

Connecting Astronomy Software with NSF TIP

 as a case study

Kyle Westfall

University of California Observatories

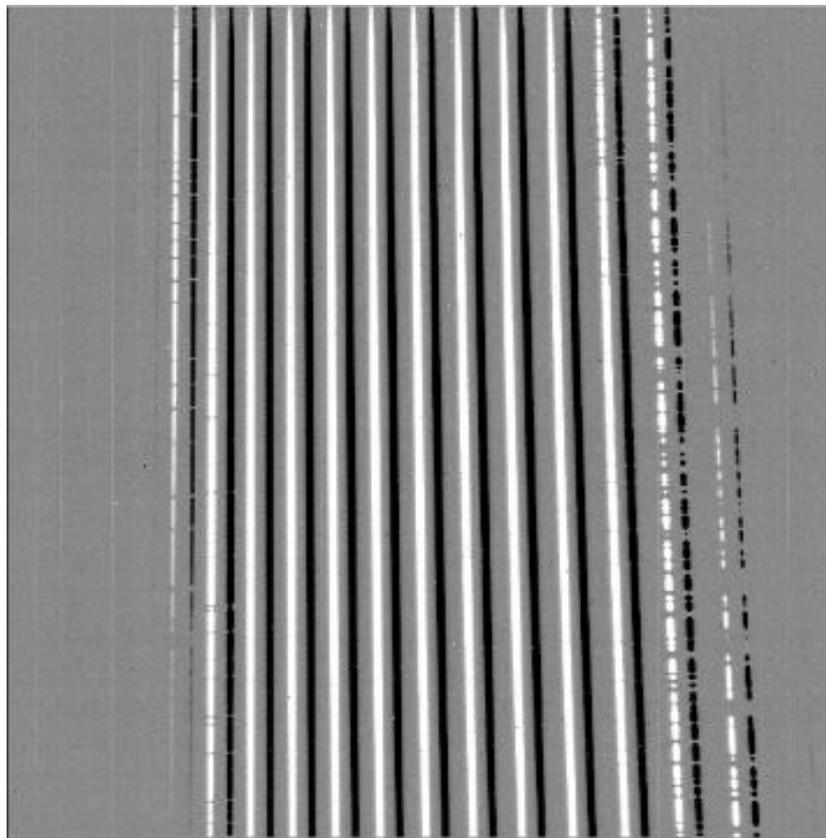
PypeIt is funded by:



Outline

- Who am I?
- What is PypeIt?
- What is the NSF TIP/POSE program?
- TIP/POSE + PypeIt development

Reduced 2D difference image from Keck/NIRSPEC



Carvalho et al. (2024)

Who am I?



UC Santa Cruz Campus



sdss-mangadap.readthedocs.io



FOBOS
FIBER-OPTIC BROADBAND OPTICAL
SPECTROGRAPH

fobos.ucolick.org



pypeit.readthedocs.io



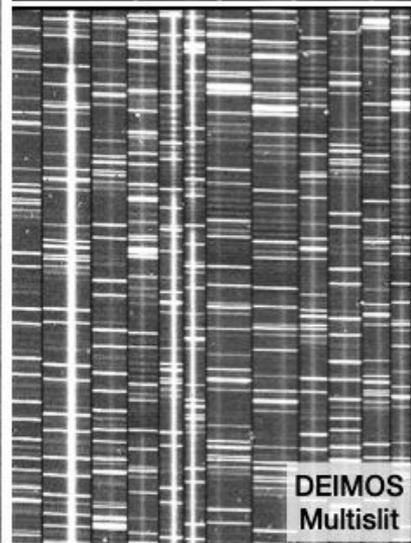
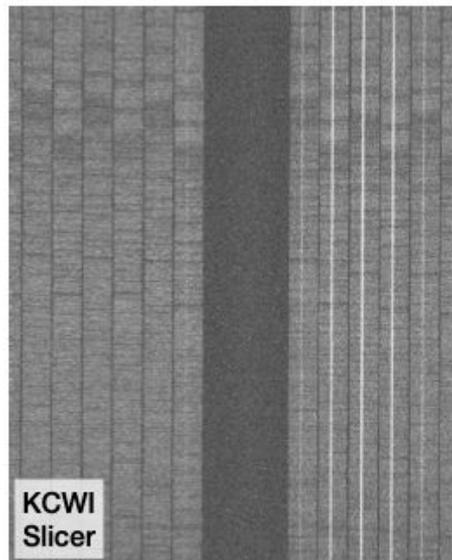
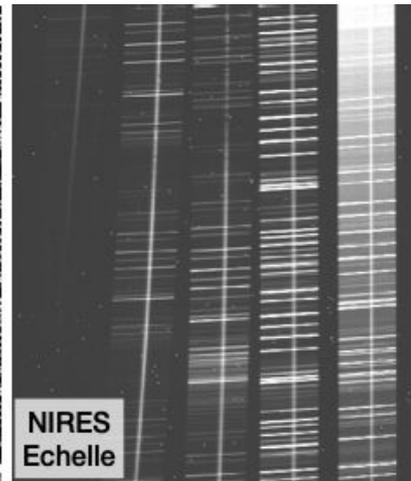
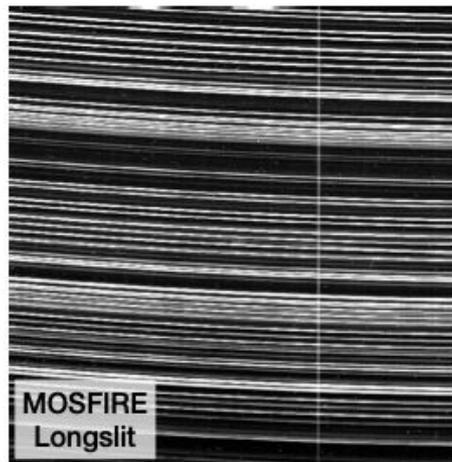
A general purpose data-processing package for astronomical spectroscopy

Core Devs

J. X. Prochaska (UCSC)
J. F. Hennawi (UCSB)
K. B. Westfall (UCO)
D. Pelliccia (UCO)
B. Holden (UCO)
D. Reichwein (UCO)

Contributors

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T. Pickering (UA/MMT)
T. Ellsworth-Bowers (Lowell)
R. Cooke (Durham)
F. Davies (MPIA)
F. Wang (UA)
M. Roberson (CIT)
+many more

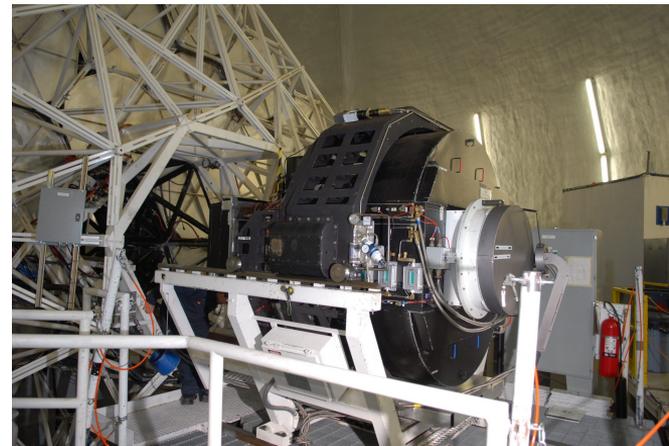




Automated Data Processing Facilitates Frontier Science

- PypeIt provides a flexible, end-to-end **data processing pipeline** that ingests raw science and calibration data from slit-based instruments and yields **science-ready spectra**.
- The code is **open-source**, easily installed, and distributed with extensive documentation.
- **User support** is provided within hours on Slack and via bi-annual workshops held over Zoom (the most recent one was yesterday!).
- New funding awards expand PypeIt's reach, open key paths for PypeIt's **sustainability** and integration into educational activities, and help us establish a new **governance** model.

Keck/LRIS

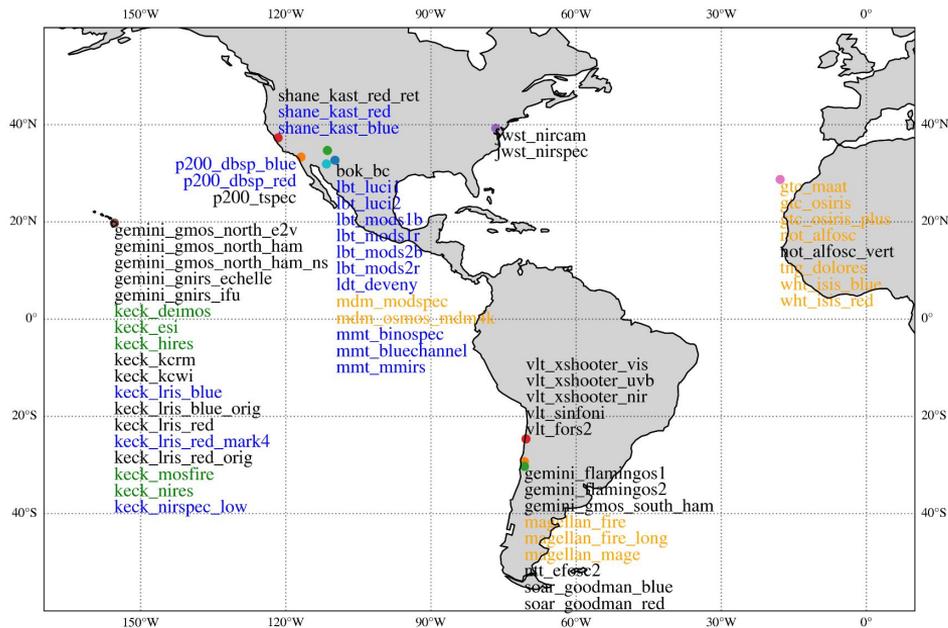


Keck/ESI



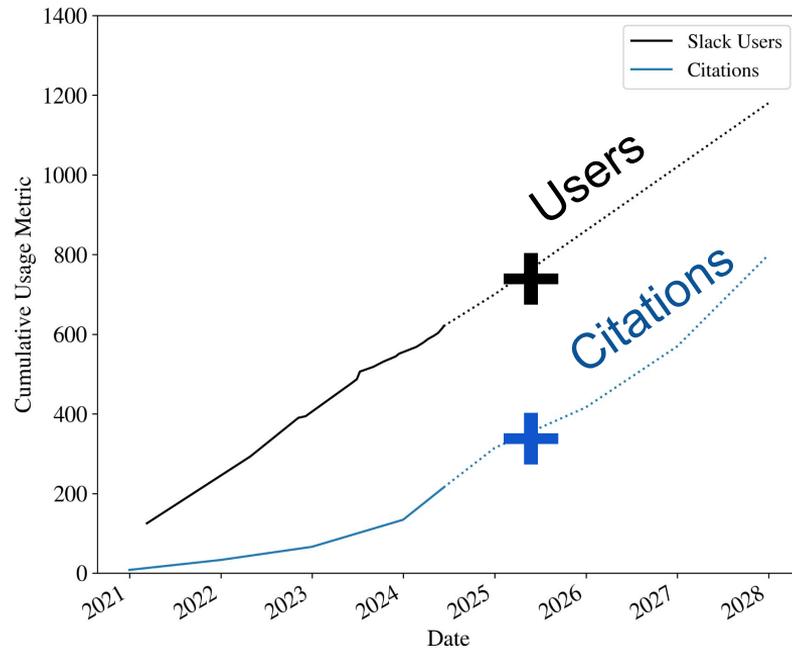


A world-wide community resource



Leveraging open-source contributions from the broader community, PypeIt now serves more than **50 spectrographs** worldwide

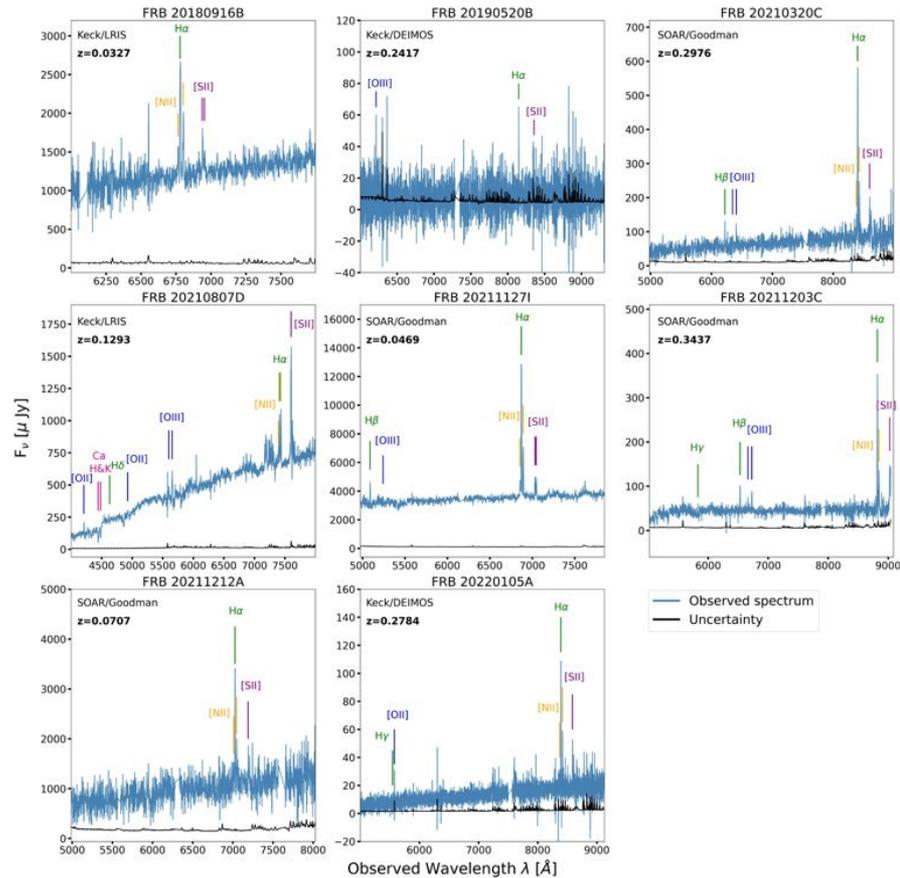
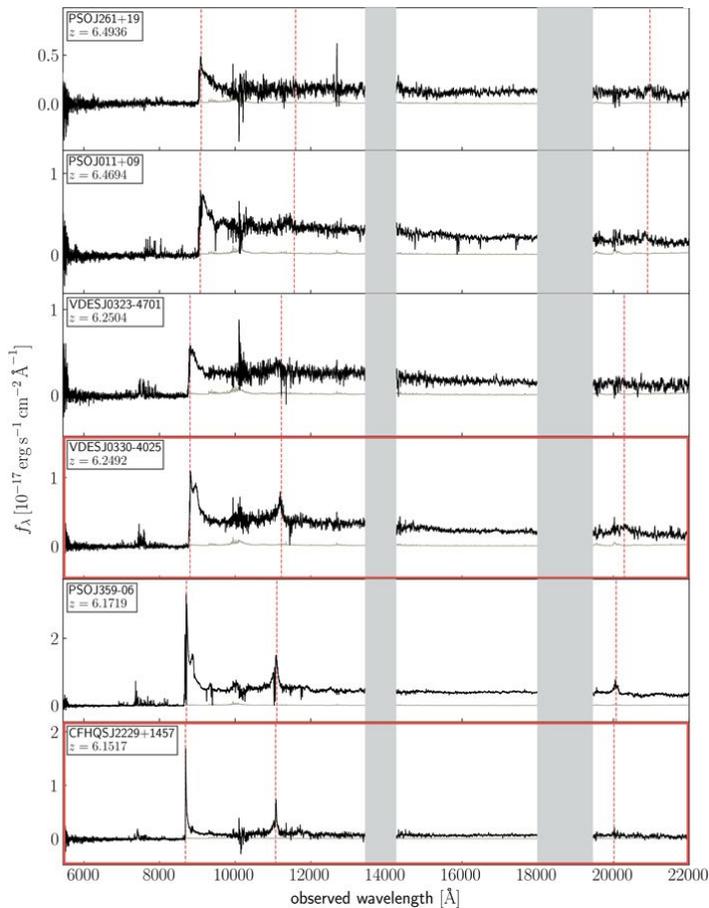
- 300+ Citations
- 20+ Contributors
- 720+ Users
- and growing!



Eilers et al. (2020)
 High-z Quasars
 VLT/XShooter, Keck/DEIMOS



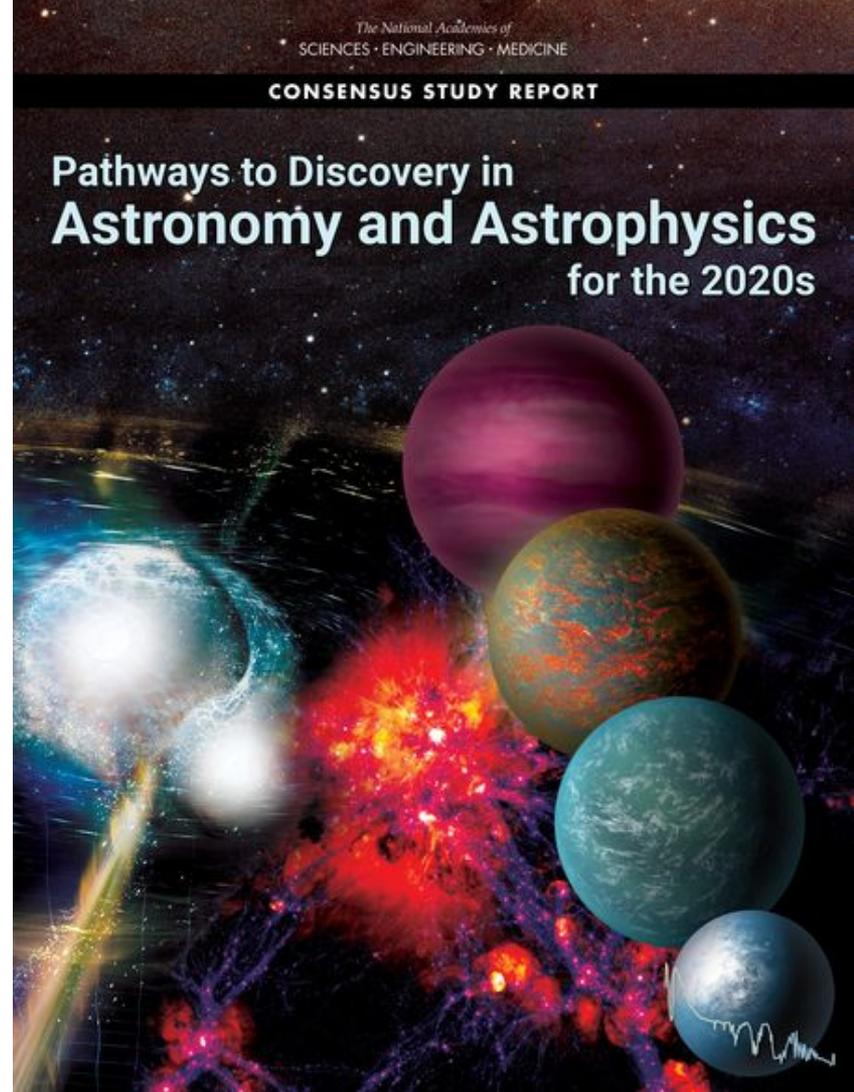
Gordon et al. (2023)
 Fast Radio Burst Host Galaxies
 Keck/LRIS, Keck/DEIMOS, SOAR/Goodman



Software projects like PypeIt are a clear priority of Astro2020.

The National Science Foundation and stakeholders should develop a plan to address how to **design, build, deploy, and sustain pipelines for producing science-ready data across all general-purpose ground-based observatories** (both federally and privately funded), providing funding in exchange for ensuring that all pipelined observations are **archived** in a standard format for eventual public use.

Final recommendation of Section 4.5.1





Automated Archiving of Processed Data Products



4. Select files to download (Help)

Download Selected Files

[Interactive Table Usage Help](#)

Select All Files

De-select All Files

Reset All Column Filters

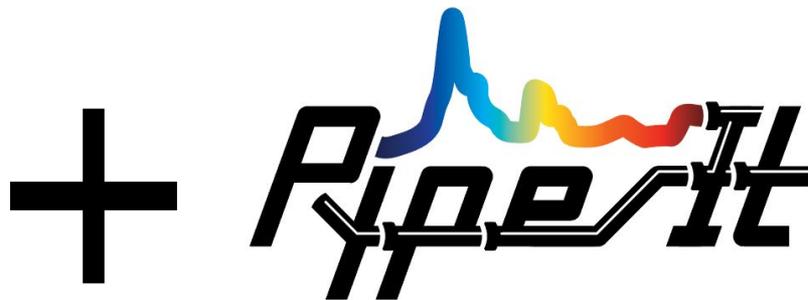
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Row ID	KOAID	Original	Instrument	Target	Image or	Frame	Previews	
		Filename		Name	Dispersion	Number		
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Showing records 1 to 14 of 24 (24 total)

TIP Technology,
Innovation and
Partnerships



NSF's Pathways to Enable
Open-Source Ecosystems



NSF TIP/POSE Program Goals



Scientist



OS Product



External User

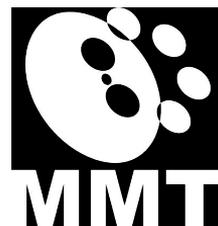
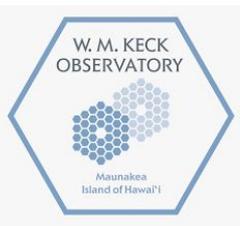
NSF TIP/POSE Program Goals



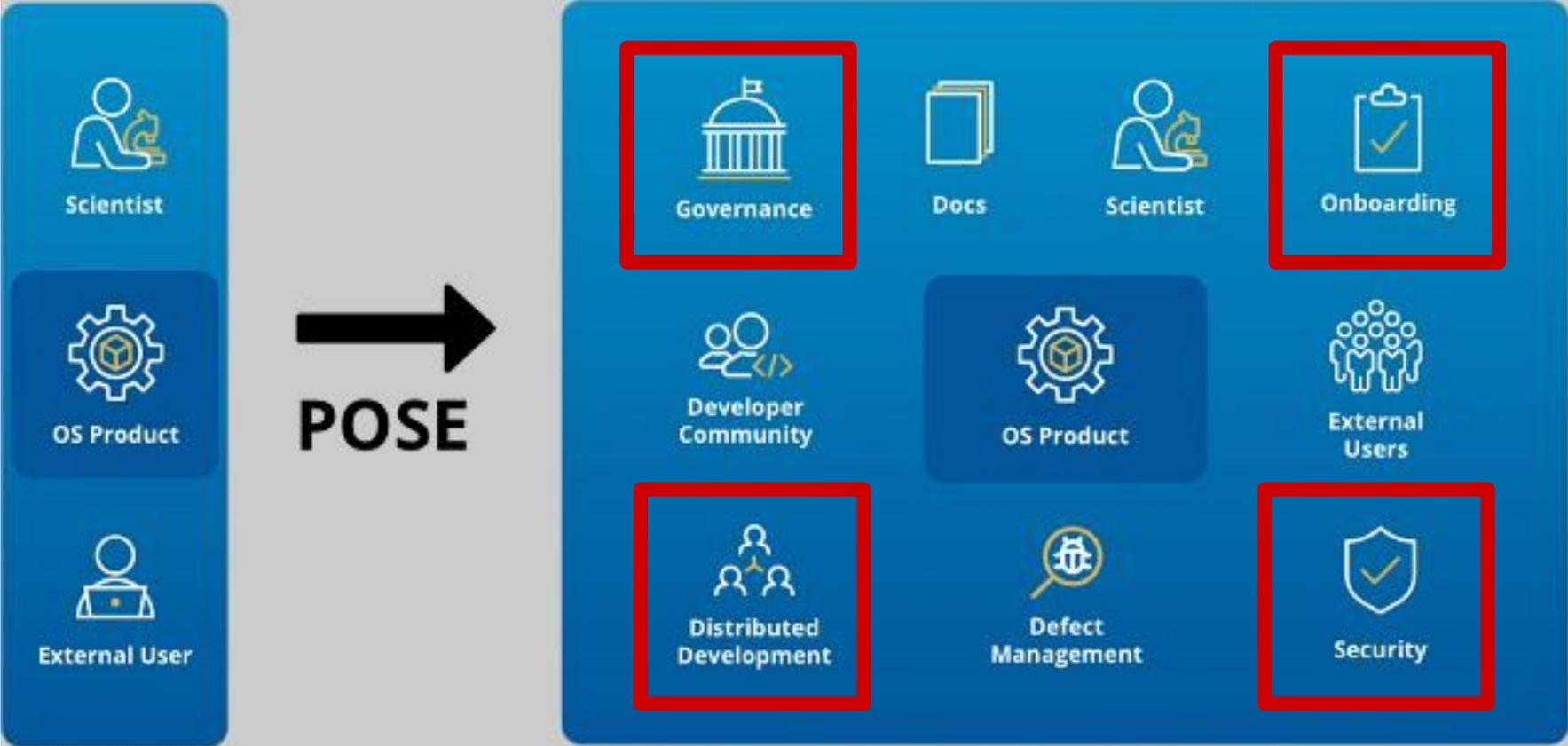


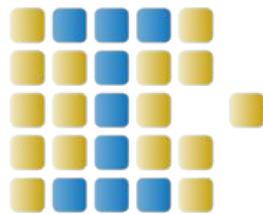
NSF TIP/POSE Provides a Pathway to Sustainability

- Funds staff at 7 observatories to add/improve PyeIt support for their spectrographs.
- Facilitates establishment of a new, community-focused governance model
- Improves documentation and long-term archiving of processed data
- Builds educational materials and enables support for commercial spectrographs used by amateur astronomers



NSF TIP/POSE Program Goals





CORPSTM
NSF Innovation Corps

Kyle Westfall
UCO Staff Scientist
POSE PI



“I-Corps for POSE” Training

- **Develop an ecosystem map**
- Construct a business model canvas adapted for open-source development
- **Conduct “ecosystem discovery” interviews**
- Identify paths to sustainability
- Establish high-level development milestones and performance metrics

Jack O’Donnell
UCSC Physics GSR
PypeIt Contributor



Tim Pickering
UA Research Prof.
Astropy Developer





Community Interviews

Astronomy DRPs are in a transition period

- Observers feeling the loss of legacy software
- PypeIt meets many of their needs, but not all ... yet

Astronomy continues to trend toward more complex instruments and higher pressure to publish quickly

- Robust, well-supported DRPs are more important than ever
- This is influencing observatory operations and planning

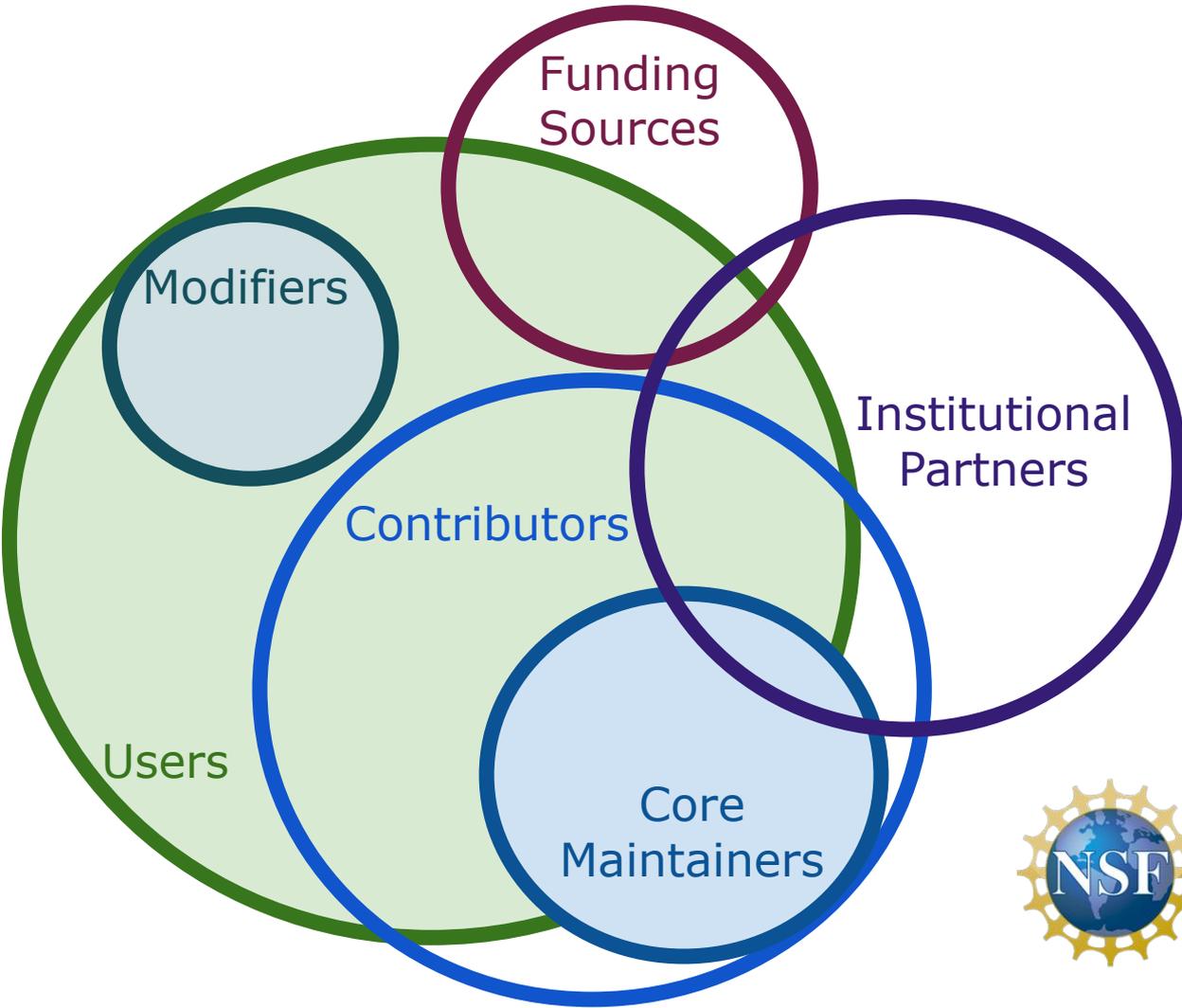
Responsive user support is critical

Significant opportunity for PypeIt to benefit

- Educators
- Amateur Astronomers

PypeIt is more broadly used than we thought

Identified specific room for growth in UI/UX



Ecosystem Map



CORPS
NSF Innovation Corps

The logo for TIP (Technology, Innovation and Partnerships) features the letters 'TIP' in a bold, blue, sans-serif font. The background of the slide is a blue-toned digital landscape with a globe, data streams, and a faint DNA helix structure.

Technology,
Innovation and
Partnerships



NSF's Pathways to Enable
Open-Source Ecosystems



Closing Remarks

- PypeIt was primed to make the transition from open-source product to open-source ecosystem
- POSE provided us a unique opportunity to do so
- I-Corps training has helped us build our development model
- Community discourse is incredibly important
- PypeIt critically depends on broadly used open-source software infrastructure

Thank you!

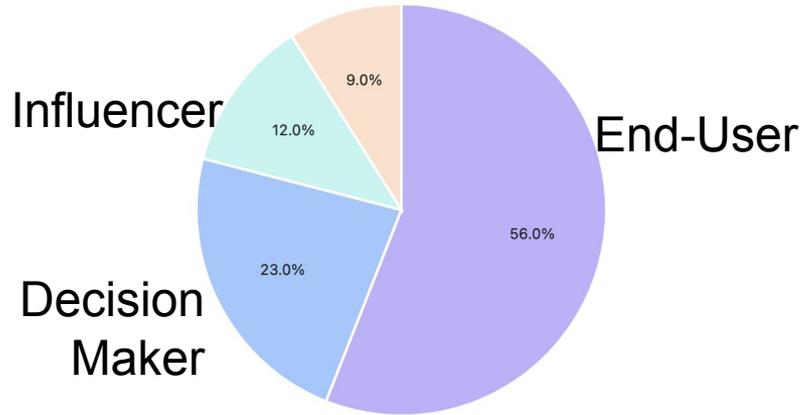
Backup Slides



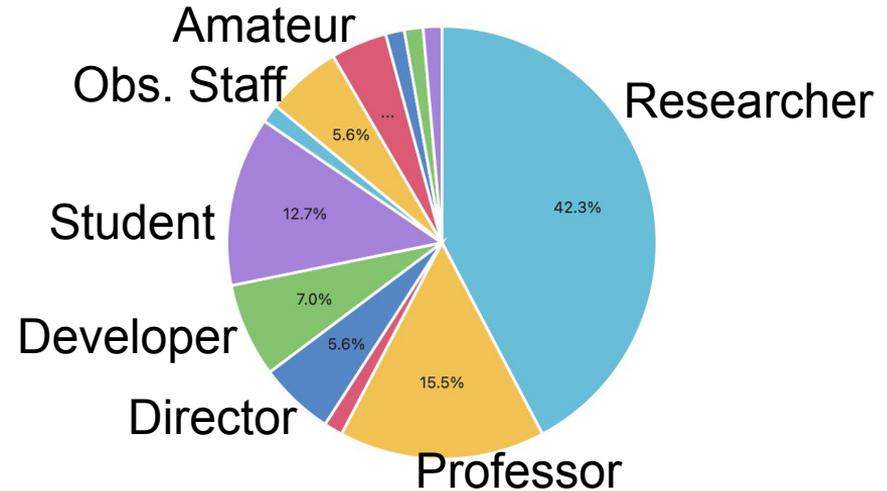
Approach

- Broad invitations posted to Slack, e-mail lists
- Targeted requests to key decision makers (senior faculty, observatory staff, facility directors, program managers)

Interviewee Breakdown: Type



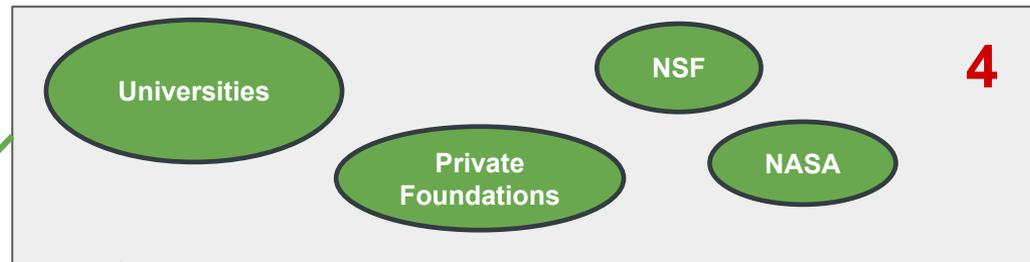
Interviewee Breakdown: Title



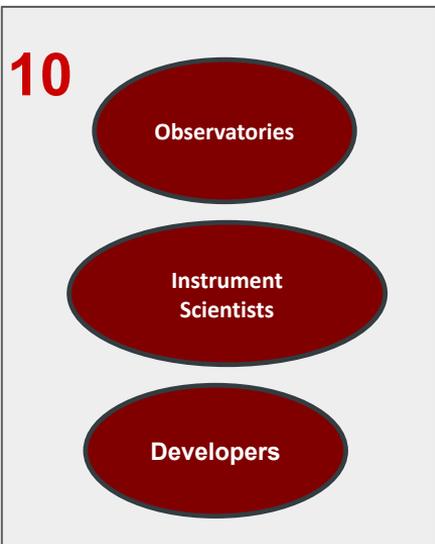
Ecosystem Map



Institutional Partners

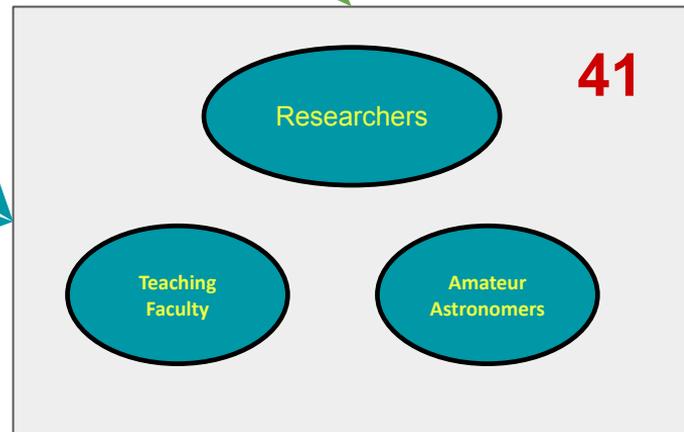
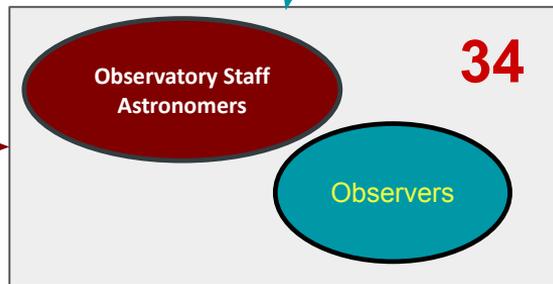


Funding Sources



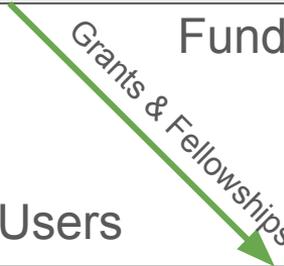
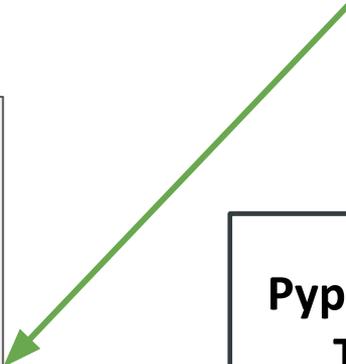
Users

Contributors



Grants & Fellowships

Pypelt-Slack



Key Partners
<ul style="list-style-type: none"> Observatory Scientists
<ul style="list-style-type: none"> Instrument builders
<ul style="list-style-type: none"> Observatory Directors

Key Activities
<ul style="list-style-type: none"> Science-driven development
<ul style="list-style-type: none"> CI and Verification Testing
<ul style="list-style-type: none"> Adoption and adaptation of state-of-the-art algorithms
<ul style="list-style-type: none"> User support
<ul style="list-style-type: none"> Community referrals

Value Propositions
<ul style="list-style-type: none"> A modern replacement for much of IRAF's functionality
<ul style="list-style-type: none"> Responsive and reliable support
<ul style="list-style-type: none"> Eases the path to science analysis
<ul style="list-style-type: none"> Quickly supports science with new instruments
<ul style="list-style-type: none"> Resilient to loss of institutional knowledge via staff turnover

Customer Relationships
<ul style="list-style-type: none"> Slack
<ul style="list-style-type: none"> User Workshops (Virtual & In-person)
<ul style="list-style-type: none"> GitHub Issues
<ul style="list-style-type: none"> Software Documentation
<ul style="list-style-type: none"> Publications
<ul style="list-style-type: none"> Observatory Newsletters

Customer Segments
<ul style="list-style-type: none"> Observatory Administrators
<ul style="list-style-type: none"> Researchers
<ul style="list-style-type: none"> Instrument Scientists
<ul style="list-style-type: none"> Teaching Faculty
<ul style="list-style-type: none"> Amateur Astronomers

Key Resources
<ul style="list-style-type: none"> Astronomy instrumentation
<ul style="list-style-type: none"> Scientific software developers
<ul style="list-style-type: none"> Python-based cyber infrastructure
<ul style="list-style-type: none"> Observatory software developers

Channels
<ul style="list-style-type: none"> Python Package Index (PyPI)
<ul style="list-style-type: none"> Anaconda (conda)
<ul style="list-style-type: none"> GitHub
<ul style="list-style-type: none"> Docker Containers

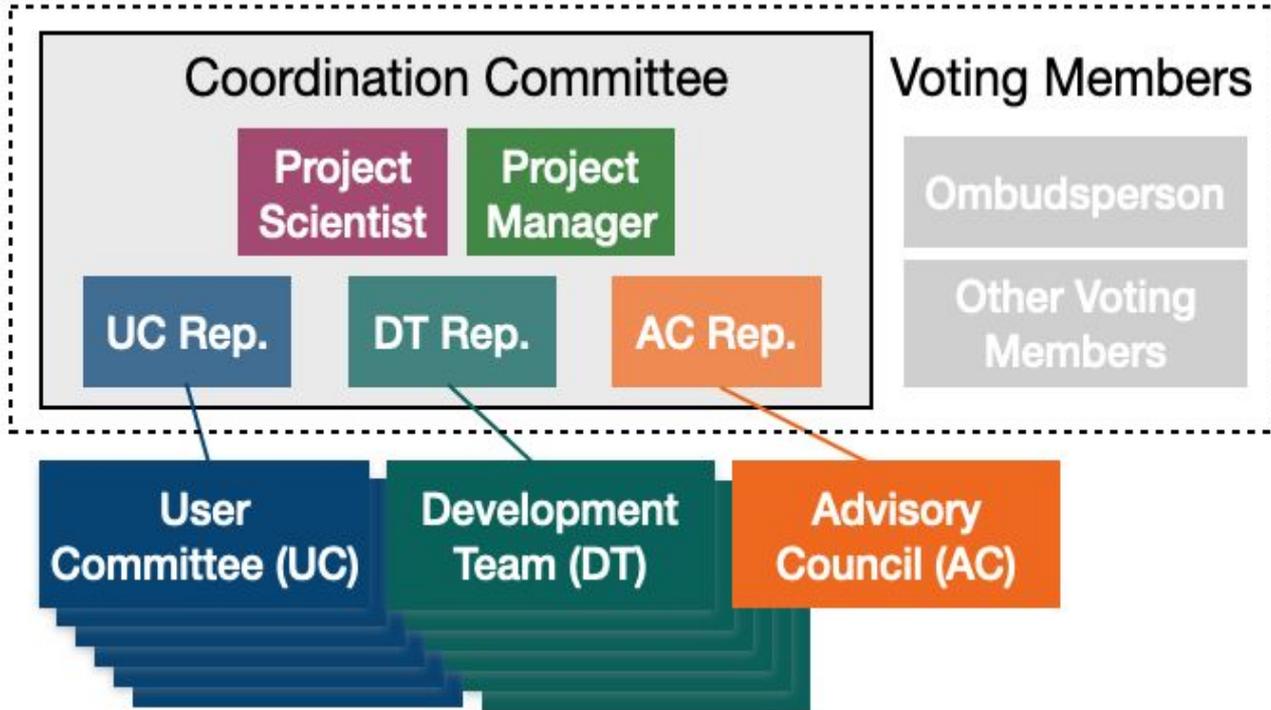
Revenue Streams
<ul style="list-style-type: none"> National funding agencies
<ul style="list-style-type: none"> Private Funding Agencies
<ul style="list-style-type: none"> Observatory Operations

Cost Structure	
<ul style="list-style-type: none"> Software personnel 	<ul style="list-style-type: none"> Management personnel
<ul style="list-style-type: none"> Observatory personnel 	<ul style="list-style-type: none"> Support services (e.g., Slack)
	<ul style="list-style-type: none"> Publications



Team 3665

Our latest model



Interviewee

Recommendations:

- Start lightweight
- Add procedures as needed
- Provide clear description of decision making procedure
- Beware of competing priorities
- Be ready to pivot

Inspired by current Astropy model



Funding Sources:

- National Agencies: NSF, NASA, DOE
- Universities
- Private Foundations (e.g., Simons)

Costs:

- Developers
 - Observatory Staff
 - Scientists
- Management
- Support services (Slack)



Development Milestones

Team 3665

