

Dr. Christoph Weniger
University of Amsterdam
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PhD position in AI-driven inference for gravitational-wave cosmology with LISA

Dear Dr. Christoph Weniger,

I am writing to apply for the PhD position on AI-driven inference for gravitational-wave cosmology with LISA. I am currently completing my Master's in Physics and Astronomy at the University of Amsterdam, where I have focused on experimental physics, data analysis, and machine learning, including your course on Machine Learning for Physics. The challenge of extracting cosmological information from LISA's complex data streams, where thousands of overlapping signals must be disentangled, is exactly the kind of problem that draws me to this field. My background in signal processing, computational physics, and machine learning has prepared me to tackle these challenges, and I am eager to contribute to developing the inference methods that will unlock LISA's scientific potential.

I have a strong background in computational methods, starting from my Bachelor's work. Growing up, I had a keen interest in programming and problem-solving, which led me to pursue a degree in physics. During my studies, I have developed skills in Fortran, C/C++, Python, TensorFlow, and PyTorch. In my Bachelor's work, I implemented particle extrapolation algorithms in C++ to improve efficiency using CERN's GEANE package. Although it was my first time working on a real programming project, I was successful in finishing a project started by other students before me, gaining a 4x boost in speed compared to the previous implementation. Although I have not used my skills in machine learning extensively in research projects yet, I have completed your course at the University of Amsterdam on Machine Learning for Physics and Astronomy, which has provided me with a solid foundation in applying ML techniques to astrophysical data analysis. I am enthusiastic about the prospect of applying these skills to the analysis of gravitational-wave data from LISA, and I believe my results in your course demonstrate my capability to learn and apply new techniques effectively.

In my master's thesis project, I am currently working on a tabletop setup in order to measure photoluminescence lifetimes of different materials used in liquid noble gas dark matter detectors. The goal of this project is to better understand and mitigate sources of background in these detectors, which is crucial for improving their sensitivity to potential dark matter signals. This project has honed my experimental skills and deepened my understanding of detector physics, which I believe will be beneficial in the context of gravitational-wave detection and

analysis. During my time here, I have also had the opportunity to improve our lab's data analysis pipeline, implementing techniques such as noise reduction and matched filtering, which are directly relevant to gravitational-wave data analysis. I was introduced to these techniques in the gravitational waves course at the University of Amsterdam, which further sparked my interest in this field.

I am particularly excited about the opportunity to work on AI-driven inference methods for gravitational-wave cosmology with LISA. The prospect of contributing to the development of novel machine learning techniques to analyze complex datasets and extract meaningful cosmological information is incredibly appealing to me. Gravitational wave astronomy is a rapidly evolving field, and I am eager to be at the forefront of this research, leveraging new machine learning techniques to push the boundaries of our understanding of the universe. I grew up dreaming about the stars, and seeing how far we have come in understanding the cosmos through a completely novel phenomenology is truly inspiring. I am motivated by the opportunity to contribute to our understanding of the cosmos through this novel observational window. Gravitational waves represent a fundamentally new way to probe the universe, and I am eager to be part of pushing this field forward.

Thank you for considering my application. I would welcome the opportunity to discuss how my background could contribute to your research group's work on gravitational-wave cosmology.

Sincerely,

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