

# Cian Roche

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🐙 cianmroche.github.io

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EDUCATION	<b>Massachusetts Institute of Technology</b> <i>Graduate Student - Physics</i>	2021 - present
	<b>Universität Tübingen</b> <i>MSc Mathematical Physics, weighted<sup>†</sup> grade average of 1.1</i>	2019 - 2021
	<b>University College Cork</b> <i>Bachelor of Science: Physics, 1<sup>st</sup> class honours degree</i>	2015 - 2019
RESEARCH	<b>Massachusetts Institute of Technology</b> <i>“Measuring the Milky Way Mass Profile via Stellar Kinematics”</i> The escape velocity profile (and therefore mass profile) of a simulated galaxy or the Milky Way is inferred via Bayesian analysis applied to the local stellar velocity distribution. Simulated datasets from the FIRE collaboration and Milky Way data to come from Gaia DR3. Supervised by Prof. Lina Necib.	09/2021 - 08/2022
	<i>“Galaxy Mergers as Dark Matter Probes”</i> High-resolution N-body simulations of galaxy mergers are used as probes of dark matter properties, and to test models of dark matter-deficient galaxy production (such as DF2 and DF4). Supervised by Prof. Lina Necib.	
	<b>Universität Tübingen</b> <i>“Exact Wavelike Solutions in General Relativity”</i> This master thesis project motivates and investigates the mathematical structure of pp-wave spacetimes. Topics include Penrose limits, the causal ladder and addressing the Ehlers-Kundt conjecture. Supervised by Prof. Carla Cederbaum. Submitted - General Relativity and Gravitation.	10/2020 - 08/2021
	<b>University College Cork</b> <i>“Exotic State Preparation in a Triangular Optical Lattice”</i> In this project, the potential for using a triangular optical lattice to create higher orbital states in a gas of ultracold atoms is investigated in a four-level scheme. Supervised by Dr. Anthony Kiely.	10/2018 - 04/2019
	<b>Max Planck Institut für Plasmaphysik</b> <i>“High Order Nulls in the Poloidal field Structure of ASDEX Upgrade”</i> Poloidal magnetic field profiles of a nuclear fusion tokamak were modelled to investigate the impact of adding additional field coils on flux tube flaring and high order null formation. Supervised by Dr. Mike Dunne.	05/2018 - 08/2018
	<b>University of Notre Dame</b> <i>“The progenitor of supernova 1992a based on late time photometry”</i> The progenitor system of a type 1a supernova was identified by studying its late time light curve, which was used to imply isotopic abundances of the progenitor system via comparison to an appropriate decay chain model. Supervised by Prof. Peter Garnavich.	05/2017 - 08/2017

All project reports available at <https://cianmroche.github.io>

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<sup>†</sup>on a scale of 1-5, where 1 is the best grade; 1.1 is approximately equivalent to a 4.0 GPA

**PUBLICATION** First author listed in **bold**

1. **Roche, C.** & Aazami, A. & Cederbaum, C. “*Exact Wavelike Solutions in General Relativity*” - Submitted to *General Relativity and Gravitation* May 11, 2022 - ([link](#))
2. **Roche, C.** & Garnavich, P. “*Testing Progenitor Models Using the Late-Time Light Curve of Supernova 1992A*” - 2020 Res. Notes AAS 4 207 - ([link](#))

**AWARDS**

- DAAD Graduate Program Full Scholarship (2019) - ([link](#))
- Naughton Research Fellowship (one of 8 in Ireland in 2017)
- Naughton Foundation Scholarship (one of 29 in Ireland in 2015) - ([link](#))
- All-Ireland Scholarship (one of 125 in Ireland in 2015)
- “College Scholar” - University College Cork

**TALKS**

1. “*Galaxies Lacking Dark Matter Produced in a Cosmological Simulation*” 08/04/22\*  
MIT Kavli Institute for Astrophysics and Space Research  
Audience: MIT Astrophysics Division
2. “*Waves in General Relativity*” 01/07/21  
Guest Lecture - Mathematical Relativity Class at the University of Tübingen  
Audience: Graduate level mathematics and physics students - ([link](#))
3. “*Exact Wavelike solutions in General Relativity*” 16/06/21  
University of Tübingen Mathematical Physics Colloquium - via Zoom  
Audience: Graduate level mathematics and physics students
4. “*How to Stop a Hurricane: Complexity in Physics*” 29/10/20  
Blow Your Mind Week 2020 - via Zoom  
Audience: General public with scientific interest - ([link](#))
5. “*Hermiticity of Young Operators*” 30/06/20  
Young Tableaux Seminar Series - Universität Tübingen  
Audience: Masters level physics and mathematics students - ([link](#))
6. “*Exotic State Preparation in a Triangular Optical Lattice*” 03/04/19  
Audience: Physics students and faculty
7. “*Which is Heavier, a Kilogram of Steel or a Kilogram of Feathers?*” 25/02/19  
University College Cork Fermi Prize talk series 2019  
Audience: General public with scientific interest
8. “*How to Trap Light with Clouds, Crystals and Condensates*” 23/04/18  
Audience: Undergraduate physics students
9. “*Signal Processing Techniques in Interferometry*” 02/05/18  
Audience: Undergraduate mathematics and physics students
10. “*The Progenitor System of Supernova 1992a*” 19/07/16  
Audience: Research faculty, University of Notre Dame

**COMMUNITY**

**Co-Lead - MIT GAGA Initiative** 06/2022 -  
The Graduates Advising Graduate Admissions (GAGA) program provides the graduate student perspective to the Chair of Graduate Admissions and advises on improvements to the admissions process. ([link](#))

**Organising Committee - MIT GAGA Initiative** 01/2021 - 06/2022

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\*The DD/MM/YY or DD/MM/YYYY date format is used throughout this document.

**Organiser - Graduate Student Lunch and Talk Series** 01/2022 - present  
Organise a weekly lunch and talk series for the graduate student population of the MIT Kavli Institute for Astrophysics and Space Research.

**Organising Committee - MIT Graduate Student Union** Ongoing  
The MIT Graduate Student Union operates fairly and democratically by distributing responsibility to the division-level. I assist with union operations in the physics department and astrophysics division.

**Organising Committee - UCC Physics and Astronomy Society** 2017-2019  
Acted as astronomy officer of the University College Cork physics society, organising multiple stargazing trips and a visit to Iceland to see the Northern lights for ~50 people.

## SKILLS

- **Daily use:** Python, git, BASH, Julia, L<sup>A</sup>T<sub>E</sub>X
- **Experienced:** MPI, C++, mathematica, SQL, ADQL, Docker, LabView
- Large-scale computing clusters (MIT Engaging cluster, TACC Stampede2, shotfile data system at Institute for Plasma Physics)
- Languages: English (native), Irish, German (B2+ level on CEFR scale)

## TEACHING

**Tutor - Gaia DR3 Hackathon** 13/06/22 -15/06/22  
I will act as a tutorial writer and instructor for a hackathon hosted by Prof. Lina Necib, whose goal is for undergraduate students to obtain and interface with the data of the Gaia data release 3 (DR3) on a computing cluster, and are encouraged to be creative in analysing the data and to look for anomalies. ([link](#))

**Mentor and co-organiser - MIT PhysGAAP program** 01/2021 - 06/2022  
The Physics Graduate Application Assistance Program (PhysGAAP) provides guidance to prospective applicants on navigating the application process, and liaises with the physics department leadership on issues of accessibility and equity in the application process. ([link](#))

**Teaching Assistant - Introductory Physics II** 2017 - 2018  
Lead tutorials for 1<sup>st</sup> year physics undergraduate students on the topics of electromagnetism, optics, special relativity and quantum mechanics.

**Leader - Peer Assisted Learning Scheme** 2016 - 2018  
Managed popular weekly mathematics/physics learning sessions for undergraduate students in scientific degrees other than math or physics for two years.

## INTERESTS

- Nature, animals, entomology, herpetology.
- Playing music (poorly), neo-soul and jazz on the piano or guitar
- Cycling, swimming, ice skating (poorly). In the Summer of 2018 I cycled across across northern Italy and hiked Rotspitze in the Austrian alps twice
- Attended three years at the “Centre for Talented Youth Ireland” to take courses in architecture, animation and music production.
- Philosophy and ethics
- Baking. Mostly cookies, but sometimes bread.