

Starlight beneath the waves: in search of TeV photon emission from Gamma-Ray Bursts with the ANTARES Neutrino Telescope

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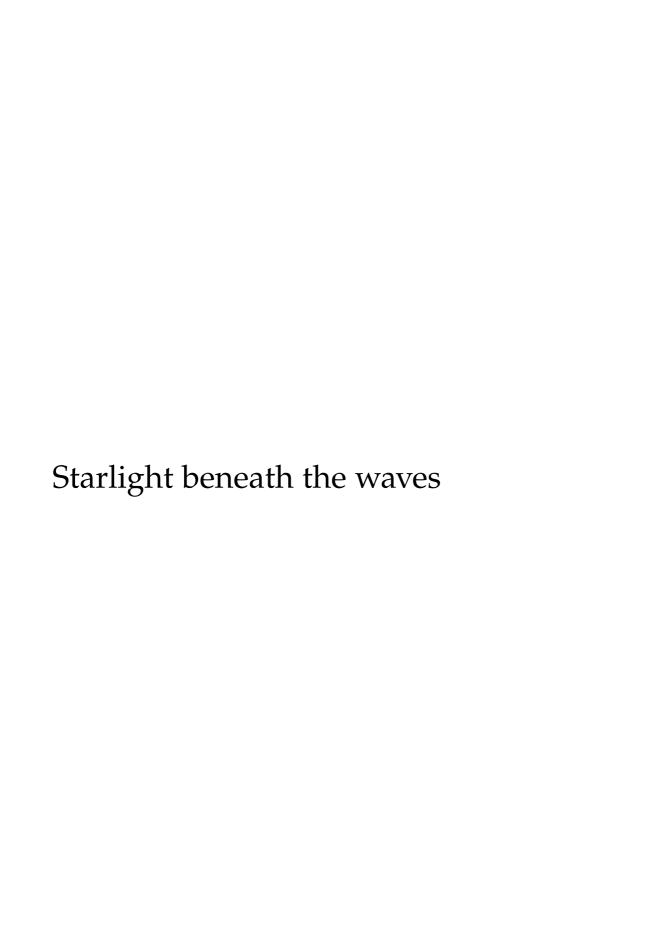
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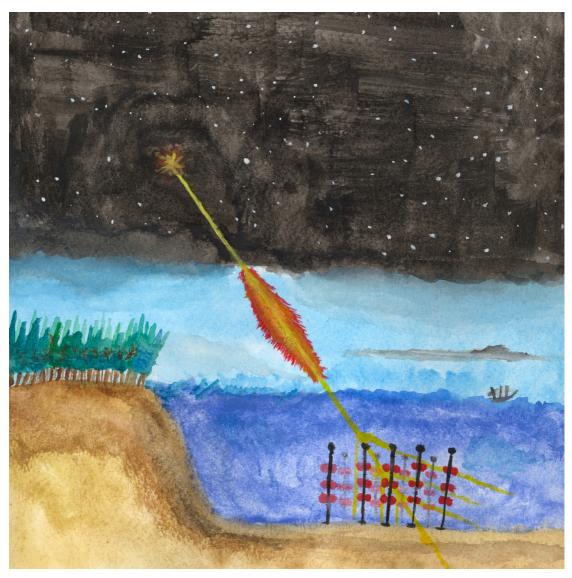
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Frontispiece: An illustration of the physical processes described in this dissertation. A Gamma-Ray Burst (GRB) emits high-energy γ -rays towards the Earth. Depending on the distance to the GRB and the energy of the γ -ray, some of them will get annihilated by the cosmic infrared background. Those that survive will initiate electromagnetic showers in the atmosphere, producing some amount of muons. The muons then penetrate the sea, losing their energy along the way. As the muons traverse the sea, electromagnetic shock-waves will be generated in the form of Čerenkov photons. These photons will then be detected as signals by the array of photomultiplier tubes that comprise ANTARES. Illustration by the author.

Starlight beneath the waves

In search of TeV photon emission from Gamma-Ray Bursts with the ANTARES Neutrino Telescope

Proefschrift

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Cover image: An artist's impression of a Gamma-Ray Burst (GRB), by A. Roquette (ESO) Cover design by Fitorio Leksono

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Dedicated to the next generation Putri Mahalia and Aria Widiadana Astraatmadja



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Preface

THIS booklet is a doctoral dissertation which came out as a result of four years of research conducted at the National Institute for Subatomic Physics (Nikhef) in Amsterdam, The Netherlands. Some of the text written in this dissertation is based on the following material:

- Astraatmadja T. L. 2011. On the detection of TeV γ-rays from GRB with km³ neutrino telescopes I. Muon event rate from single GRBs.
 MNRAS, 418: 1774–1786 (Sections 1.5, 2.2–2.3, 3.1–3.6, Chapter 4)
- Astraatmadja T. L., 2012a, On the detection of TeV γ-rays from GRB with km³ neutrino telescopes: ANTARES's responses to downgoing muons. Technical Report ANTARES-PHYS-2012-005 (Section 3.7, Chapters 7–10)
- Astraatmadja T. L., 2012b, On the detection of TeV γ -rays from GRB with km³ neutrino telescopes: Simulation and optimization of three selected GRBs. Technical Report ANTARES-PHYS-2012-006 (Chapter 11)

The offer to do this research project came from Maarten de Jong. I attended his class on astroparticle astrophysics in 2007, during my master studies at the Leiden Observatory. He was later appointed as a professor at Leiden University and offered me a PhD position. I was interested and quite enthusiastic, but was unsure to undertake a project in such an unfamiliar topic. During my visit to Nikhef for the job interview, the then leader of the AN-TARES group at Nikhef (to which I was later attached), Gerard van der Steenhoven, assured me that somebody with my background and capabilities could be a useful addition to the group. I was convinced. I would like to thank Gerard for his confidence and for telling me that there is a place for an astronomer like me in astroparticle physics.

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