ELIZABETH MARTHA GOULD McCARTHY

b.gould2@ncl.ac.uk / +44 7964499445 / bethgould.net
School of Mathematics, Statistics, and Physics – Newcastle University
Newcastle upon Tyne, UK

EDUCATION

PhD Physics (Theoretical) **2022 - Present**
Newcastle University
Thesis Topic: The Cosmic Web as a Laboratory for Fundamental Physics
Supervisor: Dr. Cora Uhlemann

MSc Astronomy (Part-Time) **2017 - 2021**
University of Sussex, Distinction, Average Grade **81%**
Thesis Topic: Constraining Early Universe Physics with Compensated Isocurvature Perturbations

MPhys Theoretical Physics **2011 - 2015**
University of Sussex, First Class Honours, Average Grade **72%**
Thesis Topic: Production of Sound Waves at First-Order Phase Transitions in the Early Universe

Physics & Astronomy Foundation Year **2010 - 2011**
University of Sussex, Average Grade **72%**

AWARDS

I was awarded the **William McCrea Prize for Outstanding Performance in Astronomy** for 2020, given to the student achieving the highest grade in the University of Sussex Cosmology and Astronomy MSc programmes.

RESEARCH PROJECTS

PhD Physics
The Cosmic Web as a Laboratory for Fundamental Physics
Supervised by Dr. Cora Uhlemann, I am currently researching the cosmic large-scale structure, and using theoretical techniques to extract information about fundamental physics from the late-time matter distribution. For the first project of my PhD, I am investigating the constraining power of the 1-point halo density probability distribution function (PDF), taking advantage of large deviations theory formalism to predict the matter PDF and combining this with a halo bias model. I am validating this with simulations, and performing a Fisher analysis to ascertain the complementarity of this approach with standard 2-point probes.

MSc Project , Grade: **81%**
Constraining Early Universe Physics with Compensated Isocurvature Perturbations
Completed under the supervision of Dr. Christian Byrnes. The aim was to understand what the new Planck satellite data, which puts the tightest ever observational constraints on isocurvature perturbations, means for the physics of the early Universe, in particular looking at multi-field models of inflation such as the curvaton model. The project explored a particularly unconstrained mode of isocurvature – compensated isocurvature (CIPs) – including reviewing and calculating the circumstances in the curvaton scenario that produce them and concluding that the largest CIP amplitudes may be detectable within the next 2-3 decades using data from next generation cosmic microwave background anisotropy and galaxy power spectrum data. This project built on my knowledge of cosmology, general relativity and quantum field theory in a mostly analytical setting.

MPhys Final Year Project, Dissertation Grade: **75%**
Production of Sound Waves at First-Order Phase Transitions in the Early Universe
In the final year of my undergraduate degree, I undertook a project under the supervision of Prof. Mark Hindmarsh in which I studied the consequences of a general 1st-order phase transition in the early universe. This involved putting to use my skills in quantum field theory and computing to develop a Python code to numerically solve the field equation for an effective potential, and calculating the velocity profile and velocity power spectrum of the surrounding fluid.

CONFERENCE TALKS

Constraining Cosmology with Halo PDFs **July 2023**
New Strategies For Extracting Cosmology From Future Galaxy Surveys ,
Sexten Centre for Astrophysics, Sexten, Italy

Cosmology and Statistics Beyong the (Gender) Binary **September 2023**
PiFORUM 2023, University of Birmingham

INCLUSIVITY AND OUTREACH WORK

Trans and Non-Binary Physicists **2020 - Present**

Administrator

I co-run the Trans and Non-Binary Physicists network, a community for transgender, non-binary, and genderqueer people at all levels in physics to network, support one another, and socialise.

PiScopia Initiative **2023 - Present**

Local Committee Member, Newcastle University

I am part of the local committee at Newcastle for the UK-wide Piscopia Initiative aiming to improve participation in maths and physics academia from women and other under-represented genders.

Cosmology Night **March 2023**

Talk: The Dark Side of the Cosmic Web

A public talk about my research aimed at a general audience at a local science night.