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To whom it may concern,

It is a pleasure for me to review the dissertation submitted by Filip Morawski. The document is structured as follows: an introductory chapter, 3 chapters consisting of 4 published papers, and a final outlook section.

The introductory chapter offers a rapid introduction to the themes discussed in the paper, in particular gravitational waves and machine learning. The text is always very clear, and it demonstrates the candidate's general theoretical knowledge in both disciplines. The reference to the literature adequate to its scope.

The main contributions of the candidate are discussed in the 3 following chapters. The common thread among them is the potential of machine learning for detecting gravitational waves, with a particular emphasis on the detection signals as anomalies in the data. In terms of the fundamental questions addressed, the focus is on the detection of signals emitted during supernova explosions and by non-axisymmetric neutron stars, and on the reconstruction of the fundamental properties of neutron stars.

The paper "Anomaly detection in gravitational waves data using convolutional autoencoders" included in Chapter 2 explores the application of convolutional autoencoders to gravitational wave data. The method is trained on both simulated and real detector data, and the anomaly searches in time-series dare are convincingly validated on real data containing confirmed gravitational wave detections.

In Papers II and III, contained in chapter 3, the candidate explore the application of convolutional neural networks to the search for core-collapse supernova and deformed neutron stars.

This pair of paper contains several interesting results: spectrograms for instance are found to be significantly better representations than time series, as the evolution of signal frequencies helps distinguish gravitational waves from noise; the method appears to offer a robust classification of the signals, and to be able in particular to discriminate between astrophysical signals and detector artifacts.

Paper IV, finally, demonstrates that neural networks with an auto-encoder architecture are able to learn and generalise the mapping between the measured parameters and the fundamental equation-of-state describing the state of the matter inside neutron stars.

Morawski's dissertation is interesting and timely. In fact, it could not have come at a better time, as it explores the interface between gravitational waves and machine learning, at a time when both disciplines are quite literally booming. The results contained in the scientific papers are clearly original, and based on the declaration of the co-authors, largely led by the candidate, which clearly demonstrates his ability to independently conduct scientific work.

In view of all this, I consider the doctoral thesis of Filip Morawski to be a valuable contribution and to meet the criteria prescribed by the law for a doctoral dissertation. Therefore, I request that this dissertation be admitted to a public defense.

Sincerely,

Gianfranco Bertone