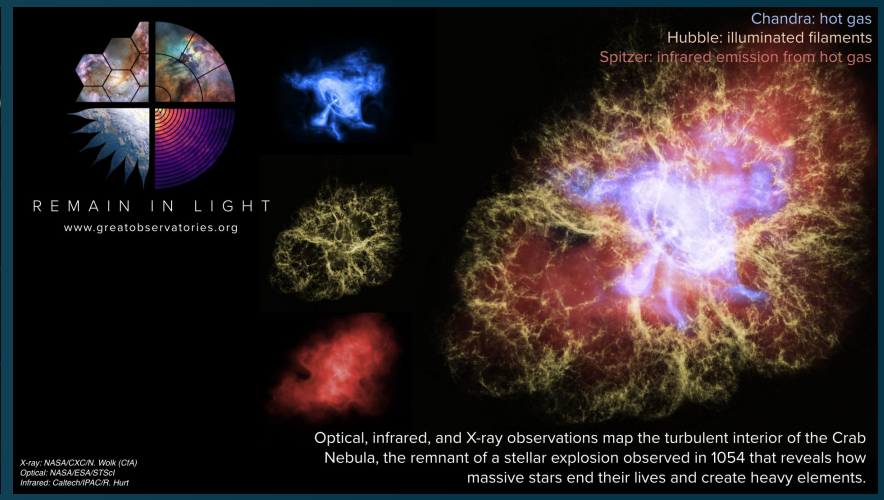
Multiwavelength Science Highlights from the SAG-10 report

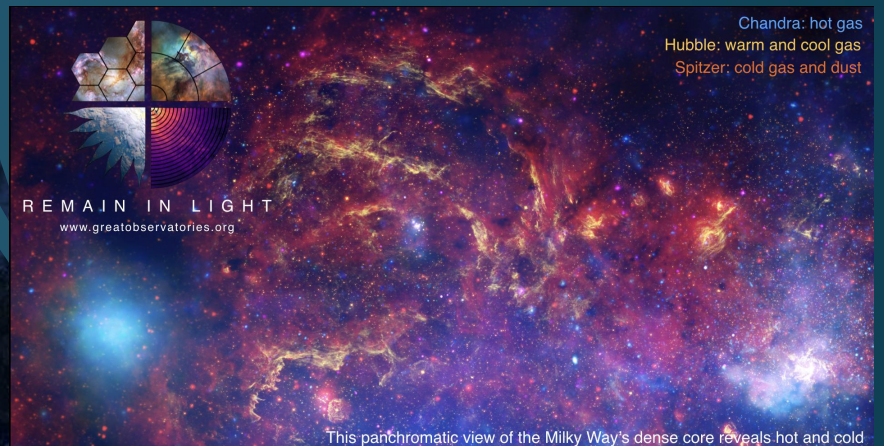
Graphics available from www.greatobservatories.org

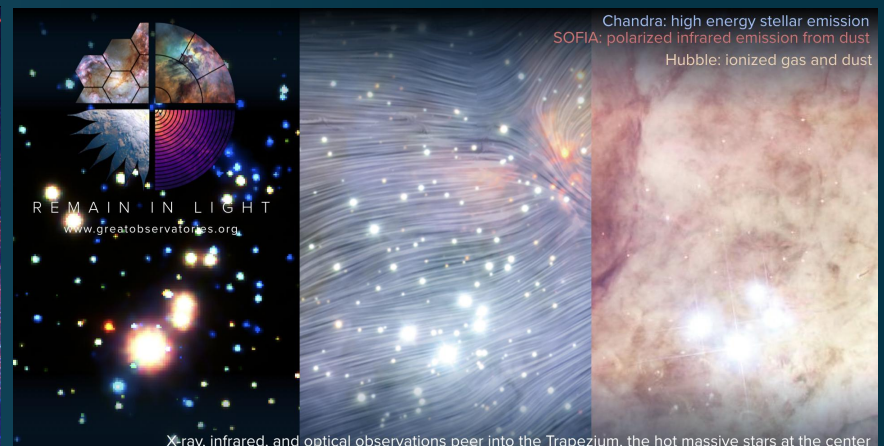












Paul Hertz has urged our community to “Seize the Future!”

Decadal Survey Goal

- NASA’s highest aspiration for the 2020 Decadal Survey is that it be ambitious
  - The important science questions require new and ambitious capabilities
  - Ambitious missions prioritized by previous Decadal Surveys have always led to paradigm shifting discoveries about the universe
- If you plan to a diminishing budget, you get a diminishing program
  - Great visions inspire great budgets
- Now is the time to be ambitious

Carpe Posterum

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A New Great Observatories SAG (?)

The successful and highly cited SAG 10 report Great Observatories: The Past and Present of Pan-Chromatic Astrophysics" analyzed the key science discoveries made by NASA's Great Observatories (Hubble, Spitzer, Chandra, Compton) and highlighted questions that still need answering with multi-wavelength data.

The Astro2020 Decadal Survey will set priorities for this decade.

What questions can be answered by a new generation of pan-chromatic observatories operating together in the next few decades?

COPAG proposes a new SAG ("Science Analysis Group") to follow up this historical analysis with a prospective synthesis of the science cases from the Flagship STDTs *Lynx*, *Origins*, *HabEx*, and *LUVOIR*.

The goals of this SAG would be to:

1. identify the key questions left unanswered by today's space astronomy missions, building on the SAG10 report,
2. synthesize the science cases of the flagships from the multi-wavelength point of view,
3. identify important questions not raised by the STDTs that can be addressed by multi wavelength observations.

Could start in Spring or Summer pending Decadal outcome.

All welcome.

Questions, Comments from Community

-Which SIG or SAG would you join? Lead?

-This approach will succeed because…

-This approach will fail because….

Panel Discussion: What I have done and liked about serving on the COPAG EC?

Panel:

Janice Lee, IPAC/CalTech

Stephan McCandliss, Johns Hopkins University

Alex Pope, University of Massachusetts, Amherst

Tom Megeath, University of Toledo

Join the Cosmic Origins (COR) Analysis Group (COPAG) Executive Committee (EC) or a lead a Science Interest Group !

- **WHY?**
  - The EC provides analysis of community input for the purposes of informing NASA of community feedback on its programs.
  - These analyses can have an impact: e.g. ADAP offerings, the Great Observatories report.
  - Coming soon: Decadal Survey results, analysis of those results will be interesting, impactful and fun to discuss.
  - New Science Interest Groups (SIGs): Cosmology, Galaxies, ISM and planet formation, Stars and stellar populations, State of the Profession and Societal Impacts
- **WHAT?**
  - The EC needs to be diverse across a variety of axes to be representative of the broad COR and astrophysics community.
  - There will be 12-16 members
  - The committee reports to NASA HQ Astrophysics Division led by Paul Hertz
- **HOW?**
  - COPAG EC has a rolling deadline for nominations and self-nominations:

https://cor.gsfc.nasa.gov/news/Call_for_Nominations_to_COPAG_EC.php

Questions?

-My favorite platform for COPAG to communicate with me is… twitter? Facebook? Email? Open Office hours?

For more information:

https://cor.gsfc.nasa.gov/copag/

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