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
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
Example Data Products
- Time ordered data
- 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](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](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](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](https://ui.adsabs.harvard.edu/abs/2022AJ....163...22H/abstract)

- A Temperature Trend for Clouds and Hazes in Exoplanet Atmospheres, Estrela et al. 2022
Current Release: 62 Planet Catalog observed with WFC3 G141

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
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.