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Leveraging Machine Learning for Retrieving Exoplanet Atmosphere Parameters from the upcoming ARIEL Space Telescope Spectra

The study of exoplanet atmospheres plays a vital role in understanding their composition. However, extracting accurate atmospheric parameters from transmission spectra poses significant challenges. Bayesian sampling algorithms, although effective, can be time-consuming and laborious. As an alternative, machine learning techniques offer promising avenues to expedite and enhance this process.

In this poster, I will present a new model we developed in the AstroAI group at the Center for Astrophysics which retrieves the atmospheric parameters of exoplanets for observations with the upcoming ARIEL space telescope. Our model is based on Normalising Flows, a machine-learning technique that allows us to generate probability distributions of the parameters for each observed spectrum, and thus gain valuable insights into the plausible compositions for each specific spectrum. This work won the 2023 ARIEL data challenge organized by the European Space Agency (ESA). To tackle this task, we put together an interdisciplinary team of experts in Machine Learning, Astronomy, Molecular Spectroscopy, and Exoplanetary Research.

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Through this interdisciplinary approach that merges astrophysics and machine learning, we aim to advance our understanding of exoplanet atmospheres and the use of machine learning tools in Simulated Based Inference in astrophysics. Our research showcases the capabilities of AI to revolutionize the analysis of exoplanetary data, preparing the ground for more efficient and accurate characterization of exoplanets in the future.

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