Introducing EXCALIBUR

Motivated by Population-Level Questions
Enabled by Uniform Analysis Methods

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EXCALIBUR: a tool for comparative planetology
EXoplanet CALIbration and Bayesian Unified Retrieval

- Fully algorithmic uniform processing
  - Operates on an input catalog
  - Data extraction/calibration through atmospheric retrieval functions

- Maintains the chain of inference
  - persistent data products with unique ID tied to specific Github change set
  - Data product quality assessment at key steps

- High agility architecture
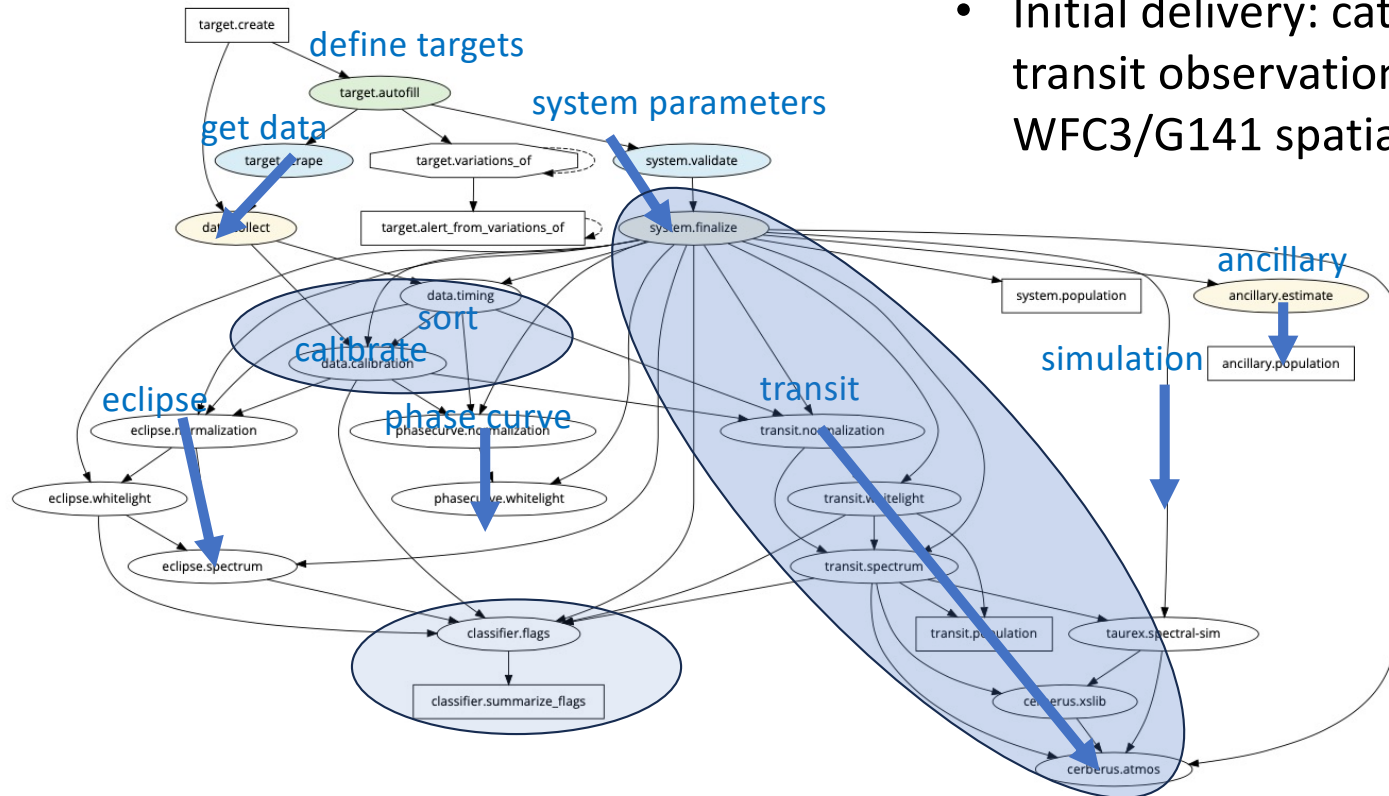 - Run-time directed graph determines processing
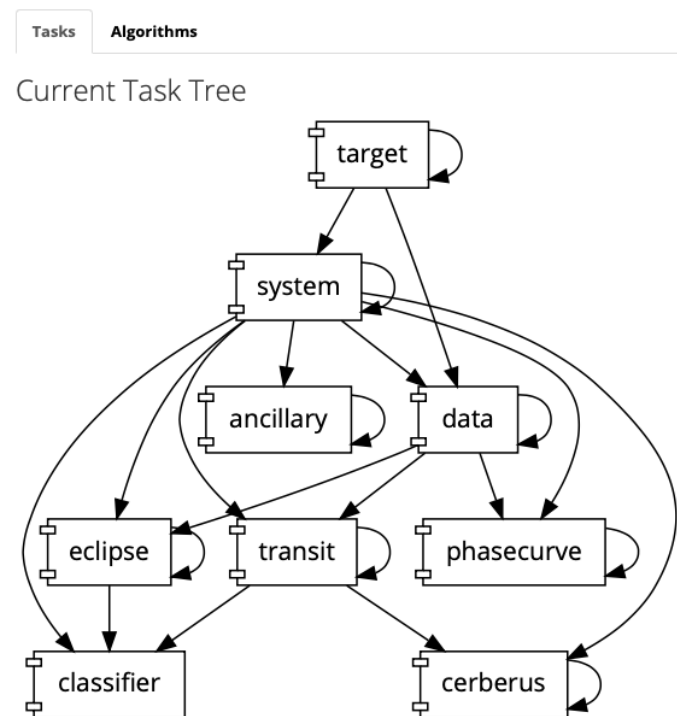
Dependency Trees

Tasks Algorithms

Current Task Tree

Dependency Trees

Current Algorithm Tree

- Major functional steps shown in blue
- Relevant graph segment indicated with blue arrow

- Initial delivery: catalog of transit observations using WFC3/G141 spatial scan mode
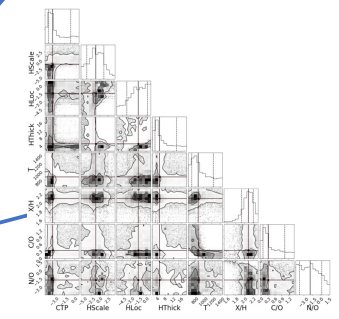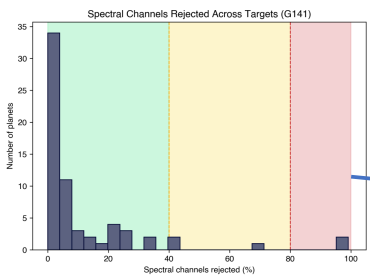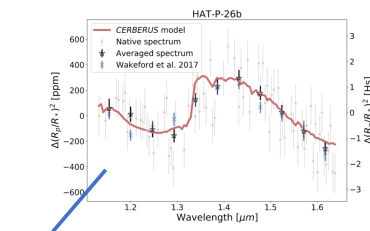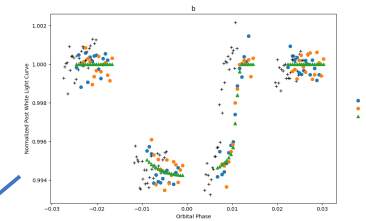
Dependency Trees

Example Data Products
- Time ordered data Current Algorithm Tree
- Target observations
- Stellar spectrum
- Broadband light curve
- Transit spectrum
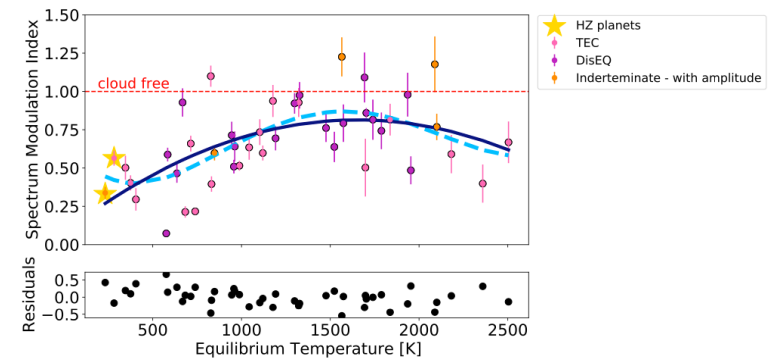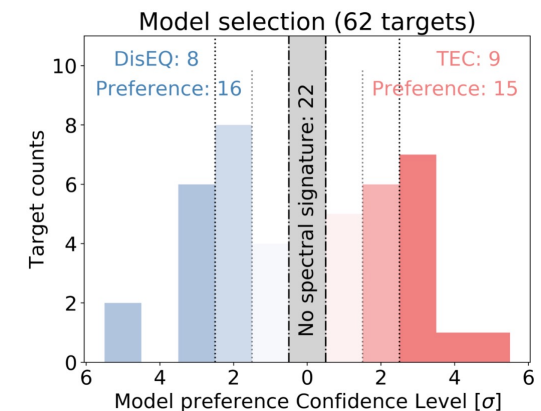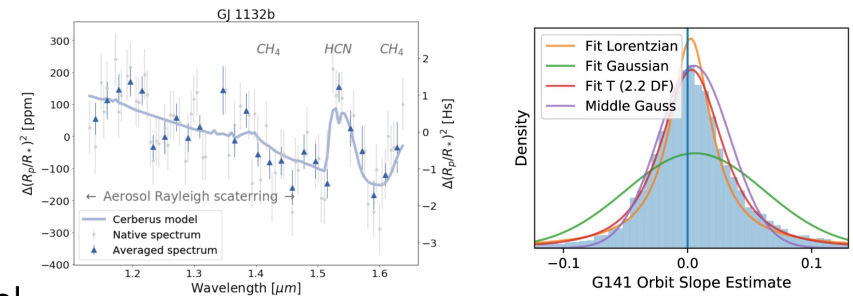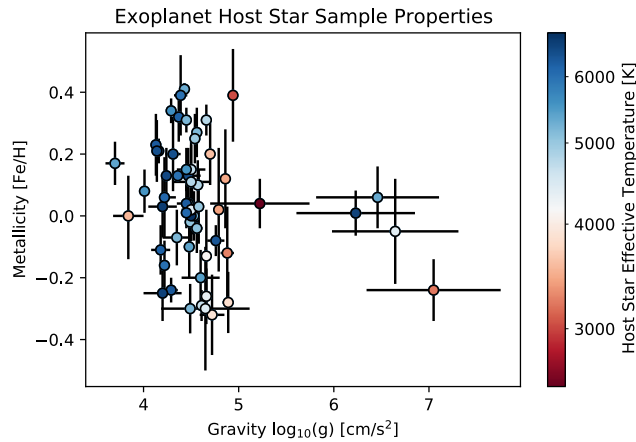- Atmospheric retrieval
- Data product quality assessment
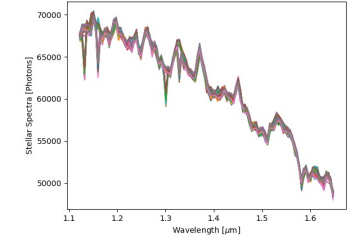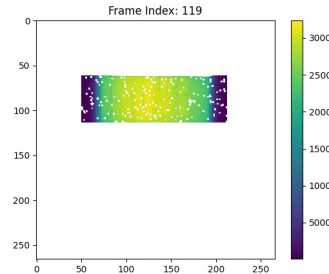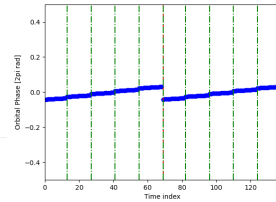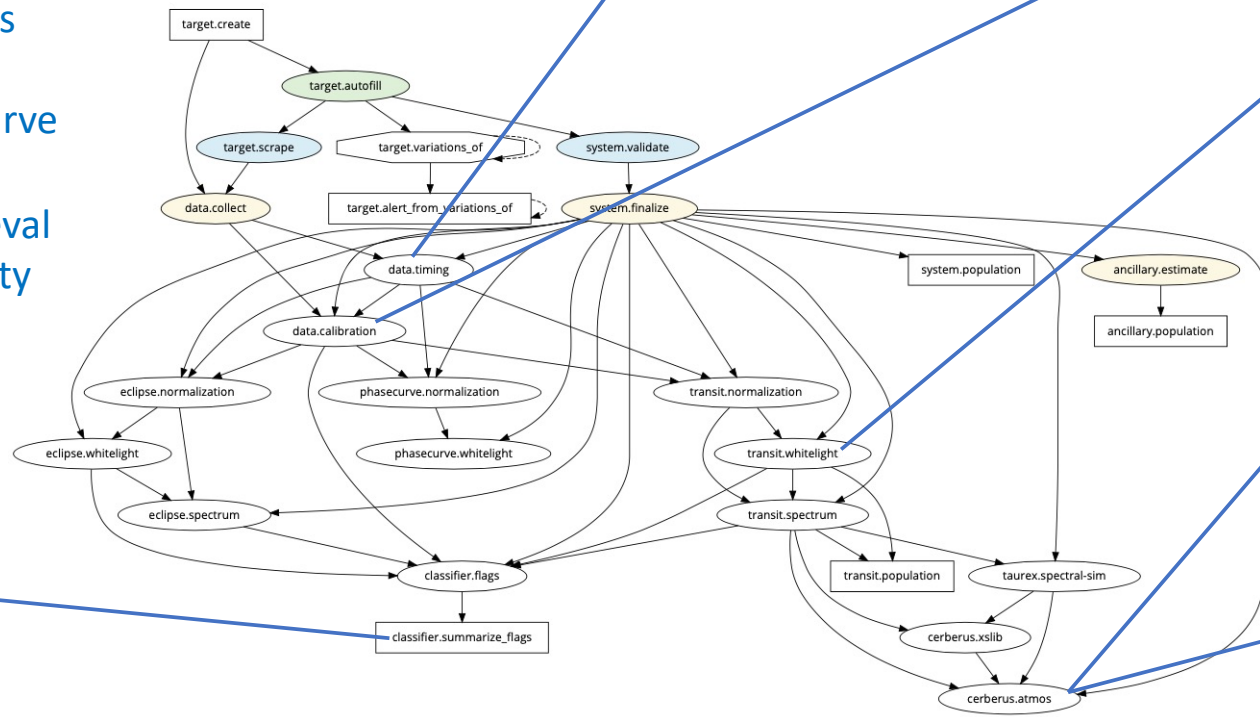
EXCALIBUR papers to date

EXCALIBUR methods

- **Detection of an Atmosphere on a Rocky Exoplanet,** Swain et al. 2021
https://ui.adsabs.harvard.edu/abs/2021AJ....161..213S/abstract

- **Disequilibrium Chemistry in Exoplanet Atmospheres Observed with the Hubble Space Telescope,** Roudier et al. 2021
https://ui.adsabs.harvard.edu/abs/2021AJ....162...37R/abstract

- Detection of Aerosols at Microbar Pressures in an Exoplanet Atmosphere, Estrela et al. 2021
https://ui.adsabs.harvard.edu/abs/2021AJ....162...91E/abstract

- **Characterization of an Instrument Model for Exoplanet Transit Spectrum Estimation through Wide-scale Analysis on HST Data,** Huber-Feely et al. 2022
https://ui.adsabs.harvard.edu/abs/2022AJ....163...22H/abstract

- A Temperature Trend for Clouds and Hazes in Exoplanet Atmospheres, Estrela et al. 2022
https://ui.adsabs.harvard.edu/abs/2022ApJ...941L...5E/abstract

Current Release: 62 Planet Catalog observed with WFC3 G141

Exoplanet Host Star Sample Properties

Catalog covers a broad range of host stars and planets
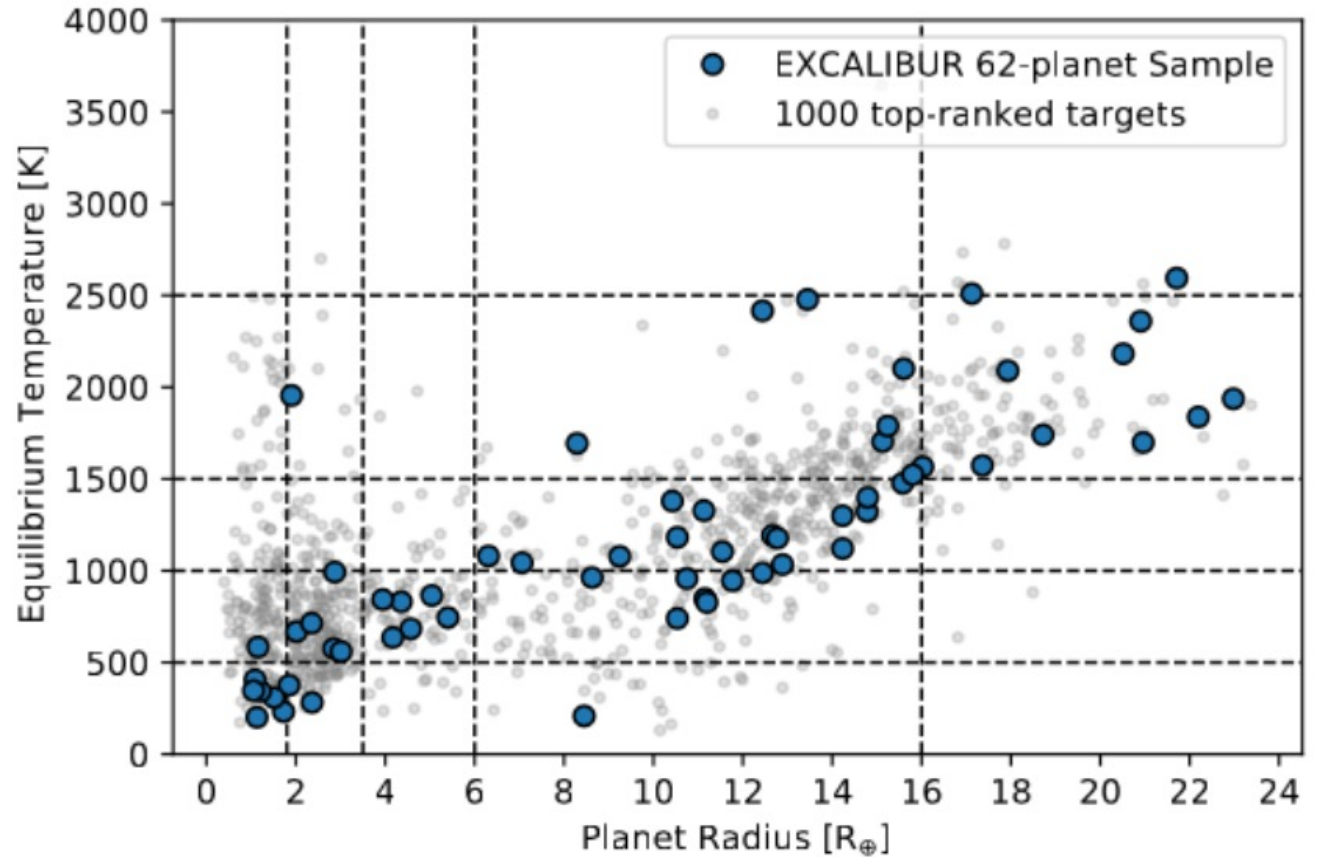
Part 2

Working with the EXCALIBUR Team

Working with the EXCALIBUR Team

- Direct Q&A – best for "one and done" type questions
  - Send email to excaliburhelp@ipac.caltech.edu
  - Weekly WebEx hosted on Tuesdays 10:30-11:30 https://jpl.webex.com/jpl/j.php?MTID=mfc76d303a4fbfa370ea3f27840e8fda7
  - A good way to expresses "I want XYZ"
- Collaborator – best for working together towards and objective where multiple questions come up as the project develops
  - Typically more involved projects requiring a period of sustained interaction
  - Invited to participate in weekly EXCALIBUR team meeting
  - Email mark.r.swain@jpl.nasa.gov or raissa.de.lourdes.freitas.estrela@jpl.nasa.gov
- Contributor
  - Develops/implements functionality in EXCALIBUR
  - Plan on the JPL remote access account taking some time to set up

EXCALIBUR catalog is a living document

- Ongoing development in a team environment

- Weekly meetings

- Coded in Python 3

- Future updates to Portal will include more targets, data products, and modes
  - Ancillary state vector example

- Current development includes WFC3 G102, STIS G750 and G430, and Spitzer IRAC 1,2

Search Database

State Vector*	Target Name*
Search	HAT-P-26

HAT-P-26	
State Vector	Run ID (display | download)
data.calibration.HST-WFC3-IR-G141-SCAN	165
data.collect.frames	137
data.timing.HST-WFC3-IR-G141-SCAN	164
system.finalize.parameters	155
transit.normalization.HST-WFC3-IR-G141-SCAN	185
transit.spectrum.HST-WFC3-IR-G141-SCAN	187
transit.whitelight.HST-WFC3-IR-G141-SCAN	186

Key Takeaways

The EXCALIBUR team is very open and supportive of dialog, collaboration, and working together with the broader community.

We hope you find the data products useful.

We solicit your feedback for future releases.