

# DR MATTHEW DAVID PITKIN

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## EMPLOYMENT

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- 2005 - present** University of Glasgow, Dept. of Physics and Astronomy  
**Post-doctoral Research Assistant**  
Working in the Institute for Gravitational Research (IGR) on gravitational wave data analysis using the LIGO and GEO 600 detectors.
- 2008** Max Plank Institut für Gravitationsphysik (Albert Einstein Institute), Hannover, Germany  
**Visiting Scientist**

## EDUCATION

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- 2002 - 2006** University of Glasgow  
**PhD in Astrophysics** - *Searches for continuous and transient gravitational waves from known neutron stars and their astrophysical implications*  
Supervisors: Dr. Graham Woan and Prof. Jim Hough
- Bayesian techniques in data analysis of gravitational wave data from the GEO 600 and the LIGO detectors as part of the LIGO Scientific Collaboration (LSC).
  - Developing and applying search techniques for gravitational waves from known pulsars.
  - Performing searches and developing vetoes for gravitational waves from quasi-normal mode oscillations of neutron stars.
- 1998 - 2002** University College London  
**M.Sci. (Hons) Astrophysics (First Class)**  
4<sup>th</sup> year research project (Supervisors - Prof. Steve Miller and Dr. Tom Stallard):
- *An infrared study of the Jovian aurora.*
- 3<sup>rd</sup> year field trip projects (at l'Observatoire de Haute Provence):
- *Imaging photometry of a pulsating variable.*
  - *Stellar spectroscopy with the 1.52 metre telescope.*

## TEACHING

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- 2007** University of Glasgow, **Lecture Course A1Y** - *Observations Methods.*
- 2002 - present** Demonstrator for the 3<sup>rd</sup> and 4<sup>th</sup> year undergraduate honours research labs at University of Glasgow Observatory. Tutor for 1<sup>st</sup> year undergraduate astronomy classes.
- Lecture:** University of Glasgow, Department of Adult and Continuing Education, Dark Energy school - *The search for gravitational waves*  
Extreme Astrophysics - *The search for gravitational waves*  
Life in the Cosmos - *Life in the Solar System*

## SKILLS

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- High level of programming skills in C and Matlab, with working knowledge of C++, Java, FORTRAN, HTML, IDL, python and bash scripting.
- Knowledge in GRID and web server applications and use of Condor job scheduling program.
- Proficient in both LINUX and Windows operating systems, including associated word processing and presentation applications and L<sup>A</sup>T<sub>E</sub>X document preparation language.
- French to A grade GCSE level, basic German.

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#### PROFESSIONAL AFFILIATIONS

- Fellow of the Royal Astronomical Society (FRAS).
- Member of the American Physical Society.

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#### SELECTED PUBLICATIONS

- 2007 J. Clark, I. S. Heng, M. Pitkin and G. Woan, *An Evidence Based Search For Gravitational Waves From Neutron Star Ring-downs*, *Phys. Rev. D*, **76**, 043003, gr-qc/0703138
- M. Pitkin and G. Woan, *Binary system delays and timing noise in searches for gravitational waves from known pulsars*, *Phys. Rev. D*, **76**, 042006, gr-qc/0703152
- B. Abbott et al (the LIGO Scientific Collaboration), M. Kramer and A. Lyne, *Upper limits on gravitational wave emission from 78 radio pulsars*, *Phys. Rev. D*, **76**, 042001, gr-qc/0702039
- 2005 B. Abbott et al (the LIGO Scientific Collaboration), M. Kramer and A. Lyne, *Limits on gravitational wave emission from selected pulsars using LIGO data*, *Phys. Rev. Lett.* **94**, 181103, gr-qc/0410007
- Conference proceedings*
- 2005 M. Pitkin for the LIGO Scientific Collaboration, *Searching for gravitational waves from known pulsars*, proceedings of GWDAW 9, *Class. Quant. Grav.*, **22**, 18, S1277, gr-qc/0505076
- 2004 M. Pitkin and G. Woan, *Searching for gravitational waves from the Crab pulsar - the problem of timing noise*, proceedings of Amaldi 5, *Class. Quant. Grav.*, **21**, 5, S843-S846, gr-qc/0312057
- Popular articles*
- 2004 M. Pitkin, *Making waves*, *Nexus News*.

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#### REFEREES

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## CONFERENCES AND SUMMER SCHOOLS

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### *Presented Talks*

- Jan 2008** 211<sup>th</sup> American Astronomical Society meeting, Austin, TX, USA. **Invited Talk**
- Dec 2007** Gravitational Wave Data Analysis Workshop 12, Boston, MA, USA. **Poster**
- Dec 2007** LSC-Virgo meeting, Boston, MA, USA. **Talk**
- Oct 2007** LSC-Virgo meeting, Albert Einstein Institute, Hannover, Germany. **Talk**
- Jul 2007** 7th Edoardo Amaldi Conference, Sydney, Australia. **Poster**
- Apr 2007** American Physical Society meeting, Jacksonville, FL, USA. **Talk**
- Mar 2007** LSC Meeting, Baton Rouge, LA, USA. **Talk**
- Mar 2007** Recontres de Moriond 2007, La Thuile, Italy. **Talk**
- Dec 2006** Gravitational Wave Data Analysis Workshop 11, Potsdam, Germany. **Talk**
- Nov 2006** LSC Meeting, MIT, Cambridge, Boston, MA, USA. **Talk**
- Oct 2006** GEO 600 meeting, The Lighthouse, Glasgow, UK. **Talk**
- Sep 2006** Royal Society GRB Discussion meeting, London, UK. **Poster**
- Aug 2006** LSC Meeting, Baton Rouge, LA, USA. **Talk**
- Jun 2006** LSC Meeting, MIT, Cambridge, Boston, MA, USA. **Talk**
- Apr 2006** American Physical Society meeting, Dallas, TX, USA. **Talk**
- Mar 2006** LSC Meeting (LIGO WA), Hanford, Washington, USA. **Talk**
- Nov 2005** LSC Meeting, MIT, Cambridge, Boston, MA, USA. **Talk**
- Jun 2005** LSC Meeting, University of Michigan, Ann Arbor, MI, USA. **Talk**
- May 2005** Cormack Meeting, University of St Andrews, St Andrews, UK. **Poster**
- Apr 2005** RAS National Astronomy Meeting, Birmingham, UK. **Two talks**
- Mar 2005** LSC Meeting (LIGO LA), Baton Rouge, LA, USA. **Talk**
- Dec 2004** Gravitational Wave Data Analysis Workshop 9, Annecy, France. **Talk**
- Nov 2004** LSC Meeting, MIT, Cambridge, Boston, MA, USA. **Talk**
- Jun 2004** LSC Meeting, Tufts University, Medford, Boston, MA, USA. **Talk**
- May 2004** Cormack Meeting, Royal Society of Edinburgh, Edinburgh, UK. **Talk**
- Mar 2004** LSC meeting (LIGO LA), Baton Rouge, Louisiana, USA. **Talk**
- Oct 2003** PPARC e-Science Summer School, NeSC, Edinburgh, UK. **Talk**.
- Jul 2003** 5th Edoardo Amaldi Conference on Gravitational Waves, Tirrenia (Pisa), Italy. **Poster**.
- Apr 2003** GEO 600 meeting, Albert Einstein Institute, Hannover, Germany. **Talk**

### *Others attended*

- Apr 2004** GEO 600 meeting, Universitat de les Illes Balears, Palma de Mallorca, Spain.
- Nov 2003** LSC meeting (LIGO WA), Hanford, Washington, USA.
- Oct 2003** UK GRAD school, Royal Albion Hotel, Brighton, UK
- Aug 2003** LSC meeting (GEO 600), Albert Einstein Institute, Hannover, Germany.
- May 2003** Cormack Meeting, University of Aberdeen, Aberdeen, UK.
- Mar 2003** LSC meeting (LIGO LA), Baton Rouge, Louisiana, USA.
- Oct 2002** GEO 600 meeting, Albert Einstein Institute, Golm, Germany.
- Sep 2002** PPARC Introductory Astronomy Summer School, Leeds, UK.

## PUBLIC TALKS

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Aidrie Public Observatory  
Stirling Astronomical Society  
Renfrewshire Astronomical Society  
Institute of Physics Evening Lecture, University of Sussex, Brighton, UK.  
Astronomy group seminar, University of Nottingham, Nottingham, UK.

## RESEARCH SUMMARY

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My research interests are the detection and study of gravitational radiation. Within this field I have played a lead role in searches for continuous gravitational wave signals and plan to apply my knowledge to other areas of analysis. The analysis methods that I have used within my research have built up my expertise in Bayesian statistical techniques, and I will continue to explore and exploit these in the detection and parameter estimation challenges to come.

Over the last three years I have spearheaded the effort to detect gravitational waves from known pulsars using data from the Laser Interferometric Gravitational-Wave Observatory (LIGO) and GEO600 gravitational wave detectors within the LIGO Scientific Collaboration (LSC). I have developed code to allow the search to include pulsars within binary systems and track pulsars with high levels of timing noise (Pitkin and Woan, 2007.) My analysis of data from the third and fourth science runs of LIGO and GEO600 has produced the best limits on gravitational wave emission from a large number of pulsars, including the first limits from pulsars within binary systems (Abbott *et al.*, 2007.) Analysis of data from the recently concluded fifth LIGO and GEO600 science run is currently underway and will include results for the majority of pulsars within our sensitive range. The highlight of this work so far has been that our limit on gravitational wave emission for the Crab pulsar is the first to beat that set by energy conservation arguments from the pulsar's observed spin-down. I plan to continue leading this search with current and future gravitational wave detectors. This work has been aided by collaboration with the pulsar astronomers Prof Andrew Lyne and Prof Michael Kramer at Jodrell Bank Observatory. I will maintain and strengthen this collaboration and also foster new ties with other astronomy groups to maximise the astrophysical input and output of our searches. During this work I have gained much experience dealing with real gravitational wave data, developing and testing software, and using the large-scale computational resources available to the LSC.

I have been involved in the development and application of a search for gravitational waves from neutron star ring-downs making use of Bayesian model selection methods (Clark, Heng, Pitkin and Woan, 2007.) Observations of ring-down, or continuous, signals from neutron stars will provide unique ways to constrain neutron star equations of state. These model selection methods provide a potentially powerful way of discriminating between real signals and detector artifacts and can be applied in many different search areas, and as a by-product can be used to perform parameter estimation. We have explored using this search to distinguish between a ring-down caused by a pulsar glitch, or soft  $\gamma$ -ray repeater flare, and detector noise, with the specific goal of targeting the times of observed glitches and flare. I am involved in the current analysis and further exploration of this technique for targeting triggers from  $\gamma$ -ray bursts and binary inspirals.

I am a participant in the mock LISA data challenges, which aims to develop tools to extract as much astrophysics from the future space-based gravitational wave detector LISA. I aim to use my knowledge of statistical techniques such as Markov Chain Monte Carlo (MCMCs) and Bayesian model selection within these challenges. The LISA work and my study of pulsars has also led me to look into aspects of gravitational wave detection using pulsar timing. In particular how this could be complementary to LISA and provide more astrophysical information than just one method alone.