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Prospects on the Detection of Neutrino Driven Core-Collapse Supernovae Gravitational Waves

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The detection of gravitational waves from core-collapse supernovae presents a unique opportunity to explore the physics of these cataclysmic events. Despite being generated by one of the most energetic phenomena in the universe, the waveform emitted by core-collapse supernovae remains elusive. Traditional detection methods like the matched filter technique are ineffective due to this waveform uncertainty. In this study, we propose a new approach integrating machine learning to tackle this challenge. Our study begins with generating phenomenological gravitational waveforms, providing an efficient alternative to computationally demanding direct simulations. We then train a convolutional neural network injecting these waveforms into real detector data, enabling the effective detection of gravitational wave signals in real data. Through comprehensive evaluation using different datasets, our approach demonstrates promising performance compared to conventional methods. Looking ahead, our method holds potential for application in future gravitational wave detectors such as the Einstein Telescope and Cosmic Explorer, paving the way for enhanced detection and analysis capabilities in gravitational wave astronomy. Furthermore, our approach could be extended to explore gravitational wave signals from rotating progenitor supernovae, enriching our understanding of these intriguing astrophysical phenomena.

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