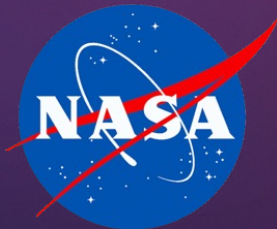


29 JULY 2022

Sagan Summer Workshop Wrap Up: Our First Hybrid Workshop!



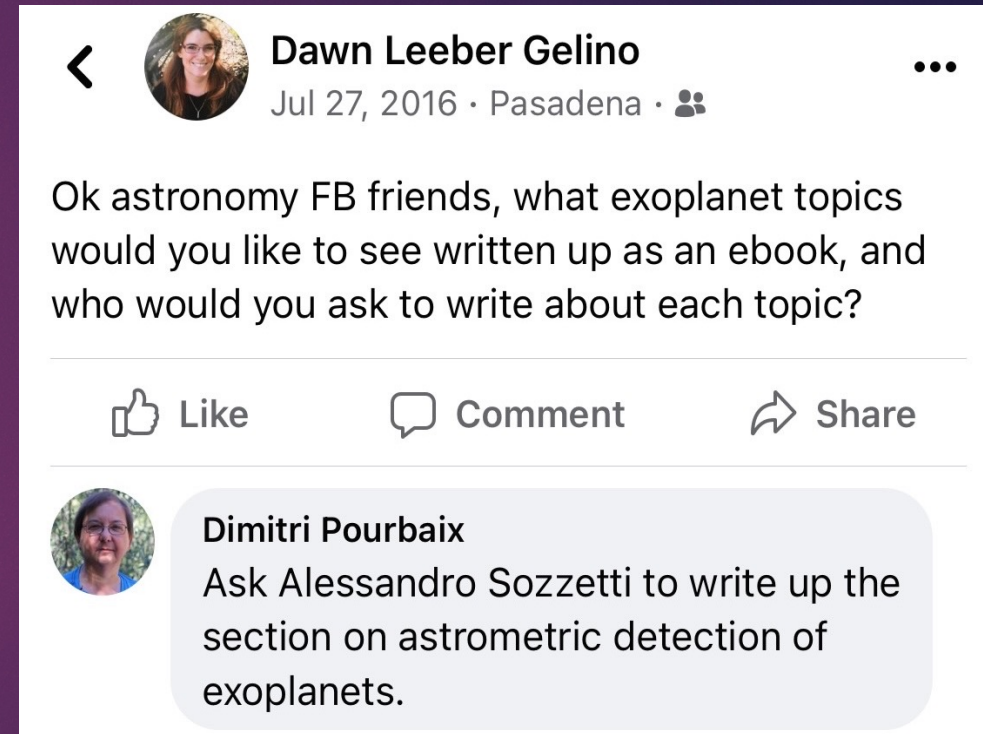
Caltech

This workshop is dedicated to

the memory of **Dimitri Pourbaix**, a key contributor to the Gaia mission and the field of astrometry.

He was the inspiration behind this year's workshop topic.

He is greatly missed.



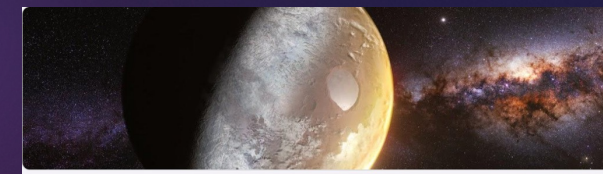
Feedback Survey & Resources

- ▶ Please fill out the feedback survey:

tinyurl.com/sagan22

- ▶ Videos of the presentations are posted both on the workshop agenda page and on our Sagan Summer Workshop YouTube channel

- ▶ Includes the past 8 years of workshop videos!



2022 Sagan Summer Workshop Feedback Survey

I am a

- Undergraduate Student
- Graduate Student
- Postdoc
- Staff
- Professor

Sagan Summer Workshop
1.95K subscribers

HOME VIDEOS PLAYLISTS COMMUNITY CHANNELS ABOUT

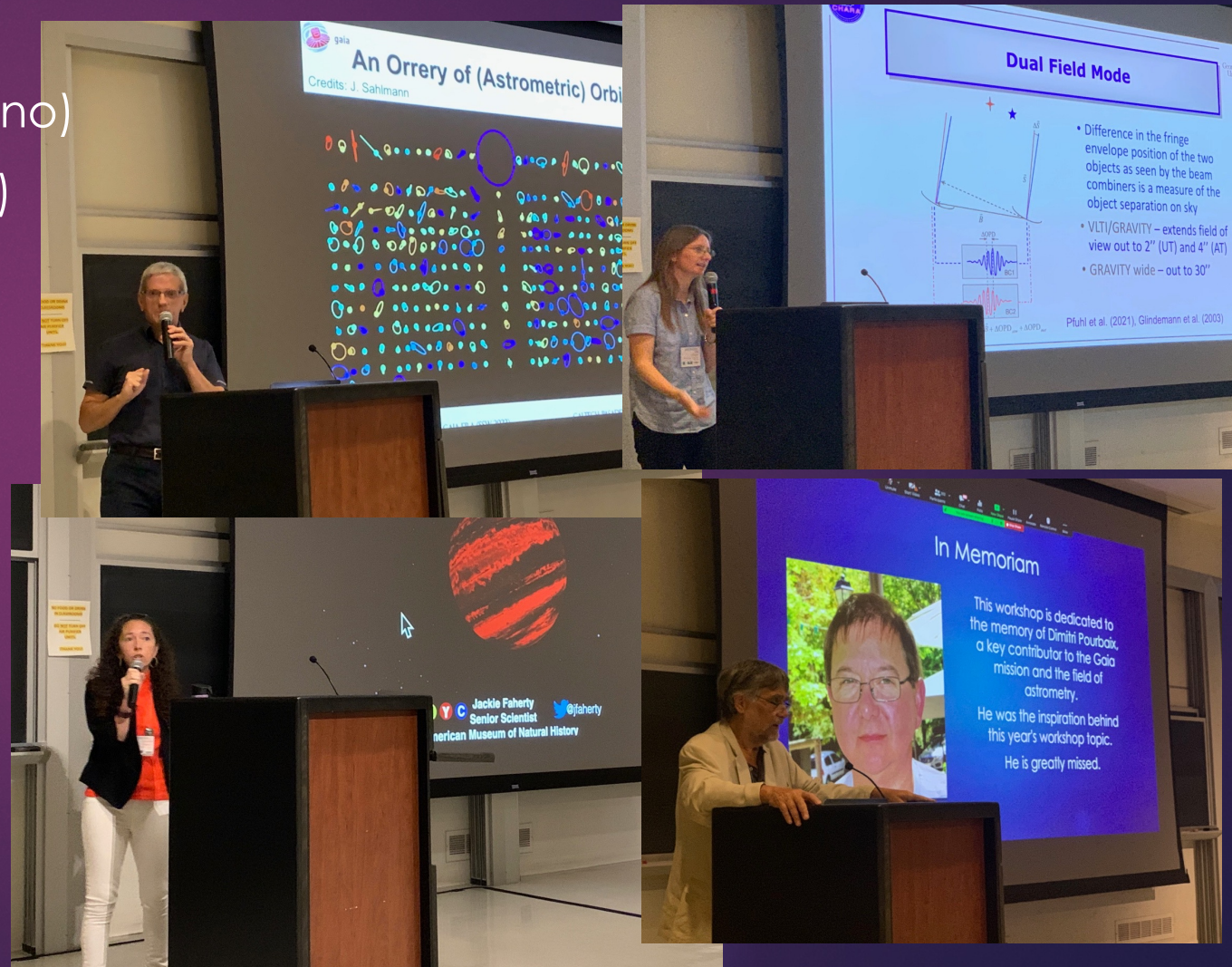
Uploads

- G. Schaefer: Micro-arcsecond Precision Astrometry Using...**
11 views • 11 hours ago
- E. Broman: Exploring Exoplanets in Open Space**
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- T. Brandt: Near-Term Exoplanet Discovery using...**
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- A. Sozzetti: Gaia Exoplanet Survey: The Astrometry...**
14 views • 11 hours ago
- Tuesday Hands-on Session: Visualizing Gaia Data**
50 views • 1 day ago
- R. Ligi: Gaia plus Interferometric Observations**
16 views • 1 day ago
- M. Kounkel: Kinematic Identification of Stellar...**
18 views • 1 day ago
- M. Ness: Galactic Kinematics and Statistical Stellar Ages**
13 views • 1 day ago

Many Thanks...

...to the SOC for a great agenda and choice of diverse and dynamic speakers:

- ▶ Jackie Faherty, Co-Chair (AMNH)
- ▶ Alessandro Sozzetti, Co-Chair (INAF-Torino)
- ▶ Frédéric Arenou (Observatoire de Paris)
- ▶ Chas Beichman (Caltech/IPAC-NExSci)
- ▶ Tim Brandt (UCSB)
- ▶ Anthony Brown (Leiden Observatory)
- ▶ Elise Furlan (Caltech/IPAC-NExSci)
- ▶ Dawn Gelino (Caltech/IPAC-NExSci)
- ▶ Lynne Hillenbrand (Caltech)
- ▶ Eric Mamajek (JPL)
- ▶ Aki Roberge (GSFC)
- ▶ Gail Schaefer (CHARA)



...to those behind the scenes...

NExSci Science Affairs Team

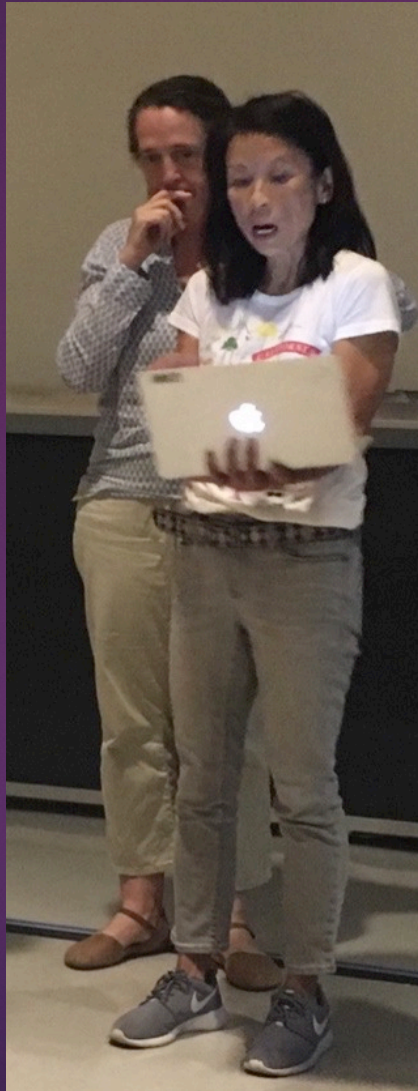
- ▶ **Ellen O'Leary**
- ▶ **Elise Furlan**
- ▶ **Megan Crane**
- ▶ **Melanie Swain**
- ▶ **Dawn Gelino**
- ▶ **Tracy Chen**
- ▶ **Rich Terrile**



...to those behind the scenes...

IPAC/Caltech

- ▶ Wendy Burt
- ▶ Mari Castillo
- ▶ Alice Hang
- ▶ Alex Hui
- ▶ Niles McElveney
- ▶ Teresa Molano
- ▶ Daniel Pina-Muro
- ▶ Nancy Solis



Caltech

- ▶ Laurel Auchampaugh (Baxter/HSS)
- ▶ Cecilia Lu (Dabney/HSS)
- ▶ Becca Rose (Academic Media Technologies)



...to our Speakers...

Thank you for:

- ▶ Your *excellent* talks
- ▶ Answering questions in Slack
- ▶ Participating in both in-person and remote "lunches" with

...about stellar parameters for exoplanets

- Mass, radius, and effective temperature (T_{eff}) of the planet host dictate the size and density of the planet, and amount of irradiation of the planet receives ("too hot, too cold, just right").
- How fast does it spin, what about magnetic storms?
- Age:
 - Can we explain the known exoplanets distribution given our current knowledge of solar system evolution?
 - Has the system evolved long enough to be able to sustain life, and what kind of life? Is it like our Solar System?

Image credit: NASA/JPL-Caltech/Libeth B. De Li

4.2 Gyr 4.5 Gyr

Revolution in stellar astrophysics through

A Reference frame : what for?

- At the very first level : to map the sky and tell where the stars are !
- To refer positions of fixed or moving sources
- To **detect** tiny motions → E. Halley 1717
- To **quantify** without bias the motion of sources
 - modelling the galactic kinematics
 - investigate rotational and translational motion of external galaxies
- To monitor the rotation of the earth
 - fix the timescale
 - study the plate motions
- Angular positions (and distances) of quasars, galaxies, stars, planets, spacecraft

F. Mignard Sagan WS 2022 29/07/2023

Resolved BD Cores
Combining Gaia and Imaging

G. Mirek Brajković
Sagan Workshop

Star formation & clusters

Stars in the OMC-23 Filament

OMC 1-18
OMC Cluster
OMC Core
OMC-1S

Kuhn+14

L1617 L1622 NGC 2068 NGC 2024 NGC
L1634 L1641 L1647

Binary orbital velocity

61 Cyg AB

$e \cos \omega = 286.019 \pm 0.069 \text{ mas}$
 $e \sin \omega = 216.039 \pm 0.039 \text{ mas}$

ELT SPECTROSCOPY OF M DWARF HABITABLE PLANETS

Quality spectra will likely need combination of ...

- High-contrast coronagraph
- Extreme adaptive optics (AO)
- High-dispersion technique

A first-generation instrument (METIS) for ELT appears to combine these features

- Coronagraphs in first-generation instrument suite for TMT or GMT
- Habitable planet candidates can be studied? TBD

...to our Speakers...

1. Planets! (Not from astrometry)

Cumulative Number of Detections

Cumulative Detections Per Year

Transit: 3875
RV: 936
Microlensing: 130
Imaging: 61
(Astrometry: 20,000?)

Methods: Radial Velocity, Transits, Microlensing, Imaging, Astrometry, Disk Kinematics, Orbital Brightness Modulation, and others.



The JASMINE mission
(Japan Astrometry Satellite Mission for Infrared Exploration)

Daisuke Kinoshita (JASMINE Project Scientist,
Mullard Space Science Laboratory, University College London)
Hayime Kawahara (JASMINE Exoplanet Science lead, SASTAR),
Naoteru Gouda (JASMINE Principal Investigator, NAOJ)

JASMINE team

T_{eff}-L-R-M relations calibrated using interferometric diameters, bolometric fluxes and dynamical masses because M dwarfs hardly evolve

What will GaiaNIR Observe?

- Star count ratio between GaiaNIR and Gaia gives 5 times more stars for a H-band limit of 20th mag and 6 times more stars for a K-band limit of 20th mag.
- About 10 or 12 billion stars for H or K-band cut-offs.
- A K-band cutoff with 12 billion stars makes more sense!
- The star count in the disk is uncertain due to the extinction model used (older models give a ratio of 3 instead of 5).
- This uncertainty in the science case in itself that cannot be resolved.

(H-band limit of 20th mag)

Observing an earth analog is equivalent to observe a Cen A&E

- 3x brighter
- 3x greater resolution than around next Sun
- Time critical because informs flagship (Kepler, GAIA, TESS)

Orientation

North Celestial Pole

North Pole

Equator

Celestial Equator

Ecliptic

Equinox

South Celestial Pole

NANCY GRACE ROMAN

SPACE TELESCOPE

Properties	Roman
Eff. Aperture	2.28m
FOV	0.281 deg ²
Wavelengths	~0.5-2 μm (WFI)
FWHM@1μm	0.10"
Pixel Size	0.11"
Launch/Lifetime	2025/years
Orbit	L2

Wide-Field Instrument (WFI)

- ~0.5-2.0 micron bandpasses
- 0.281 sq. deg. FOV (110x100 ACS FOV)
- 18 HRCO detectors (588 Channels)
- 7 filter imaging, prism and prism spectroscopy

Coronagraph Instrument (CGI)

- Visible (545-865nm) high-contrast imager
- Polarimeter and spectrograph
- 3 types of coronagraph masks

Surveys and Observations

- HLS Imaging & spectroscopy over 1000s sq deg
- She & J.L. Repetitive monitoring of smaller areas
- Coronagraph: tech-demo observations

2022 Sagan Exoplanet Summer Workshop

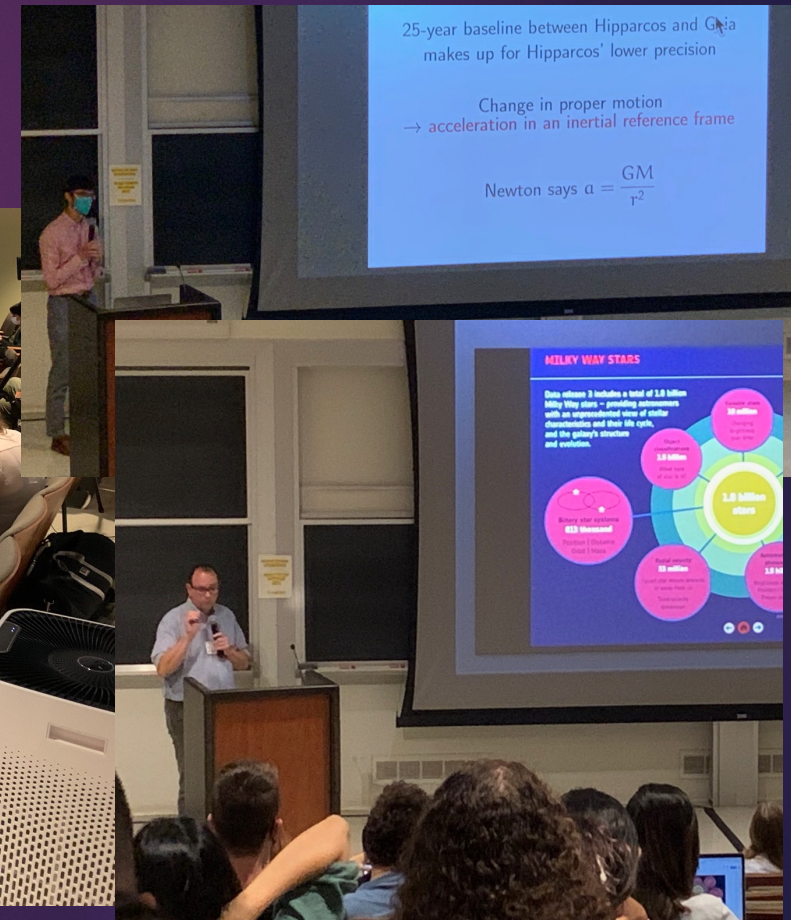
Sagan Summer Workshop

Nextsci

...and to our Hands-on Session Leaders!

The preparation and technical support in getting ready for the hands-on sessions would not have been possible without the dedicated help from:

- ▶ Tim Brandt
- ▶ Anthony Brown
- ▶ Jackie Faherty
- ▶ Alessandro Sozzetti
- ▶ Elise Furlan
- ▶ Melanie Swain



...and to our Hands-on Session Helpers!

- ▶ Ummi Abbas
- ▶ S M Rafee Adnan
- ▶ Qier An
- ▶ Stefano Bertone
- ▶ Mirek Brandt
- ▶ Hemanth Bommireddy
- ▶ Orlagh Creevey
- ▶ Louis Desdoigts
- ▶ Tara Fetherolf
- ▶ Xuan Ji
- ▶ Daisuke Kawata
- ▶ Rena Lee
- ▶ Yiting Li
- ▶ Matteo Pinamonti
- ▶ Kendall Sullivan
- ▶ Shih-Yun Tang
- ▶ Alexander Venner
- ▶ Daniel Yahalomi



NASA Exoplanet Archive/ExoFOP

The image shows two screenshots of NASA's exoplanet-related websites. The top screenshot is the NASA Exoplanet Archive homepage, featuring the IPAC logo and navigation tabs for Home, About Us, Data, Tools, Support, and Login. It displays statistics: 5,063 Confirmed Planets, 231 TESS Confirmed Planets, and 5,794 TESS Project Candidates. A search bar is available, and a news section highlights 'Three Planets, and New Masses for Two Known Planets' dated July 21, 2022. The bottom screenshot is the ExoFOP 'Welcome to ExoFOP' page, which explains the program's purpose and provides a news section with updates on data merging and availability. It also includes a 'REQUEST AN ACCOUNT' and 'RESET YOUR PASSWORD' button, and a navigation menu for STARS, PLANETS, DATA TAGS, and OBSERVATIONS.

NASA Exoplanet Archive

- ▶ The premiere exoplanet database of confirmed planets and candidates
- ▶ Over 5,000 exoplanets with more than 29,000 planetary system solutions
- ▶ Kepler, K2, and TESS candidates
- ▶ All Kepler high level products
- ▶ Transit data: 100 million light curves
- ▶ Tools to work with data
- ▶ exoplanetarchive.ipac.caltech.edu

Exoplanet Follow-up Observing Program (ExoFOP)

- ▶ The premiere web service to share exoplanet follow-up observations, data, and notes
- ▶ Kepler, K2, and TESS sites merged into one site
- ▶ More than 60,000 observations and over 1 million files uploaded by users
- ▶ Over 1,300 registered users
- ▶ exofop.ipac.caltech.edu

NASA-Keck Time

- ▶ Access to ~47 nights/semester spread over the two 10m telescopes in Maunakea, HI
- ▶ Astronomers based at any U. S. institutions may apply as a PI; Co-Is may be international
- ▶ Proposals are evaluated for NASA strategic relevance and proposed science goals
- ▶ Twilight, Cadence, and Target of Opportunity proposals accepted
- ▶ Financial support for successful PIs, contingent upon NASA funding
- ▶ Proposals for **2023A due September 15, 2022**
 - ▶ Call for Proposals will be posted mid-August
 - ▶ Will continue to use the Dual Anonymous Proposal Review process
- ▶ Stay tuned for joint NASA Keck/JWST program!



<https://nexsci.caltech.edu/missions/KSA>

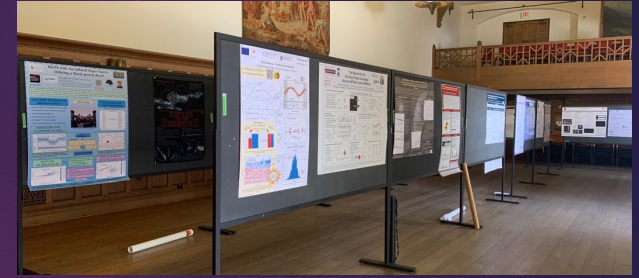
NASA Hubble Fellowship Program (NHFP)

- ▶ For independent research related to the goals of NASA Astrophysics
 - ▶ Observational, theoretical, experimental, or instrumental
 - ▶ Within 4 years of your PhD
 - ▶ Applicants can be from *anywhere* around the world, but must serve their fellowship at a US institution
 - ▶ Fellows named Sagan, Hubble, or Einstein depending on their field of study
- ▶ Call for applications online in early September 2022
- ▶ 2023 applications are **due November 3, 2022**

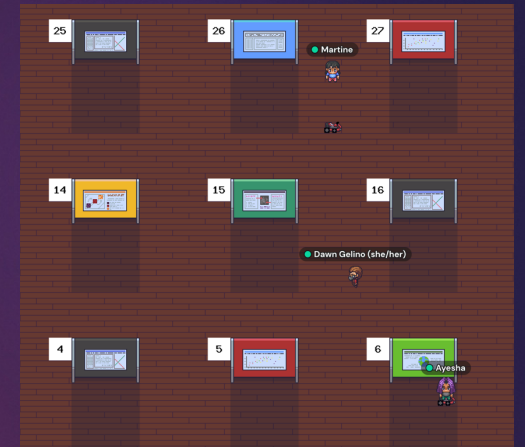


<https://nexsci.caltech.edu/sagan/fellowship.shtml>

Reminders



- ▶ **Certificate** request website is now available
 - ▶ Certificates will be sent to those who have requested them no earlier than late August, so please be patient!
 - ▶ <https://catcopy.ipac.caltech.edu/ssw/certificate.php>
- ▶ Submit your **headshot** to be part of the on-line Class Photo
 - ▶ August 19 deadline
 - ▶ https://catcopy.ipac.caltech.edu/ssw/enter_photo.php
- ▶ **Gather** will remain open until August 12, so continue to check out posters there or on the workshop website
- ▶ **Slack** will remain open, but messages older than 90 days will not be accessible
 - ▶ If you are still working on the hands-on sessions, please search in the relevant channels for answers to your questions. There are many answers in there!



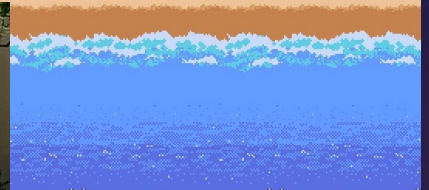
Thank You In-Person & On-line Attendees!

- ▶ This would not be a success without your interactions and involvement in asking questions and working on the hands-on sessions
- ▶ Spread the word ([#sagan2022](#)) if you enjoyed and learned something from this year's workshop!
- ▶ Feel free to keep interacting on Slack
- ▶ Check out the posters on the website/Gather and ask your questions in Slack
- ▶ Submit your headshot to be part of the Class Photo
- ▶ Fill out the survey: tinyurl.com/sagan22





2021
Class
Photo



2022
Class
Photos!