Marcus E. Lower | Curriculum Vitae

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PhD candidate studying pulsars and how we can better understand them through the application Bayesian inference techniques. Research interests include pulsar timing, tests of general relativity, neutron star magnetospheres and astrophysical inference of gravitational-wave sources.

Personal information

Present position: Astrophysics PhD Candidate (expected completion by Dec 2021).
Centre for Astrophysics and Supercomputing, Swinburne University of Technology, PO Box 218, Hawthorn, VIC 3122, Australia.

Citizenship: Australia, Canada.

Personal webpage: `https://astronomy.swin.edu.au/~mlower/`

Research experience

Swinburne University of Technology **Melbourne, Australia**
Ph.D. candidate, Centre for Astrophysics and Supercomputing *2018-present*

- *Support*: ARC Laureate Fellow PhD scholarship.
- *Supervisors*: Matthew Bailes and Ryan M. Shannon.
- *Thesis*: Application of astrophysical inference to next generation pulsar data sets.

Commonwealth Scientific and Industrial Research Organisation (CSIRO) **Sydney, Australia**
Ph.D. candidate, Astronomy and Space Science Division *2019-present*

- *Support*: CSIRO Astronomy and Space Science Studentship.
- *Supervisor*: Simon Johnston.

Swinburne University of Technology **Melbourne, Australia**
Research Intern, Centre for Astrophysics and Supercomputing *2018*

- *Responsibilities*: Vetting of 600 pulsars for the UTMOST timing program. Developed diagnostic tools for tracking telescope observation efficiency. Follow up parameter estimation of glitches.
- *Supervisors*: Matthew Bailes, Chris Flynn, Ryan M. Shannon and Adam Deller.

Education

Monash University **Melbourne, Australia**
Bachelor of Science with Honours (first class) in Astrophysics *2017*

- *Supervisors*: Eric Thrane, Paul D. Lasky and Rory J. E. Smith. Thesis resulted in a publication.
- *Thesis*: Detecting eccentricity in the orbits of merging binary black holes.

Monash University **Melbourne, Australia**
Bachelor of Science in Applied Mathematics and Astrophysics *2014-2016*

- *Thesis advisors*: Eric Thrane and Letizia Sammut.
- *Undergraduate thesis*: Can GW150914 reveal anything about dark matter?

Grants, scholarships and awards

Total awarded: $89,400

CSIRO Astronomy and Space Science Studentship, CSRIO, $5k *2019-2021*

Faculty of Science Engineering & Technology travel grant, Swinburne University, $3k *2018-2021*

ARC Laureate Fellow PhD Scholarship, Swinburne University, $81k *2018-2021*

OzGrav student travel grant, Swinburne University, $400 *2018*

- Covered travel costs for the ANITA Summer School and Workshop in Perth, Australia

Observing proposals

Principal-investigator:

Parkes Radio Telescope:

- PX057: Target of opportunity observations of Swift J1818.0−1607. Granted 8 hrs. *2020*
- PX060: Target of opportunity observation of SGR 1935+2154. Granted 3 hrs. *2020*
- PX067: Target of opportunity observation of SGR 1830+0645. Granted 1 hr. *2020*
- PX070: Target of opportunity observation of GRB 210119A. Granted 1 hr. *2021*
- P1102: A movie of a dynamic magnetar magnetosphere (NAPA). Granted up to 10.5 hrs. *2021*

MeerKAT:

- RB-P11: Timing the invisible B Pulsar of the Double Pulsar system. *2019-2021*
- RB-P12: Probing the magnetosphere of PSR J0737−3039B. *2019-2021*

Co-investigator:

Parkes Radio Telescope:

- P574: Young pulsar timing: Probing the physics of pulsars and neutron stars. Large science project, 370+ hrs. *2020-2021*
- P885: Understanding the remarkable behaviour of radio magnetars. Granted 107 hrs. *2019-2021*
- P1032: Mass measurements of southern binary pulsar systems. Granted 428 hrs. *2019-2021*

Teaching

Teaching Assistant:

- Monash University, Earth to cosmos (ASP1010; 1st-year undergraduate class). *2018*
- Monash University, Life in the Universe (ASP1022; 1st-year undergraduate class). *2017*

Outreach and service

Outreach activities

- Guinness World Record for the Most People Stargazing across Multiple Sites (Monash site). *2018*
- Monash University Open Day: science outreach and public engagement activities. *2017*
- Guinness World Record for the Most People Stargazing across Multiple Sites (Monash site). *2015*
- Monash University Open Day: first year physics lab demonstration. *2014*

Professional organisation memberships

- MeerTime Collaboration
- Parkes Pulsar Timing Array
- UTMOST Project
- OzGrav: The ARC Centre for Excellence for Gravitational-Wave Discovery (affiliate)
- Astronomical Society of Australia
- LIGO Scientific Collaboration

Media

- **Space Australia** *Parkes radio telescope spots bizarre magnetar in the Milky Way*. *2021*
- **The Age** *Unlocking the secrets of one of the universe's strongest magnets*. *2021*
- **CNET** *Astronomers trace mysterious fast radio burst to extreme, rare star*. *2020*
- **Space Australia** *Ancient distance measuring technique applied to magnetar*. *2020*
- **Space Australia** *The Dish helps study nearby magnetar*. *2020*
- **phys.org** *Mysterious spinning neutron star detected in the Milky Way proves to be an extremely rare discovery*. *2020*
- **Science Alert** *Strangely flaring dead star could be the 'missing link' between magnetars and pulsars*. *2020*
- **phys.org** *Ticking cosmic clocks reveal the evolution of stars over millions of years*. *2020*
- **Science Alert** *Astronomers have caught this pulsar glitching for the very first time*. *2019*
- **Space Australia** *Pulsar Glitches after 30 years*. *2019*

Skills

Programming languages: (proficient) Python, MATLAB, Bash, C shell, (familiar) Mathematica, Fortran90, (basic) C/C++, CUDA.

Software: PSRCHIVE, DSPSR, Tempo2, TempoNest, LIGO-LALSuite, LaTeX, GIT, SLURM, HTCondor.

Accumulated observing time: Parkes 150+ hrs.

Publications

Refereed publications: 43; **First author**: 4; **Citations**: 3600+ (62 first author); **h-index**: 24 (ADS)

Listed below are my first author publications in addition to publications where I made a *substantial* contribution as a co-author. I am also listed as a co-author on 26 LIGO Scientific Collaboration papers that not listed here, including the first LIGO-Virgo gravitational-wave transient catalogue (GWTC-1) and the GW190425 detection paper (2nd detected binary neutron-star merger).

First Author (refereed):

4. *The dynamic magnetosphere of Swift J1818.0−1607*
   M. E. Lower, S. Johnston, R. M. Shannon, M. Bailes & F. Camilo, MNRAS (2021), 502 127.
   • Covered by press release.
3. *Spectropolarimetric properties of Swift J1818.0−1607: a 1.4 s radio magnetar*
   M. E. Lower, R. M. Shannon, S. Johnston & M. Bailes, ApJL (2020) 896 L37.
   • Covered by press release.
2. *The UTMOST pulsar timing programme II: Timing noise across the pulsar population*
   M. E. Lower, M. Bailes, R. M. Shannon, S. Johnston, C. Flynn, S. Osłowski, V. Gupta, W. Farah, T. Bateman, A. J. Green, R. Hunstead, A. Jameson, F. Jankowski, A. Parthasarathy, D. C. Price, A. Sutherland, D. Temby & V. Venkatraman Krishnan, MNRAS (2020) 494 228.
   • Covered by press release.
1. *Measuring eccentricity in binary black hole inspirals with gravitational waves*
   M. E. Lower, E. Thrane, P. D. Lasky & R. Smith, PRD (2018) 98, 083028.

Co-Author (refereed):

13. *Effects of periodicity in observation scheduling on parameter estimation of pulsar glitches*
    L. Dunn, **M. E. Lower** & A. Melatos, MNRAS, submitted.
12. *Multi-frequency observations of SGR J1935+2154*
    M. Bailes, C. G. Bassa, G. Bernardi, et al., inc. **M. E. Lower**, MNRAS, accepted.
11. *The Relativistic Binary Programme on MeerKAT: Science objectives and first results*
    M. Kramer, I. H. Stairs, V. Venkatraman Krishnan, et al., inc. **M. E. Lower** MNRAS (2021) in press.
10. *Gravitational-wave Constraints on the Equatorial Ellipticity of Millisecond Pulsars*
    R. Abbott, T. D. Abbott, S. Abraham et al., inc. **M. E. Lower** ApJL (2020) 902 L21.
9. *Bayesian inference for compact binary coalescences with Bilby: Validation and application to the first LIGO−Virgo gravitational-wave transient catalogue*
   I. Romero-Shaw, C. Talbot, S. Biscoveanu, et al., inc. **M. E. Lower**, MNRAS (2020) 499 3295.
8. *A magnetar parallax*
   H. Ding, A. T. Deller, **M. E. Lower**, C. Flynn, S. Chatterjee, W. Brisken, N. Hurley-Walker, F. Camilo, J. Sarkissian, V. Gupta, MNRAS (2020) 498 3736.
   • Covered by press release.
7. *The MeerKAT Telescope as a Pulsar Facility: System verification and early science results from MeerTime*
   M. Bailes, A. Jameson, F. Abbate, et al., inc. **M. E. Lower**, PASA (2020) 37 e028.
6. *The Parkes Pulsar Timing Array Project: Second data release*
   M. Kerr, D. J. Reardon, G. Hobbs, R. M. Shannon, R. N. Manchester, S. Dai, C. J. Russell, S.-B. Zhang, W. van Straten, S. Osłowski, A. Parthasarathy, R. Spiewak, M. Bailes, N. D. R. Bhat, A. D. Cameron, W. A. Coles, J. Dempsey, X. Deng, B. Goncharov, J. F Kaczmarek, M. J. Keith, P. D. Lasky, **M. E. Lower**, B. Preisig, J. M. Sarkissian, L. Toomey, H. Wang, J. Wang, L. Zhang, X. Zhu, PASA (2020) 37 e020.

5. *The UTMOST Survey for Magnetars, Intermittent pulsars, RRATs and FRBs I: System description and overview*
V. Venkatraman Krishnan, C. Flynn, W. Farah, A. Jameson, M. Bailes, S. Osłowski, T. Bateman, V. Gupta, W. van Straten, E. F. Keane, E. D. Barr, S. Bhandari, M. Caleb, D. Campbell-Wilson, C. K. Day, A. Deller, A. J. Green, R. Hunstead, F. Jankowski, **M. E. Lower**, A. Parthasarathy, K. Plant, D. C. Price, P. A. Rosado & D. Temby, MNRAS (2020) 492 4752.

4. *Five new real-time detections of Fast Radio Bursts with UTMOST*
W. Farah, C. Flynn, M. Bailes, A. Jameson, T. Bateman, D. Campbell-Wilson, C. K. Day, A. T. Deller, A. J. Green, V. Gupta, R. Hunstead, **M. E. Lower**, S. Osłowski, A. Parthasarathy, D. C. Price, V. Ravi, R. M. Shannon, A. Sutherland, D. Temby, V. Venkatraman Krishnan, M. Caleb, S.-W. Chang, M. Cruces, J. Roy, V. Morello, C. A. Onken, B. W. Stappers & C. Wolf, MNRAS (2019) 488 2989.
- Covered by press release.

3. *The 2018 X-ray and Radio Outburst of Magnetar XTE J1810−197*
E. V. Gotthelf, J. P. Halpern, J. A. J. Alford, T. Mihara, H. Negoro, N. Kawai, S. Dai, **M. E. Lower**, S. Johnston, M. Bailes, S. Osłowski, F. Camilo, H. Miyasaka & K. K. Madsen,
ApJL (2019) 874 L25.

2. *Wideband polarized radio emission from the newly revived radio magnetar XTE J1810−197*
S. Dai, **M. E. Lower**, M. Bailes, F. Camilo, J. P. Halpern, S. Johnston, M. Kerr, J. Reynolds, J. Sarkissian & P. Scholz, ApJL (2019) 874 L14.

1. *Bilby: A user-friendly Bayesian inference library for gravitational-wave astronomy*
G. Ashton, M. Hübner, P. D. Lasky, C. Talbot, K. Ackley, S. Biscoveanu, Q. Chu, A. Divarkala, P. J. Easter, B. Goncharov, F. Hernandez Vivanco, J. Harms, **M. E. Lower**, G. D. Meadors, D. Melchor, E. Payne, M. D. Pitkin, J. Powell, N. Sarin, R. J. E. Smith & E. Thrane, ApJS (2019) 241 27.

Non-peer reviewed publications:

18. *FRB20210303A found by UTMOST*
A. Mandlik, V. Gupta, M. Bailes, A. Jameson, C. Flynn, T. Bateman, D. Campbell-Wilson, C. Day, A. Deller, W. Farah, A. J. Green, **M. E. Lower**, S. Oslowski, D. C. Price, R. Sekhri, A. Sutherland, G. Torr, G. Urquhart, T. Venville, ATel #14434 (2021).

17. *Non-detection of radio pulses from GRB 210119A/Swift J1851.2−6148 with Parkes*
M. E. Lower, R. Sengar, P. Kumar & R. M. Shannon, ATel #14347 (2021).

16. *VLBA detection of Swift J1818.0−1607*
D. Hao, A. T. Deller, **M. E. Lower** & R. M. Shannon, ATel #14005 (2020).

15. *Resurgence in the radio flux of the magnetar XTE J1810−197*
M. E. Lower, V. Gupta, C. Flynn, M. Bailes, A. Jameson, W. Farah, T. Bateman, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, A. Mandlik, S. Osłowski, A. Parthasarathy, D. C. Price, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #13840 (2020).

14. *FRB200607 found by UTMOST*
V. Gupta, M. Bailes, A. Jameson, C. Flynn, W. Farah, T. Bateman, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, A. Mandlik, **M. E. Lower**, S. Osłowski, A. Parthasarathy, D. C. Price, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #13788 (2020).

13. *No radio counterpart for IGR J18179−1621 detected during a serendipitous VLBA observation*
H. Ding, A. T. Deller, **M. E. Lower** & R. M. Shannon,
ATel #13737 (2020).

12. *FRB200508 found at UTMOST*
V. Gupta, M. Bailes, A. Jameson, C. Flynn, W. Farah, T. Bateman, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, A. Mandlik, **M. E. Lower**, S. Osłowski, A. Parthasarathy, D. C. Price, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #13715 (2020).

11. *Multi-band observations of Swift J1818.0−1607 with Parkes*
M. E. Lower & R. M. Shannon, ATel #13587 (2020).

10. *MeerKAT observation of the radio magnetar candidate Swift J1818.0−1607*
M. E. Lower, S. Buchner, S. Johnston, A. Parthasarathy, M. Geyer & M. Bailes on behalf of the MeerTime collaboration, ATel #13562 (2020).

9. *FRB191223 found at UTMOST*
V. Gupta, M. Bailes, A. Jameson, C. Flynn, W. Farah, T. Bateman, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, A. Mandlik, **M. E. Lower**, S. Osłowski, A. Parthasarathy, D. C. Price, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #13363 (2019).

8. *Detection of a glitch in PSR J0908−4913 by UTMOST*
M. E. Lower, M. Bailes, R. M. Shannon, S. Johnston, C. Flynn, T. Bateman, D. Campbell-Wilson, C. K. Day, A. Deller, W. Farah, A. J. Green, V. Gupta, R. W. Hunstead, A. Jameson, S. Osłowski, A. Parthasarathy, D. C. Price, A. Sutherland, D. Temby, G. Torr & G. Urquhart, V. Venkatraman Krishnan, RNAAS (2019) 3 192.
7. *FRB191107 found at UTMOST*
V. Gupta, M. Bailes, A. Jameson, C. Flynn, W. Farah, T. Bateman, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, A. Mandlik, **M. E. Lower**, S. Osłowski, A. Parthasarathy, D. C. Price, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #13282 (2019).
6. *FRB190806 found at UTMOST*
V. Gupta, M. Bailes, A. Jameson, C. Flynn, W. Farah, T. Bateman, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, **M. E. Lower**, S. Osłowski, A. Parthasarathy, D. C. Price, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #12995 (2019).
5. *Detection of FRB190322 at the Molonglo Radio Telescope*
V. Gupta, M. Bailes, A. Jameson, C. Flynn, W. Farah, T. Bateman, E. D. Barr, S. Bhandari, M. Caleb, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, F. Jankowski, E. F. Keane, **M. E. Lower**, S. Osłowski, A. Parthasarathy, K. Plant, D. C. Price, V. Ravi, R. M. Shannon, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #12610 (2019).
4. *Detection of FRB181228 at the Molonglo Radio Telescope*
W. Farah, M. Bailes, A. Jameson, C. Flynn, V. Gupta, T. Bateman, E. D. Barr, S. Bhandari, M. Caleb, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, F. Jankowski, E. F. Keane, **M. E. Lower**, S. Osłowski, A. Parthasarathy, K. Plant, D. C. Price, V. Ravi, R. M. Shannon, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #12335 (2018).
3. *Detection of low-frequency radio emission from the magnetar XTE J1810−197*
M. E. Lower, M. Bailes, A. Jameson, W. Farah, C. Flynn, V. Gupta, T. Bateman, E. D. Barr, S. Bhandari, M. Caleb, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, F. Jankowski, E. F. Keane, S. Osłowski, A. Parthasarathy, K. Plant, D. C. Price, V. Ravi, R. M. Shannon, A. Sutherland, D. Temby, G. Torr, G. Urquhart, V. Venkatraman Krishnan & T. Venville, ATel #12288 (2018).
2. *Two new FRBs discovered by UTMOST*
W. Farah, M. Bailes, A. Jameson, C. Flynn, V. Gupta, T. Bateman, E. D. Barr, S. Bhandari, M. Caleb, D. Campbell-Wilson, C. Day, A. Deller, A. J. Green, R. W. Hunstead, F. Jankowski, E. F. Keane, **M. E. Lower**, S. Osłowski, A. Parthasarathy, K. Plant, D. C. Price, V. Ravi, R. M. Shannon, A. Sutherland, D. Temby, G. Torr, G. Urquhart & V. Venkatraman Krishnan, ATel #12124 (2018).
1. *Detection of a glitch in the pulsar J1709−4429*
M. E. Lower, C. Flynn, M. Bailes, E. D. Barr, T. Bateman, S. Bhandari, M. Caleb, D. Campbell-Wilson, C. Day, A. Deller, W. Farah, A. J. Green, V. Gupta, R. W. Hunstead, A. Jameson, F. Jankowski, E. F. Keane, V. Venkatraman Krishnan, S. Osłowski, A. Parthasarathy, K. Plant, D. C. Price, V. Ravi, R. M. Shannon, D. Temby, G. Torr & G. Urquhart, RNAAS (2018) 2 139.

Presentations

1 colloquium, **7** conference/workshop talks, **4** department seminars, **2** posters at conferences.

Colloquia

1. *Massive scale pulsar timing with the Molonglo Observatory Synthesis Telescope*
ATNF Colloquium, CSIRO Marsfield, Sydney, Australia, Feb 2020 (**Invited**).

Conference and workshop presentations

7. *The radio magnetar XTE J1810−197: A galactic FRB analogue?*
2020 Astronomical Society of Australia Annual Scientific Meeting, held online, July 2020.
6. *The UTMOST pulsar timing programme*
10^{th} IPTA scientific meeting, Pune, India, June 2019.
5. *Bayesian pulsar timing and noise analysis with TempoNest*
10^{th} IPTA student workshop, NCRA, Pune, India, June 2019 (**Invited**).
4. *Profile domain timing: The future of pulsar timing?*
OzGrav Pulsar Timing Inference Workshop, Swinburne University of Technology, Melbourne, Australia, May 2019 (**Invited**).

3. *Pulsar inference tools*
   OzGrav Pulsar Timing Inference Workshop, Swinburne University of Technology, Melbourne, Australia, May 2019 (**Invited**).
2. *Measuring rotational instabilities in pulsars with the Molonglo telescope*
   ANITA 2019 workshop, Swinburne University of Technology, Melbourne, Australia, Feb 2019.
1. *Distinguishing eccentricity in binary black hole mergers with aLIGO*
   ANITA 2018 workshop, ICRAR Curtin University, Perth, Australia, Feb 2018.

Department seminars

4. *The dynamic magnetosphere of Swift J1818.0−1607*
   Invited journal club talk, Max-Planck-Institut für Radioastronomie, Bonn, Germany, Dec 2020.
3. *Introduction to Bayesian parameter estimation with Bilby*
   Astrophysics Coding Workshop, Swinburne University of Technology, Melbourne, Australia, Nov 2020.
2. *Exploring the spectropolarimetric properties of radio-loud magnetars*
   Mid-candidature colloquium, Swinburne University of Technology, Melbourne, Australia, Aug 2020.
1. *Application of astrophysical inference to next generation pulsar data sets*
   Confirmation of candidature colloquium, Swinburne University of Technology, Melbourne, Australia, Sept 2019.

Posters

2. *Characterising rotational irregularities in the radio pulsar population with UTMOST.*
   OzGrav Annual Retreat, Lorne, Australia, Nov 2019.
1. *Measuring eccentricity in binary black hole inspirals with gravitational waves.*
   Astronomical Society of Australia Annual Science Meeting, Melbourne, Australia, Jul 2018.