



**Jet Propulsion Laboratory**  
California Institute of Technology

# Exoplanet Exploration Program (ExEP) Office

**Dr. Gary H. Blackwood, Program Manager**  
**Jet Propulsion Laboratory**  
**California Institute of Technology**

**January 6, 2024**

**ExoPAG 29, New Orleans, LA**



# NASA Exoplanet Exploration Program

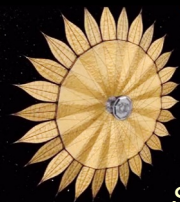


## Mission Concepts

IR / O / UV Mission Concepts

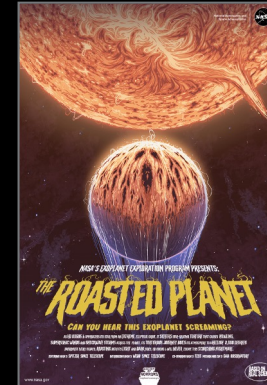
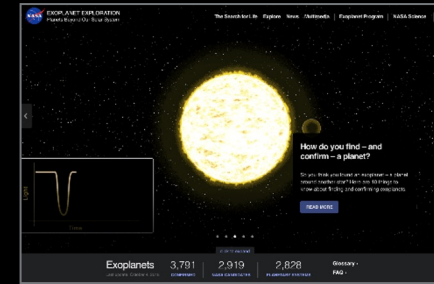


Coronagraph



Starshade

## Exoplanet Communications

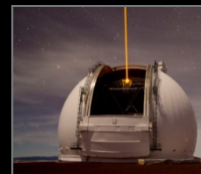


## Supporting Research & Technology

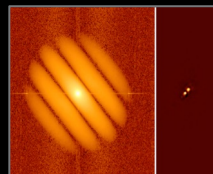
### Key Sustaining Research



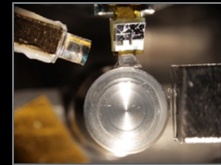
NN-EXPLORE



Keck Observatory



High Resolution Imaging

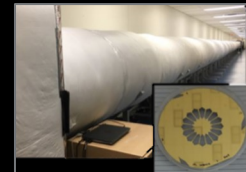


Extreme Precision Radial Velocity Technology Development

### Technology Development

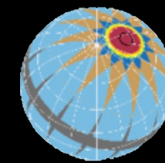
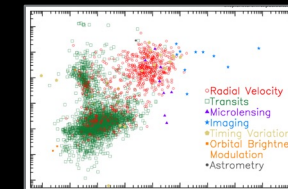


Coronagraph Technology Development



Starshade Technology Development (S5)

### NASA Exoplanet Science Institute (NExSci)



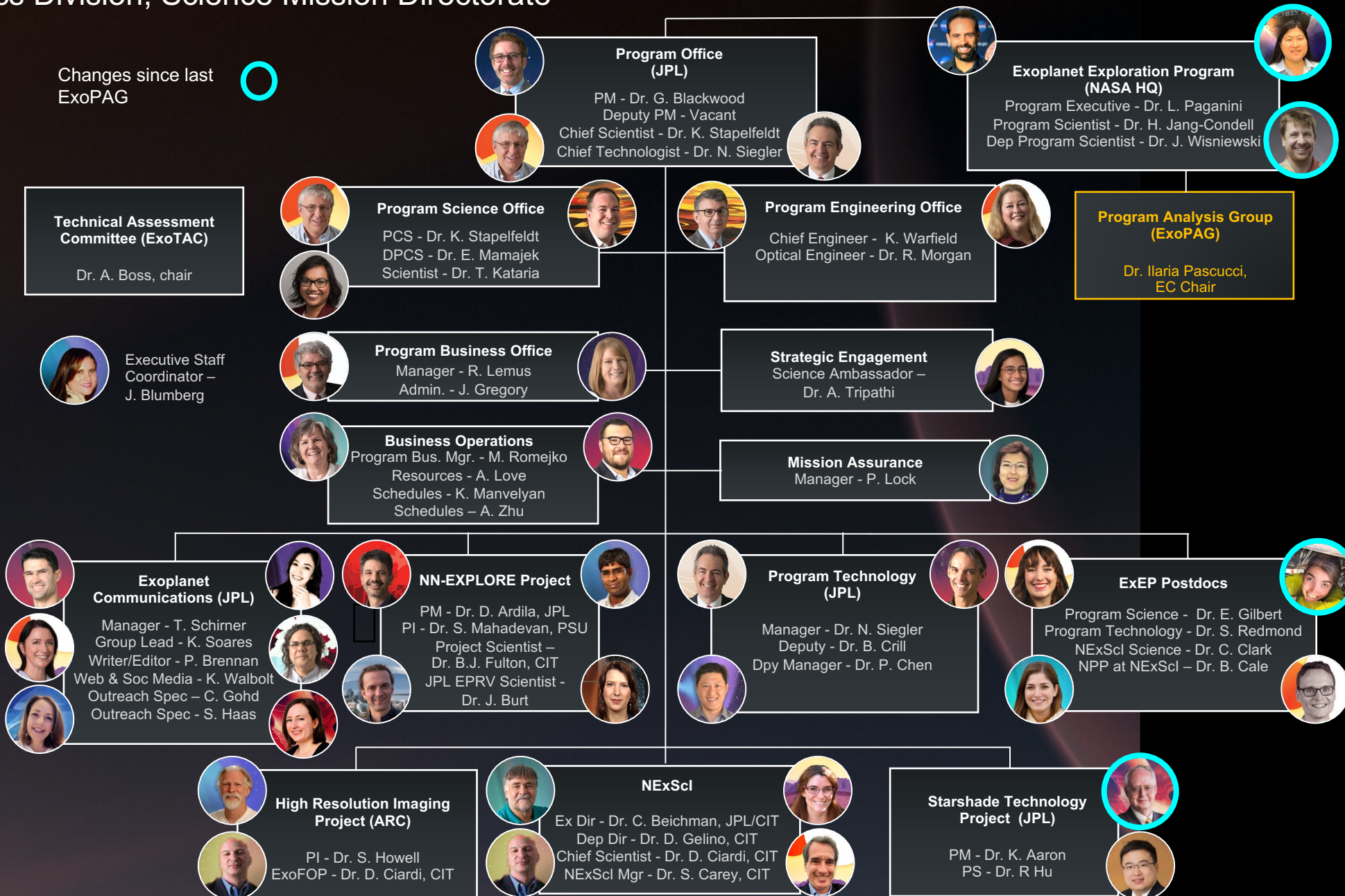
Archives, Tools, Sagan Program, Professional Engagement

# NASA Exoplanet Exploration Program

Astrophysics Division, Science Mission Directorate



Changes since last ExoPAG

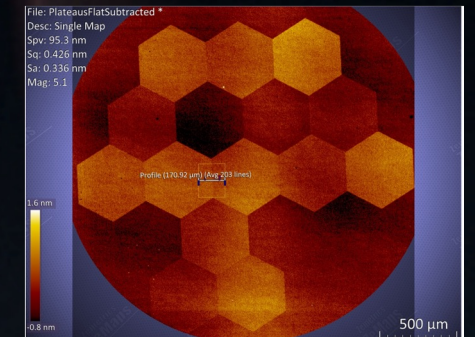
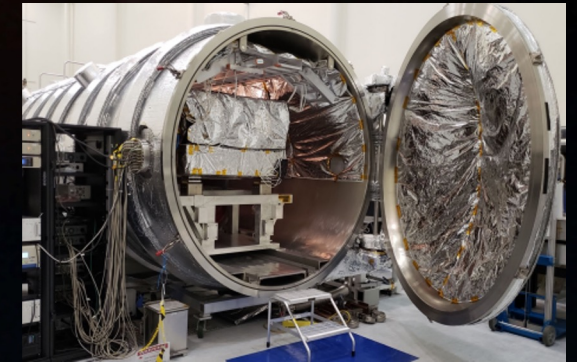




# Recent Program Highlights

## Technology

- Support to Habitable Worlds Observatory and GOMAP: Early working groups for **Technology Roadmapping**, **Science Metrics**, and **Yield Analysis**
- Coronagraph **technology demonstrations** in the High Contrast Imaging Testbed - for Strategic Astrophysics Technology Principal Investigators
- Successful build of **static wavefront generator** for segmented aperture: sub-nanometer segment positional offsets, for testbed insertion
- **Starlight Suppression Workshop** August 2023: over 300 people attended



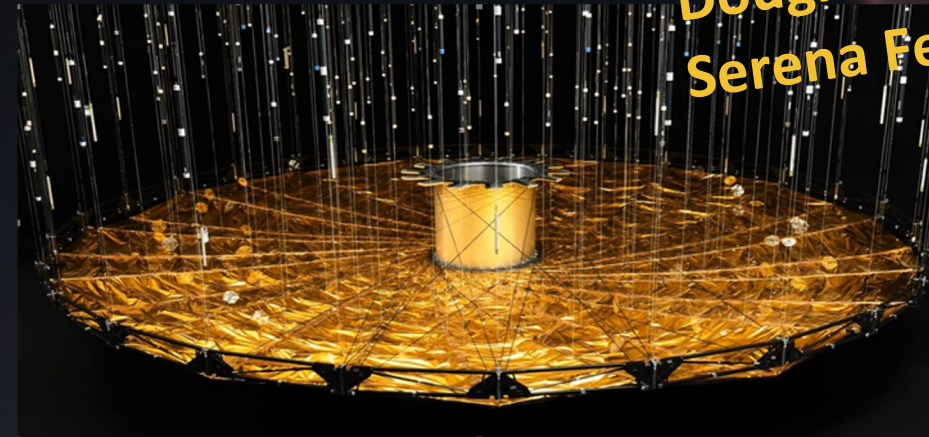
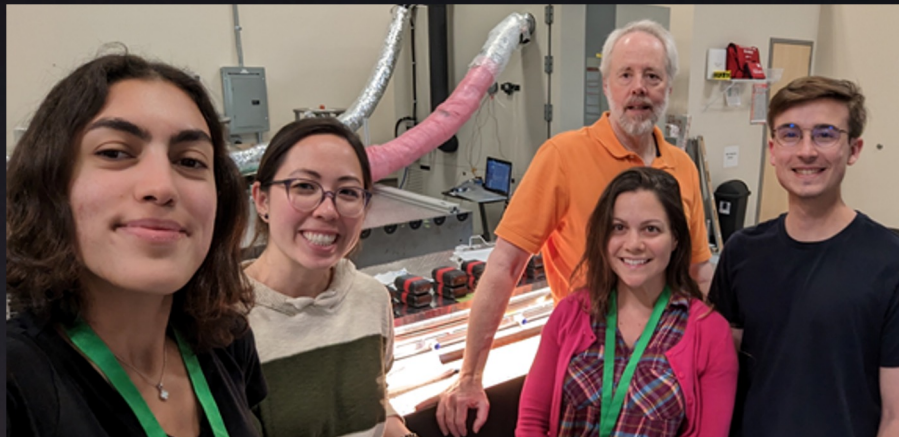
**Brendan Crill**



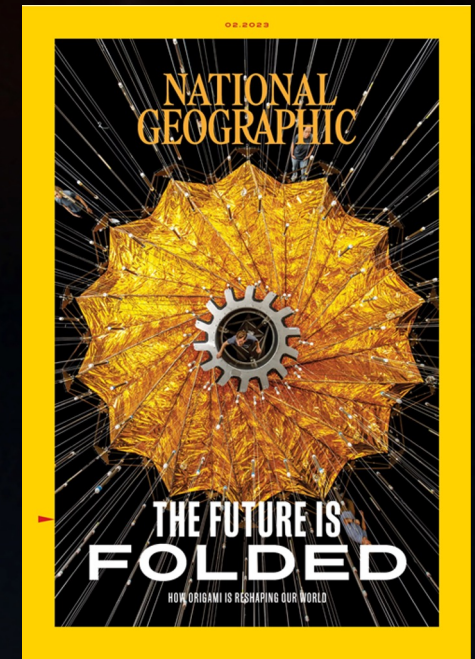
# Recent Program Highlights

## Starshade

- Delivered peer-reviewed **Starshade technology maturity** assessment for
  - Visible-wavelength starlight suppression
  - Formation Flying
- Finishing final mechanical milestones this year (petal shape, petal deployment)
- Directed effort transitions to competed effort in 2024



**Stuart Shaklan**  
**Douglas Lisman**  
**Serena Ferraro**





# Recent Program Highlights

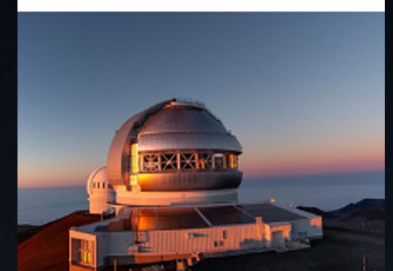
## Science

**David Ardila**

- NASA-NSF Exoplanet Observational Research Program (NN-EXPLORE): Guest Observing Opportunities
  - **NEID Spectrograph** on 3.5m Kitt Peak WIYN telescope
  - Southern Hemisphere radial velocity opportunities on **SMARTS/Chiron** and **MINERVA-Australis**
  - **High Resolution Speckle Imaging** of exoplanet host stars at WIYN, Gemini-North and South
  - **NExSci is the Science Center** that processes and archives the data
- **Extreme Precision Radial Velocity**
  - Research Coordination Network very active
  - Solar data archived for NEID and soon for ESPRES
  - AAS 243 Splinter Session for new Principal Investigators who received '23 Foundation Science Awards

**David Ciardi**

**Jennifer Burt**



*Tuesday, Jan 9th*

9 – 11 am Central  
[UTC – 6]

Convention Center  
Room : R08 / R09

Zoom Link :  
[bit.ly/EPRV\\_AAS243](https://bit.ly/EPRV_AAS243)



# NN-Explore's Extreme Precision Radial Velocity Initiative @ AAS243

Time [CT]	Talk Title	Speaker
9:00	EPRV Initiative Overview	Jennifer Burt [JPL/Caltech]
9:05	Line-By-Line Solar Observations to Separate Stellar Activity and Center-Of-Mass RVs	Drake Deming [University of Maryland, College Park]
9:20	New Strategies for Combining EPRV Observations from Multiple Instruments	Lily Zhao [Flatiron Institute]
9:35	The Infrared Sun as a Star	Nicole Wolff [Columbia University]
9:50	A Community Driven, Modular Data-Pipeline Architecture to Push EPRV Into the 1 cm/s Era	Jennifer Burt [JPL/Caltech]
10:05	Eliminating the Impact of Stellar Surface Features on Radial Velocities With Interferometric Images	Rachael Roettenbacher [University of Michigan]
10:20	NEID Updates & Performance	Chad Bender [University of Arizona]
10:30	MAROON-X Updates & Performance	Madison Brady [University of Chicago]
10:40	EXPRES Updates & Performance	John Brewer [SF State University]
10:50	General Discussion	

*Tuesday Jan 9<sup>th</sup>*  
**9 – 11 am Central  
 [UTC – 6]**  
**Convention Center  
 Room : R08 / R09**  
**Zoom Link :  
[bit.ly/EPRV\\_AAS243](https://bit.ly/EPRV_AAS243)**





# Other Relevant Splinter Sessions

**Jennifer Burt**

Tuesday January 9	9:00am- 11:00am	NN-EXPLORE's Extreme Precision Radial Velocity Initiative	CC R08/R09	Splinter Session
----------------------	--------------------	--	------------	------------------

**Julie Crooke**

Wednesday January 10	12:45pm- 3:30pm	The Habitable Worlds Observatory: Current Status & Opportunities for Engagement <a href="#">Agenda &amp; Zoom Link</a> <a href="#">Slack</a>	CC R08/R09	Splinter Session
-------------------------	--------------------	--	------------	------------------

**Rhonda Morgan**

Thursday January 11	9:00am- 11:00am	Yield Modeling Tools for Direct Imaging of Exoplanets Remix ( <a href="#">Agenda and Resources</a> )	CC 219	Splinter Session
------------------------	--------------------	---	--------	------------------



# ExEP's Yield Modeling Tools Workshop Remix

AAS243 Thursday, June 11, 9-11 am Central

Time (CT)	Title	Speaker
9:00	Importance of yield tools for science and mission requirements	Rhonda Morgan (ExEP)
9:10	Detailed overview of EXOSIMS open-source mission simulation tool	Dmitry Savransky (Cornell)
9:40	Detailed overview of AYO (Altruistic Yield Optimization)	Chris Stark (GSFC)
10:00	Interactive tutorial of EXOSIMS	Rhonda Morgan (ExEP)
10:20	Interactive tutorial of ExoVista	Alexander Howe (GSFC)
10:50	Discussion of priorities for future model improvement	Rhonda Morgan (ExEP)

NEW ORLEANS

Convention Center Room : 219

Register & WebEx : [bit.ly/YieldTools\\_AAS234](http://bit.ly/YieldTools_AAS234)

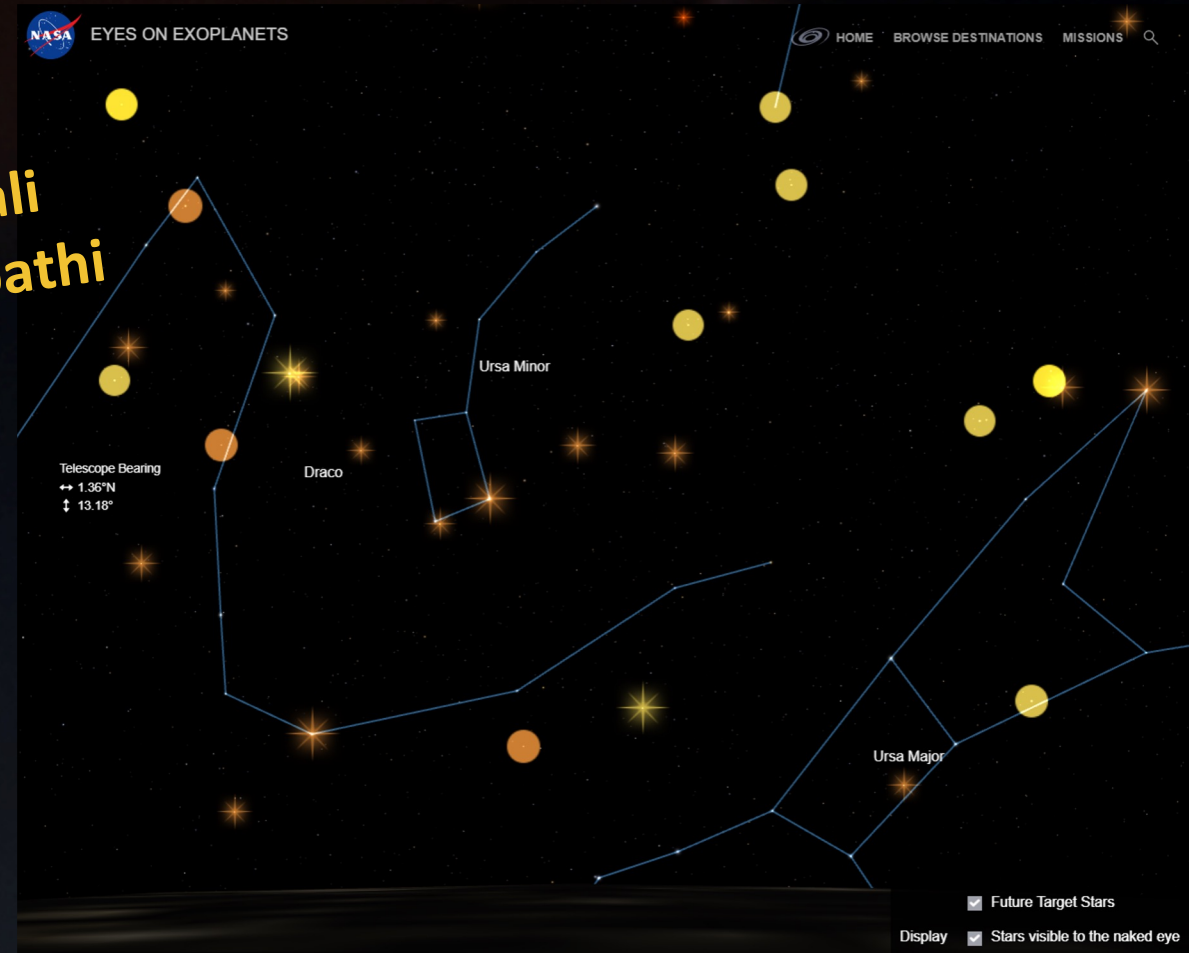


# Recent Program Highlights

## Science and Public Engagement

- Science and Public Engagement
  - **Eyes on Exoplanets**: stars with exoplanets or HWO target stars
  - View from your city

Anjali  
Tripathi



## ExoExplorers: 2024 Cohort Announced

Zahra Ahmed

Stanford University

Lili Alderson

University of Bristol

Galen Bergsten

University of Arizona

Michaela Leung

University of California,

Riverside

Garrett Levine

Yale University

James Mang

University of Texas, Austin

Fuda Nguyen

University of Arizona

Alex Polanski

University of Kansas

Maria Vincent

University of Hawaii at Manoa

Daniel Yahalomi

Columbia University

<https://exoplanets.nasa.gov/eyes-on-exoplanets/#/>

Tiffany  
Kataria



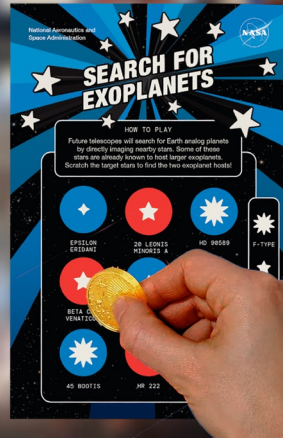
# Please Visit ExEP in the NASA Booth

Community engagement

Eyes on Exoplanets  
HWO Target Stars  
Demo



Coronagraph Demo

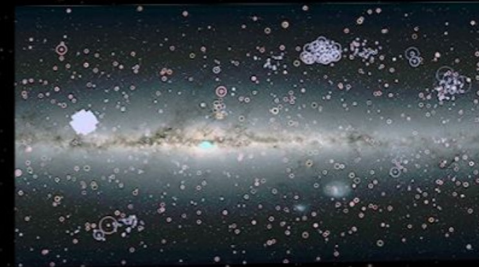


Scratchoff HWO Stars



New Stickers

## Exoplanet Exploration



### How were the first 5,000 exoplanets discovered?

- Transits**  
3,646 of 5,000 planets found
- Radial Velocity**  
813 of 5,000 planets found
- Microlensing**  
129 of 5,000 planets found
- Direct Imaging**  
58 of 5,000 planets found
- Astrometry**  
1 of 5,000 planets found



Discovery Sonification

## Tell us what you think!

What's your favorite NASA space telescope for exoplanet science?



How many known exoplanets were found with space telescopes?



What's your favorite kind of exoplanet?



When do you think we'll discover an Earth analog planet?  
(i.e. an Earth-mass planet in the habitable zone of a Sun-like star)



Community Voting Data Viz

exoplanets.nasa.gov

explore exoplanets

Sara Haas  
Anjali Tripathi  
Travis Schirner



*Exoplanets and Search for Life are Aspirational:  
They Draw us, and Impel us  
to Explore other Worlds and to Inspire our Own*







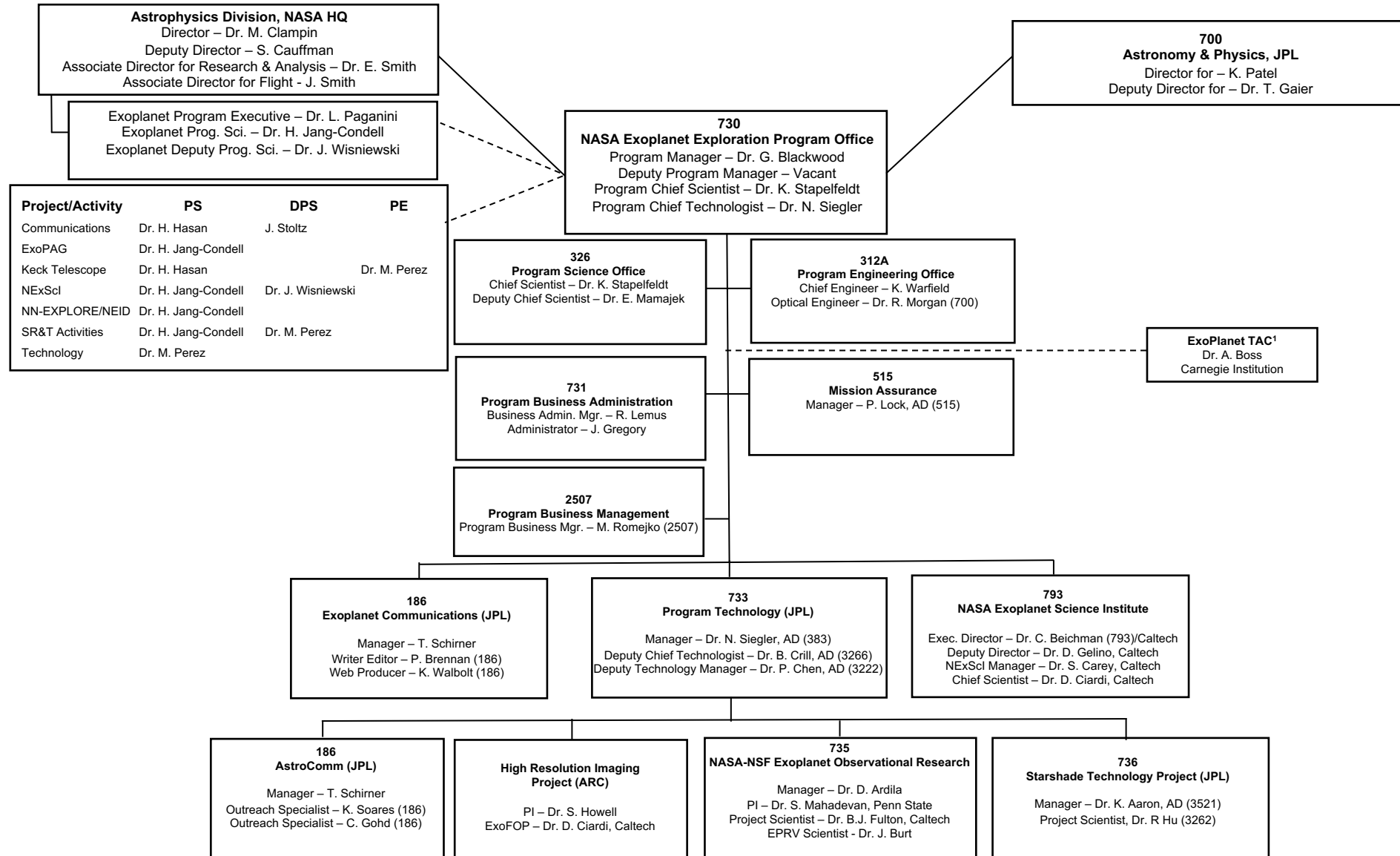
**Jet Propulsion Laboratory**  
California Institute of Technology

---

[exoplanets.nasa.gov](https://exoplanets.nasa.gov)



# NASA Exoplanet Exploration Program Organization Chart





# Acknowledgements

This work was carried out at the Jet Propulsion Laboratory, California Institute of Technology under contract with the National Aeronautics and Space Administration.

© 2024. All rights reserved.