



ASTER - Agentic Science Toolkit for Exoplanet Research

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The rapid expansion of exoplanet atmospheric observations and the proliferation of a wide range of specialized modeling tools has created a need for flexible, accessible, and user-friendly workflows. Transmission spectroscopy, in particular, has become a key technique for probing atmospheric composition of transiting exoplanets. The analyses of these data require the combination of archival queries, literature search, the use of radiative transfer models, and Bayesian retrieval frameworks, each demanding specialized expertise.

Modern large language models (LLMs) enable the coordinated execution of complex, multi-step tasks by AI agents with tool integration, structured prompts, and iterative reasoning.

In this study we present ASTER, an Agentic Science Toolkit for Exoplanet Research. ASTER is an orchestration framework that brings LLM capability to the exoplanetary community by enabling LLM-driven interaction with integrated domain-specific tools, workflow planning and management, and support for common data analysis tasks.

Currently ASTER incorporates tools for downloading planetary parameters and observational datasets from the NASA Exoplanet Archive, as well as the generation of transit spectra from the TauREx radiative transfer model, and the completion of Bayesian retrieval of planetary parameters within the TauREx framework.

Beyond tool integration, the agent assists users by proposing alternative modeling approaches, reporting potential issues and suggesting solutions, as well as higher-level interpretations. We demonstrate ASTER's workflow through a complete case study of WASP-39b, performing multiple retrievals using observational data from different sources available on the archive.

The agent efficiently transitions between datasets, generates appropriate forward model spectra and performs retrievals that recover atmospheric parameters reported in the literature. ASTER provides a unified platform for the characterization of exoplanet atmospheres. Ongoing development and community contributions will continue expanding ASTER's capabilities toward broader applications in exoplanet research.