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Fast and Automated Characterization of Core-Collapse Supernovae with Machine Learning and HPC-Driven Modeling

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The growing number of observed supernovae in current and upcoming surveys demands scalable and automated methods for their physical characterization. In this framework, we developed an AI-based pipeline to reconstruct bolometric light curves from multi-band photometric observations and infer physical parameters such as ejecta mass, explosion energy, and Ni-56 yield. Real data observation from surveys like ZTF, ATLAS have been analyzed through custom tools for data preprocessing, filtering, and quality assessment. Synthetic datasets—generated from semi-analytical and numerical codes run on the Galileo100 HPC cluster—have been used to train and validate the machine learning models. This approach enables rapid, consistent analysis across H-rich SNe and observational conditions. We also explored early applications of this framework to recent supernovae of interest, demonstrating its potential for real-time transient analysis and cross-matching with neutrino and gamma-ray observations.

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