Contribution ID: **6** Type: **not specified**

Atmospheric Retrievals with Quantum Extreme Learning Machines

Wednesday 21 May 2025 12:35 (20 minutes)

The study of exoplanetary atmospheres traditionally relies on forward models to analytically compute the spectrum of an exoplanet by fine-tuning numerous chemical and physical parameters. However, the high-dimensionality of parameter space often results in a significant computational overhead. In this work, we introduce a novel approach to atmospheric retrieval leveraging on quantum extreme learning machines (QELMs). QELMs are quantum machine learning techniques that employ quantum systems as a black box for processing input data. In this work, we propose a framework for extracting exoplanetary atmospheric features using QELMs, employing an intrinsically fault-tolerant strategy suitable for near-term quantum devices, and we demonstrate such fault tolerance with a direct implementation on IBM Fez. The QELM architecture we present shows the potential of quantum computing in the analysis of astrophysical datasets and may, in the near-term future, unlock new computational tools to implement fast, efficient, and more accurate models in the study of exoplanetary atmospheres.

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Session Classification: Team Activity Reports