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A machine learning based eigenvalue solver for core-collapse supernovae gravitational wave asteroseismology

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One of the most promising and challenging future gravitational wave (GW) sources are core-collapse supernovae. The oscillation modes of the proto-neutron star (PNS) and the stalled accretion shock will be excited triggering the GW emission. Due to the stochastic nature of these signals, it is not possible to use template matching techniques. An alternative way to analyze the signal is to perform asteroseismology in order to infer properties of the PNS. The oscillations can be described by a system of partial differential equations (PDEs), which can be solved as an eigenvalue problem. In that frame, the eigenvalues are the characteristic frequencies of the oscillation modes. We introduce a machine learning technique, the Physics Informed Neural Networks (PINNs), that simplifies the implementation of differential equations and complex boundary conditions making them suitable PDE solvers. Here we demonstrate an eigenvalue solver consisting of PINNs, which is used for the first time in the context of asteroseismology.

Presenter(s) : TSENEKLIDOU, Dimitra

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