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OPAL
*Simulating the **O**rigins of **P**lanets for **A**rie**L***

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+ Ariel-IT Team

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OPAL's Scientific Rationale

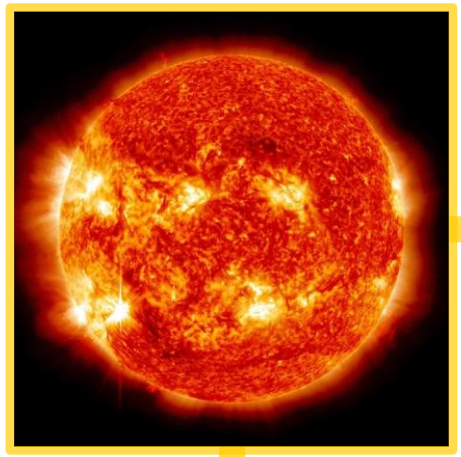
ARIEL: M4 mission of the European Space Agency, tasked with observing and spectrally characterize hundreds of exoplanets with accuracy comparable to JWST.

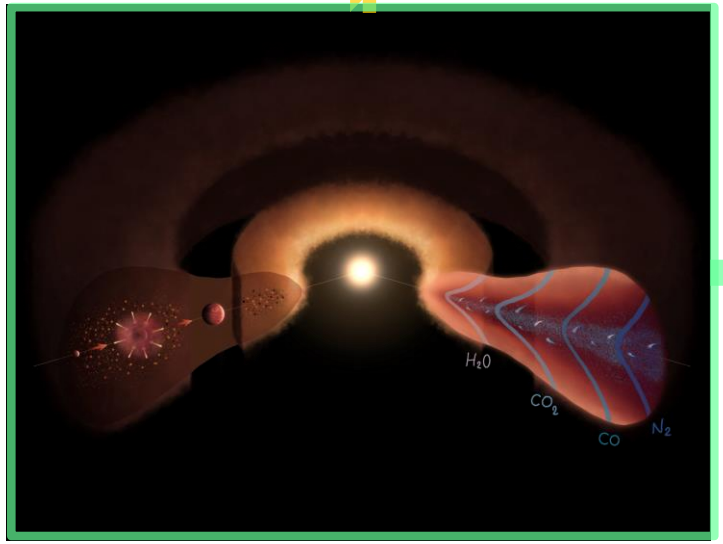
ARIEL 2025: Dry Run of Ariel promoted by ESA and the Ariel Consortium with the goal of exploring the scientific and technological readiness of the mission assuming the launch is in 2025.

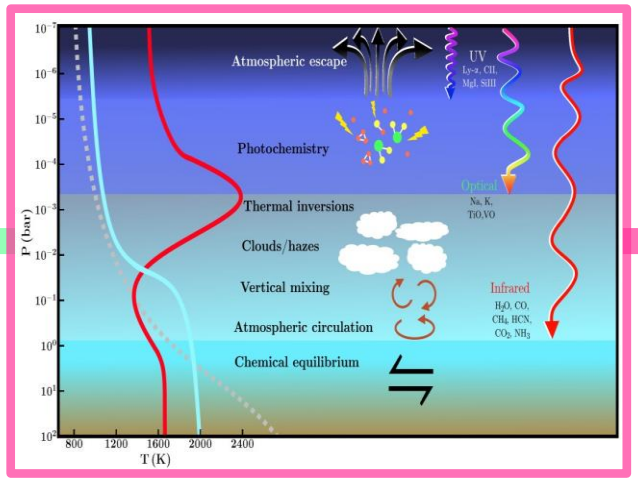
OBSTACLES:

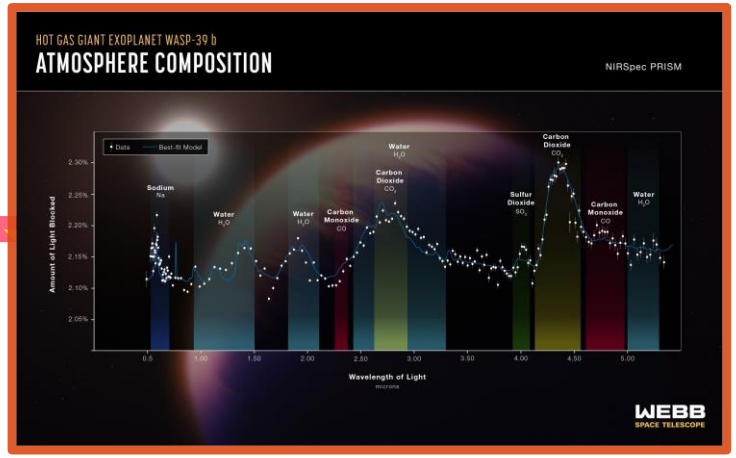
- Existing spectral data are limited and mainly provide detections of molecules, we lack reliable constraints on the atmospheric abundances.
- Many studies create synthetic atmospheres with Monte Carlo approaches but the resulting atmospheres are not realistic and provide misleading indications.

Ariel 2025: Synthetic Spectra Approach

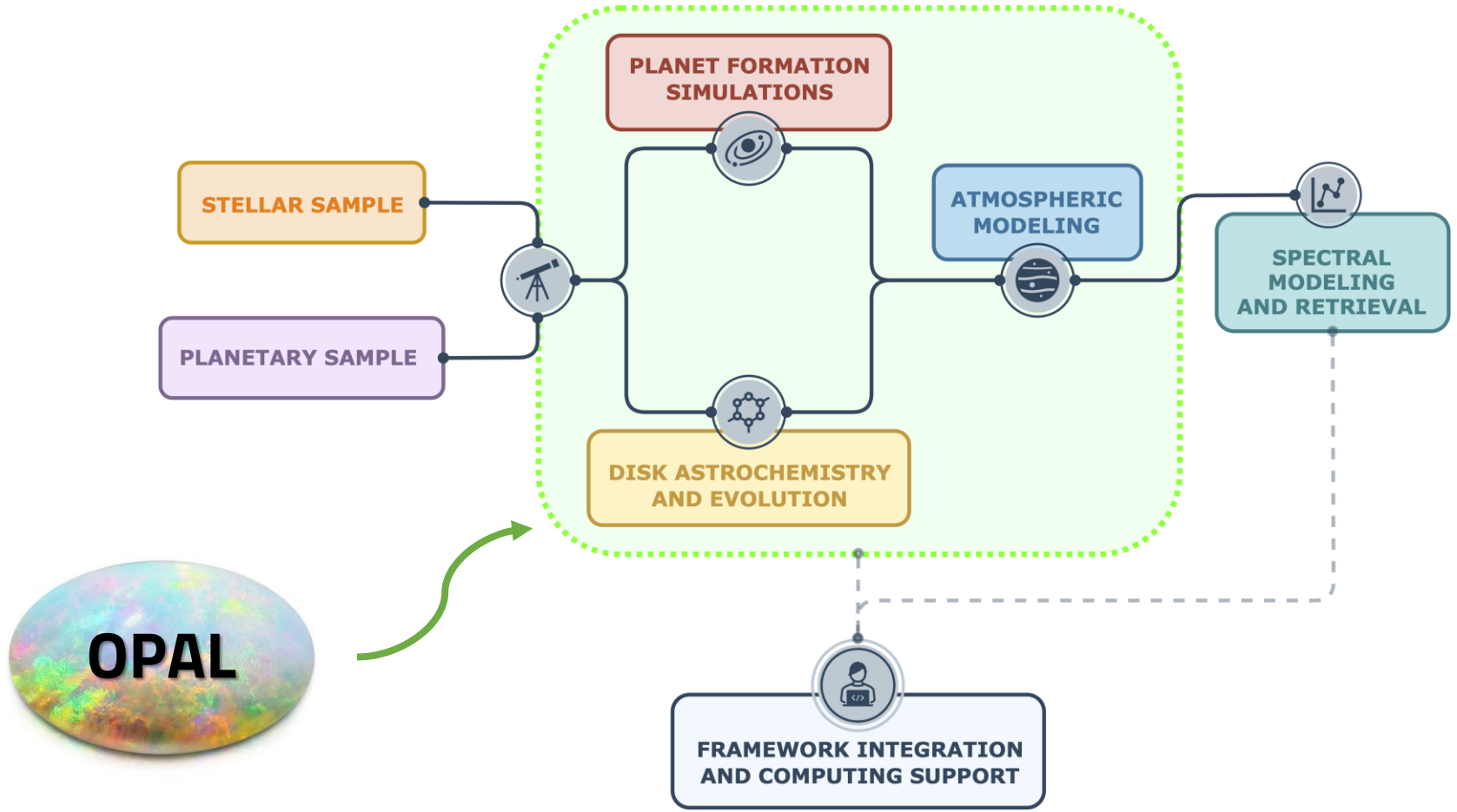








Ariel-IT 2025 and OPAL



OPAL: Modelling Complexity

JADE (Pacetti et al. in prep.) is the multi-language (Python + Fortran) data-parallel code to jointly simulate the ***physical and chemical evolution of protoplanetary disks*** of the *Arxes* suite.

Mercury-Arχes (Turrini+2019,2021) is the parallel n-body code of the *Arxes* suite incorporating physical libraries to simulate ***planet formation in protoplanetary disks*** (see Monday presentation).

HEPHAESTUS (Turrini+2021; Pacetti+2022) is the Python compositional post-processing tool of the *Arxes* suite that resolves planetary compositions across 20+ elements.

FastChem and **Vulcan** are atmospheric modelling codes from the University of Bern's *ExoClimes* suite that convert Hephaestus' elemental compositions into atmospheric molecular compositions (e.g. Fonte+2023).

OPAL as a Key Science Project

- The **seed of OPAL** is part of the Ariel-IT 2025's activities: its scope and planetary sample are limited as it relies on existing infrastructure (***Genesis cluster*** at INAF-IAPS, possible support from ***INAF Pleiadi TBD***).

- OPAL is the **next frontier in computational planetary science**: combining multi-domain and multi-physics *ab initio* simulations to fully understand the information encoded into planetary atmospheres.

- **Our community is currently the most advanced** in this integration of expertise and code in a unified scientific and computational ecosystem.

- OPAL's goals, milestones and KPI needs to be designed to adapt to the timeline with which the **CN's computational resourses** will become available.