# MADELEINE J. ZUROWSKI

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## EDUCATION

**University of Melbourne** *2014 - Present*
Doctor of Philosophy (2022)
Thesis: *Designing and assessing model independent tests of the DAMA modulation*
Supervisors: Professor Elisabetta Barberio, Associate Professor Phillip Urquijo
Committee chair: Professor Rachel Webster
Master of Science - Physics (2018)
Thesis: *Inelastic Dark Matter and the SABRE Experiment*
Supervisor: Professor Elisabetta Barberio
Result: First Class Honours
Bachelor of Science (2016)
Major: Physics
Result: First Class Honours

**Princeton University** *2017, 2018, 2019*
Visiting Student Research Collaborator Position (Oct - Dec 2019)
Collaborator: Professor Frank Calaprice
Research undertaken as part of Masters Thesis (Jan - Feb 2018, Jul - Aug 2017)

**University of California, Berkeley** *Jan - Jun 2016*
Studied physics abroad for a semester as part of an exchange program.

**Loreto Kirribilli, Sydney** *2008-2013*
Higher School Certificate

## DESCRIPTION OF RESEARCH

Much of my research to date has fallen under one of two categories, work on purifying and growing the ultra-pure sodium iodide crystals that form the heart of the SABRE experiment I am a member of, and the simulation of physical processes within the detector in order to assess the data fits to different models of dark matter and the efficacy of the detector itself.
My work on the former was largely conducted with our collaborators in Princeton. Through it I have developed precise lab skills, as the material can only be handled in a glovebox or low oxygen environments to ensure its purity.
The latter is based largely around statistical analysis, and some data processing. Over the course of both of my degrees I built a novel program that accurately modelled the progress of information and physical processes through the detector in order to test the different signatures various dark matter models might leave. I have also helped develop a number of data processing algorithms in order to correctly format raw data to be used in analysis. I am fluent in both C and python.
As a PhD student, I have also designed and supervised three research projects for undergraduate students, and mentored a Masters student.

### Areas of interest

· Dark matter direct detection and phenomenology, low background physics, experimental design.

## AWARDS AND ACHIEVEMENTS

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|---|---|
| Research Training Program Scholarship | *2019-2022* |
| Best Poster (panel vote) Centre of Excellence for Dark Matter Workshop | *2021* |
| Centre of Excellence for Dark Matter Collaboration and Centre Values Award | *2021* |
| Dr Jean Laby Women in Physics Travel Award | *2021* |
| Dr Jean E Laby Bursary | *2018* |
| Allan and Maria Myers Scholarship | *2017* |
| Melbourne Global Scholars Award | *2016* |
| Residential Scholarship for Newman College | *2015, 2016* |
| National Youth Science Forum | *2013* |
| Distinguished Achiever, Higher School Certificate | *2013* |

## RESEARCH OUTPUTS

### Papers

- M. J. Zurowski and E. Barberio 2021 J. Phys.: Conf. Ser. 2156 012212
- M. J. Zurowski and E. Barberio, *Influence of NaI background and mass on testing the DAMA modulation*, arXiv:2107.07674 (accepted to EPJC).
- M. J. Zurowski in L. J. Bignell et. al., *Quenching factor measurements of sodium nuclear recoils in NaI:Tl determined by spectrum fitting*, 2021 JINST 16 P07034
- M. Zurowski in M. Antonello et. al. [The SABRE Collaboration], *Characterization of SABRE crystal NaI-33 with direct underground counting*, Eur. Phys. J. C 81, 299 (2021)
- M. J. Zurowski, E. Barberio, and G. Busoni, *Inelastic Dark Matter and the SABRE Experiment*, JCAP12(2020)014.
- M. Zurowski in A. Mariani et al. [The SABRE Collaboration], *First measurements with a NaI(Tl) crystal for the SABRE experiment*, J.Phys.Conf.Ser, 1468(2020) 1.
- M. Zurowski in G. D'Imperio et. al. [The SABRE Collaboration], *The SABRE experiment for dark matter search*, ICHEP2018 Volume 340, August 2019.
- M. Zurowski in M. Antonello et. al. [The SABRE Collaboration], *Monte Carlo simulation of the SABRE PoP background*, Astroparticle Physics, October 2018.

### Talks

- *Designing and assessing model independent tests of DAMA's modulation signal*, University of Melbourne, PhD Completion Seminar, August 2022
- *Direct search for Dark Matter with the SABRE South experiment*, 14th International Conference on Identification of Dark Matter, July 2022
- *Hidden dependencies in model independent tests of DAMA*, 14th International Conference on Identification of Dark Matter, July 2022
- *Death to DAMA? Designing and assessing model independent tests of DAMA's modulation signal*, HEPHY Seminar, July 2022
- *Death to DAMA? Designing and assessing model independent tests of DAMA's modulation signal*, University of Minnesota Seminar, June 2022
- *Death to DAMA? Designing and assessing model independent tests of DAMA's modulation signal*, University of Toronto Seminar, June 2022
- *Status of the SABRE South Experiment at the Stawell Underground Physics Laboratory*, International Conference on Interconnections between Particle Physics and Cosmology XV, June 2022
- *Death to DAMA? Designing and assessing model independent tests of DAMA's modulation signal*, Cosmic Physics Centre Seminar, Fermilab (virtual), May 2022
- *Status of the SABRE South Experiment at the Stawell Underground Physics Laboratory*, Vienna Conference on Instrumentation (virtual), February 2022

- *SABRE Prospects and Physics Reach*, Centre of Excellence International Scientific Advisory Committee, February 2022.
- *Death to DAMA? Assessing and designing model independent tests of DAMA's modulation signal*, SLAC Special Seminar (virtual), February 2022
- *Model independent tests of DAMA*, AIP Summer Workshop, Brisbane (virtual), December 2021.
- *SABRE Prospects and Physics Reach*, ARC CDM Workshop, Melbourne, November 2021.
- *Detecting Dark Matter; The Physics of the SABRE Experiment*, Work Experience Seminar, University of Melbourne, June 2021.
- *SABRE Physics Program*, Centre of Excellence International Scientific Advisory Committee, April 2021.
- *Physics of the SABRE Experiment*, Early Career Research Workshop, CDM, February 2021.
- *Sensitivity Analysis for the SABRE Experiment*, Geoff Opat Seminar Series, University of Melbourne, May 2020.
- *Ghost Busting; Dark Matter Detection Strategies*, PSS Seminar, University of Melbourne, August 2019.
- *Detecting Dark Matter; The Physics of the SABRE Experiment*, Work Experience Seminar, University of Melbourne, July 2019.
- *Inelastic Dark Matter and the SABRE Experiment* MSc. Completion Talk, University of Melbourne, October 2018.
- *Beefing up WIMPs: the Search for Dark Matter*, Scholars' Presentation, Newman College, March 2017.

**Posters**

- *A Digitisation Tool for Detector Emulation of SABRE South and other Low Background Experiments*, AIP Summer Workshop, Brisbane (virtual), December 2021.
- *Optical simulation of the SABRE veto system*, AIP Summer Workshop, Brisbane (virtual), December 2021.
- *Influence of NaI background and mass on model independent tests of DAMA's modulation*, ARC CDM Workshop, Melbourne, November 2021 (voted best poster by panel).
- *Influence of NaI background and mass on testing the DAMA modulation*, TAUP2021, Valenica (remote).
- *Inelastic Dark Matter and SABRE*, ARC CDM Workshop, Melbourne, December 2020
- *'Eye' of the Tiger: Light detection at the SABRE Experiment*, ARC CoEPP Workshop, Adelaide, January 2017.

## SERVICE AND OUTREACH

**Talks/interviews (Public facing)**

- Veritasium: 'The Absurd Search for Dark Matter', May 2022
- ABC Afternoon: 'The search for dark matter in a gold mine', May 2022
- Dark Matter Day: 'Dark Matter in the Southern Hemisphere', October 2021
- The Age: 'Burying vital physics study can only shed light', October 2021
- Science Festival Mid-Afternoon Masterclass: 'Lighting the Dark Universe', August 2021.
- ABC Wimmera: Science Festival, August 2021
- 'Mitchell's Front Page', The Pulse, Geelong: Dark Matter and National Science Week, August 2021.
- VCE lecture series, University of Melbourne: 'Bringing Dark Matter to Light', April 2021.
- Dark Chatter Ep 4: The SABRE Experiment, March 2021.

**Speakers Committee** *2021-2022*
*SABRE South Collaboration*

· Member of committee convened to collect conferences that may be of interest to members of the collaboration, write and submit abstracts on behalf of the collaboration, and select speakers to ensure an equitable spread of speakers from different career levels and institutions.

**Equity and Diversity Committee** *2021-2022*
*Centre of Excellence for Dark Matter Particle Physics*

· Represented the Early Career Researchers in the Centre of Excellence Committee focused on promoting equity and diversity within the research community.

**Graduate Research Advisory Group** *2021*
*University of Melbourne*

· Physics representative on a group started by the Faculty of Science to get feedback on events and activities held by the faculty and identify opportunities that the Graduate Research Team or Faculty of Science could provide to improve the experience of graduate researchers.

**Postgraduate Physics Students Society** *2017-2021*
*University of Melbourne*

· Publications Officer (2020-2021): Collate and disseminate all society related publication, including the "Postgraduate Survival Guide" (also as a contributing author), and the past thesis library.
· Health and Safety Officer (2019): Represent graduate physics students in Health and Safety committee meetings, assisted with the planning and execution of PPSS events.
· Treasurer (2018): Budget all PPSS events, and apply for grants and refunds. In this role I also spearheaded a green campaign in designing and ordering society KeepCups.
· Executive member (2017): Organised events and networking opportunities for postgraduate students and faculty, as well as being a liaison point for the undergraduate Physics Students Society.

**Dark Matter Day** *2020,2021*
*Centre of Excellence for Dark Matter Particle Physics*

· Helped host an 'open day' for a virtual lab space available to the public. Provided informative posters on the SABRE experiment and was available for explanations and 'tours' of the space as well as preparing a talk.

**Antarctic Explorer** *2020*
*University of Melbourne/Laby Foundation/Antarctica Flights*

· Provided a running commentary on the magnetic field and cosmic radiation around the Antarctic region, as well an explanation of the physics causing changes for the general public, on a scenic/commercial flight in Antarctic airspace.

**Science Student Ambassador** *2017 - 2020*
*University of Melbourne*

· Selected from a range of both undergraduate and graduate students to represent faculty at a range of events and activities, both face to face and online.
· A particular focus was promoting physics (both as an undergraduate and graduate pathway) during University open days.

**Hume Central Secondary College Outreach** *2017*
*Broadmeadows, Melbourne*

· For two months I led an after school physics club at Hume Central made up of year 7 and 8 students. This involved teaching them about physics concepts in a creative and interesting way by planning fun lab activities appropriate for this age group.

## EMPLOYMENT HISTORY

**University of Melbourne** *2017-2021*
*Lab Demonstrator*

- Supervision and marking of first, second, and third year physics lab sessions in groups of 4-16.
- Traditional lab based work, as well as code based computational 'labs' written in Python.
- Received Laser Safety Training and Safe Radiation Handling Training.
- Designed a number of experiments for the second year course.

**University of Melbourne** *2017-2021*
*Tutor: Physics 1, Subatomic Physics*

- Tutored groups of 6-8 undergraduate students for an hour 2-3 times a week.
- Focus on both conceptual issues and practice exam problem solving.
- Provided marking for exams, assignments, and drop in office hours.

**Newman College, Melbourne** *2017-2018*
*Tutor: Physics 1, Electrodynamics, Quantum Mechanics, Differential Equations*

- Provided additional, out of class tutoring for students at Newman College in a range of undergraduate physics and maths courses.