Cosmic Origins Program Analysis Group Report
APAC
October 28, 2019

Margaret Meixner
(COPAG EC Chair)

COPAG EC Membership

Margaret Meixner (Chair)	STScI/Johns Hopkins University
Misty Bentz	Georgia State University
Steve Finkelstein	University of Texas
Janice Lee	Caltech/IPAC
Paul Lightsey	Ball Aerospace
Stephan McCandliss	Johns Hopkins University
Tom Megeath	University of Toledo
Alexandra Pope	University of Massachussetts
Claudia Scarlata	University of Minnesota
Jason Tumlinson	STScI
Sarah Tuttle	University of Washington
Mario Perez (Executive Secretary, Ex-Officio)	NASA HQ
Eric Tollestrup (Ex-Officio)	NASA HQ
Susan Neff (COR Program Office, Ex-Officio)	NASA/GSFC
Erin Smith (COR Program Office, Ex-Officio)	NASA/GSFC

Recruiting new members (up to four)! Deadline for nominations Nov 1. Interested? Email eric.v.tollestrup@nasa.gov.

COPAG Activities Since August

- Many COPAG EC members continued to be active contributors to the STDT exercises
- The COPAG EC has continued to track closely STDT activities through members (*) or contacts who are on the respective teams:
  - **Origins** - Margaret Meixner*, Alexandra Pope*
  - **HabEx** - Paul Scowen going forward Jason Tumlinson
  - **LUVOIR** – Jason Tumlinson*
  - **Lynx –** going forward propose Misty Bentz as liason
- COPAG has:
  - 2 SIGs: IR SIG, UVis SIG
  - 1 TIG
  - Recently Completed SAG: SAG 10 – Great Observatories
  - Proposing new SAG11 - COSMIC Dawn

Infrared Science Interest Group – Activity highlights/Near Term Plans

Naseem Rangwala & Eric Murphy (co-chairs)

AAS Winter 2020 Splinter Session

- IR SIG is organizing this splinter session
  - The theme of this splinter will be along the lines of 'The role of Infrared Astronomy in NASAs Strategic Vision to 2030'
  - Planning to have talks from Origins, SPICA, SphereX, SOFIA, JWST, and an early career scientist (ideally on multiwavelength astronomy).
  - Also Planning a panel discussion and will invite members of Decadal 2020 panels.

Monthly Webinars continue
Next Webinar (November 2019)

- Topic: Astrochemistry – Dr. Maria N. Drozdovskaya, CSH and IAU Gruber Foundation Fellow, University of Bern

Webinar Platform: Invited talks covering science/mission topics within infrared astronomy

Infrared Science Interest Group – Cont.

SIG Leadership Council membership Changes

- Current co-chairs (Rangwala, Murphy) are rotating off leadership council
- Plan to have overlap with the new co-chairs who are being recruited now
- Transition expected in Spring 2020

Continuing to Reach out to early career IR scientists

- Coordinating efforts to expand out mailing list
- Make it easy to subscribe to our mailing list
- Outreach

Solicit feedback from the entire IR SIG to help plan 2019/20 activities

- Send out a survey to poll community interest and hold telecon to discuss

SAG10 report is under revision based on comments from APAC members.
Plan to post on SAG10 site soon: https://cor.gsfc.nasa.gov/sags/sag10.php

Author list:

33 authors

2 co-chairs

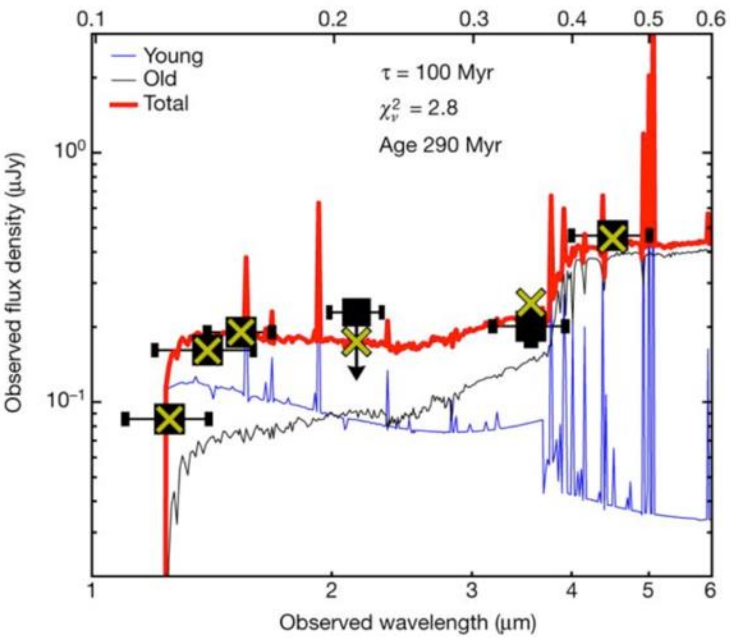
10 subject co-chairs

26 institutions

L. Armus (IPAC, California Institute of Technology), *co-chair*
S.T. Megeath (University of Toledo), *co-chair*
L. Corrales (University of Michigan), *Galactic Processes and Stellar Evolution, co-chair*
M. Marengo (Iowa State University), *Galactic Processes and Stellar Evolution, co-chair*
A. Kirkpatrick (University of Kansas), *Astrophysics of Galaxy Evolution, co-chair*
J.D. Smith (University of Toledo), *Astrophysics of Galaxy Evolution, co-chair*
M. Meyer (University of Michigan), *Origin of Life and Planets, co-chair*
S. Gezari (University of Maryland), *Fundamental Physics, co-chair*
R. Kraft (Center for Astrophysics), *Fundamental Physics, co-chair*
S. McCandliss (Johns Hopkins University), *Capabilities Facilities and Options, co-chair*
S. Tuttle (University of Washington), *Capabilities Facilities and Options, co-chair*
M. Elvis (Center for Astrophysics | Harvard & Smithsonian), *Capabilities Facilities and Options, co-chair*
M. Bentz (Georgia State University)
B. Binder (Cal Poly Pomona)
F. Civano (Center for Astrophysics | Harvard & Smithsonian)
D. Dragomir (Massachusetts Institute of Technology Kavli Institute)
C. Espaillat (Boston University)
S. Finkelstein (University of Texas at Austin)
D.B. Fox (Penn State University)
M. Greenhouse (NASA Goddard Space Flight Center)
E. Hamden (University of Arizona)
J. Kauffmann (Haystack Observatory, Massachusetts Institute of Technology)
G. Khullar (University of Chicago)
J. Lazio (Jet Propulsion Laboratory, California Institute of Technology)
J. Lee (IPAC, California Institute of Technology)
C. Lillie (Lille consulting LLC)
P. Lightsey (Ball Aerospace)
R. Mushotzky (University of Maryland)
C. Scarlata (University of Minnesota)
P. Scowen (Arizona State University)
G. Tremblay (Center for Astrophysics | Harvard & Smithsonian)
Q.D. Wang (University of Massachusetts)
S. Wolk (Center for Astrophysics | Harvard & Smithsonian)

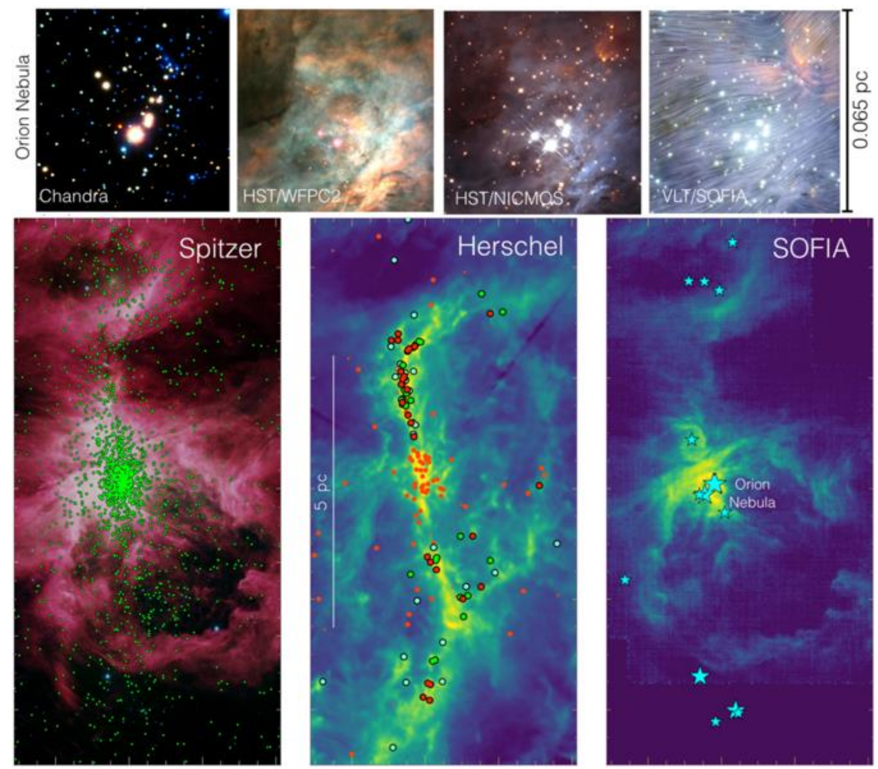
Past and Future Multi-Wavelength Science in Four Areas

Evolution of Galaxies

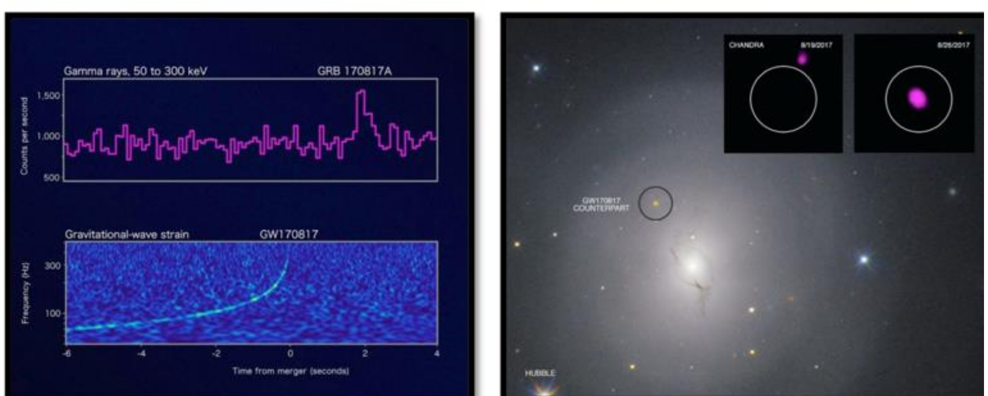


Formation of Planets, Exoplanets, and Origin of Life

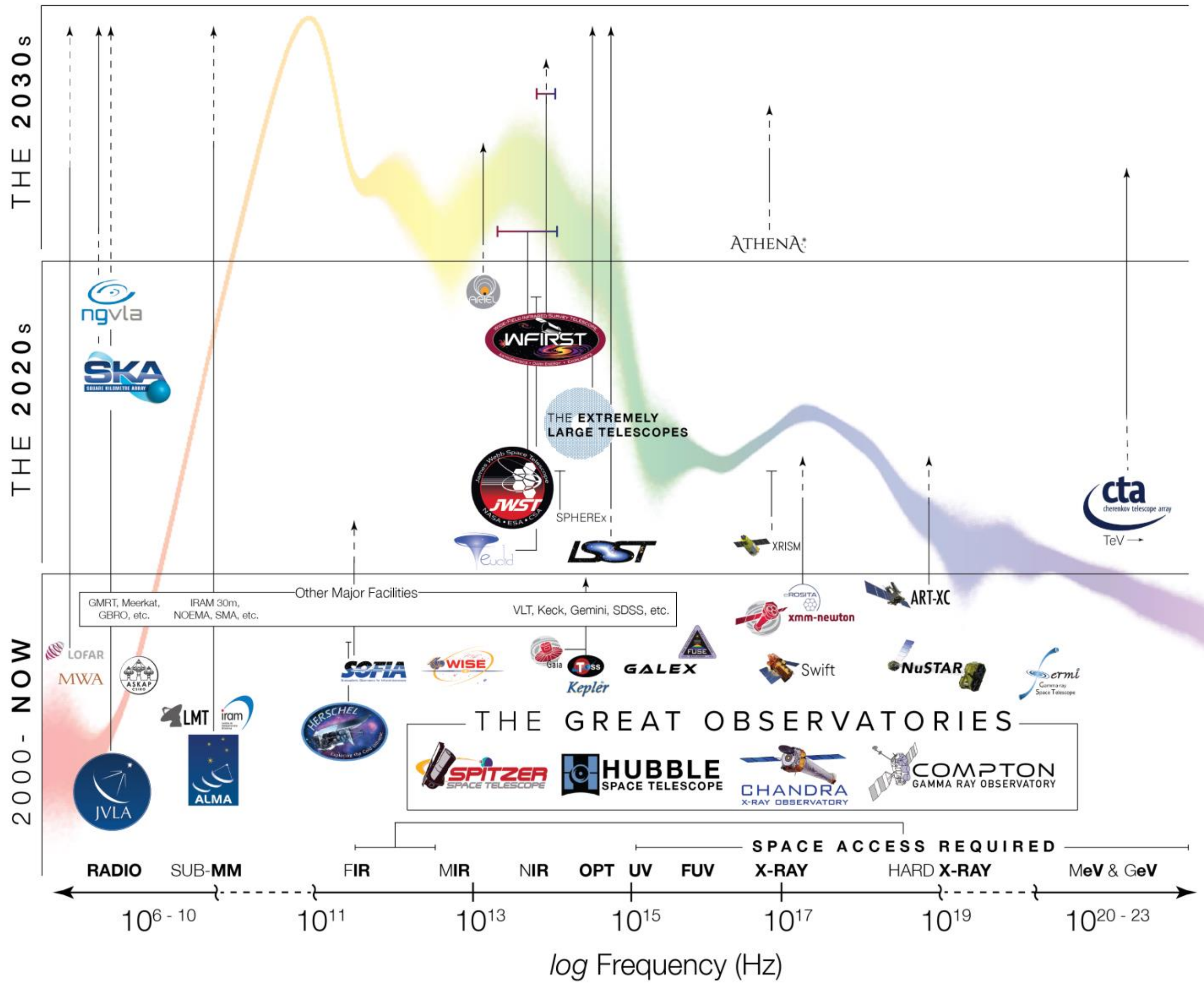
Galactic Processes and Stellar Evolution



Fundamental Physics



Impending gaps in panchromatic coverage will inhibit progress and erode expertise



"Without a concerted effort to maintain the type of panchromatic coverage enabled by the Great Observatories, the future of space astrophysics will suffer from major gaps appearing in our electromagnetic coverage. --- At the same time, these gaps present an opportunity to develop new missions and strategies for maintaining panchromatic coverage that draw on the lessons of the Great Observatories."

Lessons from the Great Observatories

Commensurability of capabilities are essential for multi-wavelength science

"The success of the Great Observatories (combined with other observatories such as *Fermi*, *Herschel* or *XMM-Newton*) was due, in large part, to their remarkable degree of **commensurability**, with different observatories sharing different combinations of capabilities. In particular, commensurate sensitivities, relative to the spectral energy distributions of astrophysical phenomena, are essential for multi-wavelength science."

Mission concurrency enables time domain science and fuels rapid progress in all areas.

"**Mission concurrency**, i.e. overlap in operational lifetimes, is also essential for progress in most of astrophysics. Concurrency allows discoveries made in one wavelength regime to be applied in multiple wavelength regimes, enabling rapid development and testing of models and leading to deeper astrophysical understanding. Time domain and multi-messenger astronomy, by definition, require concurrency to study rapidly evolving phenomena across the electromagnetic spectrum."

GO programs provide a rapid response to a changing scientific landscape

"Well-supported **General Observer (GO) programs** were essential to the Great Observatories' success, and remain crucial to the success of future missions. These programs enable the community to respond to a changing scientific landscape, and in the case of the Great Observatories, quickly advance into new, rapidly growing area."

Archives provide new science and set the foundations for future observations (but don't necessarily provide commensurability and concurrency)

"Multi-wavelength **archives** are also increasingly important, enabling new science, serving as the foundation for future studies with new observatories, and setting baselines needed to characterize time variable phenomena. Continued support for the archives is an important component for maintaining panchromatic science, but not a substitute for the capability of making new panchromatic observations."

A range of mission sizes can result in commensurate and concurrent capabilities

The great observatories ranged in costs from ~1 billion (Spitzer and Compton) to ~9 billion (Hubble)

Findings

A program with a strategic goal of maintaining broad wavelength coverage will provide maximum science return in the coming decades by re-establishing a panchromatic, community-driven, interconnected suite of space observatories.

Panchromatic capabilities can be achieved with a higher launch rate and a mix of mission sizes.

“Operating multiple concurrent observatories requires a higher rate of deployment. The **higher launch rate** can come from a **mix of mission sizes** and costs. The Great Observatories spanned nearly an order of magnitude in cost,yet functioned together as a system to redefine astrophysics. Within the current budget envelope,a range of possibilities can be employed to maintain panchromatic coverage and deliver transformational gains in science, including mixing flagship and probe-scale missions, each with GO programs, as well as Explorer missions.”

Mission longevity for strategic missions of a decade or more is key to maintaining coverage.

“Maintaining panchromatic capability also requires **longevity** for strategic missions. The Great Observatories have demonstrated that missions can be operated effectively over multi-decadal timespans. HST also showed that servicing could be a valuable way to maintain and upgrade capabilities.The use of servicing, particularly given emerging capabilities for human and robotic servicing, as well as in-orbit construction, may be viable routes for establishing long- term panchromatic capabilities with cutting-edge facilities.”

Planning is required to set mission sizes, ensure participation in international programs, and consider opportunity costs of losing capabilities.

“Commensurate and concurrent panchromatic capabilities requires strategic planning to set mission sizes and capabilities, rates of mission deployments and mission lifetimes, ensure participation in international missions, and to consider opportunity costs incurred by losing capabilities in parts of the electromagnetic spectrum. Such planning may take advantage of possible routes to lower costs, including new detectors/telescopes technologies, higher capacity commercial launch vehicles, and advances in modular spacecraft bus architectures.”

A program of "Giant Leap Observatories" that builds on the model set by the Great Observatories can advance our understanding of the Universe far into the future.

Cosmic Dawn Science Analysis Group
Proposed Charter – under review

Co-Leads: Claudia Scarlata and Steven Finkelstein

The goal of the Cosmic Dawn SAG is to address the following points:

- Identify questions that will likely remain unanswered after the conclusion of the *JWST* mission.
- Assess the potential for the proposed NASA flagship missions (LUVOIR, Origins, Lynx and HabEx) and NASA probe missions to answer these questions.
- Examine the potential for panchromatic observations that can be done now with existing telescopes and data archives in support of these ideas.
- Identify the need for coordinated programs between multiple observatories (including ground based), archives and/or numerical simulations.

This SAG will include representatives from the COPAG and the broader scientific community, with the goal to analyze the above questions and compose and publish a report, delivered to NASA HQ, by the end of 2020.

Summary Information

- COPAG has been active on several fronts: SAG10, IR, new proposed SAG
- Final SAG-10 report will be posted on SAG10 report site after review by Meixner & Perez next week or so:
  - https://cor.gsfc.nasa.gov/sags/sag10.php
- Request APAC feedback/approval on Charter for new SAG on Cosmic Dawn

COPAG Future Activities

- Bi-weekly EC telecons will continue
- Cosmic Dawn Study Analysis Group –pending approval, will begin recruitment of members
- AAS splinters to include:
  - Combined UVSIG and TIG splinter Sat. Jan. 4 10 AM – 12 PM Tumlinson & Tuttle
  - COPAG splinter Sat. Jan. 4 3:30-5:30 pm - Meixner
  - Great Observatories splinter, Sunday Jan. 5, 9:30-11:30 AM Megeath & Armus
  - IRSIG splinter, Tuesday, Jan. 7 10:30 AM-12:30 PM Rangwala/Murphy/Pope
  - Cosmic Dawn SAG, Tuesday 2-3 pm Finkelstein & Scarlata