Cian Roche

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EDUCATION

Massachusetts Institute of Technology 2021 - present
Graduate Student - Physics

Universität Tübingen 2019 - 2021
MSc Mathematical Physics, weighted[†] grade average of 1.1

University College Cork 2015 - 2019
Bachelor of Science: Physics, 1st class honours degree

RESEARCH

Massachusetts Institute of Technology 09/2021 - 08/2022
"Constraining Dark Matter using Galaxy Clusters"
The distance of the brightest galaxies in galaxy clusters from the cluster mass centers is determined via strong lensing measurements, and the distribution of these distances is used to place constraints on the self-interaction cross-section of dark matter. Supervised by Prof. Michael McDonald and Prof. Mark Vogelsberger.

"Measuring the Milky Way Mass Profile via Stellar Kinematics"
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.

Universität Tübingen 10/2020 - 08/2021
"Exact Wavelike Solutions in General Relativity"
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.

University College Cork 10/2018 - 04/2019
"Exotic State Preparation in a Triangular Optical Lattice"
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.

Max Planck Institüt für Plasmaphysik 05/2018 - 08/2018
"High Order Nulls in the Poloidal field Structure of ASDEX Upgrade"
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.

University of Notre Dame 05/2017 - 08/2017
"The progenitor of supernova 1992a based on late time photometry"
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.

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

[†]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

Member - MIT Physics Graduate Student Council 01/2021 - present
The Physics Graduate Student Council (PGSC) is the organiser of most graduate student-focused events in MIT physics, and also serves as an advisory board for the physics department and an advocate for the graduate student population. (link)

Co-Lead - MIT GAGA Initiative 06/2022 - present
The Graduates Advising Graduate Admissions (GAGA) program provides the graduate student perspective to the Chair of Graduate Admissions, offers information and

*Dates are formatted day/month/year or month/year throughout this document.

mentorship to underrepresented groups in physics and advises on improvements to the admissions process. (link)

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

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 09/2021 - present
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, LaTeX
- **Experienced**: MPI, C++, mathematica, SQL, ADQL, Docker, LabView
- Large-scale computing clusters (MIT Engaging cluster, Harvard FASRC cluster, sub-MIT cluster, TACC Stampede2, shotfile data system at Institute for Plasma Physics)
- Languages: English (native), Irish, German (B2+ level on CEFR scale)

TEACHING

Teaching Assistant - MIT Junior Lab 09/2022 - 12/2022
Wrote and presented tutorials on programming, statistics, data analysis, plotting, simulations and errors to be presented as part of the junior lab (8.13) curriculum. Also held office hours, oral exams, and provided in-lab assistance. (link)

Tutor - Gaia DR3 Hackathon 13/06/22 -15/06/22
I wrote tutorials and acted as an instructor for a hackathon hosted by Prof. Lina Necib at MIT, whose goal was for undergraduate students to obtain and interface with the data of the Gaia data release 3 (DR3) on a computing cluster, 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 liases 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 1st 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.