

# Ciaran A. J. O'Hare

## Curriculum Vitae

School of Physics, University of Sydney  
Physics Rd, Camperdown NSW 2006, Australia

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📄 [cajoha.re](http://cajoha.re)

🐦 [cajohare](https://twitter.com/cajohare)

🌐 [cajohare](https://cajohare)

## Academic history

- 2019 **Postdoctoral Research Associate**, *School of Physics*, University of Sydney, Australia.  
Supervisor: Celine Boehm
- 2017–2019 **Postdoctoral Researcher**, *Departamento de Física Teórica*, Universidad de Zaragoza, España.  
Supervisor: Javier Redondo

## Education

- 2013–2017 **PhD Physics**, *Particle Cosmology group*, University of Nottingham, United Kingdom.  
Supervisor: Anne Green  
Thesis: [WIMPs, neutrinos and axions in the next generation of dark matter experiment](#)
- 2009–2013 **Msci Physics**, University of Nottingham, 1st class (average: 92%).  
Supervisor: Adam Moss  
Thesis: [Dynamics of domain wall systems](#)

## Talks

Slides for the majority of my talks are available online at [cajoha.re/talks](http://cajoha.re/talks)

### Invited seminars

- 2021 **SLAC**, 'The status and future of directional recoil detection'.
- 2021 **Fermilab**, 'Directional dark matter detection and the CYGNUS project'.
- 2021 **UCLA**, 'Directional dark matter detection'.
- 2021 **Sydney CPPC**, 'Dark matter detection off the beaten path'.
- 2020 **Australian National University**, 'Directional dark matter detection'.
- 2020 **University of New South Wales**, 'Axions and their detection'.
- 2019 **University of Barcelona**, 'Axtronomy'.
- 2019 **University of Sydney**, 'Dark matter detection'.
- 2019 **IFT, Madrid**, 'Gaia and direct dark matter detection'.
- 2019 **Laboratori Nazionali di Frascati**, 'Introduction to directional detection'.
- 2018 **Texas A&M University**, 'How to build an axion observatory'.
- 2018 **Max Planck Institute, Munich**, 'Axiostronomy'.
- 2017 **King's College London**, 'Directly detecting the Milky Way halo'.

### Invited presentations

- 2021 **International Joint Workshop on the SM and Beyond 2021**, *NTHU, Taiwan*.  
'Searching for the axions, on Earth and in space'
- 2021 **Theory Workshop, DESY**.  
'Directional dark matter detection'
- 2021 **ARC CoE for Dark Matter Fortnightly Meeting**, *Virtual*.  
'Dark photon limits: A cookbook'
- 2021 **Asian Forum for Accelerators and Detectors**, *Novosibirsk (Virtual)*.  
'Directional dark matter detection and the Cygnus experiment'

- 2021 **ARC CoE for Dark Matter ECR Workshop**, *Virtual*.  
'The Cygnus experiment'
- 2021 **Axions beyond Gen-2**, *University of Washington (Virtual)*.  
'Axion haloscopes and the local dark matter distribution'
- 2020 **Light Dark World workshop**, *Virtual*.  
'Axion constraints 2020'
- 2020 **Magnificent CEvNS workshop**, *Virtual*.  
'Neutrino floors'
- 2020 **IAXO Collaboration Meeting**, *Virtual*.  
'Axion helioscopes as solar magnetometers'
- 2020 **MIAPP Workshop on axion cosmology**, *Technical University of Munich*.  
'Axion haloscopes and the local dark matter distribution'
- 2019 **Dark Matter Searches in the 2020s**, *Institute for Cosmic Ray Research, Tokyo*.  
'Breaking through the neutrino floor'
- 2019 **Cygnus directional detection workshop**, *Sapienza University of Rome*.  
'Physics case for the Cygnus experiment'
- 2019 **DMUK Meeting**, *Kings' College London*.  
'Gaia and direct dark matter detection'
- 2019 **Saturnalia Workshop**, *Universidad de Zaragoza*.  
'Dark Matter Hurricane'
- 2019 **CYGNUS workshop**, *University of Hawaii (Virtual)*.  
'Physics reach for the Cygnus experiment'
- 2018 **MADMAX Collaboration Meeting**, *Max Planck Institute, Munich*.  
'The axion velocity distribution'
- 2018 **Workshop on ultralight dark matter and axions**, *University of Michigan*.  
'Directional axion detection'
- 2017 **Theoretical Physics Seminar**, *Universidad de Zaragoza*.  
'Directly detecting the Milky Way halo'
- 2016 **IDM**, *University of Sheffield*.  
'Dark matter detection and the neutrino floor'
- 2015 **11th Patras workshop on axions, WIMPs and WISPs**, *Universidad de Zaragoza*.  
'Theoretical prospects for directional WIMP detection'

### Other conference & workshop presentations

- 2021 **Asia-Pacific Workshop on Particle Physics and Cosmology**, *Virtual*.  
'Searching for dark photons as dark matter'
- 2019 **TeVPA**, *Sydney, Australia*.  
'The Cygnus experiment'
- 2019 **15th Patras workshop on axions**, *Freiburg, Germany*.  
'Direct detection and Gaia'
- 2018 **OAJ-LSC Synergies meeting**, *Universidad de Zaragoza*.  
'Gaia and direct dark matter detection'
- 2018 **14th Patras workshop on axions**, *DESY, Germany*.  
'Directional axion detection'
- 2017 **13th Patras workshop on axions**, *Thessaloniki, Greece*.  
'Axion/WIMP astronomy in dark matter experiments'
- 2017 **IOP Joint APP and HEP Conference**, *University of Sheffield*.  
'Measuring the dark matter velocity distribution with WIMPs and axions'
- 2016 **TeVPA**, *CERN*.  
'Dark matter detection and the neutrino floor'
- 2016 **LINK'16 Interdisciplinary conference**, *East Midlands Conference Centre*.  
'Detecting Dark Matter'

- 2015 **DMUK**, *University of Liverpool*.  
'Directional dark matter detection and the neutrino background'
- 2014 **BUSSTEPP**, *University of Southampton*.  
'Directional detection of dark matter substructure'

## Software

- 2021 **NeutrinoFog**.  
Code for the neutrino floor/fog for direct dark matter searches
- 2021 **DarkPhotonCookbook**.  
Code for accounting for daily modulation effects in direct searches for dark photons
- 2020 **AxionLimits**.  
Library of astrophysical, cosmological and experimental constraints on axions and axion-like particles [Citations: 11]
- 2020 **solax**.  
Likelihood-based data analysis code for axion helioscopes such as IAXO. Includes precise solar axion flux calculations which account for the solar magnetic field.
- 2020 **AtmNuFloor**.  
Code for calculating the neutrino floor to direct dark matter experiments. It also allows for the inclusion of time, target and direction dependent methods for overcoming the neutrino floor.
- 2019 **DarkShards**.  
Code for analysing *Gaia* data to fit velocity and action-space substructures, as well as generate their corresponding signals in dark matter experiments.
- 2019 **IAXOmass**.  
Likelihood analysis code for measuring the axion mass in IAXO.

## Other academic duties

- 2015 **Journal referee**.  
Journal of Cosmology and Astroparticle Physics (JCAP), Physical Review Letters (PRL), Physical Review D (PRD), Astronomy & Astrophysics (A&A), PDG Review
- 2020 **Sydney CPPC**.  
Organising a series of weekly online seminars and maintaining the [YouTube channel](#).
- 2020 **Dark Chatter**.  
Host and organiser of a [web-series](#) for the promotion of early career researchers.
- 2020 **Snowmass 2021 Letter of Interest**, *CYGNUS: A nuclear recoil observatory with directional sensitivity to dark matter and neutrinos*.  
[https://www.snowmass21.org/docs/files/summaries/CF/SNOWMASS21-CF1\\_CF0-NF10\\_NF4-IF5\\_IF4\\_Vahsen-189.pdf](https://www.snowmass21.org/docs/files/summaries/CF/SNOWMASS21-CF1_CF0-NF10_NF4-IF5_IF4_Vahsen-189.pdf).
- 2020 **Snowmass 2021 Letter of Interest**, *Astrophysical signatures of the QCD axion and axion-like particles*.  
[https://www.snowmass21.org/docs/files/summaries/CF/SNOWMASS21-CF2\\_CF3-TF9\\_TF0-165.pdf](https://www.snowmass21.org/docs/files/summaries/CF/SNOWMASS21-CF2_CF3-TF9_TF0-165.pdf).
- 2020 **International advisory committee**, *International Dark Matter conference*, Vienna, Austria.  
<http://idm2020.hephy.at/>.
- 2018 **Local organising committee**, *4th MADMAX Collaboration Meeting*, Zaragoza, Spain.  
<https://indico.mpp.mpg.de/event/6018/overview>.
- 2018 **Local organising committee**, *Probing the dark universe synergies workshop*, Zaragoza, Spain.  
<https://riastronomia.es/en/probing-the-dark-universe-oaj-lsc-synergies/>.

## Teaching and Supervision

The University of Sydney

- 2021 **Special Studies Program**, Solar axions.  
(2 × 2nd year students)

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2021 ● **Special Studies Program**, Informing searches for dark matter with galaxy simulations.  
(2 × 2nd year students)

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2021 ● **Special Studies Program**, Geant4 simulations of a DNA-based particle detector.  
(2 × 2nd year students)

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2021 ● **Physics Honours**, Lattice simulations of axion cosmology.  
(1 × 4th year student)

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2021 ● **Special Studies Program**, Solar chameleons.  
(2 × 2nd year students)

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2021 ● **Dalyell Showcase**, Studying the structure with the stellar halo with *Gaia*.  
(8 × 1st year students)

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2020 ● **Summer internship**, Calculating event rates of supernova neutrinos in DUNE.  
(1 × high school student)

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2020 ● **Physics Honours**, Globular cluster dynamics with *Gaia*.  
(1 × 4th year student)

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2020 ● **Special Studies Program**, Geant4 simulations of a DNA-based particle detector.  
(3 × 2nd year students)

## University of Nottingham

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2016  
2017 ● **MSci Project**, Developing Monte Carlo simulations for dark matter detectors.  
(2 × 4th year students)

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2015  
2016 ● **MSci Project**, Distinguishing neutrino and WIMP signals in dark matter detectors.  
(2 × 4th year students)

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2013  
2016 ● **2nd year Msci physics workshops**, *University of Nottingham*,  
Approximately 3 hr/wk of workshop instruction in four 2nd year Physics courses.

- Quantum mechanics
- Thermal Physics and Statistical Mechanics
- Vector calculus and electromagnetism
- Optics and Fourier analysis

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## Media

### Articles written

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2020 ● **CERN Courier**, *Astroparticle physicists head down under* .  
<https://cerncourier.com/a/astroparticle-physicists-head-down-under/>

### Media coverage

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2021 ● **Centre of Excellence for Dark Matter Particle Physics**, *Meet the researcher*.  
<https://www.centredarkmatter.org/all-posts/meet-the-researcher-ciaran-ohare-htrjn-mjf82>

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2021 ● **Discover magazine**, *How DNA can help in the search for dark matter* .  
<https://www.discovermagazine.com/the-sciences/how-dna-can-help-the-search-for-dark-matter>

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2020 ● **AstroBites**, *MACHOs Find a New Weight Class to Compete In* .  
<https://astrobites.org/2020/09/08/machos-weight-class/>

My publication *O'Hare et al. 2018* was covered by 49 media outlets in 2018.

Altmetric score of 495 (top 5% of all research outputs): <https://aps.altmetric.com/details/45496963>

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2018 ● **CNN**, *A dark matter hurricane is headed our way [sic]*.  
<https://edition.cnn.com/2018/11/19/opinions/dark-matter-hurricane-headed-our-way-lincoln-opinion/index.html>

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2018 ● **Astronomy magazine**, *A 'dark matter hurricane' is storming past Earth* .  
<http://www.astronomy.com/news/2018/11/a-dark-matter-hurricane-is-storming-past-earth>

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2018 ● **Cosmos magazine**, *Researchers brace for dark matter 'hurricane'* .  
<https://cosmosmagazine.com/space/researchers-brace-for-dark-matter-hurricane>

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2018 ● **CNET**, *Scientists predict a 'dark matter hurricane' will collide [sic] with the Earth* .  
<https://www.cnet.com/news/scientists-predict-a-dark-matter-hurricane-will-collide-with-the-earth/>

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2018 ● **Discover Magazine**, *A 'Dark Matter Hurricane'* .  
<http://blogs.discovermagazine.com/d-brief/2018/11/12/dark-matter-hurricane/>

2018

**Gizmodo Magazine**, *So What's Going on With That 'Hurricane of Dark Matter?'* .  
<https://gizmodo.com/so-whats-going-on-with-that-hurricane-of-dark-matter-1830420899>

## Outreach

### Aimed at the public

2020

**Dark Matter Day**, *Virtual*.  
'The evidence for dark matter'

2018

**Science Slam**, *DESY, Hamburg*.  
'On safari in the Milky Way'

2017

**Pint of Science Festival**, *Bunkers Hill pub, Nottingham*.  
'The Cosmic Pint'

2017

**Guest lecture**, *Manchester Astronomy Society*.  
'The Dark Side'

2015

**TEDxUoN talk**, *Portland Building, Nottingham*.  
'Detecting Dark Matter'

2015

**Pub.hD talk**, *Vat and Fiddle pub, Nottingham*.  
'Detecting Dark Matter'

### Aimed at students

2021

**PhySoc guest lecture**, *University of Sydney*.  
Lecture on 'Dark matter' aimed at Sydney undergraduates

2020

**Sydney Physics Dialogues**, *University of Sydney*.  
Lecture on 'Dark matter' aimed at international undergraduates

2018

**School visit**, *Colegio Nuestra Señora del Pilar, Zaragoza*.  
Aimed at 14-16 year old science and english students.

2017

**School visit**, *Chilwell school, Nottinghamshire*.  
Aimed at students thinking of studying physics at university.

2015

2017

#### Sutton Trust Summer School.

An annual series of masterclasses and workshops for high school students. I was involved in the organisation of the physics branch of the school. I also lectured and led computer-based workshops on particle physics and astronomy.

2014

2017

#### Ambition Nottingham.

A series of programs at UoN aimed at local students from backgrounds under-represented at universities in the UK. I was heavily involved in the physics and astronomy 'course tasters' for the scheme as both an organiser and a lecturer.

2013

2017

#### University of Nottingham open days.

My roles involved guiding visitors around the School of Physics and giving information on research programs, undergraduate and postgraduate courses. I also ran drop-in sessions and demonstrations for the Particle Cosmology group.

I upload slides and other material related to my outreach at <https://cajoha.re/outreach>

## Publications

Total citations: 1,150. Collected from the [inspireHEP](#) database

O'Hare 2021

**25.** 'Fog on the horizon: a new definition of the neutrino floor for direct dark matter searches'  
C.A.J. O'Hare  
arXiv:[2109.03116]

O'Hare et al. 2021

**24.** 'Particle detection and tracking with DNA'  
C. A. J. O'Hare, Vassili G. Matsos, Joseph Newton, Karl Smith, Joel Hochstetter, Ravi Jaiswar, Wanna Kyaw, Aimee McNamara, Zdenka Kuncic, Sushma Nagaraja Grellscheid, and Céline Bøhm  
arXiv:[2105.11949]

- Caputo et al. 2021 **23.** 'Dark photon limits: a cookbook'  
A. Caputo, C. A. J. O'Hare, A. Millar, E. Vitagliano  
[Cited by 7 records, github page: <http://cajohare.github.io/DarkPhotonCookbook>]
- Vahsen et al. 2021 **22.** 'Directional recoil detection'  
S. Vahsen, C. A. J. O'Hare, D. Loomba  
Annu. Rev. Nucl. Part. Sci. 2021. **71** 189–224  
[Cited by 10 records]
- Boehm et al. 2021 **21.** 'Eliminating the LIGO bounds on primordial black hole dark matter'  
C. Boehm, A. Kobakhidze, C. A. J. O'Hare, Z. S. C. Picker, M. Sakellariadou  
JCAP **03** 078 (2021)  
[Cited by 24 records]
- Vahsen et al. 2020 **20.** 'CYGNUS: Feasibility of a nuclear recoil observatory with directional sensitivity to dark matter and neutrinos'  
S. Vahsen, C. A. J. O'Hare et al. (Submitted to PRD)  
[Cited by 27 records]
- O'Hare & Vitagliano 2020 **19.** 'Cornering the axion with CP-violating interactions'  
C. A. J. O'Hare, E. Vitagliano  
Phys. Rev. D **102**, 115026 (2020)  
[Cited by 11 records, github page: <http://cajohare.github.io/AxionLimits>]
- O'Hare 2020 **18.** 'Can we overcome the neutrino floor at high masses?'  
C. A. J. O'Hare  
Phys. Rev. D **102**, 063024 (2020)  
[Cited by 17 records, github page: <http://github.com/cajohare/AtmNuFloor>]
- O'Hare et al. 2020b **17.** 'Axion helioscopes as solar magnetometers'  
C. A. J. O'Hare, A. Caputo, A. J. Millar, E. Vitagliano  
Phys. Rev. D **102**, 043019 (2020)  
[Cited by 17 records, github page: <http://cajohare.github.io/solax>]
- O'Hare et al. 2020a **16.** 'Dark Shards: velocity substructure from Gaia and direct searches for dark matter'  
C. A. J. O'Hare, N. W. Evans, C. McCabe, G. Myeong, V. Belokurov  
Phys. Rev. D **101** (2020) no.2, 023006  
[Cited by 30 records, github page: <http://cajohare.github.io/DarkShards>]
- Dafni et al. 2019 **15.** 'Weighing the Solar Axion'  
T. Dafni, C. A. J. O'Hare, J. Galán, I. G. Irastorza, F. J. Iguaz, K. Jakovčić, B. Lakić, G. Luzón, J. Redondo, E. Ruiz Chóliz  
Phys. Rev. D **99** 035037 (2019)  
[Cited by 17 records, github page: <http://cajohare.github.io/IAXOmass>]
- Evans et al. 2019 **14.** 'SHM++: A refinement of the Standard Halo Model for dark matter searches'  
N. W. Evans, C. A. J. O'Hare, C. McCabe  
Phys. Rev. D **99**, 023012 (2019)  
[Cited by 78 records]
- O'Hare et al. 2018 **13.** 'A dark matter hurricane: measuring the S1 stream with dark matter detectors'<sup>1</sup>  
C. A. J. O'Hare, C. McCabe, N. W. Evans, G. Myeong, V. Belokurov  
Phys. Rev. D **98**, 103006 (2018)  
[Cited by 46 records]
- Knirck et al. 2018 **12.** 'Directional axion detection'  
S. Knirck, A. Millar, C. A. J. O'Hare, J. Redondo, F. Steffen  
JCAP **11** 051 (2018)  
[Cited by 35 records]
- O'Hare & Burrage 2018 **11.** 'The symmetron field profile in the galactic disk'  
C. A. J. O'Hare & C. Burrage  
Phys. Rev. D **98** 064019 (2018)  
[Cited by 14 records]
- O'Hare et al. 2017 **10.** 'Time-integrated directional detection of dark matter'  
C. A. J. O'Hare, B. J. Kavanagh, A. M. Green  
Phys. Rev. D **96**, 083011 (2017)  
[Cited by 15 records]

- Battaglieri et al. 2017 **9.** ['US Cosmic Visions: New Ideas in Dark Matter 2017: Community Report'](#)<sup>2</sup>  
M. Battaglieri et al., FERMILAB-CONF-17-282-AE-PPD-T (2017)  
[Cited by 443 records]
- O'Hare 2017 **8.** ['Terrestrial WIMP/Axion astronomy'](#)  
C. A. J. O'Hare  
Contributed to the 13th Patras Workshop on Axions, WIMPs and WISPs, Thessaloniki  
[Cited by 1 record]
- O'Hare & Green 2017 **7.** ['Axion astronomy with microwave cavity experiments'](#)  
C. A. J. O'Hare & A. M. Green  
Phys. Rev. D **95** 063017 (2017)  
[Cited by 43 records]
- Kavanagh & O'Hare 2017 **6.** ['Reconstructing the three-dimensional local dark matter velocity distribution'](#)  
B. J. Kavanagh & C. A. J. O'Hare  
Phys Rev. D **94**, 123009 (2016)  
[Cited by 22 records]
- O'Hare 2016 **5.** ['Dark matter astrophysical uncertainties and the neutrino floor'](#)  
C. A. J. O'Hare  
Phys. Rev. D **94**, 063527 (2016)  
[Cited by 46 records]
- Mayet et al. 2016 **4.** ['A review of the discovery reach of directional Dark Matter detection'](#)<sup>3</sup>  
F. Mayet, A. M. Green, J. B. R. Battat, J. Billard, N. Bozorgnia, G. B. Gelmini, P. Gondolo, B. J. Kavanagh, S. K. Lee, D. Loomba, J. Monroe, B. Morgan, C. A. J. O'Hare, A. H. G. Peter  
Physics Reports **627** (2016) 1  
[Cited by 145 records]
- O'Hare 2017 **3.** ['Theoretical prospects for directional WIMP detection'](#)  
C. A. J. O'Hare  
Contributed to the 11th Patras Workshop on Axions, WIMPs and WISPs, Zaragoza
- O'Hare et al. 2015 **2.** ['Readout strategies for directional detection beyond the neutrino background'](#)<sup>4</sup>  
C. A. J. O'Hare, A. M. Green, J. Billard, E. Figueroa-Feliciano, L. E. Strigari  
Phys. Rev. D **92**, 063518 (2015)  
[Cited by 61 records]
- O'Hare & Green 2014 **1.** ['Directional detection of dark matter streams'](#)<sup>5</sup>  
C. A. J. O'Hare & A. M. Green  
Phys Rev. D **90**, 123511 (2014)  
[Cited by 37 records]

<sup>1</sup> Selected as a highlighted article in [American Physical Society news](#)

<sup>2</sup> Contributed projections for the CYGNUS experiment

<sup>3</sup> Selected as a highlighted article in [Physics Reports](#)

<sup>4</sup> Contains figure selected for [PRD Kaleidoscope Sep 2015](#)

<sup>5</sup> Contains figure selected for [PRD Kaleidoscope Dec 2014](#)