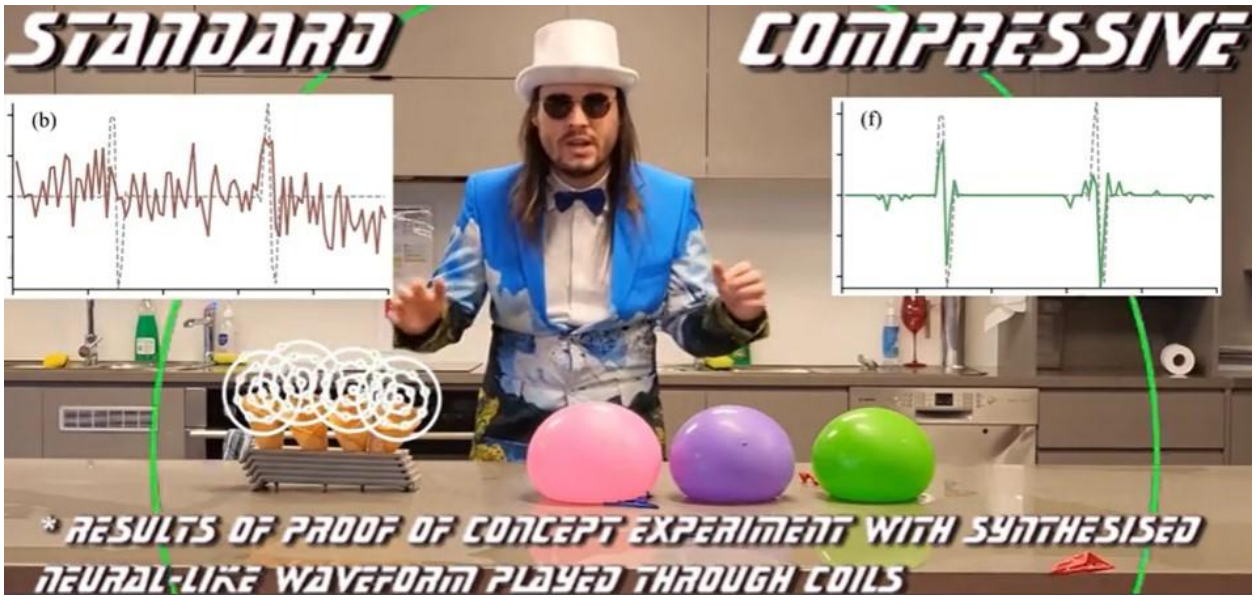
School of Physics and Astronomy News

August 2023



Still from Alex Tritt's entry to the Visualise Your Thesis competition 2023

Upcoming Events

6 Aug - Monash Open Day

14 Aug - Imaging teaching demonstrations

15 Aug - Imaging research seminars

16 Aug - Faculty of Science Equity, Diversity and Inclusion Committee Research Cakes Bake-Off

23 Aug @ 5:15pm - 3 Minute Thesis and Visualise Your Thesis competitions

24 Aug @ 1:30pm - SPA Equity, Diversity and Inclusion Committee meeting

30 Aug @ 2pm - School Colloquium: Assoc Prof Paul Lasky, Monash Astrophysics

31 Aug @ 3pm - joint seminar with MCEM by Prof Peter Moeck, Portland University. Co-convened by Prof Laure Bourgeois, MCEM and Department of Materials Science and Engineering.

8 Sep @ 10am - Entanglements with intangible materials: process and design in sound and science – featuring Dr Rosemary Mardling and Erkki Veltheim (Composer/Performer/Director)

Welcome

Welcome to our current and upcoming visitors: Wenzheng Lu (LMU), Yuri Levin (Columbia University) and Oliver Phillips (Imperial College London).

Welcome to new PhD students Hui Tong and Sergey Belkin!

News

Dean's Excellence in Teaching Award

Deputy Dean (Education) Richard Reina presenting Peter Skands with the Dean's Excellence in Teaching Award. Images by Anneliese Henjak.

Congratulations to Professor Peter Skands for winning the Dean's Excellence in Teaching Award, and to Dr Istvan Laszlo for a Commendation in the same category!

Individual category: Professor Peter Skands

Professor Peter Skands fosters a supportive and collaborative classroom atmosphere that encourages students to share their thoughts and ideas, and to actively participate in their own learning. In 4 years, ***PHS3302 Relativity and Particle Physics*** *has been raised to the highest international level while maintaining very high SETU scores, pioneering new pedagogical methods and technologies, incorporating new feedback and evaluation mechanisms, and changing the delivery to follow modern evidence-based recommendations.*

Commendation: Dr Istvan Laszlo

Based on educational research, Dr Laszlo facilitated the transition to ***Studio Learning****, created many new resources, activities, and assessments which provide automatic tailored feedback, hints, and marking, and developed a uniquely successful coding program interwoven into second year physics. These innovations have been successful and are frequently praised in SETU.*

Read more

31st International Symposium on Lepton Photon Interactions at High Energies, 17 - 21 July 2023

by **Eliot Walton**

Lepton-Photon introduction given by Prof Ulrik Egede. Image by Dr Yuki Fujii

The cold was biting the morning that Wurundjeri Elder Uncle Tony Garvey welcomed 219 particle physicists to the unceded lands of the Wurundjeri, Bunurong and Wadawurrung peoples for the 31st International Conference on Lepton-Photon Interactions hosted in the city of Melbourne, Australia. Although the distance to Melbourne is considerable, a broad range of nationalities were represented with about a third of participants being from Australia and the rest being from all over the world. About a third of these participants were students and around three-quarters were men.

The Physics Content

Over five days of pronouncements, presentations and posters a broad range of topics were covered. These topics included the current and future prospects in detector technologies; current advances in theoretical calculations with a particular focus on Effective Field Theories (EFTs); and improving diversity and outreach programs in physics. A large number of experiments presented results as well as results which prompted discussion, and started to build excitement for the next generation of measurements which seek to provide even more rigorous and insightful tests of the Standard Model of Particle Physics (SM) and improved

searches Beyond the Standard Model (BSM) physics. The results presented were too numerous to review comprehensively; however, they tended to skew towards flavour physics, with a particular emphasis on searches for Charge-Parity (CP) violation and Lepton Flavour Violation (LFV), and tests of Lepton Flavour Universality (LFU). Overall, tensions between the Standard Model (SM) expectation and experimental measurements of LFU remain.

Public Talk

On the penultimate evening of Lepton-Photon 2023, Professor Alan Duffy and Assistant-Professor Suzie Sheehy, author of *The Matter of Everything* presented a public lecture on *How to Discover a Universe*. Each speaker shared their passion for fundamental research and its applications, urging interest and curiosity on behalf of the attendees, a mix of conference participants, high-school students and the interested public. The talk concluded with a reminder that science is cultural as well as technological, and is useful for more than just solving problems; it may also enrich our lives.

Recognition and Awards

The conference was organised by the Monash University Particle Physics Group lead by Ulrik Egede, and so Lepton-Photon 2023 concluded at Monash University on July 21st, with the presentation of the conference poster awards. The judges request to make two additional commendations for excellent posters which were not however the best, showing the high quality of material on display. These commendations were awarded to Menai Lamers James for her poster on *The Hyper-Kamiokande Outer Detector* and to Meutia Wulansatiti for her poster on *The CMS Tracker Performance in Run3*. The Best Poster was awarded to Emily Filmer for her poster on *Searches for BSM physics using challenging long-lived signatures with the ATLAS detector*. The People's Choice was awarded to Eliot Jane Walton for her poster on *The Queer History of Physics*. Australia's small but growing particle physics community was extremely well represented and this conference has been vital in exposing the larger particle physics community to us. By this measure Lepton-Photon 2023 was a resounding success!

Read more

The gravitational wave background: discovering the deep voice of the universe

by **Valentina di Marco**

Image by Carl Knox, supplied by Valentina di Marco

In a groundbreaking global collaboration, Australian astronomers working in pulsar timing array experiments have recently unveiled the most compelling evidence to date of the stochastic gravitational wave background.

This cosmological signal could have originated from various sources, including supermassive black hole binaries scattered across the Universe. This represents a significant leap forward in our understanding of these mysterious gravitational waves and some of the deepest secrets of our Universe.

Gravitational Waves: From Einstein to Modern Discoveries

Back in 1916, Albert Einstein introduced the concept of four-dimensional space-time and proposed that significant cosmic events, such as merging black holes, generate ripples in the very fabric of space-time known as gravitational waves.

Fast forward almost a century to 2015, when researchers from the LIGO and Virgo collaborations achieved a groundbreaking milestone by directly detecting gravitational waves arising from the collision of two black holes with stellar masses.

Pulsar Timing Arrays Unravel Gravitational Mysteries

In contrast to the rapid oscillations observed in those gravitational waves, the pulsar timing array experiments focus on different types of gravitational waves vibrating at decade-long timescales.

The scientists working on these experiments are actively seeking gravitational waves emitted by binary supermassive black holes situated at the centre of galaxies, displaying oscillations spanning many years.

But the detection of these waves is hard as the signals are faint and require several years of continuous observations to be observed.

Data collected for almost two decades from CSIRO's Parkes radio telescope, Murriyang, has recently yielded its most compelling evidence to date in support of these low-frequency gravitational waves.

These latest findings were jointly presented by pulsar timing array teams worldwide, as part of the global collaboration known as the International Pulsar Timing Array (IPTA).

For close to two decades, the collaborative efforts of the pulsar timing array teams have been dedicated to observing a group of rapidly rotating stars known as pulsars, which emit pulses akin to a lighthouse beacon.

So in practice, this pulsar network is a galactic-sized detector listening to the collective humming produced by colliding black holes at the centre of galaxies.

Specifically, as gravitational waves wash over the pulsar-Earth system they cause tiny delays in the time of arrival of the pulses and this is what allows scientists to detect their presence.

Through meticulous compilation and analysis of this extensive dataset, scientists have now taken a significant step forward in the quest to detect gravitational waves through the study of pulsars.

Monash University's role in the discovery

Valentina di Marco and Rowina Nathan from Monash Astrophysics and the ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav), were part of the team involved in this significant discovery. They commented:

“The discovery of a gravitational wave background revolves around unravelling the intricacies of space-time and the fundamental nature of gravity. It represents a momentous breakthrough in our exploration of the natural world. This pursuit delves into the very essence of reality in the vast expanse of the universe, our home, and we are only at the initial stages of comprehending its true nature. We are very proud of making our contribution to this fundamental work”.

Stay tuned as scientists continue their relentless pursuit of unravelling the mysteries of gravitational waves and their profound implications for our understanding of the cosmos.

Rowina Nathan and Valentina di Marco toast advances in gravitational wave discovery. Image supplied by Valentina di Marco.

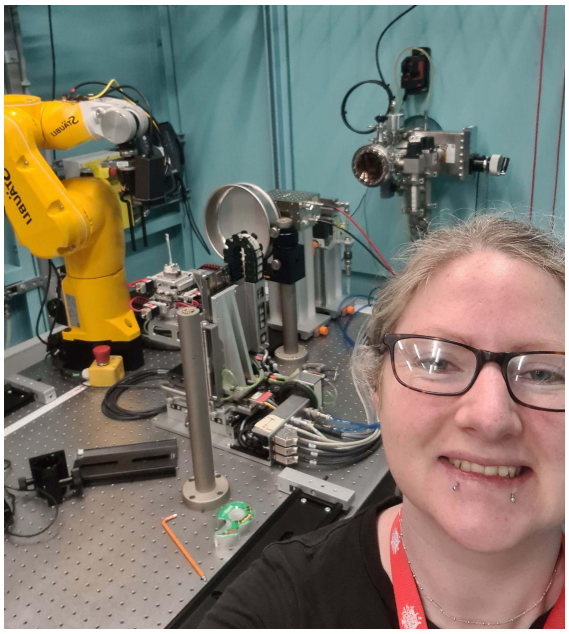
Paul Lasky joins the AAL Board of Directors

In a first for Monash Astrophysics, Associate Professor Paul Lasky has joined the Board of Directors at Astronomy Australia Limited. Congratulations to Paul!

AAL receives funding from the Australian Commonwealth Government to support Australian-based astronomers to access a range of world-class national and international astronomical facilities and to support various development projects to upgrade or develop future national and international astronomical infrastructure. The infrastructure goals supported by AAL are outlined in the Australian Academy of Sciences Astronomy Decadal Plan, which is set to be renewed in 2025. All members of Monash Astrophysics are encouraged to contribute towards the Decadal Plan; a process that is currently beginning.

Read more

AINSE Award for Michelle Croughan



Michelle Croughan at the Australian Synchrotron.

Congratulations to PhD student Michelle Croughan who has been awarded an AINSE Postgraduate Research Award, providing access to ANTSO's facilities to further enrich her research. Michelle will return to the Australian Synchrotron in September to participate in a collaborative experiment between SPA's Physics of Imaging group and a cystic fibrosis research group at the University of Adelaide.

From Michelle: 'Our goal is to use the new x-ray imaging technique I have developed during my PhD (Single-grid directional dark-field x-ray imaging) to measure structural changes in the bones and teeth of rats with cystic fibrosis'.

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3 Minute Thesis and Visualise Your Thesis competitions

Register here to support our PhD students Mitko Oldfield and Alex Tritt on 23 August at 5:15pm.

Mitko will present in the University round of the 3MT competition with his Faculty-round winning entry *Why is my device-y spicy?*

And congratulations to Alex for making the finals in the Visualise Your Thesis competition: *Compressive quantum sensing – why pay (with) more (atoms)?* - watch the video here.

Good luck Mitko and Alex!

Astronomical Society of Australia Annual Science meeting

More wins for our talented PhD students! At the Annual Science meeting of the [Astronomical Society of Australia](), Monash Astrophysics picked up -

Giulia Cinquegrana - best poster prize: *Stars that explode.*

Madeline Howell - honourable mention for talk: *Using Asteroseismology to Study Stellar Mass Loss and Multiple Populations in the Globular Cluster M80.*

Rowina Nathan - honourable mention for talk: *Improving pulsar-timing solutions through dynamic pulse fitting.*

Congratulations to Giulia, Madeline and Rowina!

Madeline Howell presenting at the Annual Science Meeting of the Astronomical Society of Australia, 3-7 July. Image supplied by Rowina Nathan.

Girls in Physics breakfast

FLEET sponsored the AiPs Girls in Physics breakfast at Monash University on 21 July, emceed by Giulia Cinquegrana. Meera Parish introduced FLEET Associate Investigator Dr Karen Livesey (University of Newcastle) to nearly 100 high school students who are considering a career in physics. As well as being a Superstar of STEM, Karen is a specialist in magnetic nanomaterials and is the Australian Institute of Physics Women in Physics Lecturer for 2023.

Calling all soccer enthusiasts

by **Pablo Resendiz Vazquez**

The SPA soccer team is looking for more players! We usually meet on Wednesdays from 5-7pm at the Monash Sports Futsal training pitches (day may change depending on weather conditions).

People can join through this slack channel where we discuss and decide what to do every week. No fees, and all players - new or experienced - are welcome!

Pablo Resendiz Vazquez, Ben Lowe and Sam Dekkers on the field.

School Manager/Occupational Health and Safety

The School is preparing for an OHS Audit on the 12th September.

The School's Safety personnel will be heavily involved on the day and in the leadup to the audit. The audit will also include a visit to a few workplaces, which will most likely include a teaching space and a few research laboratories. Please work to keep your workplaces tidy and following required OHS processes.

Please remember as per recent email communications;

1. Workplace Inductions and Building Access

- General Induction (given by Safety Officer, Manny Pumarol Crestar) and
- Local Area Laboratory/Studio Induction (given by laboratory supervisors/delegate)
- Training Needs Analysis, TNA checklist

Please send the following documents to physics.inductiontraining@monash.edu

2. Risk Assessments

When completing an electronic risk assessment in SARAH please remember to complete the Peer Review process, before submitting to your Supervisors for approval. Risk assessments should include supporting documentation including Safe Work Instructions.If you have any questions, on the above, please contact Robert Seefeld and/or Manny Pumarol Crestar(School Safety Officer).

Get to Know

Rowina Nathan, PhD student in Monash Astrophysics

Hi, I'm Rowina Nathan, a 2nd year PhD student in the department. I do pulsar timing, using rapidly and regularly spinning neutron stars to measure time. This has been quite topical lately, as on the 29th of June there was a coordinated release of the first evidence for the gravitational wave background. You can read more about this in Valentina's article above.

A few months ago I filmed a video talking about my research with OzGrav at a media training day, and this video received 2 million views on TikTok. Given the success of this video on Dr Sara Webb's TikTok and the media attention surrounding the pending gravitational wave background announcement, I decided to start my own TikTok. My first video got a million views overnight, and thus began my science communication career. It was very overwhelming having so much interest in my first video. I was obviously happy to see so many people interested in the science I do, but I was unable to keep up with the comments (both answering genuine questions and deleting the inappropriate ones).

It has been a wild ride. I have really enjoyed seeing the public interest in my work, and have been answering many questions. I even had an opportunity to be interviewed about the gravitational wave background on ABC News. I only had an hour's notice before going live, so it was a rush to get to the studio on time. I loved being on TV, and I hope I have more TV interviews in the future!

Since that first video, it has been a struggle to maintain momentum on social media. I don't have the motivation or the time to be putting out daily videos, to keep my followers interested. My PhD is my main priority, so I post sporadically here and there when I feel like it. Maintaining a following online as a science communicator is really a full-time job.

Anyway, if you want to see what I post about feel free to follow me, @pinkastrophysicist_ on TikTok, or @pinkastrophysicist on my much less popular instagram.

Recent Publications

Paraxial diffusion-field retrieval. *DAVID M. PAGANIN*, Daniele Pelliccia, *KAYE S. MORGAN*. Physical Review A (2023).

Effects of Floquet Engineering on the Coherent Exciton Dynamics in Monolayer WS2. Mitchell A. Conway, Stuart K. Earl, Jack B. Muir, Thi-Hai-Yen Vu, Jonathan O. Tollerud, Kenji Watanabe, Takashi Taniguchi, Michael S. Fuhrer, *MARK T. EDMONDS*, Jeffrey A. Davis. ACS Nano (2023).

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On the quantification of sample microstructure using single-exposure x-ray dark-field imaging via a single-grid setup. *HOW, YING YING*, *PAGANIN, DAVID M.*, *MORGAN, KAYE S.*. Scientific Reports, 13, 11001 (2023).

Nuclear Modification Factor of Neutral Pions in the Forward and Backward Regions in p -Pb Collisions. LHCb Collaboration, U. Egede, T. Hadavizadeh, R. D. L. Henderson, M. Singla & J. A. Ward et al. (1000+ authors not shown). Physical Review Letters, 131, 042302 (2023).

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Light Curves of Type IIP Supernovae from Neutrino-driven Explosions of Red Supergiants Obtained by a Semianalytic Approach. Shuai Zha, *BERNHARD MÜLLER*, Amy Weir, Alexander Heger. The Astrophysical Journal (2023).

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Measurement of antiproton production from antihyperon decays in pHe collisions at √sNN = 110 GeV. U. Egede, T. Hadavizadeh, R. D. L. Henderson, M. Singla & J. A. Ward et al. (1000+ authors not shown) Eur.Phys.J.C (2023).

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Now on YouTube

Michael Johnston

[A Spectrum of Semiconductor Photodetectors:from Nanowire Terahertz Sensors to Perovskite Solar Cells]

Valentina D'Orazi

[Breaking the Exoplanet Detection Barrier: Introducing SHARK-NIR for the Large Binocular Telescope]

Francesca Di Lodovico

[The Hyper-Kamiokande Experiment]

To suggest a story or other content please email karen.hewitt@monash.edu. Submissions are due by the last Monday of each month.