

Golden-Retriever: Unveiling planetary atmospheres using a unified model framework and advanced sampling techniques

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Golden-Retriever is part of an open-source platform that combines multiple observational datasets to retrieve physical information about the atmospheres of planets. The rapid growth of observational data available from ground- and space-based telescopes requires combining the data available in a unified framework to maximise the physical constraints in our data interpretation.

To combine different types of observational data, including high-resolution spectroscopy, we need to build atmospheric models that are fast enough to interact with nested sampling algorithms. Recent advances in GPU computing allow us to achieve this computational challenge without the need for a large computer cluster. The new software we have developed combines well-established models to calculate gas absorption cross-sections (HELIOS-K), equilibrium chemistry (FastChem), and nested sampling algorithms (UltraNest) with new atmospheric models accelerated by GPU computations. Our atmospheric codes have different levels of complexity, from simple 1D atmospheric codes to fully 3D Planetary Climate Models, and are part of our OASIS lab platform (software-oasis.com). We are currently implementing all the tools necessary to allow easy code use, which will soon be made open-source.

We will present the first test results from the Golden-Retriever software. The first tests include retrieval simulations on high-resolution spectroscopy data in emission and transmission of hot Jupiter planets. Our code can robustly constrain physical quantities such as atmospheric chemical abundances, temperature, clouds, planet bulk densities, and orbital parameters.

Golden-Retriever is intended to explore any planetary atmosphere, and our goal is to make it a standard software in the exoplanet community.