AUSTRALIAN RESEARCH COUNCIL
Discovery - Projects
Proposal for Funding Commencing in 2015

DP

PROJECT ID: DP150100963

First Investigator: Dr Paul Jackson

Admin Org: The University of Adelaide

Total number of sheets contained in this Proposal: 164

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CERTIFICATION

Certification by the Deputy/Pro Vice-Chancellor (Research) or their delegate or equivalent in the Administering Organisation

I certify that—

- I have read, understood and complied with the ARC*Funding Rules for schemes under the Discovery Program for the years 2014 and 2015*, read in conjunction with *Part C - Scheme-specific rules for Discovery Projects for funding commencing in 2015*, and to the best of my knowledge all details provided in this Proposal form and in any supporting documentation are true and complete in accordance with these Funding Rules.
- Proper enquires have been made and I am satisfied that the Participants and the organisations listed in this Proposal meet the requirements specified in the ARC *Funding Rules for schemes under the Discovery Program for the years 2014 and 2015*, read in conjunction with *Part C - Scheme-specific rules for Discovery Projects for funding commencing in 2015*. I will notify the ARC if there are changes to any named Participant or organisation after the submission of this Proposal.
- To the best of my knowledge, all Conflicts of Interest relating to parties involved in or associated with this Proposal have been disclosed to this Administering Organisation, and, if the Proposal is successful, I agree to manage all Conflicts of Interest relating to this Proposal in accordance with the *Australian Code for the Responsible Conduct of Research* (2007).
- I have obtained the agreement, attested to by written evidence, of all the relevant participants and organisations necessary to allow the Project to proceed. This written evidence has been retained and will be provided to the ARC if requested.
- This Proposal is not substantially aimed at understanding or treating a human disease or health condition (as per the ARC definition of Medical and Dental Research located on the ARC website).
- This Proposal does not duplicate Commonwealth-funded research including that undertaken in a Commonwealth-funded Research Centre.
- If this Proposal is successful, I am prepared to have the Project carried out as set out in this Proposal and agree to abide by the terms and conditions of the ARC *Funding Rules for schemes under the Discovery Program for the years 2014 and 2015*, read in conjunction with *Part C - Scheme-specific rules for Discovery Projects for funding commencing in 2015* and the ARC *Discovery Projects Funding Agreement for funding commencing in 2015*.
- The Project can be accommodated within the general facilities in this organisation and, if applicable, within the facilities of other relevant organisations specified in this Proposal, and sufficient working and office space is available for any proposed additional staff.
- All funds for this Project will only be spent for the purpose for which they are provided.
- The Project will not be permitted to commence until appropriate ethical clearance(s) has/have been obtained and all statutory requirements have been met.
- I consent, on behalf of all the parties, to this Proposal being referred to third parties, who will remain anonymous, for assessment purposes.
- I consent, on behalf of all the parties, to the ARC copying, modifying and otherwise dealing with information contained in this Proposal.
- To the best of my knowledge, the Privacy Notice appearing at the top of this form has been drawn to the attention of all the Participants whose personal details have been provided at the Personnel section.

PART A - Administrative Summary (DP150100963)

A1. If this proposal is successful, which organisation will it be administered by?

Administering Organisation Name

The University of Adelaide

A2. Proposal Working Title

(Provide a short descriptive title of no more than 75 characters (approximately 10 words). Please refer to the Instructions to Applicants for further information.)

Data Mining for the Particle Physics of Dark Matter

A3. Person Participant Summary

	Person number	Family name	First name	Current organisation
1	1	Jackson	Paul	The University of Adelaide
2	2	White	Martin	The University of Adelaide
3	3	Edsjo	Joakim	Oskar Klein Centre
4	4	Conrad	Jan	Stockholm University
5	5	Buckley	Andrew	University of Glasgow, UK
6	6	Scott	Pat	McGill University, Canada

	Relevant organisation for this proposal	Role
1	The University of Adelaide	Chief Investigator
2	The University of Adelaide	Chief Investigator
3	Oskar Klein Centre	Partner Investigator
4	Oskar Klein Centre	Partner Investigator
5	University of Glasgow, UK	Partner Investigator
6	Imperial College London	Partner Investigator

A4. Organisation Participant Summary

	Organisation number	Short name	Name	Role
1	1	Adelaide	The University of Adelaide	Administering Organisation
2	2		Oskar Klein Centre	Other Organisation
3	3	Glasgow Uni	University of Glasgow, UK	Other Organisation
4	4	Imperial College London	Imperial College London	Other Organisation

A5. Proposal Summary

(Provide a written Proposal summary of no more than 750 characters (approximately 100 words) focussing on the aims, significance and expected outcomes and benefits of the project. Refer to Instructions to Applicants for further information.)

We propose a cutting-edge data mining research program designed to test a broad range of dark matter and new physics theories against a multitude of experimental datasets, with each theory to be simultaneously compared with every available dataset. The goal is to either uncover the identity of dark matter and carefully characterise it, or rule out and constrain different new physics theories, drawing deeply on the synergies between experiments. By deriving the best inventory of theoretical dark matter knowledge ever obtained, we will provide crucial information for the design of new dark matter experiments. This novel program of holistic analysis will drive the future direction of international particle astrophysics.

A6. Impact Statement

(In no more than 500 characters (approx 75 words), please outline the intended impact of the project. Refer to the Instructions to Applicants for further information.)

This project will develop state-of-the-art data mining techniques to uncover the nature of the dark matter in our universe. The results are of enormous scientific and cultural importance. Our new international collaborations will expand Australia's national research capacity and we will train students in new advanced data mining techniques that are crucial to the "big data" problems encountered in finance, political consultancy and government policy work.

PART B - Classification and other statistical information (DP150100963)

B1. Strategic Research Priorities

Does this proposal fall within one of the Strategic Research Priorities?

(Refer to the Instructions to Applicants for further information.)

Strategic Research Priority Selected

Yes

Select which of the Strategic Research Priorities the proposal falls within, and one or more of the relevant Priority Goals for the designated Strategic Research Priority.

	Strategic Research Priority Area	Strategic Research Priority Goal
1	Lifting productivity and economic growth	Deliver skills for the new economy

B2. Field of Research (FOR)

	Field of Research (FOR)	Field of Research (FOR) Percent
1	020203 - Particle Physics	100

B3. Socio-Economic Objective (SEO-08)

	Socio Economic Objective (SEO)	Socio Economic Objective (SEO) Percent
1	970102 - Expanding Knowledge in the Physical Sciences	100

B4. Keywords

	Keywords
1	Particle Physics
2	Weakly Interacting Massive Particles

B5. If the proposed research involves international collaboration, please specify the country/ies involved.

	International Collaboration Country Name
1	Sweden
2	Switzerland
3	United Kingdom

C1. Please upload a Project Description as detailed in the Instructions to Applicants in no more than 10 A4 pages and in the required format.

Attached PDF

PROJECT TITLE: Data Mining for the Particle Physics of Dark Matter

AIMS AND BACKGROUND

Aims

CI White and PI Scott have recently co-formed an international team of statisticians, particle physicists and astrophysicists (GAMBIT) to develop new data mining techniques for uncovering the Nature of dark matter. The most senior team experts in each field are present on this proposal as CIs and/or PIs. The proposed funding will provide supercomputing resources and personnel that are essential for the completion of the GAMBIT project, and will allow our named researchers to develop new techniques for the fast modelling of particle and astrophysics data that substantially extend the GAMBIT programme.

Specifically, we will:

1. Develop new computational techniques for combining all current astrophysics and particle physics dark matter data
2. Derive a new, comprehensive inventory of viable particle dark matter models
3. Provide information for the design of future astrophysical and collider dark matter searches

Relationship to funded research: The proposed research involves challenging problems at the boundary of particle physics, astrophysics and statistics. It is therefore not part of the programme of the Centre of Excellence for Particle Physics at the Terascale (CoEPP), which has a strict focus on elements of Large Hadron Collider (LHC) physics that exclude dark matter research.

Background

Decades of collider experiments have produced a Standard Model of particle physics that explains what the basic building blocks of the universe are and how they interact. The award of the 2013 Nobel Prize in physics to Higgs and Englert puts our understanding of the universe on its smallest scales at a turning point.

At the Nobel press conference, Englert declared that the most important remaining challenge in fundamental physics is to understand the strange "dark matter" that comprises 80% of the matter in the universe. Since the 1930s, cosmic microwave background measurements, microlensing searches and the theory of big bang nucleosynthesis have all indicated that most of the matter in our universe must be "non-baryonic" (i.e. not composed of ordinary matter such as protons and neutrons). One hypothesis states that dark matter is composed of tiny black holes produced in the early universe, though recent data from the NASA Kepler experiment has excluded a wide range of masses. More popular is the "WIMP hypothesis", under which dark matter consists of a new type of Weakly Interacting Massive Particle that interacts with ordinary matter via gravity and either the weak force or some new force in Nature. The WIMP hypothesis can reproduce the observed quantity of dark matter very precisely, provided that the mass of the WIMP is within the TeV range. This is precisely the range probed by our current astrophysical and particle experiments. **Testing the WIMP hypothesis to destruction is one of hottest topics in physics, occupying tens of thousands of physicists worldwide**.

WIMP physics at the TeV scale should show up in lots of places, including high-energy accelerator searches (such as the LHC and previous experiments), neutrino mass and mixing data, direct and indirect dark matter search experiments, low energy precision measurements, flavour physics, rare decays and in cosmology. Many experiments already show tantalizing hints of dark matter or other new TeV-scale physics [1]. The problem, common to most fields, is that we are generating data at a far higher rate than we are generating algorithms to evaluate that data. To test the WIMP hypothesis thoroughly, we need to compare a wide range of possible theoretical WIMP ideas against all current data, fully accounting for all relevant uncertainties, assumptions and correlations between datasets. One can then determine which, if any, scenarios remain viable. This is a formidable computational challenge, requiring new insights and

techniques. Whilst partial progress has recently been made in this direction (by various groups including our named investigators and their collaborators [2, 3]), the magnitude of the task and degree of technical difficulty have left it largely unexplored for the majority of theories and datasets.

This project will make the exploration of generic particle dark matter models computationally tractable for the first time. We will derive the most complete inventory of theoretical dark matter knowledge ever obtained, and use it to lead the development of new collider and astrophysical searches for dark matter. All future dark matter experiments will benefit from the results of this project.

RESEARCH PROJECT

Outcomes and impact

We here give a series of key results that will be produced in the fulfilment of each of the above aims.

Aim 1: Develop new computational techniques for combining all current astrophysics and particle physics dark matter data

Dark matter requires physics beyond the Standard Model and we do not know the correct theoretical origin of dark matter *a priori*. We must therefore proceed by taking candidate models, and using composite likelihood-based statistical fits to determine if the models provide a good match to all known experimental data. Many candidates for dark matter exist in the literature, including supersymmetric extensions of the Standard Model, extra-dimensional theories, composite Higgs models and phenomenological models involving extra forces and interactions. Given a model, one can predict the expected signature in a range of experiments, and calculate a likelihood from each experimental dataset (e.g. collider data, direct search data). Established Bayesian or Frequentist statistical techniques can then be used to map a composite likelihood surface in the model, giving us our bank of knowledge of the preferred model parameters and quality of fit. Comparative studies of many models can be used to hone in on the correct explanation for dark matter, and to design future experimental searches for the best models.

The first statistically rigorous global fits for particle dark matter models were only begun in the last ten years [4, 5, 6], in the context of very simple versions of the minimal supersymmetric standard model (MSSM) [7]. Subsequent analyses have improved the statistical and computational tools involved [3, 8, 9], examined small departures from the simplest models [10, 11], and added other astrophysical data to the fits. In all of these directions (observables, techniques and models), existing analyses are only just beginning to explore what can and must be done. The biggest problem is the immense computational expense of likelihood calculations. Predicting signatures in experiments from a set of physics model parameters requires detailed calculations that take up to 3 CPU hours to complete for typical processes. Each statistical fit may require billions of such calculations in a model with a large number of parameters, rendering the problem computationally intractable. An additional drawback of current studies is that they are often hard-coded for particular models.

Building on the previous work of the CIs and PIs (e.g. [12, 13, 14, 15, 16, 17]), we will extend current methods for statistically fitting dark matter models by a) speeding up calculations by orders of magnitude, b) considerably extending the amount of data considered in dark matter fits and c) building a flexible software framework capable of coupling generic dark matter models to current experimental datasets. The speed increases are not possible without the high performance computing infrastructure requested in this proposal. Implementing the extra data requires new personnel led by our CIs and PIs. The key outcome of Aim 1 will be a new tool (the Global and Modular Beyond-the-Standard-Model Inference Tool, or "GAMBIT") with which we can explore *any* model of WIMP physics with all current relevant data. This tool will be made publicly available, and will set a new standard in international particle physics and particle astrophysics.

Aim 2: Derive a new, comprehensive inventory of viable particle dark matter models

As outlined above, current attempts to examine which theories are capable of explaining the nature of dark matter are limited to theories with a few parameters, often relying on overly restrictive assumptions. Furthermore, current studies consider only a few of the many experimental handles we currently have on dark matter. Having developed the GAMBIT tool, we will make use of our new supercomputing resources to explore a much more general model set than any previously encountered. We will use a wide range of available data, including Higgs and supersymmetry searches at the LHC and its predecessors [18, 19, 20], low-energy accelerators [21, 22, 23, 24, 25], the magnetic moment of the muon, beam dump/fixed target searches for light bosons, electroweak precision tests, dark matter direct detection experiments, searches for antimatter in cosmic rays, nuclear cosmic ray ratios, radio data, effects of dark matter on reionisation, recombination and helioseismology, the observed dark matter cosmological abundance, neutrino masses and mixings, cosmic microwave background constraints, and other indirect dark matter searches [26]. We will be able to massively expand the range of data used in particle astrophysics studies due to the computational speed increases derived in Aim 1, and through the outstanding breadth of knowledge contained in the international members of the GAMBIT collaboration.

In choosing dark matter models to explore, we will make choices based on how much attention each model commands in the literature. Supersymmetry is arguably the most popular explanation for dark matter, and we will explore both the minimal supersymmetric model (MSSM), and topical extensions such as the next-to-Minimal-Supersymmetric Model (NMSSM) and the E6SSM (a supersymmetric grand-unified theory based on the exceptional group). We will also consider non-supersymmetric models such as extra-dimensional models, little Higgs models, and simple "portal" extensions of the Standard Model. Having fulfilled Aim 1, the limits of our studies will be constrained only by the available computing time and manpower, making this proposal essential in allowing us to perform this research in a timely fashion.

Aim 3: Provide information for the design of future astrophysical and collider dark matter searches

A comprehensive inventory of viable dark matter models is a key ingredient of designing future dark matter searches, at both collider experiments and in astrophysical experiments. All members of our research team combine their theoretical work in particle astrophysics with membership of one or more experimental collaborations, putting us in a unique position to promote the results of our theoretical investigations in Aim 2 at the most important dark matter experiments of the next decade.

CI Jackson, CI White and PI Buckley are members of the ATLAS experiment of the Large Hadron Collider at CERN, which will recommence data taking in 2015 at an unprecedented centre of mass energy. This is capable of producing dark matter particles directly in proton collisions. White and Jackson both have excellent track records in designing and implementing new search techniques and theoretical frameworks in collider experiments, and will use the results of Aim 2 to promote the design of new dark matter searches at current and future collider experiments. This will greatly improve the likelihood of dark matter discovery at Earth-based colliders.

CI White and PI Conrad are members of the Cherenkov Telescope Array (CTA) experiment, a large gamma ray facility due to commence data taking in 2016 that has a greater sensitivity and mass reach than any previous experiment by orders of magnitude. Jan Conrad leads the CTA working group for dark matter searches, and will work alongside White to provide theoretical insight in the design and optimisation of the telescope array. CTA is by far the largest and most important of the forthcoming indirect searches for dark matter, with the potential for the discovery or exclusion of the most popular WIMP candidates. PIs Conrad and Scott are members of the FERMI-LAT gamma ray experiment, and PIs Edsjo and Scott are members of the IceCube neutrino telescope collaboration. These provide orthogonal constraints on dark matter, and the results of this proposal can be promoted within these collaborations to extend current experimental techniques.

CI Jackson is a member of the Belle II collaboration, and an established international expert in flavour physics. This unique expertise within GAMBIT will enhance the scope of the project as Jackson leads the addition of collider observables from low-energy experimental searches and all aspects of precision flavour physics observables from B-, D- and K-meson measurements. CI Jackson designed and led measurements of the most relevant search channels with sensitivity to missing energy, and indirect dark matter constraints at the flavour factories. Furthermore, Jackson performed some of the most challenging

analyses searching for rare exotic signatures of out-of-time decays at the LHC which will add additional discriminatory power within the GAMBIT framework.

Significance:

Nobel Laureate Englert was correct in describing the origin of dark matter as the greatest unsolved mystery in fundamental physics. Tens of thousands of physicists worldwide are engaged in performing direct or indirect searches for dark matter, or analysing particle accelerator data for evidence of dark matter production. Our techniques are the best way of extracting theoretical knowledge of particle dark matter properties, and our ability to promote the results at the highest international level through our existing experimental connections is very rare in research of this type.

Australia's commitment to addressing these internationally-recognised challenges is highlighted by the strong support for related ongoing research programs. Of particular importance to the present proposal are: CI Jackson presently holds an ARC Future Fellowship to develop flavour physics and related LHC research techniques; ARC Laureate Fellow Prof. Anthony Thomas is also based at the administering organisation, and has developed new techniques for interpreting direct dark matter search results; Adelaide hosts a node of the CoEPP which sponsors LHC research not related to dark matter.

Given the large number of dark matter experiments due to launch in the next 5 years, the research described in this proposal is highly topical, and must be completed in a timely manner.

Advances

The ambitious research program described in this proposal will enhance the knowledge base of the discipline. Fulfilling the first aim of this proposal will require the development of new computational techniques, and a synthesis of knowledge from the distinct disciplines of particle physics, astrophysics and statistics. The methods will be applicable to a much wider class of problem than particle astrophysics. The depth of theoretical knowledge gained in this proposal will establish a new foundation for dark matter studies, in both the theoretical and experimental literature. By providing a bank of knowledge to experimental researchers, we will drive the direction of future experimental searches for dark matter.

Framework and deliverables

The key to the fulfillment of our physics goals is the ability to obtain profound speed increases in likelihood calculations, the ability to simulate more experimental datasets than ever before, and the ability to explore more general models than those considered by previous computational solutions. Solving these challenges will fulfill *Aims 1 & 2*.

In order to do this, we will develop several **new methodologies**. We will increase the speed of collider simulations by orders of magnitude using parallelised Monte Carlo simulation and machine learning, both of which CI White has pioneered in particle physics [12, 13]. The existing techniques have only been tested in parameter spaces with 4 parameters, and this project will extend them to cover generic parameter spaces with up to 24 parameters. CI White will also lead the development of new fast simulations of LHC detectors, which will be developed by parameterising the published LHC detector responses. On the astrophysical side, PI Edsjo has written the most pre-eminent software code for astrophysical dark matter calculations [17], and PI Scott has an excellent track record in developing innovative fast simulations of astrophysical signatures including neutrino telescope data [15], reionisation signatures[14] and gamma ray telescopes [9]. This project will require the extension of these simulations to cover new datasets, in addition to wholly new simulations of new experimental constraints. Further work by White to apply machine learning techniques to bottlenecks in these calculations will give extra speed increases.

Throughout, we will rely heavily on significant high performance computing resources, requiring a mix of conventional supercomputers and clusters. All code will be developed, tested and run in Adelaide on the dedicated Intel Xeon Phi clusters requested in Section D. Further speed increases will be obtained by using machine learning-based interpolations of key observables. Here, our CIs and PIs will benefit from access to a series of computing clusters around the world, including the NOTUR cluster in Norway and the *eResearch SA* resources in South Australia.

To fulfill *Aim 2*, we will perform global statistical fits of a wide range of new physics models. To enhance the breadth of data considered in our studies, the GAMBIT collaboration is the only fitting collaboration to have dedicated flavour physics experts, led by CI Jackson. Along with B-physics data, constraints from precision electroweak observables, rare kaon decays and the magnetic moment of the muon will be provided. Precise measurements of rare decays of mesons involving b-quarks at the BaBar, Belle and, more recently, LHCb experiments are sensitive to contributions from heavy particles in loop mediated processes. Hints of deviations from the SM have already be seen [21, 22], and Jackson will develop new techniques for adding these results to the GAMBIT framework. Taken together with the innovative astrophysical simulations described above, this guarantees that our data sources will be the most wide ranging of any current collaboration. Throughout the lifetime of the project, datasets will continue to expand as running experiments amass exponentially more data, along with a cornucopia of new experiments commencing. The project will extract sensitive results by combining data from: (colliders) ATLAS, CMS, LHCb, Belle-II, (gamma rays) CTA, HESS-II, FERMI-LAT, (direct dark matter observatories) CDMS-II, XENON100, LUX, DarkSide, KIMS, CoGENT, HAWC, (satellites) PAMELA and AMS-02. Furthermore, CI Jackson will work throughout the project to interface some of the more challenging exotic decay channels pursued in collider physics including long-lived meta-stable particles, an area where he is a world leader. Finally, CI White and PIs Scott and Conrad will lead the development of a modular software framework capable of interfacing generic physics models to our new calculational tools, allowing any dark matter model to be explored using current data. This will include the development of a new sampling technique based on differential evolution [32], allowing us to sample large spaces more quickly and robustly than ever before. This is the crucial metholodogy that will enable us to move far beyond the state-of-the-art.

Aim 3 requires promotion of our theoretical results at leading experiments worldwide. Here we will make use of the experimental affiliations of our named researchers, and build on the proven track record of our researchers in promoting original theoretical results at the Large Hadron Collider and within astrophysical experiments.

A suggested list of milestones is provided in Table 1. We will start by delivering the core GAMBIT software code, then examine the most popular minimal SUSY models before moving on to non-standard and non-SUSY scenarios. Given that the GAMBIT team numbers 22 people in total (plus the researchers we will hire in Adelaide), we expect to work on several of these models in parallel.

Feasibility

Timing and Delivering the program: The data sets we will utilise in this proposal are assured, and the rich variety of data expected in the next five years guarantees that we will obtain interesting results even if a few experiments fall behind schedule. The core challenge is instead in ensuring that our likelihood calculation time can be reduced enough to obtain convergent fits in a 24 dimensional space. The benchmark figures from previous studies [2, 12, 13, 8] indicate that this is feasible (with a total calculation time of < 30s) and CI White has proven the techniques for speeding up LHC likelihood calculations in previous studies [12, 13]. In addition, recent advances in automated matrix element calculation (e.g. [28, 29, 30]) will allow the GAMBIT software framework to establish an interface to generic physics models without having to reinvent the technology required to do so.

The GAMBIT team: This project will benefit from international collaboration with the 22 members of the GAMBIT collaboration, a team of particle physicists, astrophysicists and statisticians from Aachen, Adelaide, Amsterdam, CERN, Glasgow, Harvard, Imperial College, LPC Clermont-Ferrand, Monash, the Oskar Klein Centre (Stockholm), Oslo, Sydney, Utah and Zurich. The team has been carefully assembled by the CIs and PIs to contain all key expertise relevant to the dark matter problem. **This proposal features the six leading collider physics and astrophysical researchers on GAMBIT**. The CIs and PIs have established records of excellence in key areas including statistical techniques (White, Scott, Conrad), the invention of novel simulations for particle astrophysics (White, Scott, Edsjo, Buckley) and flavour physics (Jackson). This range of expertise will provide excellent support for the work in this project, building on an outstanding track record of international innovation.

Table 1: A selection of key milestones to be met by the project

Milestone	Date Commenced	Date Achieved	Outcome
First convergent fit achieved (pMSSM)	January 2015	June 2015	First physics exclusion paper from GAMBIT (24 parameter SUSY space). Make software codes available, publish manuals.
Add new astrophysical data, extend framework to complex SUSY models	March 2015	September 2015	Publish updated results on SUSY dark matter (pMSSM) Publish new results in complex SUSY model.
Add the first high-energy LHC constraints	October 2015	July 2016	Publish first global new physics constraints with high energy LHC data (pMSSM, complex SUSY)
Extend framework to examine non-SUSY models	February 2016	December 2016	Publish first global new physics constraints on leading non-SUSY models
Addition of first data from SuperKEKB flavour factory	December 2016	December 2017	A paper detailing the precise exclusion from low- and high-energy collider studies in tandem with astrophysics
Data from CDMS-II, LUX, XENON-II and other direct dark matter detection experiments added	December 2017	October 2018	A full analysis of all relevant physics models consistent with all astrophysical, collider and direct DM experiments performed for the first time
Legacy results from Run II of LHC experiments (ATLAS, CMS, LHCb)	July 2018	April 2019	A full picture of the contribution to constraining DM signals from LHC experiments obtained
First data from CTA included into fits	January 2019	October 2019	Legacy paper, data from all proposed sources included

Benefits

The outcomes of this research will have world class impact. We will inspire the next generation of dark matter searches, develop the most complete theoretical knowledge of dark matter yet obtained and set a new standard in computational particle astrophysics. This project puts Australia at the cutting edge of particle physics and astrophysics research, and will improve links between Australian researchers and leading institutions in Europe such as the Oskar Klein Centre in Stockholm, the University of Glasgow and Imperial College London. In the broader context, the national benefit will also include capturing the public interest, and increasing the prestige of Australian science.

Strategic Research Priority: This research falls under "Lifting productivity and economic growth", in particular the sub-categories "deliver skills for the new economy" and "maximise Australia's competitive advantage in critical sectors". The proposed research involves developing new algorithms for crunching large data sets, and using high performance computing to make expensive calculations tractable. To give one example of where these skills are useful, consider the Australian financial sector, the largest industry in Australia by ASX market capitalization (almost 50% larger than the mining and resources sector). Several students (including Dr Marco Bartolozzi, Dr Benjamin Lasscock and Dr Peter Moran) who have recently completed their postgraduate studies in theoretical physics at the University of Adelaide have gone on to obtain employment in the finance industry. Other recent examples include Dr John Hedditch who, after a period of time at BHP Billiton, is now at Google, and Dr Dale Roberts who is now at NCI NF. We will be developing new techniques for optimisation based on differential evolution that are of primary importance in financial modelling.

Targeted Research Area: This research falls under "Pattern recognition and data mining". White and Buckley have previously published novel statistical techniques in the computing literature [13], and White has already introduced research projects on data mining into the University of Adelaide undergraduate curriculum. "Big data" is one of the central concepts of modern political discussion (see, for example, *Foreign Affairs* [31]), and this research will develop new methods for making inferences with large datasets, using all current collider and astrophysical data as the data source. The students trained by White and Jackson will be able to apply exactly the same techniques to government or industry work.

Meeting the objectives of the Discovery Projects scheme

This project is a state-of-the-art programme of particle physics and astrophysics involving an outstanding international team of researchers. It will enhance the scale and focus of research in the Strategic Research Priority of "Lifting productivity and economic growth" as described above. The project will expand Australia's knowledge base and research capability by generating new data analysis techniques and a world-leading knowledge of dark matter theory that will open up new possibilities for experimental searches. The University of Adelaide is an excellent environment for student training, and our students will also get frequent opportunities to work and network overseas. By forging new links with Imperial College London, the University of Glasgow and the Oskar Klein Centre at Stockholm University, we will significantly enhance international collaboration in research.

ROLE OF PERSONNEL

Both CIs will take full responsibility for directing and guiding the overall research program. Our PIs have all been chosen to provide essential and complementary expertise, and will take responsibility for key elements of the research programme.

In particular, our CIs will:

1. Play a leading role in the development of the GAMBIT tool, and identify which physics studies should be performed in each year of the project

2. Provide expertise on machine learning and parallel supercomputer techniques for all aspects of GAMBIT

3. Identify and lead the implementation of collider dark matter observables (LHC and flavour) throughout the life of the project

4. Lead the discussion and interpretation of the analysis of results, and promote the results at the LHC, CTA and Belle-II

5. Mentor and guide the overall education and training of the RAs at all stages

6. Co-supervise all PhD students affiliated to the project.

Our PIs will:

1. Assist in the development of fast LHC simulations (Buckley)

2. Provide more general algorithms for astrophysical dark matter calculations (Edsjo, Conrad, Scott)

3. Provide expertise on statistical techniques in particle astrophysics (Conrad, Scott)

4. Co-lead the development of a modular C++ framework for the GAMBIT system (Scott, Conrad)

Our PhD students and RAs will be organised as follows:

1. The first two PhD students, commencing in 2015, will be allocated to topics in Large Hadron Collider phenomenology and dark matter theory. An RA will be hired with expertise in dark matter constraints. The second two students, commencing in 2017, will focus on flavour physics, legacy LHC results and the implementation of the first CTA constraints on dark matter. A second RA will be hired in 2017 with primary expertise in collider phenomenology (including low energy measurements).

The research associates will be actively involved in all stages of this research program, with each focusing on their specific area of expertise, namely particle astrophysics and flavour physics, respectively. The RAs will also gain important experience by assisting in the supervision of Postgraduate and Honours Students.

RESEARCH ENVIRONMENT

The University of Adelaide is a research intensive university and a member of the Group of Eight. It is consistently ranked within the top 1% of universities worldwide, based on the Times Higher Education, QS and Jiao Tong Rankings. In the Times rankings of 2010-11, Adelaide ranked thirty-fourth in the world in Physical Sciences. The University has identified the discipline of Physics as a major research strength in a strategic area relating to National Research Priorities. In the recent Excellence in Research Australia (ERA) rankings administered by the ARC, Physical Sciences (FoR 02) at the University of Adelaide received the highest ranking of 5, which included a ranking of 5 for Astronomical & Space Sciences (FoR 0201). Nuclear and particle physics in Adelaide are being reinvigorated by the Centre for Complex Systems and the Structure of Matter, and the Centre of Excellence in Particle Physics at the Terascale. These research strengths will continue to grow, with particular focus on particle physics phenomenology. The physics department in Adelaide boasts current or former members of the ATLAS, Auger, BaBar, Belle, Belle-II, Fermi-LAT, HESS and Ice Cube experimental collaborations, providing the *breadth of knowledge and unique collection of expertise* that make Adelaide the ideal location to perform the physics outlined in this project. It is therefore no surprise that the University of Adelaide has achieved "outstanding performance well above world standard" in the research area of the current proposal.

The University of Adelaide also plays host to *eResearch SA* which maintains extensive supercomputing facilities, and is committed to exploring the new architectures requested in this proposal. This infrastructure significantly facilitates the research to be carried out in this proposal. The CIs have extensive experience in coordinating and implementing research programs on such computing resources. This experience is vital for creating a high quality research environment where students will receive training in

advanced analytical techniques, modeling and high-performance computing. Particle physics and astronomy regularly attract top students from across the state. To give one example, White's current student Sophie Underwood is a recipient of the University of Adelaide H. S. Green prize for Mathematical and Theoretical Physics.

"The Oskar Klein Centre for Cosmo Particle Physics" (OKC) at Stockholm University was created in July 2008 and financed by the Swedish Research Council for a period of ten years. OKC employs over 100 scientists with expertise in theory and experiment, particle physics, cosmology and astrophysics. One of the chief aims of the centre is to perform experimental searches for particle candidates of dark matter and, if found, determine their properties and establish an underlying theoretical framework.The combination of research expertise at the OKC makes it a truly unique place to perform research in the area of particle astrophysics and cosmology. PI Conrad is an experimentalist and a member of the OKC steering group while PI Edsjo is a theorist and is one of the leading professorial figures in the centre.

The University of Glasgow School of Physics & Astronomy is one of the leading Physics departments in the UK. In the most recent Research Assessment Exercises (RAE2008) 40% of research was rated 3* (internationally excellent), and a further 20% was rated 4* (world-leading). Glasgow has world leading experimental and theoretical particle physicists, providing PI Buckley with an excellent level of support.

The Department of Physics at Imperial College London has 45% of research rated 3* (internationally excellent), and 20% rated 4* (world-leading). PI Scott will be supported by a world leading group in astrophysical inference, including renowned researcher Dr Roberto Trotta.

COMMUNICATION OF RESULTS

Research results will be published in internationally renowned refereed journals including Physical Review Letters, Physical Review, Physics Letters, Journal of High Energy Physics, Journal of Cosmology and Astroparticle Physics, Nuclear Physics and Physics Reports. They will also be presented at international conferences and published in the associated conference proceedings wherever possible. Colloquia, seminars and public lectures will be given by the the CIs and the RAs. These international presentations are essential to ensure the promotion and propagation of the research results to other scientists and the field at large. In addition, White and Jackson have records of excellence in outreach, including a national touring show on the Science of Dr Who and lecture tours of Australian schools. New initiatives for public communication will be developed during the course of the project.

MANAGEMENT OF DATA

This project will generate large amounts of data in the form of samples of viable dark matter models generated by the GAMBIT software code. The GAMBIT code itslf also constitutes "data", since it provides fast implementations of an exhaustive list of public particle astrophysics data. We here briefly sketch our data management policy:

- The GAMBIT software code will be stored in a git repository on the popular HepForge development server for high energy physicists. This is a free development environment for high energy physics projects and is a standard in the field. The development code is only accessible by GAMBIT members, but we will also make public code releases available through the HepForge framework. All results (code and output data) will be stored for at least 10 years after the end of the project. The entire code repository is also mirrored on github which provides an essential backup.

- Samples of viable dark matter models will be documented in a series of journal publications, with the raw data stored in the HepData archive (a sister project to the HepForge framework). This is maintained externally at no cost, and is the standard repository of high energy physics data. The samples will therefore be freely available to any interested parties, including theoretical researchers and experimental collaborations.

- Ownership of all results of this project will be held jointly by all associated researchers in addition to the members of the GAMBIT collaboration.

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C2. Medical and Dental Research Statement

(If applicable, in no more than 750 characters (approx. 100 words), please justify why this Project does not constitute Medical and Dental Research as defined on the ARC website. Refer to the Instructions to Applicants for further information.)

Not applicable.

PART D - Project Cost (DP150100963)

D1. What is the proposed budget for your project?

(Please provide details of the budget proposed for your project.)

Proposal Funding Summary

Total requested budget: $955336

Year 1

Description	ARC	AdminOrg		Other Organisation	
	Cash	Cash	In-kind	Cash	In-kind
Direct Cost	151550	29134	26496	0	110990
Personnel	105750	26634	26496	0	110990
Research Associate Level A Step 8 + on costs (28% ARC/1.5% UA)	104750	1228	0	0	0
CI White Level B 0.2 FTE + on costs	0	0	26496	0	0
PI Edsjo 0.2 FTE + on costs	0	0	0	0	40500
PI Conrad 0.2 FTE + on costs	0	0	0	0	34020
PI Buckley 0.2 FTE + on costs	0	0	0	0	16470
PI Scott 0.25 FTE + on costs	0	0	0	0	20000
Teaching Relief CI White	1000	0	0	0	0
PhD stipend - Divisional Scholarship 1	0	25406	0	0	0
Equipment	27000	0	0	0	0
2 Servers each with Intel Xeon Phi Co-processors (or equivalent)	23000	0	0	0	0
Installation costs for 2 servers at eResearch SA ($1000 each)	2000	0	0	0	0
Maintenance costs for 2 servers at eResearch SA ($1000 per server)	2000	0	0	0	0
Maintenance	0	2500	0	0	0
Student Maintenance	0	2500	0	0	0
Travel	14000	0	0	0	0
Overseas conference attendance CIs	5000	0	0	0	0
Overseas conference attendance RA	5000	0	0	0	0
National Conference attendance RA and PhD students	4000	0	0	0	0
International Collaboration Award	4800	0	0	0	0
Martin White	4800	0	0	0	0

Year 2

Description	ARC	AdminOrg		Other Organisation	
	Cash	Cash	In-kind	Cash	In-kind
Direct Cost	189027	31652	26893	0	110990
Personnel	132727	26652	26893	0	110990
Research Associate Level A Step 8 + on costs (28% ARC/1.5% UA)	106321	1246	0	0	0
CI White Level B 0.2 FTE + on costs	0	0	26893	0	0
PI Edsjo 0.2 FTE + on costs	0	0	0	0	40500

Description	ARC	AdminOrg		Other Organisation	
	Cash	Cash	In-kind	Cash	In-kind
PI Conrad 0.2 FTE + on costs	0	0	0	0	34020
PI Buckley 0.2 FTE + on costs	0	0	0	0	16470
PI Scott 0.25 FTE + on costs	0	0	0	0	20000
Teaching Relief CI White	1000	0	0	0	0
PhD stipend - International Scholarship 1	25406	0	0	0	0
PhD stipend - Divisional Scholarship 1	0	25406	0	0	0
Equipment	27000	0	0	0	0
2 Servers each with Intel Xeon Phi Co-processors (or equivalent)	23000	0	0	0	0
Installation costs for 2 servers at eResearch SA ($1000 each)	2000	0	0	0	0
Maintenance costs for 2 servers at eResearch SA ($1000 per server)	2000	0	0	0	0
Maintenance	2000	5000	0	0	0
Ongoing maintenance of eResearchSA hosted servers from previous years ($1000 per server)	2000	0	0	0	0
Student Maintenance	0	5000	0	0	0
Travel	12500	0	0	0	0
Overseas conference attendance CIs	5000	0	0	0	0
Overseas conference attendance RA	5000	0	0	0	0
National Conference attendance RA and PhD students	2500	0	0	0	0
International Collaboration Award	14800	0	0	0	0
Martin White	4800	0	0	0	0
Pat Scott	10000	0	0	0	0

Year 3

Description	ARC	AdminOrg		Other Organisation	
	Cash	Cash	In-kind	Cash	In-kind
Direct Cost	218028	62077	27297	0	110990
Personnel	159728	52077	27297	0	110990
Research Associate Level A Step 8 + on costs (28% ARC/1.5% UA)	107916	1265	0	0	0
CI White Level B 0.2 FTE + on costs	0	0	27297	0	0
PI Edsjo 0.2 FTE + on costs	0	0	0	0	40500
PI Conrad 0.2 FTE + on costs	0	0	0	0	34020
PI Buckley 0.2 FTE + on costs	0	0	0	0	16470
PI Scott 0.25 FTE + on costs	0	0	0	0	20000
Teaching Relief CI White	1000	0	0	0	0
PhD stipend - International Scholarship 1	25406	0	0	0	0
PhD stipend - International Scholarship 2	25406	0	0	0	0
PhD stipend - Divisional Scholarship 1	0	25406	0	0	0
PhD stipend - Divisional Scholarship 2	0	25406	0	0	0
Equipment	27000	0	0	0	0

Description	ARC	AdminOrg		Other Organisation	
	Cash	Cash	In-kind	Cash	In-kind
2 Servers each with Intel Xeon Phi Co-processors (or equivalent)	23000	0	0	0	0
Installation costs for 2 servers at eResearch SA ($1000 each)	2000	0	0	0	0
Maintenance costs for 2 servers at eResearch SA ($1000 per server)	2000	0	0	0	0
Maintenance	4000	10000	0	0	0
Ongoing maintenance of eResearchSA hosted servers from previous years ($1000 per server)	4000	0	0	0	0
Student Maintenance	0	10000	0	0	0
Travel	12500	0	0	0	0
Overseas conference attendance CIs	5000	0	0	0	0
Overseas conference attendance RA	5000	0	0	0	0
National Conference attendance RA and PhD students	2500	0	0	0	0
International Collaboration Award	14800	0	0	0	0
Martin White	4800	0	0	0	0
Pat Scott	10000	0	0	0	0

Year 4

Description	ARC	AdminOrg		Other Organisation	
	Cash	Cash	In-kind	Cash	In-kind
Direct Cost	206847	34190	55414	0	110990
Personnel	161347	26690	55414	0	110990
Research Associate Level A Step 8 + on costs (28% ARC/1.5% UA)	109535	1284	0	0	0
CI White Level B 0.2 FTE + on costs	0	0	27707	0	0
PI Edsjo 0.2 FTE + on costs	0	0	0	0	40500
PI Conrad 0.2 FTE + on costs	0	0	0	0	34020
PI Buckley 0.2 FTE + on costs	0	0	0	0	16470
PI Scott 0.25 FTE + on costs	0	0	0	0	20000
Teaching Relief CI White	1000	0	0	0	0
PhD stipend - International Scholarship 1	25406	0	0	0	0
PhD stipend - International Scholarship 2	25406	0	0	0	0
PhD stipend - Divisional Scholarship 2	0	25406	0	0	0
CI Jackson Level B 0.2 FTE + on costs	0	0	27707	0	0
Equipment	27000	0	0	0	0
2 Servers each with Intel Xeon Phi Co-processors (or equivalent)	23000	0	0	0	0
Installation costs for 2 servers at eResearch SA ($1000 each)	2000	0	0	0	0
Maintenance costs for 2 servers at eResearch SA ($1000 per server)	2000	0	0	0	0
Maintenance	6000	7500	0	0	0
Ongoing maintenance of eResearchSA hosted servers from previous years ($1000 per server)	6000	0	0	0	0

Description	ARC	AdminOrg		Other Organisation	
	Cash	Cash	In-kind	Cash	In-kind
Student Maintenance	0	7500	0	0	0
Travel	12500	0	0	0	0
Overseas conference attendance CIs	5000	0	0	0	0
Overseas conference attendance RA	5000	0	0	0	0
National Conference attendance RA and PhD students	2500	0	0	0	0

Year 5

Description	ARC	AdminOrg		Other Organisation	
	Cash	Cash	In-kind	Cash	In-kind
Direct Cost	189884	31709	56244	0	110990
Personnel	137584	26709	56244	0	110990
Research Associate Level A Step 8 + on costs (28% ARC/1.5% UA)	111178	1303	0	0	0
CI White Level B 0.2 FTE + on costs	0	0	28122	0	0
PI Edsjo 0.2 FTE + on costs	0	0	0	0	40500
PI Conrad 0.2 FTE + on costs	0	0	0	0	34020
PI Buckley 0.2 FTE + on costs	0	0	0	0	16470
PI Scott 0.25 FTE + on costs	0	0	0	0	20000
Teaching Relief CI White	1000	0	0	0	0
PhD stipend - International Scholarship 2	25406	0	0	0	0
PhD stipend - Divisional Scholarship 2	0	25406	0	0	0
CI Jackson Level B 0.2 FTE + on costs	0	0	28122	0	0
Equipment	27000	0	0	0	0
2 Servers each with Intel Xeon Phi Co-processors (or equivalent)	23000	0	0	0	0
Installation costs for 2 servers at eResearch SA ($1000 each)	2000	0	0	0	0
Maintenance costs for 2 servers at eResearch SA ($1000 per server)	2000	0	0	0	0
Maintenance	8000	5000	0	0	0
Ongoing maintenance of eResearchSA hosted servers from previous years ($1000 per server)	8000	0	0	0	0
Student Maintenance	0	5000	0	0	0
Travel	12500	0	0	0	0
Overseas conference attendance CIs	5000	0	0	0	0
Overseas conference attendance RA	5000	0	0	0	0
National Conference attendance RA and PhD students	2500	0	0	0	0
International Collaboration Award	4800	0	0	0	0
Martin White	4800	0	0	0	0

Other Organisation Summary

	Year 1		Year 2		Year 3		Year 4		Year 5	
	Cash	In-kind	Cash	In-kind	Cash	In-kind	Cash	In-kind	Cash	In-kind
Imperial College London	0	20000	0	20000	0	20000	0	20000	0	20000

	Year 1		Year 2		Year 3		Year 4		Year 5	
	Cash	**In-kind**	**Cash**	**In-kind**	**Cash**	**In-kind**	**Cash**	**In-kind**	**Cash**	**In-kind**
Oskar Klein Centre	0	74520	0	74520	0	74520	0	74520	0	74520
University of Glasgow, UK	0	16470	0	16470	0	16470	0	16470	0	16470
Total	**0**	**110990**	**0**	**110990**	**0**	**110990**	**0**	**110990**	**0**	**110990**

E1. Justification of funding requested from the ARC

(In no more than five A4 pages fully justify in terms of need and cost, each budget item requested from the ARC (use the same headings as in the ARC Request Budget Column).)

Attached PDF

E1. Justification of funding requested from the ARC

Personnel:

Research Associate(s)

Funding for a Research Associate (RA) is requested. Australia has an opportunity to build on its excellent standing within the high energy particle physics and astroparticle physics communities by expanding our analysis base. We already lead a number of efforts in these areas and have important responsibilities to the global collaborations of which we are members.

As described in the "Roles of Personnel" section in section C, the project will apply the talents of all members of our team to a full array of important problems.

We are seeking funding for a RA position for the five year duration of the project. The activities arising from this position will play a key role in the long-term development of the global fitting strategy, core software infrastructure and in driving the publication of new results. It is anticipated that there will be two RA positions arising from the project, to run consecutively.

During the first 2.5 years of the award, we anticipate attracting a RA with a strong background in scientific computing and interpretation of a vast array of physics data. The position can fit a person from either an experimental or phenomenological background and will be particularly suited to a student who graduated having already collaborated with our international partners on GAMBIT to strengthen our global ties. This will be the first avenue pursued to hire the best person for the position. The RA hired will receive **strong research training experience** under the mentorship of CIs Jackson and White and through international exposure and close interaction with PIs Edjso, Conrad, Buckley and Scott. During the second part of the project the focus of the data sets to be combined will shift more towards flavour physics and direct dark matter detection. An expert in one (or both) of these areas will be best suited to this period of the project and will receive mentoring from CI Jackson (in flavour physics in particular) and CI White (with particular focus on the nature of dark matter). A complete basis of mentorship will be complemented by the broad expertise of the international PIs.

The budget item for RA salary is based on University of Adelaide pay scales, starting at Level A step 8, the entry-level postdoctoral salary recommended by our Research Branch. This would correspond to a starting ARC contribution of $104750 p.a. (including 28% on-costs) in 2015.

Postgraduate Students

Funding is sought for PhD Stipends of $25406 p.a. In order to fully utilise our group in the collaborative work, and be seen as the international driving force, students will be engaged across the broad spectrum of topics outlined in the project proposal and their contributions will be of vital importance. The students daily activities can be co-supervised by the RA, but he/she will be exposed to the intellectual input of CIs and PIs and encouraged to take a strong role in GAMBITs physics and technical development.

In addition to the UofA funded students (described in section E2), two PhD stipends (spanning three years each) are requested from the ARC. These will be specifically to *target the best and brightest international PhD students to study at the University of Adelaide.* The first of these will be funded from years 2 until 4 of the award, with a second stipend requested to span years 3 to 5 inclusively. CI

Jackson has an international student (Marco Santoni from Italy) who has commenced a PhD under his supervision in 2014 who will work on the implementation of models within GAMBIT and will therefore act as a precursor to the funded students requested herein. In total, four PhD students will graduate working on GAMBIT related topics during the course of the project, of which all will be funded entirely through the award **The project will therefore provide excellent research training to young scientists.**

Teaching Relief (CI White)

While CI White will limit his teaching obligations to 5% of his time, it is important to have some support for teaching relief from tutorials and the preparation of on-line materials and quizzes for lectures. The modest amount of $1,000 per year will enable Dr White to maintain uninterrupted attention to his research program at the teaching intensive times of the year. The benefit to this project of a small amount of teaching relief for the CI will clearly outweigh its costs. In addition, it will serve the equally important purpose of providing some teaching experience as an important part of the academic training of postgraduate students in their final stages and of early career postdoctoral research associates.

Equipment:

Intel Xeon Phi servers

All of the research outlined in this project relies on extremely intensive computer simulations, using algorithms that are not trivially parallelisable. The GAMBIT software application developed by the CIs, PIs and collaborators uses two levels of parallelisation: a top level where slower communication between nodes can be tolerated, and a sub-level where very rapid communication between nodes is essential. This particularly suits systems that take the form of a cluster of machines, each with a very large number of CPU cores.

Until very recently, there have been two basic approaches to high performance computing in cases where trivial parallelisation is not possible (and thus a cluster of single core machines is not suitable). The first is to use conventional "supercomputers", with many cores and very fast communication between them. As an example, CI White used a 128 core Sun supercomputer during his PhD. The second approach is to combine conventional CPUs with "accelerator" units, such as GPU cards. The problem with the latter is that it takes many months to port complex software to GPU systems, and substantial gains are only possible for certain types of repetitive calculation. The GAMBIT code makes extensive use of very complex particle physics and astrophysics software which has never been used on GPU frameworks, and the time required to port this code makes this unfeasible during the course of this project.

Very recently, Intel have developed the Xeon Phi coprocessor, based on the Intel Many Integrated Core architecture. These give up to 1.2 Tera flops per coprocessor, and do not require the use of special code frameworks to obtain rapid speed increases. The coprocessors can be used alongside Intel Xeon processors, and give a particular speed increase to applications that scale well to over one-hundred threads and make extensive use of vectors. This is precisely the case with the GAMBIT software framework. Discussions with experts at eResearch SA have revealed that this new architecture is by far the most cost effective approach for the research outlined in Section C, and thus a

substantial investment in this technology is essential to meet the aims of this proposal. There are no locally or nationally available substitutes that will perform the same job adequately.

eResearch SA and *CoEPP* (the Centre of Excellence for Particle Physics at the Terascale) recognise that the new Intel Xeon Phi architecture will have very important implications for the future of high performance computing in South Australia. The project requires that, in each year, CI Jackson and CI White purchase two servers, each containing 2 Intel Xeon Phi coprocessors alongside a standard Xeon processor, each priced at $11,500. It is only possible at present to house a maximum of two coprocessors in one server, and thus the CIs will build a cluster of Xeon Phi machines over the course of the project. The total spent on the Xeon Phi machine hardware, and installation, will be $125,000 over the course of the project, corresponding to $25,000 per annum ($23,000 for 2 coprocessors plus the installation cost of $1,000 per machine). The cost is realised as $115,000 on machine hardware and yields a total cost of $10,000 on installation over the 5 year project. eResearch SA have agreed to host these machines, and to run them from a front end provided for existing CoEPP resources.

This is an essential avenue for the GAMBIT code infrastructure, and will allow CI Jackson and CI White to perform very detailed simulations that are not possible on current resources. It is also essential to keep eResearch SA at the forefront of advances in high performance computing, and these purchases will inform future work at CoEPP and the CSSM (the ARC Special Research Centre for the Subatomic Structure of Matter). The total expenditure on Xenon Phi servers (including all installation costs) is $125,000 over the entire duration of the project.

Maintenance:

The ongoing maintenance cost is $1,000 per machine per year and thus will rise over the duration of the project. The total cost of ongoing maintenance of the 2 Intel Xeon Phi coprocessors per year is therefore $20,000. Each year a maintenance cost of $1000 per processor is requested as a standard cost required by eResearch SA, and since 2 coprocessors are requested for each of the 5 years this will sum to $10,000 over the project's lifetime. This yields a total of $30,000 maintenance costs over the 5 year project maintenance costs.

Maintenance of the hardware is critical to ensure smooth and successful research outputs as the project progresses. The costs requested herein ensure expert support from specialists in the area of high performance computational hardware.

Travel:

International

We request funds to attend regular GAMBIT collaboration meetings and conferences. These requests for travel/subsistence are key to our continued leadership roles in the project, and for our contributions to operation and maintenance of the tools we will create.

Attendance at the collaboration meetings and conferences is very important for the research training of our postgraduate students. The collaboration meetings provide opportunities for our students to interact with international colleagues on detailed problems and increase their exposure within the global research environment . The quality of our international colleagues is outstanding (including world leading researchers), and face to face interactions often lead to valuable learning

experiences. Conferences represent an excellent opportunity to present results to large audiences ($\sim$ 150 people), and to mix with international colleagues who are otherwise known only through electronic communications.

The GAMBIT collaboration holds one meeting per year hosted by one of the collaborating institutes. In October 2012 this meeting was held at CERN in Geneva, Switzerland, and we estimate the cost of travel based on experience of this meeting. This is requested for two members of personnel for the first and third year of the project. This will cover the costs for the RA or student, and one of the CIs, to attend the meeting.

We have budgeted for attendance at international conferences for one of the CIs during each year if the project and for the RAs for each year of the project. We are especially mindful of exposing the work of the younger members of our group to an international audience and will endeavour to do this where possible.

Costs are based on recent experience: GAMBIT Collaboration meeting in Geneva ($5000 for a 10 day trip, including $2500 airfare, $150 per day accommodation, $80 per day food and incidentals, $200 additional travel and miscellaneous costs); International conference travel Europe/US ($5000 per person for an 8 day visit, including $2500 airfare, $500 registration, $150 per day accommodation, $80 per day food and incidentals, $160 additional travel and miscellaneous costs).

The airfares given above are based on recent quotations from the University travel supplier, Campus Travel. We note that the food and incidental allowances are well within the Australian Tax Office recommendations of $265 per day for Switzerland and $165 per day for the United States (ATO Tax Determination TD 2013/16).

Other

We anticipate invitations to Australian conferences to give talks on GAMBIT. We would also like to send our postgraduate students to these meetings for experience in communicating their work. We are requesting funds for one person-trip per year. Costs are based on recent experience - $1600 per person for a four day meeting, including $400 air fare, $400 registration, $120 per day accommodation and $80 per day food and incidentals. We note that the per diem costs (accommodation, food and incidentals) are well within the $300-$350 per day for Brisbane, Melbourne and Sydney quoted in ATO Tax Determination TD 2013/16.

International Collaboration Awards:

We request funds for international collaboration awards for CI White and PI Scott.

CI White is an integral part of all phases of the GAMBIT collaboration, serving as leader of the collider group and an overall mentor of the physics activities of the team. It is essential that Dr White interact with colleagues in person on a yearly basis. His responsibilities include bringing colleagues up to speed with new developments at the Large Hadron Collider, proposing and helping to implement new physics studies, training junior colleagues in his computational techniques and devising new ways of using machine learning to speed up bottlenecks in sections of the GAMBIT code for which he does not have formal responsibility. Very little of this work can be accomplished efficiently by teleconference; extended physics discussions strongly benefit from hours spent at the same white board. Dr White requests $4,800 in the first, second, third and fifth years of the project, to fund four, ten day trips in total. The costs is based on recent experience: $2500 airfare, $150 per

day accommodation, $80 per day food and incidentals. The first year is a particularly important year to travel given that the LHC will have restarted that year at a higher centre of mass energy. Priority is then attached to the early years of the project, in which most of the software development is concentrated. Dr White will then make a final trip in the fifth year to organise the legacy of the project, and coordinate strategies for the continuation of the work beyond the initial 5 year lifespan.

PI Scott requests two collaboration awards of $10k in years 2 and 3 of the award. Dr Pat Scott is a world expert on the fast modelling of astrophysical data from direct and indirect search experiments, and the two awards will allow him to make two extended trips to Australia to work closely with the CIs and the RA and students on combined likelihood extraction from direct and indirect dark matter data. He is also a leading figure in the development of the GAMBIT C++ framework, making his expertise vital in training our students to use, and develop, the code. His presence in Australia will also be of interest to the gamma ray and neutrino astronomy communities, both of whom have existing connections with Dr Scott.

E2. Details of non-ARC contributions

(In no more than two A4 pages provide an explanation of how non-ARC contributions will support the proposed project (use the same headings as in the non-ARC contributions Budget Column).)

Attached PDF

E2. Details of non-ARC Contributions

Administering Organisation

Personnel:
CI (White)

Chief Investigator White will devote a minimum of 20% of his time to this research. The University contributions for CI White includes 20% of his salary plus 29.5% on-costs. This amounts to a minimum of $26496 per year for Dr. White, for each for the five years of the project. As one of the project's leaders, Dr White will devote the majority of his research time to GAMBIT related activities. Dr White will be a driving force behind the collider phenomenology side of the project and it is reasonable to assume he can fulfil this role adequately within the allotted time commitment. Further to this CI White will devote research hours to the supervision of research students.

CI (Jackson)

CI Jackson will enjoy funding from an ARC Future Fellowship until December 2017 and thus will be paid by an external source throughout the duration of the first three years of the project. At the culmination of this award CI Jackson will return to a continuing position in the School of Chemistry and Physics at the University of Adelaide. The University contribution for CI Jackson includes 20% of his salary plus 29.5% on-costs. This amounts to a minimum of $27707 for years 4 and 5 for Dr. Jackson. As the continuing position is as a Level B lecturer this pay grade is applied. CI Jackson will devote 0.2 FTE and devote research hours to the supervision and mentoring of students and postdoctoral research associates.

Research Associates

University contributions for the Research Associate reflects the difference between the actual University of Adelaide salary plus 29.5% on-costs and the ARC funded rate of 28% on-costs. Therefore, 1.5% of the on-costs for each RA, will be funded by University of Adelaide, equating to $1,228 to $1,303 per year for the term of the project.

PhD Stipend - Divisional Scholarships

The project will mentor one local PhD student commencing in the first year with CI Jackson and CI White as co-supervisors. A second local PhD student will be sought to commence in the third year of the project. The timing of these PhD awards will allow for overlap during the final year of the initial PhD student, leading to co-mentoring of the incoming student.

Funding for these incoming PhD students will come from the University of Adelaide Faculty of Sciences Divisional Scholarships. The current funding rate is $25406 per year, per student. The projected model suggests two students commencing throughout the duration of the project which fits with the current rate of students progressing through to study under the supervision of CIs Jackson and White on this topic.

Maintenance:
Student maintenance

For each higher degree graduate student, the University of Adelaide School of Chemistry and Physics contributes $2,500 per year to support the costs associated with performing research. As above, it could reasonably be expected to see a commencing student in year 1, along with a further commencing student in year 3. Funds for maintenance to support he international students commencing in years 3 and 4 are also reflected in this budget line. and the proposed budget in Section D1 reflects this recruitment rate.

Other Organisation

Oskar Klein Centre for Cosmoparticle Physics
PI Edjso and PI Conrad will both contribute 0.2 FTE time to GAMBIT. In terms of salary and indirect costs this amounts to $74.5k p.a. of contribution from the Oskar Klein Centre for Cosmoparticle Physics, where both hold Professor positions, in conjunction with Stockholm University.

University of Glasgow
PI Buckley will contribute 0.2 FTE time to the project. As one of the leaders of the ATLAS collaborations Monte Carlo working group PI Buckley provides a unique position that will be of vital importance. Playing an international leadership role in global Monte Carlo generation and event simulator development he will devote this expertise to guide the choices and development of Monte Carlo tools within GAMBIT. How we use these tools to make improved descriptions of the results from the LHC experiments will be impacted by the expertise of PI Buckley. His salary and indirect cost contribution from the University of Glasgow amounts to $16.5k p.a.

Imperial College London
PI Scott will contribute 0.25 FTE to the project. As a co-leader of the GAMBIT collaboration and a STFC Advanced Fellow PI Scott will provide leadership in the Core code component of GAMBIT and is co-convenor of the theory working group. His salary and indirect cost contribution from Imperial College London amounts to $20k p.a.

Other Collaborative Partners not named as PIs
The GAMBIT collaboration is comprised of researchers from our global partners with overseas funding agencies in Canada, France, Germany, Norway, Sweden, Switzerland, the United States and the United Kingdom all contributing. The laboratories and University groups in these countries all contribute computing and personnel, and CIs Jackson and White have ongoing research collaborations with individuals in all of these countries. Most collaborators will be invited to visit the University of Adelaide, at their own expense, throughout the course of the project, particularly in year 3 when we intend to host the GAMBIT collaboration meeting. CIs Jackson and White are hosting the GAMBIT collaboration meeting at the University of Adelaide in March 2014 and intend to do so again after a period of three years has passed.

PART F - Personnel (Dr Paul Jackson)

F1. Personal details

(The personal details will be filled out for you automatically. To update any of your personal details in this form, please update your profile accordingly and your details will update automatically in this form.)

Title

Doctor

Family Name

Jackson

First Name

Paul

Second Name

Douglas

Person identifier

72563013

Role

Chief Investigator

F2. Postal address

(The postal address will be filled out for you automatically. To update your postal address, please update your profile accordingly and your postal address will update automatically in this form.)

Postal Address Line 1

Rm 126, Physics Building

Postal Address Line 2

North Terrace Campus

Locality

University of Adelaide

State

SA

Postcode

5000

Country

Australia

F3. Are you a current member of the ARC or its selection or other advisory committees?

(This relates only to College of Experts or Selection Advisory Committee members for National Competitive Grants Program funding schemes.)

Current Member of Advisory Committee

No

F4. Please name any Commonwealth-funded Research Centres that you will be associated with as at 1 January 2015.

	Full Legal Name of Centre	Start Date	Cessation Date	Centre Role
1	Centre of Excellence for Particle Physics at the Terascale	01/11/2011	31/12/2017	Other

	Centre Role if Other
1	Affiliated with the CoE through academic role

F5. Are you an Indigenous Participant?

Indigenous Participant

No

F6. PhD Qualification

F6.1. Do you hold a PhD or expect to be awarded a PhD qualification in the near future?

PhD Yes/No

Yes

F6.2. If you hold a PhD or expect to be awarded a PhD qualification in the near future, please enter the date your PhD has been awarded or the date your thesis will be submitted, respectively.

Date of Award

22/06/2004

F7. Qualifications

	Degree/Award	Year	Discipline/Field	Organisation Name
1	PhD	2004	Physics	University of Victoria, Canada
2	MSc	2001	Physics	University of Victoria, Canada
3	MPhys	1998	Physics and Cosmology	Lancaster University

	Country
1	Canada
2	Canada
3	United Kingdom

F8. Current and previous appointment(s)/position(s) – during the past 10 years

	Position	Organisation Name	Department	Year Appointed
1	ARC Future Fellow	The University of Adelaide	Department of Physics	2014
2	Lecturer in High Energy Particle Physics	The University of Adelaide	School of Chemistry and Physics	2011
3	Senior Research Associate	SLAC National Accelerator Laboratory	Particle Physics Division	2008
4	INFN Research Fellow, INFN Rome	Sapienza University of Rome	Physics	2006
5	Postdoctoral Research Assoicate	Ohio State University	Physics	2004

	Continuity	Employment Kind	Current
1	Contract	Full Time	Yes
2	Contract	Full Time	No
3	Contract	Full Time	No
4	Contract	Full Time	No
5	Contract	Full Time	No

F9. Organisational affiliations for eligibility purposes for this Proposal

(Name of the organisation you will be associated with for the purposes of satisfying the eligibility requirements for your nominated role in undertaking the proposed research (i.e. for a CI this will usually be the Eligible Organisation at which they will employed or hold an adjunct appointment as at 1 January 2015 and beyond; for PIs it will generally be their main employer as at 1 January 2015).)

Organisation Name

The University of Adelaide

Type of Affiliation

Employee

F10. What is your time commitment (%FTE) to this Project?

20

F11. Are you requesting an International Collaboration Award?

(Note: If you are an Australian-based PI, you must choose 'No'. Also, if you are a PI working in an Australian Eligible Organisation overseas campus you must choose 'No'.)

International Collaboration Award

No

F12. Research Opportunity and Performance Evidence (ROPE)

F12.1. Details on your career and opportunities for research over the last 10 years

(Write a maximum of 5250 characters (approx. 750 words). Please detail your career and opportunities over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(i) Dr Jackson graduated with a PhD 10 years ago at the University of Victoria, BC, Canada.

(ii)
In 2004 Dr Jackson published a constraint on light dark matter scalar production arising from his thesis search for rare flavour-changing neutral current B-meson decays. This resulted from improvements Dr Jackson made throughout that year to the semi-leptonic B-meson reconstruction technique which he invented and was used in 2004 for first publication of B meson decays to a single kaon or tau lepton and missing energy, along with entirely invisible final states.

In 2004-2005 during a first postdoctoral position at The Ohio State University Dr Jackson led a team that constructed 80% of the optical readout boards for the ATLAS (A Toroidal LHC Apparatus) pixel detector at the CERN Large Hadron Collider (LHC). These boards remain operational in the ATLAS detector to this day.

In 2005 Dr Jackson was awarded the role of convener of the Leptonic Bottom and Charm Working group of the BaBar Collaboration and moved to Stanford Linear Accelerator Center to fulfil this role. This physics group contained over 40 active researchers pursuing 10-15 data analyses at any one time and overlapped with Dr Jackson's leadership of the Recoil method physics group. Through this position Dr Jackson guided the BaBar Collaboration to the successful completion of the entire suite of purely leptonic B, D and Ds meson decays, in many cases using methods and techniques he invented.

In 2006 Dr Jackson was awarded an INFN fellowship at the Universita' di Roma ``La Sapienza'' under the supervision of current INFN president Professor Fernando Ferroni. During this role Dr Jackson supervised three PhD students through to completion of their studies and, along with working on leptonic bottom and charm meson decays, made telling contributions to charmonium and bottomonium spectroscopy. Dr Jackson ran the BaBar detector during its last 10 days of operation, performing a novel energy scan above the nominal machine operating energy to search for new exotic mesons publishing the worlds most accurate measurement of the exotic X(3872) meson.

From 2008 until 2011 Dr Jackson held a senior research associate position with Stanford University and the SLAC National Accelerator Laboratory, working on the ATLAS experiment at the LHC in Geneva, Switzerland. Dr Jackson prepared and calibrated the ATLAS pixel detector to be ready for first beam while understanding the response of the detector to cosmic rays and hadronic jets.

From 2010-2011 Dr Jackson was a subconvener of the ATLAS Supersymmetry working group, responsible for producing results in the search for new physics at the LHC. The group consisted of some 300 physicists, from students through to world renowned research leaders. The position of subconvener coincided with the first year that the LHC ran at high luminosity collecting a huge data sample allowing the searches to reach unprecedented regions of parameter space which had previously never been probed. Dr Jackson was responsible for guiding strategy and developing new ideas for my team to pursue. Throughout this period of leadership in the Supersymmetry working group, over 25 peer reviewed publications emerged. These publications rank as some of the most highly cited physics papers since their publication.

Since moving to the University of Adelaide in late 2011 Dr Jackson has been a group leader in the ATLAS experiment, a member of advisory boards and has taken over the leadership of analyses involving tau leptons in a Supersymmetry group while developing new analysis ideas and mentoring younger colleagues.

In 2013, Dr Jackson won an ARC Future Fellowship. Upon completion of his fellowship Dr Jackson will return to his continuing tenurable position.

In 2014 Dr Jackson commenced as the team leader of the University of Adelaide group on the Belle II experiment at KEK, Japan.

(iii) Dr Jackson's first research position (2004-2006) required mentoring, undergraduate students and engineers and one PhD student which took 20% of his time. From 2006 to 2008 at INFN Roma Dr Jackson invested 30% of his time mentoring three PhD students. From 2008 to 2011 while employed as a full-time researcher at Stanford University. Dr Jackson calibrated the ATLAS pixel detector and supervised two

students, taking in total 40% of his time. Since November 2011 at the University of Adelaide as a lecturer in physics, 40% of Dr Jackson's time has been devoted to administrative and teaching duties in the department. Upon undertaking a Future Fellowship in early 2014, Dr Jackson now has a significant majority of his time for research.

(iv) N/A

(v) During the last ten years Dr Jackson has worked at leading laboratories in Europe and the US Department of Energy. He has mentored 6 PhD students (all of whom have completed) and one CERN summer student. Dr Jackson regularly participates in international workshops/meetings and conferences to enhance his exposure among fellow physicists. Dr Jackson currently mentors 4 graduate students and 2 postdoctoral fellows at the University of Adelaide.

(vi) N/A

F12.2. Recent significant research outputs and ARC grants (since 2004)

(Please attach a PDF with a list of your recent significant research outputs and ARC grants most relevant to the Proposal (20 pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Recent significant research outputs and ARC grants (2004 onwards)

These are the publications by the author from 2004 to the present day. To remain within the 20 page maximum the list of 658 published papers has been truncated. Dr Jackson's papers since 2004 have received over 38,000 citations, with an average of 58.0 citations per paper. **Dr Jackson has an h-index of 91 for papers published in the last 10 years**.

Scholarly Books/Scholarly Book Chapters

Not Applicable

Referee Journal Articles

1. * **P. Jackson** in the ATLAS Collaboration, "Measurement of the mass difference between top and anti-top quarks in *pp* collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector", Phys. Lett. B **728** (2014) 363

2. * **P. Jackson** in the ATLAS Collaboration, "Search for dark matter in events with a hadronically decaying W or Z boson and missing transverse momentum in *pp* collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector", Phys. Rev. Lett. **112** (2014) 041802

3. * **P. Jackson** in the ATLAS Collaboration, "Search for new phenomena in photon+jet events collected in proton–proton collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector,". Phys. Lett. B **728** (2014) 562

4. * **P. Jackson** in the ATLAS Collaboration, "Search for long-lived stopped R-hadrons decaying out-of-time with pp collisions using the ATLAS detector", Phys. Rev. D **88** (2013) 112003

5. * **P. Jackson** in the ATLAS Collaboration, "Search for charginos nearly mass-degenerate with the lightest neutralino based on a disappearing-track signature in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector", Phys. Rev. D **88** (2013) 112006

6. **P. Jackson** in the ATLAS Collaboration, "Search for microscopic black holes in a like-sign dimuon final state using large track multiplicity with the ATLAS detector", Phys. Rev. D **88**, 072001 (2013)

7. * **P. Jackson** in the ATLAS Collaboration, "Search for direct third-generation squark pair production in final states with missing transverse momentum and two b-jets in $\sqrt{s} = 8$ TeV *pp* collisions with the ATLAS detector", JHEP **1310** (2013) 189

8. * **P. Jackson** in the ATLAS Collaboration, "Search for new phenomena in final states with large jet multiplicities and missing transverse momentum at $\sqrt{s} = 8$ TeV proton-proton collisions using the ATLAS experiment", JHEP **1310** (2013) 130

9. * **P. Jackson** in the ATLAS Collaboration, "Evidence for the spin-0 nature of the Higgs boson using ATLAS data," Phys. Lett. B **726** (2013) 120 [arXiv:1307.1432 [hep-ex]].

10. * **P. Jackson** in the ATLAS Collaboration, "Measurements of Higgs boson production and couplings in diboson final states with the ATLAS detector at the LHC," Phys. Lett. B (2013) [arXiv:1307.1427 [hep-ex]].

11. **P. Jackson** in the ATLAS Collaboration, "Search for third generation scalar leptoquarks in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," JHEP **1306** (2013) 033 [arXiv:1303.0526 [hep-ex]].

12. **P. Jackson** in the ATLAS Collaboration, "Improved luminosity determination in *pp* collisions at $\sqrt{s}$ = 7 TeV using the ATLAS detector at the LHC," Eur. Phys. J. C **73** (2013) 2518 [arXiv:1302.4393 [hep-ex]].

13. **P. Jackson** in the ATLAS Collaboration, "Search for a light charged Higgs boson in the decay channel $H^+ \to c\bar{s}$ in $t\bar{t}$ events using pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," Eur. Phys. J. C **73** (2013) 2465 [arXiv:1302.3694 [hep-ex]].

14. **P. Jackson** in the ATLAS Collaboration, "Measurement of the cross-section for W boson production in association with b-jets in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," JHEP **1306** (2013) 084 [arXiv:1302.2929 [hep-ex]].

15. **P. Jackson** in the ATLAS Collaboration, "Measurements of $W\gamma$ and $Z\gamma$ production in pp collisions at $\sqrt{s}$= 7 TeV with the ATLAS detector at the LHC," Phys. Rev. D **87** (2013) 112003 [arXiv:1302.1283 [hep-ex]].

16. **P. Jackson** in the ATLAS Collaboration, "Measurement of hard double-parton interactions in $W(\to l\nu)$+ 2 jet events at $\sqrt{s}$=7 TeV with the ATLAS detector," New J. Phys. **15** (2013) 033038 [arXiv:1301.6872 [hep-ex]].

17. **P. Jackson** in the ATLAS Collaboration, "Search for long-lived, multi-charged particles in pp collisions at $\sqrt{s}$=7 TeV using the ATLAS detector," Phys. Lett. B **722** (2013) 305 [arXiv:1301.5272 [hep-ex]].

18. * **P. Jackson** in the ATLAS Collaboration, "Multi-channel search for squarks and gluinos in $\sqrt{s} = 7$ TeV pp collisions with the ATLAS detector," Eur. Phys. J. C **73** (2013) 2362 [arXiv:1212.6149 [hep-ex]].

19. **P. Jackson** in the ATLAS Collaboration, "Observation of Associated Near-side and Away-side Long-range Correlations in $\sqrt{s_{NN}}$=5.02 TeV Proton-lead Collisions with the ATLAS Detector," Phys. Rev. Lett. **110** (2013) 182302 [arXiv:1212.5198 [hep-ex]].

20. * **P. Jackson** in the ATLAS Collaboration, "Search for new phenomena in events with three charged leptons at $\sqrt{s} = 7$ TeV with the ATLAS detector," Phys. Rev. D **87** (2013) 052002 [arXiv:1211.6312 [hep-ex]].

21. **P. Jackson** in the ATLAS Collaboration, "Measurement of ZZ production in pp collisions at $\sqrt{s} = 7$ TeV and limits on anomalous ZZZ and $ZZ\gamma$ couplings with the ATLAS detector," JHEP **1303** (2013) 128 [arXiv:1211.6096 [hep-ex]].

22. **P. Jackson** in the ATLAS Collaboration, "Search for resonances decaying into top-quark pairs using fully hadronic decays in pp collisions with ATLAS at $\sqrt{s} = 7$ TeV," JHEP **1301** (2013) 116 [arXiv:1211.2202 [hep-ex]].

23. **P. Jackson** in the ATLAS Collaboration, "Measurement of isolated-photon pair production in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," JHEP **1301** (2013) 086 [arXiv:1211.1913 [hep-ex]].

24. * **P. Jackson** in the ATLAS Collaboration, "Searches for heavy long-lived sleptons and R-Hadrons with the ATLAS detector in pp collisions at $\sqrt{s} = 7$ TeV," Phys. Lett. B **720** (2013) 277 [arXiv:1211.1597 [hep-ex]].

25. * **P. Jackson** in the ATLAS Collaboration, "Search for supersymmetry in events with photons, bottom quarks, and missing transverse momentum in proton-proton collisions at a centre-of-mass energy of 7 TeV with the ATLAS detector," Phys. Lett. B **719** (2013) 261 [arXiv:1211.1167 [hep-ex]].

26. **P. Jackson** in the ATLAS Collaboration, "Search for contact interactions and large extra dimensions in dilepton events from pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," Phys. Rev. D **87** (2013) 015010 [arXiv:1211.1150 [hep-ex]].

27. **P. Jackson** in the ATLAS Collaboration, "Search for Extra Dimensions in diphoton events using proton-proton collisions recorded at $\sqrt{s} = 7$ TeV with the ATLAS detector at the LHC," New J. Phys. **15** (2013) 043007 [arXiv:1210.8389 [hep-ex]].

28. **P. Jackson** in the ATLAS Collaboration, "Search for long-lived, heavy particles in final states with a muon and multi-track displaced vertex in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," Phys. Lett. B **719** (2013) 280 [arXiv:1210.7451 [hep-ex]].

29. **P. Jackson** in the ATLAS Collaboration, "A search for high-mass resonances decaying to $\tau^+\tau^-$ in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," Phys. Lett. B **719** (2013) 242 [arXiv:1210.6604 [hep-ex]].

30. **P. Jackson** in the ATLAS Collaboration, "Measurement of Z boson Production in Pb+Pb Collisions at $\sqrt{s_{NN}} = 2.76$ TeV with the ATLAS Detector," Phys. Rev. Lett. **110** (2013) 022301 [arXiv:1210.6486 [hep-ex]].

31. **P. Jackson** in the ATLAS Collaboration, "Jet energy resolution in proton-proton collisions at $\sqrt{s} = 7$ TeV recorded in 2010 with the ATLAS detector," Eur. Phys. J. C **73** (2013) 2306 [arXiv:1210.6210 [hep-ex]].

32. * **P. Jackson** in the ATLAS Collaboration, "Search for pair production of heavy top-like quarks decaying to a high-pT W boson and a b quark in the lepton plus jets final state at $\sqrt{s}$=7 TeV with the ATLAS detector," Phys. Lett. B **718** (2013) 1284 [arXiv:1210.5468 [hep-ex]].

33. * **P. Jackson** in the ATLAS Collaboration, "Search for pair-produced massive coloured scalars in four-jet final states with the ATLAS detector in proton-proton collisions at $\sqrt{s} = 7$ TeV," Eur. Phys. J. C **73** (2013) 2263 [arXiv:1210.4826 [hep-ex]].

34. * **P. Jackson** in the ATLAS Collaboration, "Search for dark matter candidates and large extra dimensions in events with a jet and missing transverse momentum with the ATLAS detector," JHEP **1304** (2013) 075 [arXiv:1210.4491 [hep-ex]].

35. **P. Jackson** in the ATLAS Collaboration, "Measurement of W^+W^- production in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector and limits on anomalous WWZ and $WW\gamma$ couplings," Phys. Rev. D **87** (2013) 112001 [arXiv:1210.2979 [hep-ex]].

36. * **P. Jackson** in the ATLAS Collaboration, "Search for direct chargino production in anomaly-mediated supersymmetry breaking models based on a disappearing-track signature in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," JHEP **1301** (2013) 131 [arXiv:1210.2852 [hep-ex]].

37. **P. Jackson** in the ATLAS Collaboration, "ATLAS search for new phenomena in dijet mass and angular distributions using pp collisions at $\sqrt{s} = 7$ TeV," JHEP **1301** (2013) 029 [arXiv:1210.1718 [hep-ex]].

38. **P. Jackson** in the ATLAS Collaboration, "Measurement of the flavour composition of dijet events in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," Eur. Phys. J. C **73** (2013) 2301 [arXiv:1210.0441 [hep-ex]].

39. **P. Jackson** in the ATLAS Collaboration, "Search for displaced muonic lepton jets from light Higgs boson decay in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," Phys. Lett. B **721** (2013) 32 [arXiv:1210.0435 [hep-ex]].

40. **P. Jackson** in the ATLAS Collaboration, "Search for dark matter candidates and large extra dimensions in events with a photon and missing transverse momentum in pp collision data at $\sqrt{s} = 7$ TeV with the ATLAS detector," Phys. Rev. Lett. **110** (2013) 011802 [arXiv:1209.4625 [hep-ex]].

41. * **P. Jackson** in the ATLAS Collaboration, "Search for light top squark pair production in final states with leptons and b^- jets with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions," Phys. Lett. B **720** (2013) 13 [arXiv:1209.2102 [hep-ex]].

42. * **P. Jackson** in the ATLAS Collaboration, "Search for direct production of charginos and neutralinos in events with three leptons and missing transverse momentum in $\sqrt{s} = 7$ TeV pp collisions with the ATLAS detector," Phys. Lett. B **718** (2013) 841 [arXiv:1208.3144 [hep-ex]].

43. * **P. Jackson** in the ATLAS Collaboration, "Search for direct slepton and gaugino production in final states with two leptons and missing transverse momentum with the ATLAS detector in pp collisions at $\sqrt{s} = 7$ TeV," Phys. Lett. B **718** (2013) 879 [arXiv:1208.2884 [hep-ex]].

44. * **P. Jackson** in the ATLAS Collaboration, "Search for new phenomena in the $WW \to \ell\nu\ell'\nu'$ final state in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," Phys. Lett. B **718** (2013) 860 [arXiv:1208.2880 [hep-ex]].

45. **P. Jackson** in the ATLAS Collaboration, "Measurement of the jet radius and transverse momentum dependence of inclusive jet suppression in lead-lead collisions at $\sqrt{s_{NN}}$= 2.76 TeV with the ATLAS detector," Phys. Lett. B **719** (2013) 220 [arXiv:1208.1967 [hep-ex]].

46. * **P. Jackson** in the ATLAS Collaboration, "Search for squarks and gluinos with the ATLAS detector in final states with jets and missing transverse momentum using 4.7 fb^{-1} of $\sqrt{s} = 7$ TeV proton-proton collision data," Phys. Rev. D **87** (2013) 012008 [arXiv:1208.0949 [hep-ex]].

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262. **P. Jackson** in the BaBar Collaboration, "Study of D_{sJ} decays to D^*K in inclusive e^+e^- interactions," Phys. Rev. D **80** (2009) 092003 [arXiv:0908.0806 [hep-ex]].

263. **P. Jackson** in the BaBar Collaboration, "Measurement of $D^0\bar{D}^0$ Mixing using the Ratio of Lifetimes for the Decays $D^0 \to K^-\pi^+$ and K^+K^-," Phys. Rev. D **80** (2009) 071103 [arXiv:0908.0761 [hep-ex]].

264. * **P. Jackson** in the BaBar Collaboration, "A Model-independent search for the decay $B^+ \to \ell^+\nu_\ell\gamma$," Phys. Rev. D **80** (2009) 111105 [arXiv:0907.1681 [hep-ex]].

265. **P. Jackson** in the BaBar Collaboration, "Measurement of Branching Fractions and CP and Isospin Asymmetries in $B \to K^*(892)\gamma$ Decays," Phys. Rev. Lett. **103** (2009) 211802 [arXiv:0906.2177 [hep-ex]].

266. **P. Jackson** in the BaBar Collaboration, "Measurement of the $\gamma\gamma^* \to \pi^0$ transition form factor," Phys. Rev. D **80** (2009) 052002 [arXiv:0905.4778 [hep-ex]].

267. * **P. Jackson** in the BaBar Collaboration, "Search for Dimuon Decays of a Light Scalar Boson in Radiative Transitions $\Upsilon \to \gamma A^0$," Phys. Rev. Lett. **103** (2009) 081803 [arXiv:0905.4539 [hep-ex]].

268. **P. Jackson** in the BaBar Collaboration, "Search for $b \to u$ transitions in $B^0 \to D^0K^{*0}$ decays," Phys. Rev. D **80** (2009) 031102 [arXiv:0904.2112 [hep-ex]].

269. **P. Jackson** in the BaBar Collaboration, "Improved limits on lepton flavor violating τ decays to $\ell\phi$, $\ell\rho$, ℓK^* and $\ell\bar{K}^*$," Phys. Rev. Lett. **103** (2009) 021801 [arXiv:0904.0339 [hep-ex]].

270. **P. Jackson** in the BaBar Collaboration, "Exclusive Initial-State-Radiation Production of the $D\bar{D}$, $D\bar{D}^*$, and $D^*\bar{D}^*$ Systems," Phys. Rev. D **79** (2009) 092001 [arXiv:0903.1597 [hep-ex]].

271. * **P. Jackson** in the BaBar Collaboration, "Search for the Rare Leptonic Decays $B^+ \to \ell^+\nu_\ell$ ($\ell = e, \mu$)," Phys. Rev. D **79** (2009) 091101 [arXiv:0903.1220 [hep-ex]].

272. * **P. Jackson** in the BaBar Collaboration, "Measurement of the Semileptonic Decays $B \to D\tau^-\bar{\nu}_\tau$ and $B \to D^*\tau^-\bar{\nu}_\tau$," Phys. Rev. D **79** (2009) 092002 [arXiv:0902.2660 [hep-ex]].

273. **P. Jackson** in the BaBar Collaboration, "Measurement of Time-Dependent CP Asymmetry in $B^0 \to c\bar{c}K^{(*)0}$ Decays," Phys. Rev. D **79** (2009) 072009 [arXiv:0902.1708 [hep-ex]].

274. **P. Jackson** in the BaBar Collaboration, "Observation of B Meson Decays to ωK^* and Improved Measurements for $\omega\rho$ and ωf_0," Phys. Rev. D **79** (2009) 052005 [arXiv:0901.3703 [hep-ex]].

275. **P. Jackson** in the BaBar Collaboration, "Improved Measurement of $B^+ \to \rho^+\rho^0$ and Determination of the Quark-Mixing Phase Angle α," Phys. Rev. Lett. **102** (2009) 141802 [arXiv:0901.3522 [hep-ex]].

276. **P. Jackson** in the BaBar Collaboration, "Dalitz Plot Analysis of $B^- \to D^+\pi^-\pi^-$," Phys. Rev. D **79** (2009) 112004 [arXiv:0901.1291 [hep-ex]].

277. **P. Jackson** in the BaBar Collaboration, "Search for Lepton Flavor Violating Decays $\tau \to \ell^- K^0_s$ with the BABAR Experiment," Phys. Rev. D **79** (2009) 012004 [arXiv:0812.3804 [hep-ex]].

278. **P. Jackson** in the BaBar Collaboration, "Search for the $Z(4430)^-$ at BABAR," Phys. Rev. D **79** (2009) 112001 [arXiv:0811.0564 [hep-ex]].

279. **P. Jackson** in the BaBar Collaboration, "Measurement of the $e^+e^- \to b\bar{b}$ cross section between $\sqrt{s}$ = 10.54 GeV and 11.20 GeV," Phys. Rev. Lett. **102** (2009) 012001 [arXiv:0809.4120 [hep-ex]].

280. **P. Jackson** in the BaBar Collaboration, "Measurement of time dependent CP asymmetry parameters in B^0 meson decays to ωK^0_s, $\eta' K^0_s$, and $\pi^0 K^0_s$," Phys. Rev. D **79** (2009) 052003 [arXiv:0809.1174 [hep-ex]].

281. * **P. Jackson** in the BaBar Collaboration, "Measurements of the Semileptonic Decays $\bar{B} \to D\ell\bar{\nu}$ and $\bar{B} \to D^*\ell\bar{\nu}$ Using a Global Fit to $DX\ell\bar{\nu}$ Final States," Phys. Rev. D **79** (2009) 012002 [arXiv:0809.0828 [hep-ex]].

282. **P. Jackson** in the BaBar Collaboration, "Evidence for $X(3872) \to \psi_{2S}\gamma$ in $B^{\pm} \to X(3872)K^{\pm}$ decays, and a study of $B \to c\bar{c}\gamma K$," Phys. Rev. Lett. **102** (2009) 132001 [arXiv:0809.0042 [hep-ex]].

283. **P. Jackson** in the BaBar Collaboration, "Measurement of the $B^+ \to \omega\ell^+\nu$ and $B^+ \to \eta\ell^+\nu$ Branching Fractions," Phys. Rev. D **79** (2009) 052011 [arXiv:0808.3524 [hep-ex]].

284. **P. Jackson** in the BaBar Collaboration, "Measurements of time-dependent CP asymmetries in $B^0 \to D^{(*)} + D^{(*)}$ - decays," Phys. Rev. D **79** (2009) 032002 [arXiv:0808.1866 [hep-ex]].

285. **P. Jackson** in the BaBar Collaboration, "Dalitz Plot Analysis of $D_s+ \to \pi^+\pi^-\pi^+$," Phys. Rev. D **79** (2009) 032003 [arXiv:0808.0971 [hep-ex]].

286. * **P. Jackson** in the BaBar Collaboration, "Measurement of Semileptonic B Decays into Orbitally-Excited Charmed Mesons," Phys. Rev. Lett. **103** (2009) 051803 [arXiv:0808.0333 [hep-ex]].

287. * **P. Jackson** in the BaBar Collaboration, "Measurement of $B \to X\gamma$ Decays and Determination of $|V_{td}/V_{ts}|$," Phys. Rev. Lett. **102** (2009) 161803 [arXiv:0807.4975 [hep-ex]].

288. * **P. Jackson** in the BaBar Collaboration, "Direct CP, Lepton Flavor and Isospin Asymmetries in the Decays $B \to K^{(*)}\ell^+\ell^-$," Phys. Rev. Lett. **102** (2009) 091803 [arXiv:0807.4119 [hep-ex]].

289. **P. Jackson** in the BaBar Collaboration, "Constraints on the CKM angle γ in $B^0 \to \bar{D}^0 D^0 K^{*0}$ with a Dalitz analysis of $D^0 \to K^0_s\pi^+\pi^-$," Phys. Rev. D **79** (2009) 072003 [arXiv:0805.2001 [hep-ex]].

290. **P. Jackson** in the BaBar Collaboration, "Branching Fractions and CP-Violating Asymmetries in Radiative B Decays to $\eta K\gamma$," Phys. Rev. D **79** (2009) 011102 [arXiv:0805.1317 [hep-ex]].

291. * **P. Jackson** in the BaBar Collaboration, "Angular Distributions in the Decays $B \to K^*\ell^+\ell^-$," Phys. Rev. D **79** (2009) 031102 [arXiv:0804.4412 [hep-ex]].

(iv) Refereed Conference Papers

292. **P. Jackson**, "Search for R-parity violating supersymmetry with the ATLAS detector," PoS EPS-HEP2011 (2011) 264, [arXiv:1112.0369 [hep-ex]].

293. **P. Jackson**, "Searches for rare leptonic and semileptonic charm decays at BABAR," Int. J. Mod. Phys. A **21**, 5475 (2006).

(2) DETAILS OF ARC GRANTS AWARDED IN THE LAST 10 YEARS

Project Id	**CI Names/s**	**Amount Funded**	**Amount of Years**	**Project Title**	**Publications**
FT130100018	Dr P. Jackson	$732,000	4	Probing the experimental frontier of particle physics with high-precision and high-energy collisions	–

F12.3. Ten career-best research outputs

(Please attach a PDF with a list of your ten career-best research outputs (five pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Attached PDF

F12.3 Ten career-best publications - Dr P. Jackson

Details of ARC Grants awarded to Dr Jackson – *Not Applicable*

- C. Bird, **P. Jackson**, R. V. Kowalewski and M. Pospelov.
  * "Search for dark matter in $b \to s$ transitions with missing energy",
  Phys. Rev. Lett. **93**, 201803 (2004), hep-ph/0401195
  Impact Factor: 7.180
  Citations: 92
  First measurements from B-factory experiments to constrain light dark matter from searches for events with missing energy. These constraints resulted directly from the PhD thesis work of Dr Jackson.

- **P. Jackson** in the BABAR Collaboration,
  * "A Search for $B^+ \to \tau^+\nu$ with Hadronic B tags"
  Phys. Rev. D **77**, 011107 (2008), [arXiv:0708.2260 [hep-ex]]
  Impact Factor: 5.050
  Citations: 124
  A result of output from two groups pioneered by Dr Jackson. Leptonic decays of B mesons using a full reconstruction technique remains a highly relevant decay channel to study.

- **P. Jackson** in the BABAR Collaboration,
  * "Observation of the bottomonium ground state in the decay $\Upsilon_{3S} \to \gamma\eta_b$",
  Phys. Rev. Lett. **101**, 071801 (2008), [Erratum-ibid. **102**, 029901 (2009)], arXiv:0807.1086 [hep-ex]
  Impact Factor: 7.180
  Citations 192
  Observation of the ground state of the bottomonium system. Dr Jackson gave the first conference presentation of this result at the prestigious International Conference of High Energy Physics.

- **P. Jackson** in the BABAR Collaboration,
  * "Measurement of the $e^+e^- \to b\bar{b}$ cross section between $\sqrt{s}$ = 10.54-GeV and 11.20-GeV"
  Phys. Rev. Lett. **102**, 012001 (2009), [arXiv:0809.4120 [hep-ex]]
  Impact Factor: 7.180
  Citations: 72
  Dr Jackson proposed to scan above the nominal operating energy to search for new states. Dr Jackson ran detector operations, liaised with the accelerator team and performed the analysis.

- **P. Jackson** in the BABAR Collaboration,
  * "A Search for $B^+ \to \ell^+ \nu_\ell$ Recoiling Against $B^- \to D^0 \ell^- \bar{\nu} X$",
  Phys. Rev. D **81**, 051101 (2010), [arXiv:0912.2453 [hep-ex]]
  Impact Factor: 5.050
  Citations: 87 (corresponding conference contribution, SLAC-PUB-13300, BABAR-CONF-08-005, has an additional 50 citations)
  Most comprehensive use of B meson reconstruction technique invented by Dr Jackson. Improved "tagging" approach will be crucial in future analyses that will employ this method at Belle-II.

- **P. Jackson** in the ATLAS Collaboration,
  * "The ATLAS Simulation Infrastructure",
  Eur. Phys. J. C **70**, 823 (2010), [arXiv:1005.4568 [physics.ins-det]]
  Citations: 683
  The ATLAS detector GEANT4 based simulation includes significant improvements based on analysis work by Dr Jackson, relying on the simulation working in situations where detectors record particles in non-standard ways.

- **P. Jackson** in the ATLAS Collaboration,
  * "Search for stable hadronising squarks and gluinos with the ATLAS experiment at the LHC",
  Phys. Lett. B **701**, 1 (2011), [arXiv:1103.1984 [hep-ex]]
  Impact Factor: 4.034
  Citations: 75
  Physics analysis placing world's most stringent limits on long-lived stable particles. Dr Jackson was the leader of the team that completed this work.

- **P. Jackson** in the ATLAS Collaboration,
  * "Search for squarks and gluinos using final states with jets and missing transverse momentum with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions",
  Phys. Lett. B **710**, 67 (2012), [arXiv:1109.6572 [hep-ex]]
  Impact Factor: 4.034
  Citations: 292
  Most stringent published limits from ATLAS collaboration on the search for supersymmetry in hadronic final states. Research was completed while Dr Jackson was subconvener of the ATLAS supersymmetry working group.

- **P. Jackson** in the ATLAS Collaboration,
  * "Search for supersymmetry in final states with jets, missing transverse momentum and one isolated lepton in sqrts = 7 TeV pp collisions using 1 fb^{-1} of ATLAS data",
  Phys. Rev. D **85**, 012006 (2012), [arXiv:1109.6606 [hep-ex]]
  Impact Factor: 5.050
  Citations: 116
  Along with the previous paper, this work set a new standard in searches for supersymmetry at the LHC. In this case one charged lepton is included in the final state.

- **P. Jackson** in the ATLAS Collaboration,
  * "Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC",
  Phys. Lett. B **716**, 1 (2012), [arXiv:1207.7214 [hep-ex]]
  Impact Factor: 4.034
  Citations: 2235
  Observation of the Higgs Boson ignited public interest in LHC. Measurement utilises technologies Dr Jackson constructed for the ATLAS tracker. Discovery led to the award of the Nobel Prize for physics in 2013.

F12.4. Further evidence in relation to research impact and contributions to the field over the last 10 years most relevant to this Proposal

(Write a maximum of 7500 characters (approx. 1000 words). Please detail further evidence in relation to research impact and contributions to the field over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(1)
PRIZES AND AWARDS:
2014 Australia-Harvard Fellowship (2014): $13k
2013 Awarded the Dean's Order of Merit for Excellence in Research
2013 - 2017 ARC Future Fellowship: $732k
2012 Deputy Vice Chancellor Research Equipment Grant: $15k
2012 School of Chemistry and Physics Small Grant Scheme: $9.5k
2006 -2008: INFN research fellowship: $100k
- This award covered my entire salary and on-costs including a travel stipend to travel from Rome to California, USA to attend meetings at SLAC National Accelerator Laboratory and to interact with colleagues.
2004: Heavy, Quarks and Leptons - Best Conference talk award,
- Won the first prize of a Sony Vaio laptop computer.

ATLAS AND BABAR INTERNAL DOCUMENTATION:
Working in large particle physics collaborations often leads to work that does not yield publications but is of internal significance to the collaboration. As a member of ATLAS I have produced 12 such internal notes, on BaBar I was responsible for 25 notes. These cover not only physics analyses but my crucial contributions to the construction and operation of these detectors and the computing infrastructures that they rely upon. In particular I authored a detailed internal note that acts as the manual for running the ATLAS pixel detectors data acquisition software.

(2)
QUALITY OF PUBLICATIONS:
My sustained ability to produce the highest quality research is highlighted by my extremely impressive publication record. As of February 2014 I have produced 940 publications, with 698 appearing in refereed journals. I am authoring one refereed book chapter that will appear in press in the coming months. According to the INSPIRE database, my papers have received more than 44,000 citations.
To date 8 papers have received over 500 citations, with 74 papers receiving over 100 citations.
My published articles receive an average of 64.0 citations per paper, an excellent indicator of the importance of my work. I have an h-index of 97, a remarkable value for such a young researcher. It is notable that I have published the majority of articles in the prestigious Physical Review Letters and Physics Review D,
journals with the highest impact factors. This outstanding publication record is clear evidence that I am an established research leader of rare qualities and exhibit fantastic potential for continued research excellence. I played a role in all publications listed in 15.2. As can be seen from the ten best list in 15.3, those where I make a significant contribution have considerably higher citation counts, reflecting the quality of my research output.

INVITED KEYNOTE SPEAKER ADDRESSES AT INTERNATIONAL MEETINGS/WORKSHOPS:
The international recognition of the quality of my research is evident in the frequent invitations to present research at specialist meetings. I have presented seminars and colloquia in Australia, Canada, Italy, Switzerland, UK, USA and have given regular presentations on research at the CERN national laboratory.
Selected Conference presentations include:
* ``Searches for direct pair production of third generation squarks with the ATLAS detector'', presented to SUSY13, Trieste, Italy.
* ``Recent Result from ATLAS'', APPC12, Chiba, Japan.
* ``Search for RPV SUSY and Displaced vertices'', presented to European Physical Society, EPS 2011, Grenoble, France July 2011
* ``Searches for long-lived particles stopped in the ATLAS detector'' presented at SUSY 2010, Bonn, Germany, 23 August 2010.
* ``Bottomonium Spectroscopy: Experimental Review'' presented at the International Conference in High Energy Physics (ICHEP), Philadelphia, USA, 1 August 2008. First public presentation of the discovery of the eta_b meson.
* ``Searches for New States in Charmonium Decays: Experimental Review'', presented at Flavour Physics and CP Violation, Taipei, Taiwan, May 2008.

* ``Rare leptonic and semileptonic charm decays with the BaBar detector'', presented at Charm 2006, Beijing, China, 5 June, 2006.
* ``Rare B Decays at BaBar, Belle and CLEO'', presented at Heavy Quarks and Leptons 2004, San Juan, Puerto Rico, 1 June, 2004.

COLLABORATION LEADERSHIP ROLES:
Given the magnitude of the collaborations with which I have been associated (ATLAS > 3000 physicists and BaBar > 600 collaborators), roles within these collaborations can be seen as serving the greater physics research community. Significant leadership roles include:

* Belle-II collaboration - Team Leader: University of Adelaide (2014 -)
* ATLAS collaboration - Speakers Committee Advisory Board (2013 - 2015)
* ATLAS collaboration - Team Leader: University of Adelaide (2012 -)
* ATLAS collaboration - Supersymmetry with tau leptons group subconvener (2012 -- present)
* ATLAS collaboration - Supersymmetry working group subconvener (2010 - 2011)
* BaBar collaboration - Leptonic Bottom and Charm working group subconvener (2005 -2008)
* BaBar collaboration - Recoil Method Tools group co-convener (2004 - 2008)
* ATLAS collaboration - Leader of construction of opto-boards pixel detector (2004 - 2005)

CONFERENCE/WORKSHOP/MEETING ORGANISATION:
* AFAD/ACAS 2014 (Jan 2014) - 120 attendees: Local Organising committee, Detector Session Chair
* CoEPP Supersymmetry Workshop - 25 attendees: Organiser
* ICHEP 2012 (July 2012) - 800 attendees: Local Organising committee
* Workshop on "Long-lived particles in ATLAS" (May 2011) - 35 attendees: at the Universita' di Roma "La Sapienza".
* ATLAS Supersymmetry Working Group (2010-2011) - 300 collaborators: Meetings organised and chaired regularly throughout the course of the year with two workshops held at CERN.
* BaBar Leptonic B&C (2005-2008) -60 collaborators: Biweekly meetings organised and chaired

PEER REVIEW:
As a leader in my research field, I have been requested to review and referee papers for top ranking international journals such as Physical Review Letters, Physical Review D.

ATLAS/BABAR EDITORIAL BOARDS:
I have served as Editorial Board chair on the analysis of
* "Supersymmetry search with Z + MET" on ATLAS
* "Measurement of form factors with D -> K l nu decays" on BaBar

F12.5. A statement on your most significant contributions to the research field of this Proposal

(Write a maximum of 3750 characters (approx. 500 words). Please refer to the Instructions to Applicants for the required content and formatting.)

MAJOR RESEARCH ACCOMPLISHMENTS:

* Inventor of semi-leptonic B-meson recoil technique, led to over 40 papers using these methods from the BaBar and Belle collaborations

* Utilised recoil technique to extract first indirect constraints on light dark matter scalar particles from flavour physics experiments. The resulting publication in Physical Review Letters in 2004 has 92 citations.

* As ATLAS Supersymmetry working group subconvener I guided the first published searches for supersymmetry at the LHC leading to around 20 high impact papers.

* Leader of Leptonic bottom and charm meson decays with BaBar. In particular my searches for B -> tau nu have over 400 combined citations.

* Leader of construction of optoboards used to readout ATLAS pixel detector

FURTHER DETAILS ON SIGNIFICANT RESEARCH:
I have assumed leadership roles in the two most crucial areas of experimental collider particle physics: high

energy proton-proton collisions with the ATLAS experiment at the CERN Large Hadron Collider and precision electron-positron collisions with the BaBar experiment at the SLAC B-Factory. These two complementary approaches to interrogating the Standard Model have been the driving force behind the major discoveries in particle physics in the last two decades. The discovery of CP violation in the B-meson system by the BaBar experiment, and the subsequent confirmation of the CKM picture of nature was awarded the Nobel Prize in Physics in 2008. The discovery of a new particle in the search for the Standard Model Higgs Boson at the Large Hadron Collider in 2012 is probably the biggest result in physics for over 30 years. I am a key player in the experiments responsible for both of these discoveries.

I played a crucial role in the physics of the BaBar experiment in Stanford, California, with a particular focus on ``B-recoil'' techniques. For my PhD dissertation, I invented the use of a method of semi-leptonic B-meson reconstruction. With this novel method, one performs an exclusive reconstruction of one of the pair of B mesons produced in a collision. The remaining particles are then studied for consistency with a signal decay mode of interest. These techniques are the only way to extract signals of rare processes with missing energy (from neutrinos or neutral massive particles such as dark matter) present in B meson decays. I performed the most sensitive measurement of B+ -> tau+ nu. With new results from the Belle collaboration

disagreeing with previous searches, precise measurement and characterisation of this decay process is one of the pillars of the physics program of the high-luminosity B-factory being prepared for data taking at the KEK laboratory. The detector being designed to exploit this new machine is Belle-II, an upgrade to the previous Japanese experiment. In order to provide the strongest impact using the high energy proton collision searches and the precision electron-positron collision analyses, I am a founder member of the Global And Modular BSM Inference Tool (GAMBIT) Collaboration, formed in October 2012. We are designing tools to perform global fitting with an assortment of data inputs to provide new beyond standard model constraints.

This international collaboration has strong Australian involvement, and spans Europe and North America. I am the leader of the B/Flavour physics and electroweak precision observables section of the collider phenomenology group of GAMBIT. As such this provides a unique window on the particle physics community, sitting between experiment and phenomenology, and between high energy and precision collider groups. I will use my expertise to publish broadly on a variety of topics impacting the physics of this proposal.

PART F - Personnel (Dr Martin White)

F1. Personal details

(The personal details will be filled out for you automatically. To update any of your personal details in this form, please update your profile accordingly and your details will update automatically in this form.)

Title

Doctor

Family Name

White

First Name

Martin

Second Name

John

Person identifier

U1319821

Role

Chief Investigator

F2. Postal address

(The postal address will be filled out for you automatically. To update your postal address, please update your profile accordingly and your postal address will update automatically in this form.)

Postal Address Line 1

School of Chemistry & Physics

Postal Address Line 2

The University of Adelaide

Locality

Adelaide

State

SA

Postcode

5005

Country

Australia

F3. Are you a current member of the ARC or its selection or other advisory committees?

(This relates only to College of Experts or Selection Advisory Committee members for National Competitive Grants Program funding schemes.)

Current Member of Advisory Committee

No

F4. Please name any Commonwealth-funded Research Centres that you will be associated with as at 1 January 2015.

	Full Legal Name of Centre	Start Date	Cessation Date	Centre Role
1	N/A			

	Centre Role if Other
1	

F5. Are you an Indigenous Participant?

Indigenous Participant

No

F6. PhD Qualification

F6.1. Do you hold a PhD or expect to be awarded a PhD qualification in the near future?

PhD Yes/No

Yes

F6.2. If you hold a PhD or expect to be awarded a PhD qualification in the near future, please enter the date your PhD has been awarded or the date your thesis will be submitted, respectively.

Date of Award

26/01/2008

F7. Qualifications

	Degree/Award	Year	Discipline/Field	Organisation Name
1	PhD	2008	Particle Physics	University of Cambridge
2	MSci	2003	Natural Sciences (Physics)	University of Cambridge
3	BA	2002	Natural Sciences	University of Cambridge

	Country
1	United Kingdom
2	United Kingdom
3	United Kingdom

F8. Current and previous appointment(s)/position(s) – during the past 10 years

	Position	Organisation Name	Department	Year Appointed
1	Lecturer in Theoretical Physics	The University of Adelaide	School of Chemistry and Physics	2013
2	Research Associate	The University of Melbourne	Experimental Particle Physics	2010
3	Research Associate	University of Cambridge	Department of Physics	2006

	Continuity	Employment Kind	Current
1	Contract	Full Time	Yes
2	Contract	Full Time	No
3	Contract	Full Time	No

F9. Organisational affiliations for eligibility purposes for this Proposal

(Name of the organisation you will be associated with for the purposes of satisfying the eligibility requirements for your nominated role in undertaking the proposed research (i.e. for a CI this will usually be the Eligible Organisation at which they will employed or hold an adjunct appointment as at 1 January 2015 and beyond; for PIs it will generally be their main employer as at 1 January 2015).)

Organisation Name

The University of Adelaide

Type of Affiliation

Employee

F10. What is your time commitment (%FTE) to this Project?

20

F11. Are you requesting an International Collaboration Award?

(Note: If you are an Australian-based PI, you must choose 'No'. Also, if you are a PI working in an Australian Eligible Organisation overseas campus you must choose 'No'.)

International Collaboration Award

Yes

F12. Research Opportunity and Performance Evidence (ROPE)

F12.1. Details on your career and opportunities for research over the last 10 years

(Write a maximum of 5250 characters (approx. 750 words). Please detail your career and opportunities over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(i) Dr White obtained his PhD from the University of Cambridge in 2008, under the supervision of Prof Andy Parker.

(ii) As a PhD student at the University of Cambridge from 2004-2006, Dr White joined the ATLAS collaboration of the Large Hadron Collider at CERN, Geneva, and split his time between Cambridge and CERN. He developed new techniques for measuring the parameters of supersymmetric theories using LHC data (in the top 5% of papers published in 2006), and worked closely with CERN physicists to perform detailed simulations of supersymmetric theories consistent with dark matter observations. As a research associate at Cambridge between 2006 and 2010, Dr White spent ~ 70% FTE at CERN leading the monitoring project for the ATLAS semiconductor tracker at CERN and studying the detector performance (leading to six papers with >200 citations). This was a challenging leadership role during the demanding period of first beam at the Large Hadron Collider. In his 30% research time, Dr White published four theoretical papers on supersymmetric dark matter models and supervised a first year PhD student on the first ATLAS ``minimum bias'' analysis. This has collected 192 citations and is the fundamental publication that establishes all future analysis at the ATLAS detector.

In 2010, Dr White moved to the University of Melbourne for a full-time research position dedicated to supersymmetry searches at the LHC. Dr White designed and performed the first Large Hadron Collider search for the supersymmetric partner of the top quark. Most unusually for an ATLAS paper, Dr White performed the entire analysis himself, and the work has collected 39 citations in its first year, placing it amongst the hottest topics in supersymmetry research. His status as a world leader was cemented by an invitation to review the first set of ATLAS stop quark results at the biennial International Conference on Particle Physics (the single most prestigious conference in the field). In 2012, Dr White performed a new search for stop quarks, and a search for supersymmetric particles decaying to tau leptons. In addition, Dr White independently established the first collaborations between particle experimentalists and theorists at the universities of Melbourne and Monash. This yielded 4 theoretical research papers, one of which was accepted by Physical Review Letters (the most esteemed journal in high energy physics), and another of which is in the top 3% of papers published in 2013. Finally, Dr White formed the GAMBIT collaboration with Pat Scott of Imperial College, London, involving 22 researchers at leading international institutions such Harvard, Stockholm University and CERN. This work led to the award of a Lectureship in Theoretical Physics from the University of Adelaide in 2013, where Dr White's research involves dark matter and collider physics.

(iii) During his PhD years (2004-2006) Dr White had a 10% teaching load, and 90% research time. His postdoctoral position at the University of Cambridge involved 70% detector commissioning work, most of which cannot be counted as research. His proportion of active research time was 30%. His position at the University of Melbourne was a research only position. He currently holds a lectureship at the University of Adelaide with 60% teaching and administration load and 40% research time.

(iv) Dr White has had no career interruptions.

(v) Dr White has frequently collaborated with world leaders in particle physics and dark matter, and he retains close links with his previous collaborators. Most notably, his recent formation of GAMBIT with Pat Scott of Imperial College, London, has forged close links with 22 of the world's leading researchers in particle astrophysics.

The University of Adelaide hosts world experts in particle physics in the Centre of Excellence for Particle Physics at the Terascale, including Laureate Fellow Prof Anthony Thomas, Prof Tony Williams and Future Fellows Dr Ross Young and Dr Paul Jackson. The University also hosts high performance computing expertise in the ARC Special Research Centre for the Subatomic Structure of Matter and eResearch SA. Finally, the astrophysics group hosts national leaders in gamma ray and neutrino physics in the form of Dr Gavin Rowell and Future Fellow Dr Gary Hill.

Dr White has supervised 5 PhD students at Cambridge, Melbourne and CERN, and informally supervised a Monash PhD student on two papers, one of which was accepted by PRL. Since starting at Adelaide in July 2012, he has supervised one honours student and 3 undergraduate research projects. He currently has 2 PhD students, 2 MPhil students and 2 honours students.

(vi) Much of the work on a large collaboration such as ATLAS does not lead directly to journal publications, but results in internal notes or internal collaboration talks. Dr White has been a primary author on 9 such internal notes over the last 5 years, documenting searches for supersymmetric particles. He has given numerous, high profile, internal ATLAS collaboration talks, including 3 final presentations of analyses to the entire collaboration (the final step before results are made public).

F12.2. Recent significant research outputs and ARC grants (since 2004)

(Please attach a PDF with a list of your recent significant research outputs and ARC grants most relevant to the Proposal (20 pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Attached PDF

(1) Recent significant research outputs (since 2004)

Scholarly books

Not Applicable

Scholarly book chapters

Not Applicable

Refereed journal articles

1. * **M. J. White** in the ATLAS Collaboration, "Measurement of the mass difference between top and anti-top quarks in pp collisions at $\sqrt{(s)}$ = 7 TeV using the ATLAS detector", Phys. Lett. B **728** (2014) 363
2. * **M. J. White** in the ATLAS Collaboration, "Search for dark matter in events with a hadronically decaying W or Z boson and missing transverse momentum in pp collisions at sqrt(s)=8 TeV with the ATLAS detector", Phys. Rev. Lett. **112** (2014) 041802
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5. * **M. J. White** in the ATLAS Collaboration, "Search for charginos nearly mass-degenerate with the lightest neutralino based on a disappearing-track signature in pp collisions at $\sqrt{s}$ = 8 TeV with the ATLAS detector", Phys. Rev. D **88** (2013) 112006
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14. **M. J. White** in the ATLAS Collaboration, "Measurement of the top quark charge in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", JHEP **1311** (2013) 031

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249. **M. J. White** in the ATLAS Collaboration, "Search for high-mass states with one lepton plus missing transverse momentum in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", Phys. Lett. B **701**, 50 (2011)

250. * **M. J. White** in the ATLAS Collaboration, "Search for squarks and gluinos using final states with jets and missing transverse momentum with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions", Phys. Lett. B **701**, 186 (2011)

251. **M. J. White** in the ATLAS Collaboration, "Measurement of Dijet Azimuthal Decorrelations in pp Collisions at $\sqrt{s} = 7$ TeV", Phys. Rev. Lett. **106**, 172002 (2011)

252. * **M. J. White** in the ATLAS Collaboration, "Search for supersymmetry using final states with one lepton, jets, and missing transverse momentum with the ATLAS detector in $\sqrt{s} = 7$ TeV pp", Phys. Rev. Lett. **106**, 131802 (2011)

253. **M. J. White** in the ATLAS Collaboration, "Search for Massive Long-lived Highly Ionising Particles with the ATLAS Detector at the LHC", Phys. Lett. B **698**, 353 (2011)

254. **M. J. White** in the ATLAS Collaboration, "Luminosity Determination in pp Collisions at $\sqrt{s} = 7$ TeV Using the ATLAS Detector at the LHC" , Eur. Phys. J. C **71**, 1630 (2011)

255. **M. J. White** in the ATLAS Collaboration, "Study of Jet Shapes in Inclusive Jet Production in pp Collisions at $\sqrt{s} = 7$ TeV using the ATLAS Detector", Phys. Rev. D **83**, 052003 (2011)

256. **M. J. White** in the ATLAS Collaboration, "Measurement of the production cross section for W^- bosons in association with jets in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", Phys. Lett. B **698**, 325 (2011)

257. **M. J. White** in the ATLAS Collaboration, "Measurement of the centrality dependence of J/ψ yields and observation of Z production in lead-lead collisions with the ATLAS detector at the LHC", Phys. Lett. B **697**, 294 (2011)

258. **M. J. White** in the ATLAS Collaboration, "Measurement of the inclusive isolated prompt photon cross section in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", Phys. Rev. D **83**, 052005 (2011)

259. **M. J. White** in the ATLAS Collaboration, "Charged-particle multiplicities in pp interactions measured with the ATLAS detector at the LHC", New J. Phys. **13**, 053033 (2011)

260. * **M. J. White** in the ATLAS Collaboration, "Search for Diphoton Events with Large Missing Transverse Energy in 7 TeV Proton-Proton Collisions with the ATLAS Detector", Phys. Rev. Lett. **106**, 121803 (2011)

261. **M. J. White** in the ATLAS Collaboration, "Measurement of the top quark-pair production cross section with ATLAS in pp collisions at $\sqrt{s} = 7$ TeV", Eur. Phys. J. C **71**, 1577 (2011)

262. **M. J. White** in the ATLAS Collaboration, "Measurement of underlying event characteristics using charged particles in pp collisions at $\sqrt{s} = 900GeV$ and 7 TeV with the ATLAS detector", Phys. Rev. D **83**, 112001 (2011)

263. **M. J. White** in the ATLAS Collaboration, "Studies of the performance of the ATLAS detector using cosmic-ray muons", Eur. Phys. J. C **71**, 1593 (2011)

264. **M. J. White** in the ATLAS Collaboration, "Search for Quark Contact Interactions in Dijet Angular Distributions in pp Collisions at $\sqrt{s} = 7$ TeV Measured with the ATLAS Detector", Phys. Lett. B **694**, 327 (2011)

265. **M. J. White** in the ATLAS Collaboration, "Measurement of inclusive jet and dijet cross sections in proton-proton collisions at 7 TeV centre-of-mass energy with the ATLAS detector", Eur. Phys. J. C **71**, 1512 (2011)

266. **M. J. White** in the ATLAS Collaboration, "Measurement of the $W \to \ell\nu$ and $Z/\gamma^* \to \ell\ell$ production cross sections in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", JHEP **1012**, 060 (2010)

267. **M. J. White** in the ATLAS Collaboration, "Observation of a Centrality-Dependent Dijet Asymmetry in Lead-Lead Collisions at $\sqrt{s_{NN}} = 2.77$ TeV with the ATLAS Detector at the LHC", Phys. Rev. Lett. **105**, 252303 (2010)

268. **M. J. White** in the ATLAS Collaboration, "Search for New Particles in Two-Jet Final States in 7 TeV Proton-Proton Collisions with the ATLAS Detector at the LHC", Phys. Rev. Lett. **105**, 161801 (2010)

269. **M. J. White** in the ATLAS Collaboration, "Readiness of the ATLAS Tile Calorimeter for LHC collisions", Eur. Phys. J. C **70**, 1193 (2010)

270. **M. J. White** in the ATLAS Collaboration, "Commissioning of the ATLAS Muon Spectrometer with Cosmic Rays", Eur. Phys. J. C **70**, 875 (2010)

271. **M. J. White** in the ATLAS Collaboration, "Performance of the ATLAS Detector using First Collision Data", JHEP **1009**, 056 (2010)

272. **M. J. White** in the ATLAS Collaboration, "The ATLAS Simulation Infrastructure", Eur. Phys. J. C **70**, 823 (2010)

273. **M. J. White** in the ATLAS Collaboration, "The ATLAS Inner Detector commissioning and calibration", Eur. Phys. J. C **70**, 787 (2010)

274. **M. J. White** in the ATLAS Collaboration, "Charged-particle multiplicities in pp interactions at $\sqrt{s} = 900$ GeV measured with the ATLAS detector at the LHC", Phys. Lett. B **688**, 21 (2010)

275. **M. J. White** in the ATLAS Collaboration, "Drift Time Measurement in the ATLAS Liquid Argon Electromagnetic Calorimeter using Cosmic Muons", Eur. Phys. J. C **70**, 755 (2010)

276. * **M. J. White** and F. Feroz, MSSM dark matter measurements at the LHC without squarks and sleptons, JHEP 1007, 064 (2010)

277. **M. J. White** in the ATLAS Collaboration, "Readiness of the ATLAS Liquid Argon Calorimeter for LHC Collisions", Eur. Phys. J. C **70**, 723 (2010)

278. * **M. J. White** ,Z. Kang, N. Kersting, S. Kraml and A. R. Raklev, Neutralino Reconstruction at the LHC from Decay-frame Kinematics, Eur. Phys. J. C **70**, 271 (2010)

279. * **M. J. White**, S. Kraml and A. R. Raklev, NMSSM in disguise: Discovering singlino dark matter with soft leptons at the LHC, Phys. Lett. B **672**, 361 (2009)

Refereed conference papers

280. * **M. J. White**, "Searches for third generation squarks with the ATLAS detector", PoS ICHEP **2012**, 122 (2013).

281. * **M. J. White**, B. Farmer, C. BALAZS, A. Buckley and D. Carter, "Should we still believe in constrained supersymmetry?", PoS ICHEP **2012**, 102 (2013).

282. * **M. J. White**, B. Farmer, C. BALAZS, A. Buckley and D. Carter, "Should we still believe in constrained supersymmetry?", PoS DSU **2012**, 004 (2012).

Other

283. * **M. J. White** et al, "The Science of Dr Who": National touring stage show presented by the Royal Institute of Australia in association with BBC Worldwide Australia and New Zealand. Playing in Perth, Brisbane, Sydney, Adelaide and Melbourne from April to June 2014

284. * **M. J. White**, "Higgs discovery live interview", Sky News Australia, July 2012

285. * **M. J. White** "Unravelling the mysteries of the universe with the Large Hadron Collider", school and public lecture tour presented by the Australian Institute of Physics, Tasmania, August 2011

286. * **M. J. White**, J. Ellis, "Australians at the LHC", live video lecture from CERN to the Royal Institute Science Exchange in Adelaide, July 2010

287. * **M. J. White**, "LHC relaunch live interview", BBC News 24, 2010

(2) ARC grants (since 2004)

Not applicable

F12.3. Ten career-best research outputs

(Please attach a PDF with a list of your ten career-best research outputs (five pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Attached PDF

F12.3: Ten career-best research outputs

Details of ARC grants: *Not applicable.*

1. * **M. J. White**, Csaba Balazs, Andy Buckley, Daniel Carter and Benjamin Farmer
   "Should we still believe in constrained supersymmetry?"
   Eur. Phys. J. C **73**, 2563 (2013)
   Impact Factor: 5.247
   Citations: 34
   ARC grant: *Not applicable*
   Uses novel analysis techniques with collider and astrophysical data to show that the most popular supersymmetric model is now massively disfavoured. Top 3% of HEP papers published in 2013.

2. * **M. J. White** in the ATLAS Collaboration
   "Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC"
   Phys. Lett. B **716**, 1 (2012)
   Impact Factor: 4.569
   Citations: 2235
   ARC grant: *Not applicable*
   Discovery of the elusive Higgs boson using the detector which Dr White helped to commission at CERN. Led to the 2013 Nobel Prize in Physics for Higgs and Englert.

3. * **M. J. White** in the ATLAS Collaboration
   "Search for direct top squark pair production in final states with one isolated lepton, jets, and missing transverse momentum in $\sqrt{s} = 7$ TeV pp collisions using 4.7 fb^{-1} of ATLAS data"
   Phys. Rev. Lett. **109**, 211803 (2012)
   Impact Factor: 7.943
   Citations: 65
   ARC grant: *Not applicable*
   Provided the best constraints on the supersymmetric top quark mass. Dr White gave regular feedback during the analysis design stage and presented the first results at ICHEP 2012.

4. * **M. J. White** in the ATLAS Collaboration
   "Search for light top squark pair production in final states with leptons and b jets with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions"
   Phys. Lett. B **720**, 13 (2013)
   Impact Factor: 4.569
   Citations: 50
   ARC grant: *Not applicable*
   A search for supersymmetric top quarks in a different final state. Dr White gave regular feedback during the analysis design stage and presented the first results at ICHEP 2012.

5. * **M. J. White** in the ATLAS Collaboration
   "Search for a supersymmetric partner to the top quark in final states with jets and missing transverse momentum at $\sqrt{s} = 7$ TeV with the ATLAS detector"
   Phys.Rev.Lett. **109** 211802 (2012)
   Impact Factor: 7.943

Citations: 67
ARC grant: *Not applicable*
A search for supersymmetric top quarks using the ATLAS detector. Dr White gave regular feedback during the analysis design stage and presented the first results at ICHEP 2012.

6. * **M. J. White** in the ATLAS Collaboration
"Search for light scalar top quark pair production in final states with two leptons with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions"
Eur. Phys. J. C **72**, 2237 (2012)
Impact Factor: 5.247
Citations: 41
ARC grant: *Not applicable*
Performed entirely by Dr White, this is the first LHC search for the supersymmetric partner of the top quark. Rules out the range of masses consistent with electroweak baryogenesis.

7. * **M. J. White** in the ATLAS Collaboration
"Search for squarks and gluinos using final states with jets and missing transverse momentum with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions"
Phys. Lett. B **710**, 67 (2012)
Impact Factor: 4.569
Citations: 293
ARC grant: *Not applicable*
Search for supersymmetry using the ATLAS detector that provided the strongest constraints on supersymmetry up to that point. Dr White did much preparatory work in the supersymmetry group.

8. **M. J. White** in the ATLAS Collaboration
"The ATLAS Inner Detector commissioning and calibration"
Eur. Phys. J. C **70**, 787 (2010)
Impact Factor: 5.247
Citations: 111
ARC grant: *Not applicable*
Summarises the development and testing of the detector subsystem that Dr White commissioned at CERN, including analysis results from Dr White. Top 1% of HEP papers from 2010.

9. **M. J. White** in the ATLAS Collaboration
"Charged-particle multiplicities in pp interactions at $\sqrt{s} = 900$ GeV measured with the ATLAS detector at the LHC"
Phys. Lett. B **688**, 21 (2010)
Impact Factor: 4.569
Citations: 194
ARC grant: *Not applicable*
The first ATLAS analysis, on which all future analyses are based. Dr White and his student measured the tracking efficiency and presented results to the analysis group.

10. * **M. J. White**, C. Lester, M. Parker
"Determining SUSY model parameters and masses at the LHC using cross-sections, kinematic edges

and other observables"
JHEP **0601** (2006) 080
Impact Factor: 5.618
Citations: 68
ARC grant: *Not applicable*
Presents new methods for extracting the best measurements of the parameters of new physics theories using collider data. Continues to influence statistical fits of new physics models.

Reference

Impact Factor: 2012 Journal Citation Reports (Thomson Reuters)

F12.4. Further evidence in relation to research impact and contributions to the field over the last 10 years most relevant to this Proposal

(Write a maximum of 7500 characters (approx. 1000 words). Please detail further evidence in relation to research impact and contributions to the field over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

Research Outputs other than Publications:

(a) ATLAS internal documentation: Much of the work on the ATLAS experiment does not lead directly to publications. Dr White and his students have performed many studies of the detector performance, data quality checks, detector software development, and detailed calculations of the statistical and systematic errors affecting new particle searches. This work is vital to the research output of ATLAS, and is distributed in internal collaboration notes. Dr White has written 14 such technical notes in the last ten years.

(b) Prizes and Awards: Dr White received a competitive $13,400 Early Career Researcher grant from the University of Melbourne in 2012 in order to develop a programme of dark matter research. In 2003, he was awarded a PhD scholarship from the UK particle physics funding body (STFC), and a Churchill College (University of Cambridge) scholarship. His PhD research won prizes from the UK Institute of Physics and the STFC.

(c) Other notable honours: Within the ATLAS collaboration of 3000 members, top researchers are given the honour of editing conference papers or journal publications, and are invited to give final presentations of results to the full collaboration. These honours are extremely competitive, as the researcher must be selected from the often large teams performing the work. Within the last 2 years, Dr White has been selected as the editor of two journal publications, two conference papers and three internal papers, and has been selected to a give a final analysis review on three separate occasions in the last 2 years. This recognition is a very clear indicator of White's international standing in experimental particle physics.

Research Impact relative to opportunity:

(a) Publication record: Dr White has a unique publication record that combines success in theoretical and experimental particle physics. To date, he has published 274 papers in refereed journals, with an average of 67 citations per paper, and an H index of 63 (taken from the INSPIRE database which is the appropriate choice for high energy physics). The perennial complaint of ARC referees is that this number is biased by the large number of papers from the 3,000 strong ATLAS collaboration, and we therefore take care here to put Dr White's excellent publication record in its proper context.

Although Dr White can lay claim to all ATLAS papers due to the large amount of technical work he has performed on the detector, the papers to which he has made very strong direct contributions are amongst the most highly cited ATLAS papers. His commissioning work on the semiconductor tracker has yielded 6 detector papers, including a paper in the top 1% of detector papers published in 2010. His leadership role on the semiconductor tracker during the first beam at the Large Hadron Collider was crucial in allowing ATLAS to efficiently record the results of the first LHC collisions, culminating in a high publication rate from the experiment. In 2010, Dr White and his Cambridge student made vital contributions to the first ATLAS "minimum bias analysis", which is in the top 0.5% of high energy physics papers from 2010. This was the first analysis of LHC collisions from the ATLAS collaboration, and the paper established the methods on which all subsequent ATLAS analyses are based.

Dr White's particular interest is in searches for physics beyond the Standard Model. His recent searches for supersymmetric top quarks with the ATLAS detector include a paper written entirely by himself that is in the top 5% of high energy physics papers published in 2012 and two further conference papers that have change the direction of supersymmetry research by excluding natural supersymmetry models. Dr White's consistent ability to produce papers at the top end of the ATLAS collaboration output marks him out as a particularly distinguished researcher in experimental particle physics. His success in designing and leading analyses in very small teams is highly unusual in the competitive environment of an LHC experiment.

In addition, there are few people in the world who combine a celebrated experimental career with parallel success in theoretical physics. Dr White has published 10 theoretical physics papers with over 130 citations in total. His PhD work introduced new methods for extracting parameters of new physics theories from Large Hadron Collider data, and is in the top 6% of high energy physics papers published since 2006. This work

has become even more important since the start of the LHC, as it provides the most advanced method for establishing limits on new physics models from negative results in LHC searches. Dr White recently applied his innovative parameter estimation techniques to the case of supersymmetry, generating a paper in the top 3% of high energy physics papers published in 2013. This work proved that the simplest supersymmetric model is massively disfavoured, prompting studies of more general cases. His work is exclusively published in top ranked journals such as JHEP, Phys. Rev. D, EPJC and Physical Review Letters. Dr White has firmly established himself as a world leader in theoretical physics and phenomenology, and he has clear potential for continued excellence.

(b) Other professional activities:

Dr White leads the GAMBIT (Global And Modular Beyond-the-Standard-Model Inference Tool) collaboration with Pat Scott of Imperial College, London, a team of 22 physicists and statisticians at 16 institutes worldwide. In July 2012, Dr White was the assistant to the chair of the Higgs session at the International Conference on High Energy Physics, the first session on Higgs physics after the announcement of the discovery of the Higgs boson.

Whilst at Cambridge, Dr White was regularly invited to meet and discuss particle physics and astronomy with senior politicians, including greeting members of the House of Commons Science and Technology Select Committee at CERN, and touring the UK Science Minister around the CERN facility. Dr White also gave live TV and radio interviews with national BBC stations.

Since arriving in Australia in 2010, Dr White has swiftly become a national leader in particle physics. He was the inaugural chair of the national experimental meetings of the ARC Centre of Excellence in Particle Physics at the Terascale (CoEPP) in 2011, despite not being a member of CoEPP. He has taught at the CoEPP schools on particle physics, and developed the first national masterclass on particle physics at the Australian Synchrotron in July 2012. He organised a national workshop on supersymmetry at the University of Adelaide in November 2013, spoke on an expert panel on the 2013 Nobel Prize in Melbourne, and presented an after dinner speech at the AIP 50th anniversary dinner in South Australia in December 2013. Dr White's public profile includes interviews with Sky News Australia and The Age newspaper, and he has a show on the Science of Dr Who that has played to sold out audiences in Adelaide and Canberra. In 2014, the show is undergoing a national tour sponsored by the BBC, the first of its kind in Australia.

Dr White's status as a leading figure in particle physics has been recognised by requests to referee papers for top ranking international journals such as the Journal of Instrumentation, The Journal of High Energy Physics and Physics Letters B.

F12.5. A statement on your most significant contributions to the research field of this Proposal

(Write a maximum of 3750 characters (approx. 500 words). Please refer to the Instructions to Applicants for the required content and formatting.)

The proposed project requires expertise in four areas in which Dr White is a world leader:

1. Particle phenomenology: The central question of phenomenology is “how do we use astrophysical and collider data to measure new theories of physics"? Dr White has over 100 citations as a phenomenologist, and is a leader in the field of parameter extraction. He published the first method capable of using the rate of new particle production at the Large Hadron Collider (LHC) to extract measurements of new physics models (top 6% of theoretical particle papers since 2006) and recently used machine learning to show that the most popular supersymmetric model in the literature is now massively disfavoured ([1] of Section C3, cited in the top 3% of papers in 2013). Dr White's recent theoretical work includes a PRL showing that a popular class of supersymmetric models require significant fine tuning ([80] of Section C2). Dr White's status as a world leader is further signified by his formation (with Pat Scott of Imperial College, London) of the GAMBIT collaboration. This major new international initiative, comprising 22 researchers across the globe will set a new standard in particle astrophysics computation.

2. Understanding particle detectors: Dr White has been a member of the ATLAS collaboration at the LHC since 2003. For 5 years, Dr White had a leadership role in the ATLAS semiconductor tracker, culminating in 6 publications in detector physics, one of which is in the top 1% of detector papers from 2010 ([8] of Section C3). This project requires fast simulations of LHC detectors, and Dr White's first-hand knowledge and

experience will be invaluable.

3. LHC data analysis: This project involves reinterpreting LHC data, and requires detailed knowledge of LHC analysis techniques. Dr White performed crucial work for the first ATLAS analysis of LHC data ([9] of Section C3), including high level internal presentations. This was the basis for all future ATLAS analyses, and is in the top 0.5% of high energy physics papers of 2010. He was the first person at the LHC to perform a search for the supersymmetric partner of the top quark, the current most sought-after particle in supersymmetry. Dr White's analysis was performed entirely by himself which is highly unusual, and he supervised a Cambridge postdoc in cross-checking the results. The work is in the top 5% of 2012 particle physics papers, and inspired similar studies ([3,4,5,7] of Section C3) which Dr White presented at the ICHEP conference in 2012 (the single most prestigious conference in particle physics). More recently, Dr White performed the first LHC search that can directly constrain the fine tuning of supersymmetric models in tau final states. Very few phenomenologists have such a detailed, first-hand knowledge of LHC physics.

4. Particle astrophysics: This project requires a detailed knowledge of the overlaps between particle physics and astrophysics. Dr White took a leading role in the only joint project between the ATLAS supersymmetry group and an astrophysical experiment (the HESS gamma ray telescope), and chaired informal discussons at the Universities of Paris and Montpellier between particle physicisits and gamma ray astronomers. In a follow up study, Dr White proposed an original method for improving dark matter measurements at the LHC by orders of magnitude ([263] of Section C2), and showed that direct dark matter search experiments are competitive with the LHC. His recent study of the CMSSM ([1] of Section C3) relies heavily on the use of data from direct search dark matter experiments.

Dr White has a unique breadth of knowledge and a proven leadership ability. He is the ideal candidate to lead the research in this proposal.

PART F - Personnel (Prof Joakim Edsjo)

F1. Personal details

(The personal details will be filled out for you automatically. To update any of your personal details in this form, please update your profile accordingly and your details will update automatically in this form.)

Title

Professor

Family Name

Edsjo

First Name

Joakim

Person identifier

94739344

Role

Partner Investigator

F2. Postal address

(The postal address will be filled out for you automatically. To update your postal address, please update your profile accordingly and your postal address will update automatically in this form.)

Postal Address Line 1

Oskar Klein Centre and Department of Physics

Postal Address Line 2

Stockholm University

Locality

Stockholm

Postcode

SE-106 91

Country

Sweden

F3. Are you a current member of the ARC or its selection or other advisory committees?

(This relates only to College of Experts or Selection Advisory Committee members for National Competitive Grants Program funding schemes.)

Current Member of Advisory Committee

No

F4. Please name any Commonwealth-funded Research Centres that you will be associated with as at 1 January 2015.

	Full Legal Name of Centre	Start Date	Cessation Date	Centre Role
1	Not applicable			

	Centre Role if Other
1	

F5. Are you an Indigenous Participant?

Indigenous Participant

No

F6. PhD Qualification

F6.1. Do you hold a PhD or expect to be awarded a PhD qualification in the near future?

PhD Yes/No

Yes

F6.2. If you hold a PhD or expect to be awarded a PhD qualification in the near future, please enter the date your PhD has been awarded or the date your thesis will be submitted, respectively.

Date of Award

28/05/1997

F7. Qualifications

	Degree/Award	Year	Discipline/Field	Organisation Name
1	Docent	2003	Theoretical Physics	Stockholm University
2	PhD	1997	Theoretical Physics	Uppsala University, Sweden

	Country
1	Sweden
2	Sweden

F8. Current and previous appointment(s)/position(s) – during the past 10 years

	Position	Organisation Name	Department	Year Appointed
1	Professor in Theoretical Physics	Oskar Klein Centre	Oskar Klein Centre and the Department of Physics, Stockholm University	2011

	Position	Organisation Name	Department	Year Appointed
2	Associate Professor (on leave of absence during the special researcher position)	Stockholm University	Department of Physics, Stockholm University	2006
3	Special Researcher	Stockholm University	Department of Physics, Stockholm University	2004
4	Assistant professor	Stockholm University	Department of Physics, Stockholm University	2000

	Continuity	Employment Kind	Current
1	Permanent	Full Time	Yes
2	Permanent	Full Time	No
3	Contract	Full Time	No
4	Contract	Full Time	No

F9. Organisational affiliations for eligibility purposes for this Proposal

(Name of the organisation you will be associated with for the purposes of satisfying the eligibility requirements for your nominated role in undertaking the proposed research (i.e. for a CI this will usually be the Eligible Organisation at which they will employed or hold an adjunct appointment as at 1 January 2015 and beyond; for PIs it will generally be their main employer as at 1 January 2015).)

Organisation Name

Oskar Klein Centre

Type of Affiliation

Employee

F10. What is your time commitment (%FTE) to this Project?

20

F11. Are you requesting an International Collaboration Award?

(Note: If you are an Australian-based PI, you must choose 'No'. Also, if you are a PI working in an Australian Eligible Organisation overseas campus you must choose 'No'.)

International Collaboration Award

No

F12. Research Opportunity and Performance Evidence (ROPE)

F12.1. Details on your career and opportunities for research over the last 10 years

(Write a maximum of 5250 characters (approx. 750 words). Please detail your career and opportunities over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(i) 16 years since I graduated with a PhD in Theoretical Physics, Uppsala University, Sweden, Supervisor: Hector Rubinstein, Department of Theoretical Physics. Assistant supervisor: Lars Bergstrom, Department of Physics, Stockholm University, Sweden.

(ii) All of my positions since 2004 have been full-time, modulo any paternity leave taken (see iv).

- Jan 2004 - March 2004 : Assistant professor (forskarassistent) in theoretical astroparticle physics, Department of Physics, Stockholm University, Sweden.
- April 2004 - April 2011: Special researcher (radsforskare), Stockholm University, financed by VR. The grant (taking paternity leave into account) ended in December 2010.
- January 2006 - April 2011: Associate Professor (lektor) in theoretical physics, Stockholm University (on leave of absence for the duration of the special researcher grant).
- May 2011 - present: Professor Stockholm University and Oskar Klein Centre for Cosmoparticle physics

- Other more extended visits: visiting scientist, KITP, UC Santa Barbara, USA, December, 2009.

(iii) For my position as assistant professor, I spent 80% time on research, 20% on
teaching. As a special researcher from 2004-2011 I held an 80% research/20%
teaching role. Since 2011, as a full professor I am director of undergraduate studies which takes 30% of my time, teaching duties take up a further 10% leaving
60% of my time for research.

(iv) Between 2004 and 2008, I have for extended periods been on paternity leave part-time (in total about one year full-time equivalent).

(v)
My research is conducted through the Oskar Klein Centre for Cosmo Particle Physics at Stockholm University (OKC) which was created by the Faculty of Science in July 2008 and financed by the Swedish Research Council through a centre of excellence grant for a period of ten years. The aim of the centre is to focus on three main areas:

1. Identifying theoretically, and probing observationally, measurables related to dark energy to elucidate the nature of what is driving the accelerated expansion of the universe.

2. Searching experimentally for particle candidates of dark matter, which naturally means going beyond the standard model of particle physics, and if found, determining their properties and elucidating the underlying theoretical framework.

3. Investigating the physics of extreme objects, such as supernovae, neutron stars, and black holes. The work packages around these themes are formed by intertwining the applying teams within the AlbaNova University Centre in Stockholm.

The Centre is an independent entity of the Faculty with a Steering Group appointed by the Vice-Chancellor of the University.

The OKC contains over 100 researchers at various levels including affiliations with KTH Stockholm and Stockholm University. I am one of the major contact people with the Stockholm University Department of Physics.

In conjunction with this exceptional research environment I have access to a large pool of talented graduate students whom I supervise on a variety of projects.

In the last ten years I have been the main supervisor for the following finished PhD students:
Mia Schelke (PhD 2004),
Christofer Gunnarsson (PhD 2005),
Michael Gustafsson (PhD 2008),
Patrick Scott (PhD 2010),
Erik Lundstrom (PhD 2010),
Yashar Akrami (PhD 2011),
Sara Rydbeck (PhD 2011),
Soa Sivertsson (PhD 2012).

I am currently supervising one PhD student as their main supervisor:
Natallia Karpenka (expected to finish spring 2014).

I have also been in numerous PhD thesis committees and been the opponent (or equivalent) for the dissertation of:

Janne Holopainen (PhD 2007, University of Turku, Finland)
Miguel Pato (PhD 2011, University of Padova)

(vi) No further circumstances

F12.2. Recent significant research outputs and ARC grants (since 2004)

(Please attach a PDF with a list of your recent significant research outputs and ARC grants most relevant to the Proposal (20 pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Prof. Joakim Edsjo: Recent Significant Publications (since 2004)

(1) Research publications

(a) Scholarly books

None.

(b) Scholarly book chapters

1. * **J. Edsjo**, F. Boudjema and P. Gondolo, "SUSY Tools for Dark Matter and at the Colliders" in Bertone, G. (ed.): Particle dark matter (Cambridge University Press), 325-344 (Mar 2010).

(c) Refereed journal articles

2. **J Edsjo** in the IceCube Collaboration,"Sensitivity of IceCube-DeepCore to neutralino dark matter in the MSSM-25", JCAP **1303**, 027 (2013)

3. **J Edsjo** in the IceCube Collaboration,"Use of event-level neutrino telescope data in global fits for theories of new physics", JCAP **1211**, 057 (2012)

4. **J Edsjo**, S. Sivertsson,"WIMP diffusion in the solar system including solar WIMP-nucleon scattering", Phys. Rev. D **85**, 123514 (2012)

5. * **J Edsjo**, Y. Akrami, C. Savage, P. Scott, J. Conrad, "Statistical coverage for supersymmetric parameter estimation: a case study with direct detection of dark matter", JCAP **1107**, 002 (2011)

6. * **J Edsjo**., Y. Akrami, C. Savage, P. Scott, J. Conrad,"How well will ton-scale dark matter direct detection experiments constrain minimal supersymmetry?", JCAP **1104**, 012 (2011)

7. * **J Edsjo**, L. Bergstrom and T. Bringmann, "Complementarity of direct dark matter detection and indirect detection through gamma-rays", Phys. Rev. D **83**, 045024 (2011)

8. * **J Edsjo**, M. Johansen, S. Hellman and D. Milstead,"Long-lived stops in MSSM scenarios with a neutralino LSP", JHEP **1008**, 005 (2010)

9. * **J Edsjo**, Y. Akrami, P. Scott, J. Conrad and L. Bergstrom, "A Profile Likelihood Analysis of the Constrained MSSM with Genetic Algorithms", JHEP **1004**, 057 (2010)

10. * **J Edsjo**, E. Lundstrom, S. Rydbeck and J. Sjolin, "Early search for supersymmetric dark matter models at the LHC without missing energy", JHEP **1003**, 054 (2010)

11. **J Edsjo** and S. Sivertsson, "Accurate calculations of the WIMP halo around the Sun and prospects for its gamma ray detection", Phys. Rev. D **81**, 063502 (2010)

12. * **J Edsjo**, P. Scott, J. Conrad, L. Bergstrom, C. Farnier and Y. Akrami, "Direct Constraints on Minimal Supersymmetry from Fermi-LAT Observations of the Dwarf Galaxy Segue 1", JCAP **1001**, 031 (2010)

13. * **J Edsjo**, M. Berg, P. Gondolo, E. Lundstrom and S. Sjors, "Neutralino Dark Matter in BMSSM Effective Theory", JCAP **0908**, 035 (2009)

14. * **J Edsjo**, L. Bergstrom and G. Zaharijas, "Dark matter interpretation of recent electron and positron data", Phys. Rev. Lett. **103**, 031103 (2009)

15. **J Edsjo** and G. Wikstrom, "Limits on the WIMP-nucleon scattering cross-section from neutrino telescopes", JCAP **0904**, 009 (2009)

16. **J Edsjo**, L. Bergstrom, G. Bertone, T. Bringmann, and M. Taoso, "Gamma-ray and Radio Constraints of High Positron Rate Dark Matter Models Annihilating into New Light Particles", Phys. Rev. D **79**, 081303 (2009)

17. **J Edsjo**, E. Lundstrom, and M. Gustafsson, "The Inert Doublet Model and LEP II Limits", Phys. Rev. D **79**, 035013 (2009)

18. **J Edsjo**, P. Scott, M. Fairbairn,"Dark stars at the Galactic centre - the main sequence", Mon. Not. Roy. Astron. Soc. **394**, 82 (2009)

19. **J Edsjo**, L. Bergstrom, and T. Bringmann, "New Positron Spectral Features from Supersymmetric Dark Matter - a Way to Explain the PAMELA Data?", Phys. Rev. D **78**, 103520 (2008)

20. * **J Edsjo**, E. A. Baltz, B. Berenji, G. Bertone, L. Bergstrom, E. Bloom, T. Bringmann, J. Chiang and J. Cohen-Tanugi *et al.*, "Pre-launch estimates for GLAST sensitivity to Dark Matter annihilation signals", JCAP **0807**, 013 (2008)

21. **J Edsjo**, M. Fairbairn, and P. Scott, "The Zero Age Main Sequence of WIMP burners", Phys. Rev. D **77**, 047301 (2008)

22. * **J Edsjo**, T. Bringmann, L. Bergstrom, "New Gamma-Ray Contributions to Supersymmetric Dark Matter Annihilation", JHEP **0801**, 049 (2008)

23. **J Edsjo**, M. Blennow, T. Ohlsson, "Neutrinos from WIMP annihilations using a full three-flavor Monte Carlo", JCAP **0801**, 021 (2008)

24. * **J Edsjo**, M. Gustafsson, E. Lundstrom, L. Bergstrom, "Significant Gamma Lines from Inert Higgs Dark Matter", Phys. Rev. Lett. **99**, 041301 (2007)

25. **J Edsjo**, M. Blennow, T. Ohlsson, "Neutrinos from WIMP annihilations in the Sun including neutrino oscillations", Phys. Scripta T **127**, 19 (2006).

26. * **J Edsjo**, L. Bergstrom, M. Gustafsson and P. Salati, "Is the dark matter interpretation of the egret gamma excess compatible with antiproton measurements?", JCAP **0605**, 006 (2006)

27. **J Edsjo**, M. Schelke, P. Ullio and P. Gondolo, "Relic density calculations in mSUGRA including all coannihilations", New Astron. Rev. **49**, 159 (2005).

28. * **J Edsjo**, P. Gondolo, P. Ullio, L. Bergstrom, M. Schelke and E. A. Baltz, "DarkSUSY 4.00 neutralino dark matter made easy", New Astron. Rev. **49**, 149 (2005).

29. * **J Edsjo**, P. Gondolo, P. Ullio, L. Bergstrom, M. Schelke and E. A. Baltz, "DarkSUSY: Computing supersymmetric dark matter properties numerically", JCAP **0407**, 008 (2004)

30. * **J Edsjo**, M. Schelke and P. Ullio, "Direct versus indirect detection in mSUGRA with self-consistent halo models", JCAP **0409**, 004 (2004)

31. * **J Edsjo** and J. Lundberg, "WIMP diffusion in the solar system including solar depletion and its effect on earth capture rates", Phys. Rev. D **69**, 123505 (2004)

(d) Refereed conference proceedings

32. **J. Edsjo**, M. Blennow and T. Ohlsson, "Neutrinos from WIMP annihilations in the Sun including neutrino oscillations", Nucl. Phys. Proc. Suppl. **221**, 37 (2011).

33. **J. Edsjo**, L. Bergstrom, J. Conrad, A. Goobar, P. O. Hulth, E. Mortsell and U. Danielsson, "Short history of Hector Rubinstein's scientific career and his years in Sweden", PoS HRMS **2010**, 007 (2010).

34. **J. Edsjo**, M. Blennow, T. Ohlsson, "WIMP neutrinos from the Sun and the Earth", PoS IDM **2008**, 116 (2008).

35. **J. Edsjo** and S. Sivertsson, "Accurate calculations of the WIMP halo around the Sun and prospects for gamma ray detection", PoS IDM **2008**, 112 (2008)

36. * **J. Edsjo**, P. Scott and M. Fairbairn "Impacts of WIMP dark matter upon stellar evolution: main-sequence stars", PoS IDM **2008**, 073 (2008)

37. **J. Edsjo** in the GLAST LAT Collaboration, "GLAST sensitivity to cosmological dark matter annihilations into gamma-rays", AIP Conf. Proc. **921**, 504 (2007).

38. * **J. Edsjo**, "Indirect detection of WIMPs", Nucl. Phys. Proc. Suppl. **143**, 435 (2005).

(e) Other (e.g. major exhibitions, compositions or performances)

I have also actively worked with outreach activities and had leading roles in open houses and similar activities. Furthermore, I have published a popular science review on cosmology (in Swedish), published in "Kosmos", the Swedish Physical Society yearbook in 2006.

(2) ARC grants (since 2004)

Not applicable

F12.3. Ten career-best research outputs

(Please attach a PDF with a list of your ten career-best research outputs (five pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Attached PDF

Prof. Joakim Edsjo: Ten career-best publications

1. * **J Edsjo**, L. Bergstrom, and T. Bringmann, "New Positron Spectral Features from Supersymmetric Dark Matter - a Way to Explain the PAMELA Data?", Phys. Rev. D **78**, 103520 (2008), *Showed that detailed features of the spectrum of excess positrons measured by the PAMELA experiment can be explained by supersymmetric dark matter models. 167 citations.*
   ARC grant: *Not applicable*

2. * **J Edsjo**, T. Bringmann, L. Bergstrom, "New Gamma-Ray Contributions to Supersymmetric Dark Matter Annihilation", JHEP **0801**, 049 (2008). *Calculated the electromagnetic radiative corrections to supersymmetric dark matter annihilation processes. 145 citations.*
   ARC grant: *Not applicable*

3. * **J Edsjo**, P. Gondolo, P. Ullio, L. Bergstrom, M. Schelke and E. A. Baltz, "DarkSUSY: Computing supersymmetric dark matter properties numerically", JCAP **0407**, 008 (2004). *Presented a computer program for performing supersymmetric dark matter calculations. This is now a standard tool in the field of particle astrophysics. 575 citations.*
   ARC grant: *Not applicable*

4. * **J Edsjo**, P. Ullio, L. Bergstrom and C. G. Lacey"Cosmological dark matter annihilations into gamma-rays - a closer look", Phys. Rev. D **66**, 123502 (2002). *First detailed calculations of the particle astrophysics of supersymmetric dark matter decays to gamma rays. 193 records.*
   ARC grant: *Not applicable*

5. * **J Edsjo**, E. A. Baltz, K. Freese and P. Gondolo, "The Cosmic ray positron excess and neutralino dark matter", Phys. Rev. D **65**, 063511 (2002). *Showed that the positron excess in cosmic rays observed by the HEAT experiment can be explained by supersymmetric dark matter. 145 citations.*
   ARC grant: *Not applicable*

6. **J Edsjo**, E. Andres, P. Askebjer, X. Bai, G. Barouch, S. W. Barwick, R. C. Bay, K. H. Becker and L. Bergstrom *et al.*, "Observation of high-energy neutrinos using Cherenkov detectors embedded deep in Antarctic ice", Nature **410**, 441 (2001). *Flagship paper of the AMANDA experiment, published in Nature. Established a technology*

with which to build a kilometre-scale neutrino observatory. 138 citations.
ARC grant: *Not applicable*

7. **J Edsjo** and E. A. Baltz, "Positron propagation and fluxes from neutralino annihilation in the halo", Phys. Rev. D **59**, 023511 (1998). *Calculated the flux of positrons expected at the Earth from supersymmetric dark matter annihilation in the Milky Way halo. 317 citations.*
ARC grant: *Not applicable*

8. * **J Edsjo** and P. Gondolo, "Neutralino relic density including coannihilations", Phys. Rev. D **56**, 1879 (1997). *Calculated the relic density of supersymmetric dark matter, including coannihilation processes with other light particles for the first time. 313 citations.*
ARC grant: *Not applicable*

9. * **J Edsjo**, L. Bergstrom and P. Ullio, "Cosmic anti-protons as a probe for supersymmetric dark matter?", Astrophys. J. **526**, 215 (1999). *Computed the flux of cosmic antiprotons from supersymmetric dark matter annihilations in the Milky Way halo, and examined detection prospects for a large sample of SUSY models. 155 citations.*
ARC grant: *Not applicable*

10. * **J Edsjo**, L. Bergstrom and P. Gondolo, "Indirect detection of dark matter in km size neutrino telescopes", Phys. Rev. D **58**, 103519 (1998). *Examined the trade off between the area and the muon energy threshold for kilometer scale neutrino telescopes. 144 citations.*
ARC grant: *Not applicable*

F12.4. Further evidence in relation to research impact and contributions to the field over the last 10 years most relevant to this Proposal

(Write a maximum of 7500 characters (approx. 1000 words). Please detail further evidence in relation to research impact and contributions to the field over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(1) Research Output other than publications

COMPETITIVE GRANTS, HONOURS AND AWARDS:

I was deeply involved in the application for the High Energy Astrophysics and Cosmology Centre (excellence centre for strong research environment, VR), that was funded 2005 - 2010). The total funding was $3.4M AUD for five years.

I was one of the co-applicants for the Linneus Centre 'The Oskar Klein Centre for Cosmoparticle physics' that was funded for 2008 - 2018.
The total funding is $11.5 M AUD for ten years.

(2) Evidence of the quality of my research

PUBLICATION LIST DETAILS:

As of February 2013 I have 87 citeable papers on the SPIRES hep database. These have collectively received 4900 citations. I have an h-index of 37 and my published journal papers have an average citations per paper of 83.1. I am cited most highly when publishing in the journals of greatest impact such as Nature, Physical Review Letters, Physical Review D and Astrophysics J.

PUBLICLY AVAILABLE OUTPUT:

I am the main author of the DarkSUSY code which is the key tool in the community for computing the density of supersymmetric dark matter in the Universe today.

I have published some of the preeminent work on neutralino relic densities, neutralino detection rates in neutrino telescopes, 'clumpy' neutralino dark matter and cosmic-ray positrons, anti-protons and gamma-rays in relation to dark matter and supersymmetry.

OTHER:

I was the chair of the local organizing committee for `TOOLS 2012', held at AlbaNova, Stockholm June 18 - 21, 2012. The conference attracted around 60 international participants.

I was the chair of the local organizing committee for `TeV Particle Astrophysics 2011', held at AlbaNova, Stockholm August 1 - 5, 2011. The conference attracted around 130 international participants.

I was the chair of the local organizing committee for `Identication of dark matter', held
at AlbaNova, Stockholm August 18 - 22, 2008. The conference attracted around 160 international participants.

I have co-chaired other smaller workshops and conferences including:
`SNOW 2006', held at AlbaNova, 2006, `Astroparticle Physics - A Pathfinder to New Physics',

A Nordita programme held at Nordita, in spring, 2009

'Cosmic ray backgrounds to dark matter searches', held at the Oskar Klein Centre,
AlbaNova, January 25 - 27, 2010

F12.5. A statement on your most significant contributions to the research field of this Proposal

(Write a maximum of 3750 characters (approx. 500 words). Please refer to the Instructions to Applicants for the required content and formatting.)

RESEARCH HIGHLIGHTS:

I am the main author of the DarkSUSY code which is the key tool in the community for computing the neutralino density in the Universe today using precision methods. It includes effects such as resonances, pair-production thresholds and co-annihilations, and the paper describing this tool 'DarkSUSY: Computing supersymmetric dark matter properties numerically' has been cited 574 times. The tool also allows accelerator bounds to be checked to identify viable dark matter candidates.

I am a world leader on constraining and understanding weakly interacting massive particles from galactic sources. I have published details on direct and indirect dark matter detection searches in diverse areas such as gamma ray astronomy, experimental neutrino observatories and long-lived particles at collider experiments.

As precision data is coming in from various dark matter and new physics searches, a proper understanding of the particle physics models, signals and backgrounds in indirect, direct and accelerator dark matter searches, including knowledge of the associated uncertainties, is crucial. This project will help in resolving these issues and is therefore of very high importance for various dark matter searches.
I will complement the skills of my Australian partners in collider detector experiments by bringing considerable expertise in direct and indirect detection from a theoretical and computational modelling perspective.

To guide and interpret the experimental efforts, theoretical modelling and analysis is needed, both on the particle physics side, but also on the astrophysical side. The goal of this project is to provide this guidance, model building and interpretation in close contact with the experimental efforts. It is also crucial to perform these kinds of analyses in a consistent framework, which is a central part of this project, through the development of the tools related to GAMBIT.

SPECIFIC RESEARCH CONTRIBUTIONS TO THIS PROPOSAL:

• Theoretical particle physics model building, to investigate viable particle physics options for the dark matter that is consistent with current and coming data

• accurate predictions of expected signals and backgrounds in dark matter search experiments like AMS (electrons, positrons, anti-protons, anti-deuterons), CTA (gamma-rays, electrons), IceCube (neutrinos) and direct detection experiments, to be able to predict these signals in a consistent way

• investigating new physics processes that can affect the dark matter models (e.g. effects of light states in the particle physics models, or Sommerfeld enhancements).

• using state-of-the-art astrophysical modelling of the dark matter halo density and velocity profile in the Milky Way, to make refined predictions of various dark matter signals and provide a much better understanding of their uncertainties

• using other indirect probes, like dark stars, i.e. stars whose evolution is affected by dark matter

Ultimately this will lead to the final goal of the project in performing global analyses of all available data, updated with the wealth of new data expected to arrive within the coming years and the duration of the project.

PART F - Personnel (Prof Jan Conrad)

F1. Personal details

(The personal details will be filled out for you automatically. To update any of your personal details in this form, please update your profile accordingly and your details will update automatically in this form.)

Title

Professor

Family Name

Conrad

First Name

Jan

Person identifier

32959029

Role

Partner Investigator

F2. Postal address

(The postal address will be filled out for you automatically. To update your postal address, please update your profile accordingly and your postal address will update automatically in this form.)

Postal Address Line 1

Albanova University Centre

Postal Address Line 2

Stockholm

Postcode

10691

Country

Sweden

F3. Are you a current member of the ARC or its selection or other advisory committees?

(This relates only to College of Experts or Selection Advisory Committee members for National Competitive Grants Program funding schemes.)

Current Member of Advisory Committee

No

F4. Please name any Commonwealth-funded Research Centres that you will be associated with as at 1 January 2015.

	Full Legal Name of Centre	Start Date	Cessation Date	Centre Role
1	not applicable			

	Centre Role if Other
1	

F5. Are you an Indigenous Participant?

Indigenous Participant

No

F6. PhD Qualification

F6.1. Do you hold a PhD or expect to be awarded a PhD qualification in the near future?

PhD Yes/No

Yes

F6.2. If you hold a PhD or expect to be awarded a PhD qualification in the near future, please enter the date your PhD has been awarded or the date your thesis will be submitted, respectively.

Date of Award

01/01/2003

F7. Qualifications

	Degree/Award	Year	Discipline/Field	Organisation Name
1	PhD	2003	High Energy Physics	Uppsala University

	Country
1	Sweden

F8. Current and previous appointment(s)/position(s) – during the past 10 years

	Position	Organisation Name	Department	Year Appointed
1	Professor	Stockholm University	Department of Physics	2012
2	Research fellow of the Royal Swedish Academy of Sciences	Stockholm University	Department of Physics	2009
3	Assistant Professor (Swedish Research Council)	Stockholm University	Physics Department	2007
4	Assistant professor (Swedish Research Council)	Royal Institute of Technology, Stockholm (KTH)	Division of Particle Physics and astroparticle physics	2005

	Position	Organisation Name	Department	Year Appointed
5	Postdoctoral Research Fellow	European Organisation for Nuclear Research	Physics Division	2004

	Continuity	Employment Kind	Current
1	Permanent	Full Time	Yes
2	Contract	Full Time	No
3	Contract	Full Time	No
4	Contract	Full Time	No
5	Contract	Full Time	No

F9. Organisational affiliations for eligibility purposes for this Proposal

(Name of the organisation you will be associated with for the purposes of satisfying the eligibility requirements for your nominated role in undertaking the proposed research (i.e. for a CI this will usually be the Eligible Organisation at which they will employed or hold an adjunct appointment as at 1 January 2015 and beyond; for PIs it will generally be their main employer as at 1 January 2015).)

Organisation Name

Oskar Klein Centre

Type of Affiliation

Employee

F10. What is your time commitment (%FTE) to this Project?

20

F11. Are you requesting an International Collaboration Award?

(Note: If you are an Australian-based PI, you must choose 'No'. Also, if you are a PI working in an Australian Eligible Organisation overseas campus you must choose 'No'.)

International Collaboration Award

No

F12. Research Opportunity and Performance Evidence (ROPE)

F12.1. Details on your career and opportunities for research over the last 10 years

(Write a maximum of 5250 characters (approx. 750 words). Please detail your career and opportunities over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(i) My PhD in High Energy Physics was awarded ten years ago in November 2003 by the Uppsala University, Sweden.

(ii) I have occupied research positions for the last ten years, including a CERN postdoctoral fellowship (Jan. 2004 - Dec. 2005), an assistant professorship at the Royal Institute of Technology (KTH), Stockholm (Jan. 2006 - Jul. 2007), an assistant professorship at Stockholm University (July. 2007 to Jan. 2009), a Royal Swedish Academy of Sciences research fellowship (Jan. 2009 to May 2012) and, finally, a professorship in astroparticle physics at Stockholm University, commencing in May 2012.

(iii) During the last 10 years, I estimate that I have spent 60% of my time on research, 20% of my time on

teaching and 20% of my time on administration.

(iv) I have had no career interruptions.

(v) I have had access to excellent mentoring and research facilities through my career. CERN is the leading international laboratory in particle physics, and I worked closely with leading experimentalists in detector physics. KTH is ranked in the top 100 universities in the world for physics, Stockholm University is a leading international institution, and a world leader in particle astrophysics. It is a partner in the Oskar Klein Institute, which provides a unique collaborative environment at the boundary of particle physics and astrophysics.

(vi) I currently have a heavy administrative load as the leader of the Experimental Astroparticle Physics group in Stockholm.

F12.2. Recent significant research outputs and ARC grants (since 2004)

(Please attach a PDF with a list of your recent significant research outputs and ARC grants most relevant to the Proposal (20 pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Prof. Jan Conrad: Recent Significant Publications (since 2004)

(1) Research publications

(i) Scholarly books

None.

ii) Scholarly book chapters

None.

(iii) Refereed journal articles

1. **Jan Conrad** "The First Fermi-LAT Catalog of Sources above 10 GeV", Astrophys. J. Suppl. **209**, 34 (2013)
2. **Jan Conrad** *et al.* "Constraints on the Galactic Population of TeV Pulsar Wind Nebulae Using $FERMI$ Large Area Telescope Observations", Astrophys. J. **773**, 77 (2013)
3. * **Jan Conrad** *et al.* "Introducing the CTA concept", Astropart. Phys. **43**, 3 (2013)
4. **Jan Conrad** in the Fermi-LAT Collaboration, "Detection of the Characteristic Pion-Decay Signature in Supernova Remnants", Science **339**, 807 (2013)
5. * **Jan Conrad** in the H.E.S.S. Collaboration, "Search for photon line-like signatures from Dark Matter annihilations with H.E.S.S", Phys. Rev. Lett. **110**, 041301 (2013)
6. **Jan Conrad** *et al*, "Fermi large area telescope study of cosmic rays and the interstellar medium in nearby molecular clouds", Astrophys. J. **755**, 22 (2012), [Erratum-ibid. **778**, 82 (2013)]
7. * **Jan Conrad** in the CTA Collaboration, "Dark Matter and Fundamental Physics with the Cherenkov Telescope Array", Astropart. Phys. **43**, 189 (2013)
8. * **Jan Conrad** and H. Dickinson, "Handling Systematic Uncertainties and Combined Source Analyses for Atmospheric Cherenkov Telescopes", Astropart. Phys. **41**, 17 (2013)
9. **Jan Conrad** in the Fermi-LAT Collaboration, "The Imprint of The Extragalactic Background Light in the Gamma-Ray Spectra of Blazars", Science **338**, 1190 (2012)
10. **Jan Conrad** in the HESS Collaboration, "Discovery of gamma-ray emission from the extragalactic pulsar wind nebula N157B with the High Energy Stereoscopic System", Astron. Astrophys. **545**, L2 (2012)

11. * **Jan Conrad**, L. Bergstrom, G. Bertone, C. Farnier and C. Weniger, "Investigating Gamma-Ray Lines from Dark Matter with Future Observatories", JCAP **1211**, 025 (2012)

12. **Jan Conrad** in the Fermi LAT Collaboration, "GeV Observations of Star-forming Galaxies with *Fermi* LAT", Astrophys. J. **755**, 164 (2012)

13. **Jan Conrad** in the LAT Collaboration, "Constraints on the Galactic Halo Dark Matter from Fermi-LAT Diffuse Measurements", Astrophys. J. **761**, 91 (2012)

14. **Jan Conrad** in the H.E.S.S. Collaboration, "Spectral analysis and interpretation of the $\gamma-$ray emission from the Starburst galaxy NGC 253", Astrophys. J. **757**, 158 (2012)

15. * **Jan Conrad** in the H.E.S.S. Collaboration, "Search for Dark Matter Annihilation Signals from the Fornax Galaxy Cluster with H.E.S.S", Astrophys. J. **750**, 123 (2012)

16. **Jan Conrad** in the LAT Collaboration, "Anisotropies in the diffuse gamma-ray background measured by the Fermi LAT", Phys. Rev. D **85**, 083007 (2012)

17. * **Jan Conrad** in the Fermi LAT Collaboration, "Search for Dark Matter Satellites using the FERMI-LAT", Astrophys. J. **747**, 121 (2012)

18. * **Jan Conrad** in the Fermi-LAT Collaboration, "Limits on Large Extra Dimensions Based on Observations of Neutron Stars with the Fermi-LAT", JCAP **1202**, 012 (2012)

19. **Jan Conrad** in the H.E.S.S. and VERITAS Collaborations, "The 2010 very high energy gamma-ray flare and 10 years of multi-wavelength observations of M 87", Astrophys. J. **746**, 151 (2012)

20. **Jan Conrad** in the H.E.S.S. Collaobration, "Discovery of extended VHE $\gamma-$ray emission from the vicinity of the young massive stellar cluster Westerlund 1", Astron. Astrophys. **537**, A114 (2012)

21. **Jan Conrad** in the H.E.S.S. Collaboration, "Simultaneous multi-wavelength campaign on PKS 2005-489 in a high state", Astron. Astrophys. **533**, A110 (2011)

22. * **Jan Conrad** in the Fermi-LAT Collaboration, "Constraining Dark Matter Models from a Combined Analysis of Milky Way Satellites with the Fermi Large Area Telescope", Phys. Rev. Lett. **107**, 241302 (2011)

23. **Jan Conrad** in the H.E.S.S. Collaboration, "HESS J1943+213: a candidate extreme BL Lacertae object", Astron. Astrophys. **529**, A49 (2011)

24. * **Jan Conrad** in the H.E.S.S. Collaboration, "Search for Lorentz Invariance breaking with a likelihood fit of the PKS 2155-304 Flare Data Taken on MJD 53944", Astropart. Phys. **34**, 738 (2011)

25. * **Jan Conrad** in the "H.E.S.S. constraints on Dark Matter annihilations towards the Sculptor and Carina Dwarf Galaxies", Astropart. Phys. **34**, 608 (2011)

26. * **Jan Conrad**, J. Ripken and P. Scott, "Implications for constrained supersymmetry of combined H.E.S.S. observations of dwarf galaxies, the Galactic halo and the Galactic Centre",JCAP **1111**, 004 (2011)

27. **Jan Conrad** in the LAT, MAGIC and VERITAS Collaborations, "Insights Into the High-Energy Gamma-ray Emission of Markarian 501 from Extensive Multifrequency Observations in the Fermi Era", Astrophys. J. **727**, 129 (2011)

28. * **Jan Conrad**, Y. Akrami, C. Savage, P. Scott and J. Edsjo, "Statistical coverage for supersymmetric parameter estimation: a case study with direct detection of dark matter", JCAP **1107**, 002 (2011)

29. * **Jan Conrad**, Y. Akrami, C. Savage, P. Scott and J. Edsjo, "How well will ton-scale dark matter direct detection experiments constrain minimal supersymmetry?", JCAP **1104**, 012 (2011)

30. **Jan Conrad** in the Fermi LAT Collaboration, "Fermi-LAT Search for Pulsar Wind Nebulae around gamma-ray Pulsars", Astrophys. J. **726**, 35 (2011)

31. **Jan Conrad** in the Fermi LAT Collaboration, "Constraints on the Cosmic-Ray Density Gradient beyond the Solar Circle from Fermi gamma-ray Observations of the Third Galactic Quadrant", Astrophys. J. **726**, 81 (2011)

32. * **Jan Conrad** in the CTA Consortium Collaboration, "Design concepts for the Cherenkov Telescope Array CTA: An advanced facility for ground-based high-energy gamma-ray astronomy", Exper. Astron. **32**, 193 (2011)

33. * **Jan Conrad**, A. Cuoco, A. Sellerholm and S. Hannestad, "Anisotropies in the Diffuse Gamma-Ray Background from Dark Matter with Fermi LAT: a closer look", Mon. Not. Roy. Astron. Soc. **414**, 2040 (2011)

34. **Jan Conrad** in the Fermi LAT Collaboration, "The First Fermi Large Area Telescope Catalog of Gamma-ray Pulsars", Astrophys. J. Suppl. **187**, 460 (2010), [Erratum-ibid. **193**, 22 (2011)]

35. **Jan Conrad** in the Fermi-LAT Collaboration, "Searches for Cosmic-Ray Electron Anisotropies with the Fermi Large Area Telescope", Phys. Rev. D **82**, 092003 (2010)

36. **Jan Conrad**, A. A. Abdo, M. Ackermann, M. Ajello, L. Baldini, J. Ballet, G. Barbiellini, D. Bastieri and K. Bechtol *et al.*, "Fermi-LAT Study of Gamma-ray Emission in the Direction of Supernova Remnant W49B", Astrophys. J. **722**, 1303 (2010)

37. **Jan Conrad**, A. A. Abdo, M. Ackermann, M. Ajello, W. B. Atwood, L. Baldini, J. Ballet, G. Barbiellini and D. Bastieri *et al.*, "Gamma-Ray Emission Concurrent with the Nova in the Symbiotic Binary V407 Cygni",Science **329**, 817 (2010)

38. **Jan Conrad** in the FERMI LAT Collaboration, "Fermi LAT observations of cosmic-ray electrons from 7 GeV to 1 TeV", Phys. Rev. D **82**, 092004 (2010)

39. **Jan Conrad** in the Fermi LAT Collaboration, "Fermi Large Area Telescope Observation of a Gamma-ray Source at the Position of Eta Carinae", Astrophys. J. **723**, 649 (2010)

40. **Jan Conrad** in the Fermi LAT Collaboration, "Fermi Large Area Telescope View of the Core of the Radio Galaxy Centaurus A", Astrophys. J. **719**, 1433 (2010)

41. **Jan Conrad**, V. A. Acciari, E. Aliu, T. Arlen, T. Aune, M. Bautista, M. Beilicke, W. Benbow and M. Bottcher *et al.*, "The Discovery of gamma-Ray Emission From The Blazar RGB J0710+591", Astrophys. J. **715**, L49 (2010)

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49. **Jan Conrad** in the Fermi LAT Collaboration, "Observations of Milky Way Dwarf Spheroidal galaxies with the Fermi-LAT detector and constraints on Dark Matter models", Astrophys. J. **712**, 147 (2010)

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68. **Jan Conrad** in the Fermi GBM/LAT Collaboration, "A limit on the variation of the speed of light arising from quantum gravity effects", Nature **462**, 331 (2009)

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70. **Jan Conrad** in the Fermi LAT Collaboration, "Fermi LAT Observations of LS I +61 303: First detection of an orbital modulation in GeV Gamma Rays", Astrophys. J. **701**, L123 (2009)

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78. **Jan Conrad** in the LAT Collaboration, "Fermi Discovery of Gamma-Ray Emission from NGC 1275", Astrophys. J. **699**, 31 (2009)

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81. **Jan Conrad** in the Fermi LAT Collaboration, "Fermi/LAT discovery of gamma-ray emission from the flat-spectrum radio quasar PKS 1454-354", Astrophys. J. **697**, 934 (2009)

82. **Jan Conrad** in the Fermi LAT Collaboration, "Discovery of Pulsed Gamma Rays from the Young Radio Pulsar PSR J1028-5819 with the Fermi Large Area Telescope", Astrophys. J. **695**, L72 (2009)

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89. **Jan Conrad** in the ALICE Collaboration, "ALICE: Physics performance report, volume II", J. Phys. G **32**, 1295 (2006).

90. **Jan Conrad** in the AMANDA Collaboration, "Limits on the muon flux from neutralino annihilations at the center of the Earth with AMANDA", Astropart. Phys. **26**, 129 (2006).

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(iv) Refereed conference proceedings

106. **Jan Conrad** in the Fermi LAT Collaboration, "Fermi-LAT measurement of the diffuse gamma-ray emission and constraints on the Galactic Dark Matter signal", Nucl. Phys. Proc. Suppl. **239-240**, 88 (2013)

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109. * **Jan Conrad**, "Indirect detection of Dark matter with gamma-rays - status and perspectives", PoS IDM **2010**, 048 (2011)

110. * **Jan Conrad** in the Fermi LAT Collaboration, "Constraints on the Galactic Halo Dark Matter from Fermi-LAT Diffuse Measurements", PoS IDM **2010**, 111 (2011)

111. **Jan Conrad**, "Short history of Hector Rubinstein's scientific career and his years in Sweden", PoS HRMS **2010**, 007 (2010).

112. * **Jan Conrad** in the IceCube Collaboration, "IceCube: A multipurpose neutrino telescope", J. Phys. Soc. Jap. Suppl. **77B**, 71 (2008).

113. * **Jan Conrad** in the Fermi LAT Collaboration, "Detecting Dark Matter annihilation lines with Fermi",PoS IDM **2008**, 111 (2008)

114. **Jan Conrad**, P. Papini, O. Adriani, M. Ambriola, G. C. Barbarino, A. Basili, G. A. Bazilevskaja, M. Boezio and E. A. Bogomolov *et al.*, "In-flight performances of the PAMELA satellite experiment", Nucl. Instrum. Meth. A **588**, 259 (2008).

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125. **Jan Conrad**, A. Pepato, G. Anelli, F. Antinori, A. Badala, M. Burns, G. E. Bruno, I. A. Cali and M. Campbell *et al.*, "The mechanics and cooling system of the ALICE silicon pixel detector", Nucl. Instrum. Meth. A **565**, 6 (2006).

126. **Jan Conrad**, P. Riedler, G. Anelli, F. Antinori, A. Badala, A. Boccardi, G. E. Bruno, M. Burns and I. A. Cali *et al.*,"Overview and status of the ALICE silicon pixel detector", Nucl. Instrum. Meth. A **565**, 1 (2006).

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132. **Jan Conrad** in the AMANDA Collaboration, "New results from the AMANDA neutrino telescope', Nucl. Phys. Proc. Suppl. **145**, 319 (2005).

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134. **Jan Conrad** in the IceCube Collaboration, "Status of the IceCube Neutrino Observatory", New Astron. Rev. **48**, 519 (2004).

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(2) ARC grants awarded in the last 10 years

None.

F12.3. Ten career-best research outputs

(Please attach a PDF with a list of your ten career-best research outputs (five pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Attached PDF

Prof. Jan Conrad: Ten career-best publications

1. * **Jan Conrad** in the Fermi-LAT Collaboration, "Constraints on the Galactic Halo Dark Matter from Fermi-LAT Diffuse Measurements", Astrophys. J. **761**, 91 (2012). *Leading constraints on Dark Matter from measurements of the galactic diffuse emission, one of the most challenging analyses in the Fermi-LAT. I proposed the analysis method. 13 citations.*

2. * **Jan Conrad** in the Fermi-LAT Collaboration, "Constraining Dark Matter Models from a Combined Analysis of Milky Way Satellites with the Fermi Large Area Telescope", Phys. Rev. Lett. **107**, 241302 (2011). *Extremely stringent constraints on dark matter. I invented the analysis method and performed the analysis. APS Physics highlight, APS PRL Editor's suggestion. 158 citations.*

3. * **Jan Conrad**, P. Scott, J. Edsjo, L. Bergstrom, C. Farnier and Y. Akrami, "Direct Constraints on Minimal Supersymmetry from Fermi-LAT Observations of the Dwarf Galaxy Segue 1", JCAP **1001**, 031 (2010). *Established the method to put direct constraints on an underlying WIMP theory using accurate representation of Fermi-LAT data. I proposed and supervised the project. 59 citations.*

4. * **Jan Conrad** in the Fermi-LAT Collaboration, "Constraints on Cosmological Dark Matter Annihilation from the Fermi-LAT Isotropic Diffuse Gamma-Ray Measurement", JCAP **1004**, 014 (2010). *I proposed and performed the first search for dark matter in the isotropic gamma-ray background using Fermi-LAT data. 129 citations.*

5. **Jan Conrad** in the Fermi-LAT Collaboration, "The Spectrum of the Isotropic Diffuse Gamma-Ray Emission Derived From First-Year Fermi Large Area Telescope Data", Phys. Rev. Lett. **104**, 101101 (2010). *One of the key results of the Fermi-LAT. I am senior author of this paper (my student was one of the three contact authors). 150 citations.*

6. * **Jan Conrad**, A. A. Abdo, M. Ackermann, M. Ajello, W. B. Atwood, L. Baldini, J. Ballet, G. Barbiellini and D. Bastieri *et al.*,"Fermi LAT Search for Photon Lines from 30 to 200 GeV and Dark Matter Implications", Phys. Rev. Lett. **104**, 091302 (2010). *Performed the first search for a line signal from dark matter annihilation in Fermi-LAT data. I invented the analysis method and completed it with my student. 120 citations.*

7. **Jan Conrad**, E. A. Baltz, B. Berenji, G. Bertone, L. Bergstrom, E. Bloom, T. Bringmann, J. Chiang and J. Cohen-Tanugi *et al.*, "Pre-launch estimates for GLAST sensitivity to Dark Matter annihilation signals", JCAP **0807**, 013 (2008) *As single lead author, I provided a comprehensive prediction of Fermi-LAT sensitivity to dark matter searches. 132 citations.*

8. **Jan Conrad** in the ALICE Collaboration, "ALICE: Physics performance report, volume II", J. Phys. G **32**, 1295 (2006). *Reporting the expected physics performance of the ALICE detector at LHC. I contributed the section on minimum bias triggers. 341 citations.*

9. * **Jan Conrad**, W. A. Rolke and A. M. Lopez, "Limits and confidence intervals in the presence of nuisance parameters", Nucl. Instrum. Meth. A **551**, 493 (2005). *A frequentist statistical method to include nuisance parameters into confidence interval calculations. I wrote most of the paper and implemented the code. 121 citations.*

10. * **Jan Conrad**, O. Botner, A. Hallgren and C. Perez de los Heros, "Including systematic uncertainties in confidence interval construction for Poisson statistics", Phys. Rev. D **67**, 012002 (2003). *I invented a frequentist method to include systematic uncertainties into confidence intervals. 195 citations.*

F12.4. Further evidence in relation to research impact and contributions to the field over the last 10 years most relevant to this Proposal

(Write a maximum of 7500 characters (approx. 1000 words). Please detail further evidence in relation to research impact and contributions to the field over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(1) Research Outputs other than Publications:

Grants:

- CERN postdoctoral research fellowship (2004)
- DESY postdoctoral research fellowship (2004) declined.
- Swedish Research Council (VR) grant (position as assistant professor)(2004)
- Grant holder for Swedish FERMI consortium (2007{) (6 MSEK so far)
- Position as Special Researcher, VR, (2008) declined.
- Position as Research Fellow of the Royal Swedish Academy of Science" (2009)
- Grant holder for Swedish H.E.S.S. consortium (2009)(6 MSEK so far)
- Grant holder for Swedish CTA consortium (2010) (3 MSEK so far)
- Chair for NORDITA program: "What is Dark Matter?", (2014, 300 kSEK)
- Selected founding member of Swedish Young Academy (KVA), 2011

(2) Quality of research

I have authored over 150 refereed research articles, most of which are published in leading physics journals such as Physical Review Letters (A*), Nature (A*) and Physical Review D (A), or in the top journals in astrophysics including the Astrophysical Journal (A*) and Astronomy and Astrophysics (A). According to the INSPIRE database (the standard in the field), I have 8,279 citations in total, and an H index of 50. My work includes original papers in statistics that have very large numbers of citations. I have obtained funding to in excess of over two million AUD in my career so far.

I am one of the preeminent researchers in my field in Sweden. In Stockholm, I lead the Experimental Astroparticle Physics group, including one assistant professor, four postdoctoral researchers and two PhD students. My high profile in Sweden is evidenced by my national leadership roles in three gamma ray different gamma ray telescope experiments, including Principal Investigator of the Swedish FERMI consortium, Principal Investigator for the Swedish H.E.S.S. consortium and Principal Investigator for the Swedish CTA consortium. I am a member of the Swedish Research Council evaluation panel in subatomic physics, an external referee for the Swedish research council and a member of the Swedish National Committee for Astronomy and the Royal Swedish Academy of Sciences.

My strong national profile is complemented by a very strong international profile in gamma ray physics, including past positions as the co-leader of the FERMI Working group for Dark Matter/New Physics, and as the co-leader of CTA design study working group for Dark Matter/New Physics. I am a member of 6 scientific advisory/organising committees, 12 administrative committees, I am a referee for 8 international journals (in particular Physical Review Letters and Physical Review D, two of the most prestigious journals in the field). I have been invited to give plenary reviews at 17 conferences, including Darkness Visible 2010 in Cambridge, and a role as lecturer at the SLAC Summer Institute at Stanford in 2009.

F12.5. A statement on your most significant contributions to the research field of this Proposal

(Write a maximum of 3750 characters (approx. 500 words). Please refer to the Instructions to Applicants for the required content and formatting.)

I am Chief grant holder and head of the Swedish consortia in Fermi, HESS and CTA.

Fermi (formerly known as GLAST) is a space borne gamma ray observatory designed to observe the gamma-ray sky in the energy range between 10 MeV and 300 GeV. From the point of view of fundamental physics, the most important Fermi-LAT highlight consists of the most stringent constraints on Dark Matter particles in indirect detection, an analysis that was conceived by me and performed in my group. In particular, I proposed a novel method to combine several sources.
My students and I then applied this method to obtain the most robust and stringent constraints on Weakly Interacting Massive Particle (WIMP) dark matter so
far, excluding thermal WIMPs below 30 GeV for the first time. The corresponding

results represent the state of the art for indirect searches of dark matter and were chosen as an APS Physics highlight at the suggestion of a Physical Review Letters Editor.

HESS consists of four telescopes with a mirror area of about 100 square metres each, which are placed in a square formation with a side length of 120 metres, optimised for maximum sensitivity at an energy of around 100 GeV. In summer 2012, HESS has been upgraded with a fifth, larger telescope located in the centre of the four existing identical telescopes. This telescope has an effective mirror size of 600 square metres, which will expand the energy range of the instrument down to 20 GeV.

CTA is the next generation air Cherenkov telescope with an envisaged threshold of close to 10 GeV and increased sensitivity by an order of magnitude.
With these three facilities my analyses will be sensitive to dark matter observations throughout a wide range of energies.

Using these tools, currently my focus is on indirect detection of dark matter with astrophysical gamma-rays. Gamma-rays are the “golden channel” of indirect detection due to the wealth of information they can bear about the particle that produced them. Using this probe and a novel analysis method I have been able to exclude thermally produced WIMPs below masses of about 30 GeV for the first time, and can extend this reach much further.

My group has been the strongest group in Dark Matter searches in the Fermi-LAT. I was the co-leader of the respective working group for 2 years, in the most crucial period of the mission. In HESSII, a member of my group is currently the co-leader of the Dark Matter search working group. In CTA, I co-lead the working group occupied with Dark Matter searches. This gives me a unique role and position at the forefront of experiments that search for dark matter. My group is internationally renowned and I hold a strong position to lead the searches that might yield a WIMP Dark Matter discovery.

In tandem with my world leading position in experimental gamma-ray astronomy as a probe for dark matter I have considerable expertise in the statistical techniques required by this proposal (including statistics papers in the top 1% of cited papers on INSPIRE), and I have worked as a research associate at CERN on experimental searches with the Large Hadron Collider.

In summary, as a direct result of my research work, we have probed deeply in to the space of the most promising WIMP models, from masses of a few of GeV to several TeV. If the current paradigm of WIMP dark matter is correct, detection is now possible, potentially on the time frame of this proposal. If not, my work will seriously challenge the WIMP paradigm.

PART F - Personnel (Dr Andrew Buckley)

F1. Personal details

(The personal details will be filled out for you automatically. To update any of your personal details in this form, please update your profile accordingly and your details will update automatically in this form.)

Title

Doctor

Family Name

Buckley

First Name

Andrew

Second Name

Gordon

Person identifier

23632881

Role

Partner Investigator

F2. Postal address

(The postal address will be filled out for you automatically. To update your postal address, please update your profile accordingly and your postal address will update automatically in this form.)

Postal Address Line 1

CERN

Postal Address Line 2

Route de Meyrin 385, Meyrin

State

Geneve

Postcode

1217

Country

Switzerland

F3. Are you a current member of the ARC or its selection or other advisory committees?

(This relates only to College of Experts or Selection Advisory Committee members for National Competitive Grants Program funding schemes.)

Current Member of Advisory Committee

No

F4. Please name any Commonwealth-funded Research Centres that you will be associated with as at 1 January 2015.

	Full Legal Name of Centre	Start Date	Cessation Date	Centre Role
1	Not applicable			

	Centre Role if Other
1	

F5. Are you an Indigenous Participant?

Indigenous Participant

No

F6. PhD Qualification

F6.1. Do you hold a PhD or expect to be awarded a PhD qualification in the near future?

PhD Yes/No

Yes

F6.2. If you hold a PhD or expect to be awarded a PhD qualification in the near future, please enter the date your PhD has been awarded or the date your thesis will be submitted, respectively.

Date of Award

01/03/2006

F7. Qualifications

	Degree/Award	Year	Discipline/Field	Organisation Name
1	PhD	2006	Particle physics	University of Cambridge

	Country
1	United Kingdom

F8. Current and previous appointment(s)/position(s) – during the past 10 years

	Position	Organisation Name	Department	Year Appointed
1	Royal Society and Glasgow Leadership Research Fellow	University of Glasgow, UK	School of Physics and Astronomy	2013
2	Royal Society University Research Fellow in particle physics	University of Edinburgh, UK	PPE Group, School of Physics & Astronomy	2013
3	SUPA Advanced Research Fellow in particle physics	University of Edinburgh	School of Physics & Astronomy	2009
4	Research associate	Durham University	Institute for Particle Physics Phenomenology	2005

	Continuity	Employment Kind	Current
1	Contract	Full Time	Yes
2	Contract	Full Time	No
3	Contract	Full Time	No
4	Contract	Full Time	No

F9. Organisational affiliations for eligibility purposes for this Proposal

(Name of the organisation you will be associated with for the purposes of satisfying the eligibility requirements for your nominated role in undertaking the proposed research (i.e. for a CI this will usually be the Eligible Organisation at which they will employed or hold an adjunct appointment as at 1 January 2015 and beyond; for PIs it will generally be their main employer as at 1 January 2015).)

Organisation Name

University of Glasgow, UK

Type of Affiliation

Employee

F10. What is your time commitment (%FTE) to this Project?

20

F11. Are you requesting an International Collaboration Award?

(Note: If you are an Australian-based PI, you must choose 'No'. Also, if you are a PI working in an Australian Eligible Organisation overseas campus you must choose 'No'.)

International Collaboration Award

No

F12. Research Opportunity and Performance Evidence (ROPE)

F12.1. Details on your career and opportunities for research over the last 10 years

(Write a maximum of 5250 characters (approx. 750 words). Please detail your career and opportunities over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(i) My PhD in High Energy Physics was awarded eight years ago in March 2006 by the University of Cambridge.

(ii) I have occupied research positions for the past ten years. My PhD was completed working as an experimental particle physicist at the University of Cambridge, with much of my time spent at CERN as a member of the LHCb experiment. I then moved to Durham University as a Research Associate in Monte Carlo generator phenomenology, receiving accelerated promotion to Senior Research Associate. I combined this role with a visiting fellowship at University College London (UCL), allowing me to become a member of the ATLAS experiment, and perform research at both UCL and CERN. In 2009, I moved to the University of Edinburgh as a SUPA Advanced Fellow, with a continuing involvement in the ATLAS experiment. I became a CERN Scientific Associate in 2012, allowing me to move to CERN for one year. In 2013 I began a Royal Society University Research Fellowship originally affiliated to the University of Edinburgh but later transferred to the University of Glasgow along with acceptance of a Leadership Fellow research grant.

(iii) I have occupied research only positions for the last ten years, with a relatively low teaching load. I have held a large number of international administrative responsibilities, however, including senior roles in the ATLAS experiment (full simulation coordinator 2010-2011, Monte Carlo simulation convenor 2011-2013), and membership of international management and steering committees within the Monte Carlo community. In total, I estimate that I have spent 70% of my time on research, 20% on administration and 10% on teaching within the last ten years.

(iv) I have had no career interruptions.

(v) I have worked in several of the worlds top research institutions. My work on the LHCb experiment was supervised by Prof Val Gibson, the UK national spokesperson for LHCb, at the University of Cambridge. The Institute for Particle Physics Phenomenology at Durham University is one of top groups in the world for Monte Carlo physics, and I was mentored closely by experts such as Prof Nigel Glover, Prof Peter Richardson and Prof Frank Krauss. My concurrent work as a visiting fellow at UCL allowed me to work closely with Prof Jon Butterworth, the UK spokesperson for the ATLAS experiment of the LHC, and a renowned expert in jet substructure. University of Edinburgh is a research intensive university ranked top in Scotland, top 5 in the UK and top 50 in the world. The particle physics group is playing a leading role in ATLAS simulation work, and whilst based there I played a leading role in those efforts, and in several measurements of soft QCD backgrounds important for the early LHC operation. The University of Glasgow is a leading ATLAS group for ttH and VH measurements (Higgs physics), and provides access to expert beyond the Standard Model and QCD theorists who actively collaborate with the experimental group. I have access to outstanding GRID computing facilities. Through my whole career, I have spent large portions of my time at CERN which is the worlds leading particle physics laboratory. My CERN Associateship allows me to lead teams of experimentalists and theorists, and liase closely with world experts to further my research. I also am a leading collaborator on many high energy physics toolkits for event simulation at colliders including LHEF, HepMC, LHAPDF, Rivet and Professor.

(vi) The two particle physics experiments on which I have worked (LHCb and ATLAS) only started running in the 7th year of my research career (measured from the start of my PhD). I therefore have less experimental particle physics papers than physicists who have been on active experiments for their entire career. This is balanced by a much stronger involvement in theory than is common in an experimental physicist, as I used the time before the LHC commenced running to become one of the worlds leading experts in Monte Carlo physics. I spent 2011-2013 leading the working group on this topic at CERN to improve proton collision event modelling based on Standard Model data, and produce the simulated events used for the 2012 Higgs boson discovery and subsequent study.

F12.2. Recent significant research outputs and ARC grants (since 2004)

(Please attach a PDF with a list of your recent significant research outputs and ARC grants most relevant to the Proposal (20 pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Dr Andrew Buckley: Recent Significant Publications (since 2004)

(1) Research publications

(a) Scholarly books

None.

(b) Scholarly book chapters

None.

(c) Refereed journal articles

1. **A. Buckley** in the ATLAS Collaboration, "Standalone vertex finding in the ATLAS muon spectrometer", JINST **9**, P02001 (2014)

2. **A. Buckley** in the ATLAS Collaboration, "Measurement of the mass difference between top and anti-top quarks in pp collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector", Phys. Lett. B **728**, 363 (2014)

3. * **A. Buckley** in the ATLAS Collaboration, "Search for dark matter in events with a hadronically decaying W or Z boson and missing transverse momentum in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector",Phys. Rev. Lett. **112**, 041802 (2014)

4. **A. Buckley** in the ATLAS Collaboration, "Search for new phenomena in photon+jet events collected in proton–proton collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector",Phys. Lett. B **728**, 562 (2014)

5. **A. Buckley** in the ATLAS Collaboration, "Search for long-lived stopped R-hadrons decaying out-of-time with pp collisions using the ATLAS detector", Phys. Rev. D **88**, 112003 (2013)

6. * **A. Buckley** in the ATLAS Collaboration, "Search for charginos nearly mass-degenerate with the lightest neutralino based on a disappearing-track signature in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector", Phys. Rev. D **88**, 112006 (2013)

7. **A. Buckley** in the ATLAS Collaboration, "Search for microscopic black holes in a like-sign dimuon final state using large track multiplicity with the ATLAS detector",Phys. Rev. D **88**, 072001 (2013)

8. * **A. Buckley** in the ATLAS Collaboration, "Search for direct third-generation squark pair production in final states with missing transverse momentum and two b-jets in $\sqrt{s} = 8$ TeV pp collisions with the ATLAS detector",JHEP **1310**, 189 (2013)

9. * **A. Buckley** in the ATLAS Collaboration, "Search for new phenomena in final states with large jet multiplicities and missing transverse momentum at sqrt(s)=8 TeV proton-proton collisions using the ATLAS experiment",JHEP **1310**, 130 (2013)

10. **A. Buckley** in the ATLAS Collaboration, "Search for excited electrons and muons in $\sqrt{s}$=8 TeV proton-proton collisions with the ATLAS detector", New J. Phys. **15**, 093011 (2013)

11. **A. Buckley** in the ATLAS Collaboration, "Dynamics of isolated-photon plus jet production in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",Nucl. Phys. B **875**, 483 (2013)

12. **A. Buckley** in the ATLAS Collaboration, "Measurement of top quark polarization in top-antitop events from proton-proton collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector",Phys. Rev. Lett. **111**, 232002 (2013)

13. **A. Buckley** in the ATLAS Collaboration, "Measurement of jet shapes in top-quark pair events at $\sqrt{s} = 7$ TeV using the ATLAS detector",Eur. Phys. J. C **73**, 2676 (2013)

14. **A. Buckley** in the ATLAS Collaboration, "Measurement of the top quark charge in *pp* collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",JHEP **1311**, 031 (2013)

15. * **A. Buckley** in the ATLAS Collaboration, "Evidence for the spin-0 nature of the Higgs boson using ATLAS data",Phys. Lett. B **726**, 120 (2013)

16. * **A. Buckley** in the ATLAS Collaboration, "Measurements of Higgs boson production and couplings in diboson final states with the ATLAS detector at the LHC",Phys. Lett. B **726**, 88 (2013)

17. **A. Buckley** in the ATLAS Collaboration, "Measurement of the differential cross-section of B^+ meson production in pp collisions at $\sqrt{s} = 7$ TeV at ATLAS",JHEP **1310**, 042 (2013)

18. **A. Buckley** in the ATLAS Collaboration, "Measurement of the Azimuthal Angle Dependence of Inclusive Jet Yields in Pb+Pb Collisions at $\sqrt{s_{NN}}$= 2.76 TeV with the ATLAS detector",Phys. Rev. Lett. **111**, 152301 (2013)

19. **A. Buckley** in the ATLAS Collaboration, "Performance of jet substructure techniques for large-R jets in proton-proton collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector",JHEP **1309**, 076 (2013)

20. **A. Buckley** in the ATLAS Collaboration, "Measurement of the high-mass Drell–Yan differential cross-section in pp collisions at $\sqrt{s}$=7 TeV with the ATLAS detector",Phys. Lett. B **725**, 223 (2013)

21. **A. Buckley** in the ATLAS Collaboration, "Measurement of the distributions of event-by-event flow harmonics in lead-lead collisions at = 2.76 TeV with the ATLAS detector at the LHC",JHEP **1311**, 183 (2013)

22. * **A. Buckley** in the ATLAS Collaboration, "A search for $t\bar{t}$ resonances in the lepton plus jets final state with ATLAS using 4.7 fb^{-1} of *pp* collisions at $\sqrt{s} = 7$ TeV",Phys. Rev. D **88**, 012004 (2013)

23. **A. Buckley** in the ATLAS Collaboration, "Triggers for displaced decays of long-lived neutral particles in the ATLAS detector",JINST **8**, P07015 (2013)

24. **A. Buckley** in the ATLAS Collaboration, "Search for resonant diboson production in the lvjj decay channels with the ATLAS detector at 7 TeV",Phys. Rev. D **87**, 112006 (2013)

25. **A. Buckley** in the ATLAS Collaboration, "Measurement of the production cross section of jets in association with a Z boson in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",JHEP **1307**, 032 (2013)

26. **A. Buckley** in the ATLAS Collaboration, "Search for non-pointing photons in the diphoton and $E_{\mathrm{T}}^{\mathrm{miss}}$ final state in $\sqrt{s} = 7$ TeV proton-proton collisions using the ATLAS detector",Phys. Rev. D **88**, 012001 (2013)

27. **A. Buckley** in the ATLAS Collaboration, "Measurement of the inclusive jet cross section in pp collisions at sqrt(s)=2.76 TeV and comparison to the inclusive jet cross section at $\sqrt{s} = 7$ TeV using the ATLAS detector",Eur. Phys. J. C **73**, 2509 (2013)

28. **A. Buckley** in the ATLAS Collaboration, "Measurement with the ATLAS detector of multi-particle azimuthal correlations in p+Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV",Phys. Lett. B **725**, 60 (2013)

29. **A. Buckley** in the ATLAS Collaboration, "Search for third generation scalar leptoquarks in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",JHEP **1306**, 033 (2013)

30. **A. Buckley** in the ATLAS Collaboration, "Characterisation and mitigation of beam-induced backgrounds observed in the ATLAS detector during the 2011 proton-proton run",JINST **8**, P07004 (2013)

31. **A. Buckley** in the ATLAS Collaboration, "Search for WH production with a light Higgs boson decaying to prompt electron-jets in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",New J. Phys. **15**, 043009 (2013)

32. **A. Buckley** in the ATLAS Collaboration, "Improved luminosity determination in *pp* collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector at the LHC",Eur. Phys. J. C **73**, 2518 (2013)

33. **A. Buckley** in the ATLAS Collaboration, "Search for a light charged Higgs boson in the decay channel $H^+ \to c\bar{s}$ in $t\bar{t}$ events using pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",Eur. Phys. J. C **73**, 2465 (2013)

34. **A. Buckley** in the ATLAS Collaboration, "Measurement of the cross-section for W boson production in association with b-jets in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",JHEP **1306**, 084 (2013)

35. **A. Buckley** in the ATLAS Collaboration, "Measurement of kT splitting scales in $W \to \ell\nu$ events at $\sqrt{s} = 7$ TeV with the ATLAS detector",Eur. Phys. J. C **73**, 2432 (2013)

36. **A. Buckley** in the ATLAS Collaboration, "Measurements of $W\gamma$ and $Z\gamma$ production in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector at the LHC",Phys. Rev. D **87**, 112003 (2013)

37. **A. Buckley** in the ATLAS Collaboration, "Measurement of hard double-parton interactions in $W(\to l\nu)$+ 2 jet events at $\sqrt{s} = 7$ TeV with the ATLAS detector",New J. Phys. **15**, 033038 (2013)

38. * **A. Buckley** in the ATLAS Collaboration, "Search for long-lived, multi-charged particles in pp collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector",Phys. Lett. B **722**, 305 (2013)

39. **A. Buckley** in the ATLAS Collaboration, "Search for single b^*-quark production with the ATLAS detector at $\sqrt{s} = 7$ TeV",Phys. Lett. B **721**, 171 (2013)

40. * **A. Buckley** in the ATLAS Collaboration, "Multi-channel search for squarks and gluinos in $\sqrt{s} = 7$ TeV *pp* collisions with the ATLAS detector",Eur. Phys. J. C **73**, 2362 (2013)

41. **A. Buckley** in the ATLAS Collaboration, "A search for prompt lepton-jets in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",Phys. Lett. B **719**, 299 (2013)

42. **A. Buckley** in the ATLAS Collaboration, "Observation of Associated Near-side and Away-side Long-range Correlations in $\sqrt{s_{NN}} = 5.02$ TeV Proton-lead Collisions with the ATLAS Detector",Phys. Rev. Lett. **110**, 182302 (2013)

43. **A. Buckley** in the ATLAS Collaboration, "Search for charged Higgs bosons through the violation of lepton universality in $t\bar{t}$ events using pp collision data at $\sqrt{s} = 7$ TeV with the ATLAS experiment",JHEP **1303**, 076 (2013)

44. **A. Buckley** in the ATLAS Collaboration, "Search for a heavy narrow resonance decaying to $e\mu$, $e\tau$, or $\mu\tau$ with the ATLAS detector in $\sqrt{s} = 7$ TeV pp collisions at the LHC",Phys. Lett. B **723**, 15 (2013)

45. **A. Buckley** in the ATLAS Collaboration, "Measurement of Upsilon production in 7 TeV pp collisions at ATLAS",Phys. Rev. D **87**, no. 5, 052004 (2013)

46. **A. Buckley** in the ATLAS Collaboration, "Measurement of the ttbar production cross section in the tau+jets channel using the ATLAS detector",Eur. Phys. J. C **73**, 2328 (2013)

47. **A. Buckley** in the ATLAS Collaboration, "Search for the neutral Higgs bosons of the Minimal Supersymmetric Standard Model in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",JHEP **1302**, 095 (2013)

48. **A. Buckley** in the ATLAS Collaboration, "Measurement of angular correlations in Drell-Yan lepton pairs to probe Z/gamma* boson transverse momentum at $\sqrt{s} = 7$ TeV with the ATLAS detector",Phys. Lett. B **720**, 32 (2013)

49. **A. Buckley** in the ATLAS Collaboration, "Search for new phenomena in events with three charged leptons at $\sqrt{s} = 7$ TeV with the ATLAS detector",Phys. Rev. D **87**, no. 5, 052002 (2013)

50. **A. Buckley** in the ATLAS Collaboration, "Measurement of ZZ production in pp collisions at $\sqrt{s} = 7$ TeV and limits on anomalous ZZZ and $ZZ\gamma$ couplings with the ATLAS detector",JHEP **1303**, 128 (2013)

51. **A. Buckley** in the ATLAS Collaboration, "Measurement of isolated-photon pair production in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",JHEP **1301**, 086 (2013)

52. * **A. Buckley** in the ATLAS Collaboration, "Searches for heavy long-lived sleptons and R-Hadrons with the ATLAS detector in pp collisions at $\sqrt{s} = 7$ TeV",Phys. Lett. B **720**, 277 (2013)

53. * **A. Buckley** in the ATLAS Collaboration, "Search for supersymmetry in events with photons, bottom quarks, and missing transverse momentum in proton-proton collisions at a centre-of-mass energy of 7 TeV with the ATLAS detector",Phys. Lett. B **719**, 261 (2013)

54. **A. Buckley** in the ATLAS Collaboration, "Search for Extra Dimensions in diphoton events using proton-proton collisions recorded at $\sqrt{s} = 7$ TeV with the ATLAS detector at the LHC",New J. Phys. **15**, 043007 (2013)

55. * **A. Buckley** in the ATLAS Collaboration, "Search for long-lived, heavy particles in final states with a muon and multi-track displaced vertex in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",Phys. Lett. B **719**, 280 (2013)

56. **A. Buckley** in the ATLAS Collaboration, "A search for high-mass resonances decaying to $\tau^+\tau^-$ in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",Phys. Lett. B **719**, 242 (2013)

57. **A. Buckley** in the ATLAS Collaboration, "Measurement of Z boson Production in Pb+Pb Collisions at $\sqrt{s_{NN}} = 2.76$ TeV with the ATLAS Detector",Phys. Rev. Lett. **110**, 022301 (2013)

58. **A. Buckley** in the ATLAS Collaboration, "Jet energy resolution in proton-proton collisions at $\sqrt{s} = 7$ TeV recorded in 2010 with the ATLAS detector", Eur. Phys. J. C **73**, 2306 (2013)

59. **A. Buckley** in the ATLAS Collaboration, "Search for pair-produced massive coloured scalars in four-jet final states with the ATLAS detector in proton-proton collisions at $\sqrt{s} = 7$ TeV", Eur. Phys. J. C **73**, 2263 (2013)

60. * **A. Buckley** in the ATLAS Collaboration, "Search for dark matter candidates and large extra dimensions in events with a jet and missing transverse momentum with the ATLAS detector",JHEP **1304**, 075 (2013)

61. **A. Buckley** in the ATLAS Collaboration, "Measurement of W^+W^- production in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector and limits on anomalous WWZ and $WW\gamma$ couplings",Phys. Rev. D **87**, 112001 (2013)

62. * **A. Buckley** in the ATLAS Collaboration, "Search for direct chargino production in anomaly-mediated supersymmetry breaking models based on a disappearing-track signature in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",JHEP **1301**, 131 (2013)

63. **A. Buckley** in the ATLAS Collaboration, "Measurement of the flavour composition of dijet events in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",Eur. Phys. J. C **73**, 2301 (2013)

64. **A. Buckley** in the ATLAS Collaboration, "Search for displaced muonic lepton jets from light Higgs boson decay in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector",Phys. Lett. B **721**, 32 (2013)

65. * **A. Buckley** in the ATLAS Collaboration, "Search for dark matter candidates and large extra dimensions in events with a photon and missing transverse momentum in pp collision data at $\sqrt{s} = 7$ TeV with the ATLAS detector",Phys. Rev. Lett. **110**, 011802 (2013)

66. * **A. Buckley** in the ATLAS Collaboration, "Search for light top squark pair production in final states with leptons and b^- jets with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions", Phys. Lett. B **720**, 13 (2013)

67. **A. Buckley** in the ATLAS Collaboration, "Measurement of the jet radius and transverse momentum dependence of inclusive jet suppression in lead-lead collisions at $\sqrt{s_{NN}} = 2.76$ TeV with the ATLAS detector",Phys. Lett. B **719**, 220 (2013)

68. * **A. Buckley** in the ATLAS Collaboration, "Search for squarks and gluinos with the ATLAS detector in final states with jets and missing transverse momentum using 4.7 fb^{-1} of $\sqrt{s} = 7$ TeV proton-proton collision data",Phys. Rev. D **87**, 012008 (2013)

69. **A. Buckley** in the ATLAS Collaboration,"Measurement of charged-particle event shape variables in $\sqrt{s} = 7$ TeV proton-proton interactions with the ATLAS detector",Phys. Rev. D **88**, 032004 (2013)

70. **A. Buckley** in the ATLAS Collaboration, "Measurements of top quark pair relative differential cross-sections with ATLAS in pp collisions at $\sqrt{s} = 7$ TeV",Eur. Phys. J. C **73**, 2261 (2013)

71. **A. Buckley** in the ATLAS Collaboration,"Measurement of the Λ_b lifetime and mass in the ATLAS experiment", Phys. Rev. D **87**, no. 3, 032002 (2013)

72. * C. Balazs, **A. Buckley**, D. Carter, B. Farmer and M. White, "Should we still believe in constrained supersymmetry?", Eur. Phys. J. C **73**, 2563 (2013)

73. **A. Buckley** in the ATLAS Collaboration, "Single hadron response measurement and calorimeter jet energy scale uncertainty with the ATLAS detector at the LHC", Eur. Phys. J. C **73**, 2305 (2013)

74. **A. Buckley** in the ATLAS Collaboration,"Jet energy measurement with the ATLAS detector in proton-proton collisions at $\sqrt{s} = 7$ TeV", Eur. Phys. J. C **73**, 2304 (2013)

75. * **A. Buckley** et al., "Rivet user manual", Phys. Commun. **184**, 2803 (2013)

76. **A. Buckley** in the ATLAS Collaboration, "Search for resonances decaying into top-quark pairs using fully hadronic decays in *pp* collisions with ATLAS at $\sqrt{s} = 7$ TeV" , JHEP **1301**, 116 (2013)

77. **A. Buckley** in the ATLAS Collaboration, "Search for contact interactions and large extra dimensions in dilepton events from *pp* collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Rev. D **87**, 015010 (2013)

78. **A. Buckley** in the ATLAS Collaboration, "Search for pair production of heavy top-like quarks decaying to a high-pT W boson and a b quark in the lepton plus jets final state at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Lett. B **718**, 1284 (2013)

79. **A. Buckley** in the ATLAS Collaboration, "ATLAS search for new phenomena in dijet mass and angular distributions using *pp* collisions at $\sqrt{s} = 7$ TeV" , JHEP **1301**, 029 (2013)

80. * **A. Buckley** in the ATLAS Collaboration, "Search for direct production of charginos and neutralinos in events with three leptons and missing transverse momentum in $\sqrt{s} = 7$ TeV *pp* collisions with the ATLAS detector" , Phys. Lett. B **718**, 841 (2013)

81. * **A. Buckley** in the ATLAS Collaboration, "Search for direct slepton and gaugino production in final states with two leptons and missing transverse momentum with the ATLAS detector in *pp* collisions at $\sqrt{s} = 7$ TeV" , Phys. Lett. B **718**, 879 (2013)

82. **A. Buckley** in the ATLAS Collaboration, "Search for new phenomena in the WW to $\ell\nu\ell'\nu'$ final state in *pp* collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Lett. B **718**, 860 (2013)

83. **A. Buckley** in the ATLAS Collaboration, "Search for doubly-charged Higgs bosons in like-sign dilepton final states at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Eur. Phys. J. C **72**, 2244 (2012)

84. **A. Buckley** in the ATLAS Collaboration, "Search for pair production of massive particles decaying into three quarks with the ATLAS detector in $\sqrt{s} = 7$ TeV *pp* collisions at the LHC" , JHEP **1212**, 086 (2012)

85. **A. Buckley** in the ATLAS Collaboration, "Search for anomalous production of prompt like-sign lepton pairs at $\sqrt{s} = 7$ TeV with the ATLAS detector" , JHEP **1212**, 007 (2012)

86. **A. Buckley** in the ATLAS Collaboration, "Search for R-parity-violating supersymmetry in events with four or more leptons in $\sqrt{s} = 7$ TeV *pp* collisions with the ATLAS detector" , JHEP **1212**, 124 (2012)

87. **A. Buckley** in the ATLAS Collaboration, "Search for Supersymmetry in Events with Large Missing Transverse Momentum, Jets, and at Least One Tau Lepton in 7 TeV Proton-Proton Collision Data with the ATLAS Detector" , Eur. Phys. J. C **72**, 2215 (2012)

88. **A. Buckley** in the ATLAS Collaboration, "Search for resonant top plus jet production in $t\bar{t}$ + jets events with the ATLAS detector in pp collisions at $\sqrt{s} = 7$ TeV" , Phys. Rev. D **86**, 091103 (2012)

89. **A. Buckley** in the ATLAS Collaboration, "ATLAS search for a heavy gauge boson decaying to a charged lepton and a neutrino in pp collisions at $\sqrt{s} = 7$ TeV" , Eur. Phys. J. C **72**, 2241 (2012)

90. **A. Buckley** in the ATLAS Collaboration, "Search for a heavy top-quark partner in final states with two leptons with the ATLAS detector at the LHC" , JHEP **1211**, 094 (2012)

91. **A. Buckley** in the ATLAS Collaboration, "Search for high-mass resonances decaying to dilepton final states in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , JHEP **1211**, 138 (2012)

92. **A. Buckley** in the ATLAS Collaboration, "Search for diphoton events with large missing transverse momentum in 7 TeV proton-proton collision data with the ATLAS detector" , Phys. Lett. B **718**, 411 (2012)

93. **A. Buckley** in the ATLAS Collaboration, "Measurements of the pseudorapidity dependence of the total transverse energy in proton-proton collisions at $\sqrt{s} = 7$ TeV with ATLAS" , JHEP **1211**, 033 (2012)

94. **A. Buckley** in the ATLAS Collaboration, "Further search for supersymmetry at $\sqrt{s} = 7$ TeV in final states with jets, missing transverse momentum and isolated leptons with the ATLAS detector" , Phys. Rev. D **86**, 092002 (2012)

95. **A. Buckley** in the ATLAS Collaboration, "Search for light scalar top quark pair production in final states with two leptons with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions" , Eur. Phys. J. C **72**, 2237 (2012)

96. **A. Buckley** in the ATLAS Collaboration, "Search for direct top squark pair production in final states with one isolated lepton, jets, and missing transverse momentum in $\sqrt{s} = 7$ TeV pp collisions using 4.7 fb^{-1} of ATLAS data" , Phys. Rev. Lett. **109**, 211803 (2012)

97. **A. Buckley** in the ATLAS Collaboration, "Search for a supersymmetric partner to the top quark in final states with jets and missing transverse momentum at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Rev. Lett. **109**, 211802 (2012)

98. **A. Buckley** in the ATLAS Collaboration, "Measurement of WZ production in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Eur. Phys. J. C **72**, 2173 (2012)

99. **A. Buckley** in the ATLAS Collaboration, "Underlying event characteristics and their dependence on jet size of charged-particle jet events in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Rev. D **86**, 072004 (2012)

100. * **A. Buckley** in the ATLAS Collaboration, "Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC" , Phys. Lett. B **716**, 1 (2012)

101. **A. Buckley** in the ATLAS Collaboration, "Search for top and bottom squarks from gluino pair production in final states with missing transverse energy and at least three b-jets with the ATLAS detector" , Eur. Phys. J. C **72**, 2174 (2012)

102. **A. Buckley** in the ATLAS Collaboration, "A search for $t\bar{t}$ resonances in lepton+jets events with highly boosted top quarks collected in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , JHEP **1209**, 041 (2012)

103. * **A. Buckley** in the ATLAS Collaboration, "Combined search for the Standard Model Higgs boson in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Rev. D **86**, 032003 (2012)

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233. **A. Buckley** in the ATLAS Collaboration, "Measurement of Wgamma and Zgamma production in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS Detector" , JHEP **1109**, 072 (2011)

234. **A. Buckley** in the ATLAS Collaboration, "Measurement of the WW cross section in $\sqrt{s} = 7$ TeV pp collisions with ATLAS" , Phys. Rev. Lett. **107**, 041802 (2011)

235. **A. Buckley** in the ATLAS Collaboration, "Search for Contact Interactions in Dimuon Events from pp Collisions at $\sqrt{s} = 7$ TeV with the ATLAS Detector" , Phys. Rev. D **84**, 011101 (2011)

236. **A. Buckley** in the ATLAS Collaboration, "Search for pair production of first or second generation leptoquarks in proton-proton collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector at the LHC" , Phys. Rev. D **83**, 112006 (2011)

237. **A. Buckley** in the ATLAS Collaboration, "Measurement of the differential cross-sections of inclusive, prompt and non-prompt J/ψ production in proton-proton collisions at $\sqrt{s} = 7$ TeV" , 10.1016/j.nuclphysb.2011.05.015 , Nucl. Phys. B **850**, 387 (2011)

238. **A. Buckley** in the ATLAS Collaboration, "Measurement of the Inelastic Proton-Proton Cross-Section at $\sqrt{s} = 7$ TeV with the ATLAS Detector" , 10.1038/ncomms1472 , Nature Commun. **2**, 463 (2011)

239. **A. Buckley** in the ATLAS Collaboration, "Search for an excess of events with an identical flavour lepton pair and significant missing transverse momentum in $\sqrt{s} = 7$ TeV proton-proton collisions with the ATLAS detector" , Eur. Phys. J. C **71**, 1647 (2011)

240. **A. Buckley** in the ATLAS Collaboration, "Search for supersymmetric particles in events with lepton pairs and large missing transverse momentum in $\sqrt{s} = 7$ TeV proton-proton collisions with the ATLAS experiment" , Eur. Phys. J. C **71**, 1682 (2011)

241. **A. Buckley** in the ATLAS Collaboration, "Search for high mass dilepton resonances in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS experiment" , Phys. Lett. B **700**, 163 (2011)

242. **A. Buckley** in the ATLAS Collaboration, "Search for a heavy particle decaying into an electron and a muon with the ATLAS detector in $\sqrt{s} = 7$ TeV pp collisions at the LHC" , Phys. Rev. Lett. **106**, 251801 (2011)

243. **A. Buckley** in the ATLAS Collaboration, "Search for supersymmetry in pp collisions at $\sqrt{s} =$ 7TeV in final states with missing transverse momentum and b^- jets" , Phys. Lett. B **701**, 398 (2011)

244. **A. Buckley** in the ATLAS Collaboration, "Search for New Physics in Dijet Mass and Angular Distributions in pp Collisions at $\sqrt{s} = 7$ TeV Measured with the ATLAS Detector" , New J. Phys. **13**, 053044 (2011)

245. **A. Buckley** in the ATLAS Collaboration, "Measurement of the Muon Charge Asymmetry from W Bosons Produced in pp Collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Lett. B **701**, 31 (2011)

246. **A. Buckley** in the ATLAS Collaboration, "Search for stable hadronising squarks and gluinos with the ATLAS experiment at the LHC" , Phys. Lett. B **701**, 1 (2011)

247. **A. Buckley** in the ATLAS Collaboration, "Measurements of underlying-event properties using neutral and charged particles in pp collisions at 900 GeV and 7 TeV with the ATLAS detector at the LHC" , Eur. Phys. J. C **71**, 1636 (2011)

248. **A. Buckley** in the ATLAS Collaboration, "Search for high-mass states with one lepton plus missing transverse momentum in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Lett. B **701**, 50 (2011)

249. **A. Buckley** in the ATLAS Collaboration, "Search for squarks and gluinos using final states with jets and missing transverse momentum with the ATLAS detector in $\sqrt{s} = 7$ TeV proton-proton collisions" , Phys. Lett. B **701**, 186 (2011)

250. **A. Buckley** in the ATLAS Collaboration, "Measurement of Dijet Azimuthal Decorrelations in pp Collisions at $\sqrt{s} = 7$ TeV" , Phys. Rev. Lett. **106**, 172002 (2011)

251. **A. Buckley** in the ATLAS Collaboration, "Search for supersymmetry using final states with one lepton, jets, and missing transverse momentum with the ATLAS detector in $\sqrt{s} = 7$ TeV pp" , Phys. Rev. Lett. **106**, 131802 (2011)

252. **A. Buckley** in the ATLAS Collaboration, "Search for Massive Long-lived Highly Ionising Particles with the ATLAS Detector at the LHC" , Phys. Lett. B **698**, 353 (2011)

253. **A. Buckley** in the ATLAS Collaboration, "Luminosity Determination in pp Collisions at $\sqrt{s} = 7$ TeV Using the ATLAS Detector at the LHC" , Eur. Phys. J. C **71**, 1630 (2011)

254. **A. Buckley** in the ATLAS Collaboration, "Study of Jet Shapes in Inclusive Jet Production in pp Collisions at $\sqrt{s} = 7$ TeV using the ATLAS Detector" , Phys. Rev. D **83**, 052003 (2011)

255. **A. Buckley** in the ATLAS Collaboration, "Measurement of the production cross section for W^- bosons in association with jets in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Lett. B **698**, 325 (2011)

256. **A. Buckley** in the ATLAS Collaboration, "Measurement of the centrality dependence of J/ψ yields and observation of Z production in lead-lead collisions with the ATLAS detector at the LHC" , Phys. Lett. B **697**, 294 (2011)

257. **A. Buckley** in the ATLAS Collaboration, "Measurement of the inclusive isolated prompt photon cross section in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , Phys. Rev. D **83**, 052005 (2011)

258. **A. Buckley** in the ATLAS Collaboration, "Charged-particle multiplicities in pp interactions measured with the ATLAS detector at the LHC", New J. Phys. **13**, 053033 (2011)

259. **A. Buckley** in the ATLAS Collaboration, "Search for Diphoton Events with Large Missing Transverse Energy in 7 TeV Proton-Proton Collisions with the ATLAS Detector" , Phys. Rev. Lett. **106**, 121803 (2011)

260. **A. Buckley** in the ATLAS Collaboration, "Measurement of the top quark-pair production cross section with ATLAS in pp collisions at $\sqrt{s} = 7$ TeV" , Eur. Phys. J. C **71**, 1577 (2011)

261. **A. Buckley** in the ATLAS Collaboration, "Measurement of underlying event characteristics using charged particles in pp collisions at $\sqrt{s} = 900GeV$ and 7 TeV with the ATLAS detector" , Phys. Rev. D **83**, 112001 (2011)

262. **A. Buckley** in the ATLAS Collaboration, "Studies of the performance of the ATLAS detector using cosmic-ray muons" , Eur. Phys. J. C **71**, 1593 (2011)

263. **A. Buckley** in the ATLAS Collaboration, "Search for Quark Contact Interactions in Dijet Angular Distributions in *pp* Collisions at $\sqrt{s} = 7$ TeV Measured with the ATLAS Detector" , Phys. Lett. B **694**, 327 (2011)

264. **A. Buckley** in the ATLAS Collaboration, "Measurement of inclusive jet and dijet cross sections in proton-proton collisions at 7 TeV centre-of-mass energy with the ATLAS detector" , Eur. Phys. J. C **71**, 1512 (2011)

265. **A. Buckley** in the ATLAS Collaboration, "Observation of a Centrality-Dependent Dijet Asymmetry in Lead-Lead Collisions at $\sqrt{s_{NN}} = 2.77$ TeV with the ATLAS Detector at the LHC" , Phys. Rev. Lett. **105**, 252303 (2010)

266. **A. Buckley** in the ATLAS Collaboration, "Measurement of the $W \to \ell\nu$ and $Z/\gamma^* \to \ell\ell$ production cross sections in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector" , JHEP **1012**, 060 (2010)

267. **A. Buckley** in the ATLAS Collaboration, "Search for New Particles in Two-Jet Final States in 7 TeV Proton-Proton Collisions with the ATLAS Detector at the LHC" , Phys. Rev. Lett. **105**, 161801 (2010)

268. **A. Buckley** in the ATLAS Collaboration, "Readiness of the ATLAS Tile Calorimeter for LHC collisions" , Eur. Phys. J. C **70**, 1193 (2010)

269. **A. Buckley** in the ATLAS Collaboration, "Commissioning of the ATLAS Muon Spectrometer with Cosmic Rays" , Eur. Phys. J. C **70**, 875 (2010)

270. **A. Buckley** in the ATLAS Collaboration, "Performance of the ATLAS Detector using First Collision Data" , JHEP **1009**, 056 (2010)

271. * **A. Buckley** in the ATLAS Collaboration, "The ATLAS Simulation Infrastructure" , Eur. Phys. J. C **70**, 823 (2010)

272. **A. Buckley** in the ATLAS Collaboration, "The ATLAS Inner Detector commissioning and calibration" , Eur. Phys. J. C **70**, 787 (2010)

273. **A. Buckley** in the ATLAS Collaboration, "Charged-particle multiplicities in *pp* interactions at $\sqrt{s} = 900$ GeV measured with the ATLAS detector at the LHC" , Phys. Lett. B **688**, 21 (2010)

274. **A. Buckley** in the ATLAS Collaboration, "Drift Time Measurement in the ATLAS Liquid Argon Electromagnetic Calorimeter using Cosmic Muons" , Eur. Phys. J. C **70**, 755 (2010)

275. **A. Buckley** in the ATLAS Collaboration, "Readiness of the ATLAS Liquid Argon Calorimeter for LHC Collisions", Eur. Phys. J. C **70**, 723 (2010)

276. **A. Buckley**, Hendrik Hoeth, Heiko Lacker, Holger Schulz and Jan Eike von Seggern, "Systematic event generator tuning for the LHC", Eur.Phys.J. **C65** (2010)

277. **A. Buckley**, J. H. Bibby, R. J. U. Chamonal, S. Easo, S. Eisenhardt, V. Gibson, N. Harnew and F. Muheim *et al.* "Performance of 8- and 12-dynode stage multianode photo-multipliers", Nucl. Instrum. Meth. A **567**, 302 (2006).

278. **A. Buckley**, S. Hayward, E. Salje, T. Abraham, C. Morrison, A. Buckley and S. Redfern, "A simultaneous X-ray diffractometer / calorimeter for the study of structural phase transitions in solids", JINST **1**, P10006 (2006).

279. * **A. Buckley**, J. Alwall, A. Ballestrero, P. Bartalini, S. Belov, E. Boos, J. M. Butterworth and L. Dudko *et al.*. "A Standard format for Les Houches event files", Comput. Phys. Commun. **176**, 300 (2007)

280. **A. Buckley**,J. Bibby, R. Chamonal, S. Easo, S. Eisenhardt, V. Gibson, N. Harnew and F. Muheim *et al.*, "Performance of multi-anode photomultiplier tubes for the LHCb RICH detectors", Nucl. Instrum. Meth. A **546**, 93 (2005).

(d) Refereed conference proceedings

281. **A. Buckley** *et al.*, "The SM and NLO Multileg and SM MC Working Groups: Summary Report", FERMILAB-PUB-12-885-CD (2012)

282. **A. Buckley**, "Soft QCD in ATLAS: Measurements and modelling of multi-parton interactions", Acta Phys.Polon. **B42** (2011) 2669-2696

283. * **A. Buckley**, C. Ay, J. Butterworth, J. Ferland, I. Hinchliffe, O. Jinnouchi, J. Katzy and B. Kersevan *et al.*, "Monte Carlo generators in ATLAS software", J. Phys. Conf. Ser. **219**, 032001 (2010).

284. **A. Buckley**, P. Bartalini, T. Binoth, (Ed.), J. Blumlein, A. Buckley, T. Hahn, A. L. Kataev, W. B. Perkins and T. Riemann *et al.*, "Round Table Discussion. Event generation: Are we ready for LHC?", PoS ACAT **08**, 129 (2008).

285. **A. Buckley**, J. M. Butterworth, L. Lonnblad, J. W. Monk, E. Nurse, L. Sonnenschein, B. Waugh and M. R. Whalley, "CEDAR: Progress and status report", J. Phys. Conf. Ser. **119**, 052006 (2008).

(e) Other (e.g. major exhibitions, compositions or performances)

None

(2) ARC grants (since 2004)

Not applicable

F12.3. Ten career-best research outputs

(Please attach a PDF with a list of your ten career-best research outputs (five pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Attached PDF

Dr Andrew Buckley: Ten career-best publications

1. * **Andy Buckley**, M. J. White, Csaba Balazs, Daniel Carter and Benjamin Farmer, "Should we still believe in constrained supersymmetry?" Eur. Phys. J. C **73**, 2563 (2013). *I developed, with CI White, a novel analysis technique for using LHC measurements to determine the viability of supersymmetric models. Top 3% of HEP papers published in 2013 (34 citations).*
   ARC grant: *Not applicable*

2. * **A. Buckley** in the ATLAS Collaboration, "Search for the Standard Model Higgs boson produced in association with a vector boson and decaying to a b-quark pair with the ATLAS detector", Phys.Lett. B **718** 369-390 (2012). *Pioneering search for the Higgs boson decaying to b quarks. I supervised two students on background measurements and statistical analysis. 50 citations.*
   ARC grant: *Not applicable*

3. * **A. Buckley** in the ATLAS Collaboration, "Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC", Phys. Lett. B **716**, 1 (2012). *Flagship paper of the ATLAS experiment announcing the discovery of a Higgs like particle. My ATLAS Monte Carlo work was crucial for the final measurement. 1800 citations.*
   ARC grant: *Not applicable*

4. * **A. Buckley**, Jonathan Butterworth, Stefan Gieseke *et al.*, "General-purpose event generators for LHC physics", Phys.Rept. 504 (2011) 145-233. *Wide ranging review of Monte Carlo physics for the Large Hadron Collider, summarising much of my research. 81 citations.*
   ARC grant: *Not applicable*

5. **A. Buckley** in the ATLAS Collaboration, "Charged-particle multiplicities in pp interactions measured with the ATLAS detector at the LHC", New J. Phys. **13**, 053033 (2011).*Crucial ATLAS measurement of the distribution of particles. I was deeply involved in the analysis design, and in the use of the data for ATLAS MC modelling optimisation. 155 citations.*
   ARC grant: *Not applicable*

6. **A. Buckley** in the ATLAS Collaboration, "Measurement of underlying event characteristics using charged particles in pp collisions at $\sqrt{s} = 900GeV$ and 7 TeV with the ATLAS detector", Phys. Rev. D **83**, 112001 (2011). *ATLAS measurement of the*

processes that form a background to all measurements performed at the LHC. I did much of the analysis. 70 citations.
ARC grant: *Not applicable*

7. **A. Buckley** in the ATLAS Collaboration, "Charged-particle multiplicities in pp interactions at $\sqrt{s} = 900$ GeV measured with the ATLAS detector at the LHC", Phys. Lett. B **688**, 21 (2010). *The first ATLAS measurement of charged particle multiplicities. 177 citations.*
ARC grant: *Not applicable*

8. * **A. Buckley** in the ATLAS Collaboration, "The ATLAS Simulation Infrastructure", Eur. Phys. J. C **70**, 823 (2010). *Paper describing the simulation of the ATLAS detector, implemented using GEANT 4. I led and performed much of the work, which underpins all ATLAS measurements. 481 citations.*
ARC grant: *Not applicable*

9. * **A. Buckley**, Hendrik Hoeth, Heiko Lacker, Holger Schulz and Jan Eike von Seggern, "Systematic event generator tuning for the LHC", Eur.Phys.J. **C65** (2010). *Describes a novel toolkit for improving Monte Carlo simulations of collider processes. I created the toolkit, managed the development and oversaw the integration with LHC collaborations. 129 citations.*
ARC grant: *Not applicable*

10. * **A. Buckley**, Johan Alwall, A. Ballestrero *et al.*, "A Standard format for Les Houches event files", Comput.Phys.Commun. **176** (2007). *With other MC experts, I created a standard format for the output of Monte Carlo event generators. 132 citations.*
ARC grant: *Not applicable*

F12.4. Further evidence in relation to research impact and contributions to the field over the last 10 years most relevant to this Proposal

(Write a maximum of 7500 characters (approx. 1000 words). Please detail further evidence in relation to research impact and contributions to the field over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(1) Research Outputs other than Publications:

(a) Internal experiment papers: Large collaborations are very common in both particle physics and astrophysics. Much of my work on both the LHCb and ATLAS collaborations is of a nature that supports external publications but does not lead directly to published papers. I have written 38 internal physics notes for the ATLAS collaboration, describing the tuning of Monte Carlo (MC) event generator parameters, and precision studies of jet physics. On the LHCb experiment, I contributed to the Ring Imaging Cherenkov detector engineering and design reports.

(b) Grants: In 2009 I received an Advanced Research Fellowship from the Scottish Universities Physics Alliance to work on the ATLAS experiment. Since 2010 I have received three consecutive Associateship grants of £4k from the Institute for Particle Physics Phenomenology at Durham University, to support my work on Monte Carlo physics. In 2011 I was awarded a prestigious CERN Associateship, not usually given to junior researchers, to further my work with CERN theorists and as ATLAS Monte Carlo generators convener. In 2012 I was awarded a Royal Society University Research Fellowship. I am a member of the MCnet EU research network, whose second iteration has been funded starting mid-2013.

(2) Quality of research: According to the INSPIRE database, I have 209 published papers, with over 10,342 citations in total. Most of the papers are published in the principal journals in particle physics, including Physical Review Letters (A*), the Journal of High Energy Physics (A), Physics Letters B (A*), European Physical Journal (A) and Physical Review D (A). Unusually for an experimental physicist, I have papers in the top 3% of cited papers as a leading author outside of a large collaboration. In addition, I have made leading contributions to several of the most highly cited ATLAS papers.

I have an outstanding track record in international leadership. I lead two high profile, international research collaborations (Professor and Rivet). I am a member of the HepData steering committee (the leading system for long term storage of High Energy Physics data), and a member of the management committee for MCnet, a European, Marie-Curie funded initiative to support Monte Carlo development for LHC physics. For the ATLAS experiment, I am the Monte Carlo generators convenor, in which I am responsible to overseeing the MC development and application issues relevant for all published ATLAS results. In the field of detector simulation, I have served on the technical advisory board of GEANT4 (the detector simulation package used by ATLAS in all published papers), and I serve on the ATLAS simulation steering committee. I also serve on the ATLAS physics coordination steering committee, responsible for directing the ATLAS physics programme. I am the Monte Carlo and detector simulation expert in the GAMBIT collaboration which is the subject of this proposal.

I have given many invited presentations, the most high profile being three talks at the IEEE Nuclear Physics Symposium in Knoxville, USA in 2010, an invited plenary review of soft QCD physics for the ATLAS experiment at the Polish School of Theoretical Physics, a review of ATLAS MC physics at the QCD@LHC conference at St. Andrews in 2011 and a plenary talk on soft QCD measurements at the SM@LHC conference in Durham in 2011. I am a lead author of a highly cited review article of MC physics at the LHC.

My international service positions include, in addition to those described above, being a referee for IEEE Transactions in Nuclear Science, and being a reviewer/session convener for the 2010 and 2011 Nuclear Science Symposia. I am the Editor of ATLAS analysis notes/papers on leading track/jet underlying event studies. I am an ATLAS editorial board member for the double partonic interaction analyses.

I have supervised two PhD students, two Masters students, and 7 summer students during my time on ATLAS at Edinburgh. I additionally wrote, delivered, and assessed a graduate course in BSM physics for three years, and been involved in PhD student assessment. In my PhD and first postdoc positions I was a tutor for many undergraduate courses and co-wrote/assessed a 2nd year computational physics course.

F12.5. A statement on your most significant contributions to the research field of this Proposal

(Write a maximum of 3750 characters (approx. 500 words). Please refer to the Instructions to Applicants for the required content and formatting.)

I have enjoyed a diverse career in particle physics, starting as an experimental b-physicist on the LHCb experiment where I worked on DAQ, Cherenkov ring reconstruction, and extraction of the CKM weak decay angle from simulated data. I proceeded to work as a Monte Carlo (MC) generator phenomenologist during which time I have become a world expert in Monte Carlo event generation for LHC physics, and in particle physics detector simulation.

All searches for new physics at the LHC involve the use of detailed simulations to predict the Standard Model behaviour. The first step is to perform a Monte Carlo simulation of the fundamental processes resulting from proton-proton collisions, and one must carefully tune the parameters of the model to match data. As an early postdoc, I created the Rivet and Professor toolkits for MC tuning, and have managed their development and assisted their incorporation into LHC experiment and phenomenology environments since 2006. The paper describing the system has 129 citations. Within the ATLAS collaboration, I organised and performed world-leading work to construct MC tunes in response to the first LHC data. These tunes substantially improved the modelling of pile-up and the underlying event, and have been used inside and outside ATLAS for myriad purposes including the ATLAS 2011 and 2012 Higgs analyses. At the same time as Rivet, I created the HepForge development system (which hosts many international science software projects), rewrote HepData (a leading repository of particle physics data) for the LHC era, and have been actively involved in the development of the LHAPDF library used in all LHC simulation studies.

In my current role as ATLAS MC generator convenor, I am responsible for a wide programme of operational activities and physics studies. These range from the organisation, technical logistics and physics content of all ATLAS simulated event samples, to development of new generator features, detailed physics studies of perturbative QCD and electroweak effects, and tuning of non-perturbative QCD models. Running the MC group involves close involvement with many aspects of the ATLAS physics programme, from improved jet and photon modelling to scanning methods for BSM parameter spaces and spin correlations in Higgs decays. I combine this work with a programme of fundamental QCD measurements in ATLAS data. Since the first LHC running I have performed several minimum bias and underlying event analyses (including supervision of a Masters' student and a PhD student), a double-partonic scattering analysis in W+2 jet events, and a study of rapidity-dependent transverse energy flow. The resulting papers have over 500 citations in total, and they provide the foundations for all physics measurements at the LHC.I am currently applying my detailed knowledge of jet physics to the search for the Higgs in its decays to two b quarks. I am supervising an Edinburgh PhD student, and am on the short list for a highly competitive European Research Council starter grant to establish a 60 month programme of research to perform the measurement. This is a crucial step in assessing whether we have indeed seen the Standard Model Higgs boson.

The second step of simulating LHC physics involves modelling the interactions between particles and detectors. As the ATLAS GEANT4 simulation expert, I was responsible for many developments in performance, software robustness, and physics used in all ATLAS analysis. I therefore have a deep knowledge of the detector principles necessary to ensure the success of the GAMBIT programme.

PART F - Personnel (Dr Pat Scott)

F1. Personal details

(The personal details will be filled out for you automatically. To update any of your personal details in this form, please update your profile accordingly and your details will update automatically in this form.)

Title

Doctor

Family Name

Scott

First Name

Pat

Person identifier

22585089

Role

Partner Investigator

F2. Postal address

(The postal address will be filled out for you automatically. To update your postal address, please update your profile accordingly and your postal address will update automatically in this form.)

Postal Address Line 1

4444 rue Drolet

Locality

Montreal

State

Quebec

Postcode

H2W 2L8

Country

Canada

F3. Are you a current member of the ARC or its selection or other advisory committees?

(This relates only to College of Experts or Selection Advisory Committee members for National Competitive Grants Program funding schemes.)

Current Member of Advisory Committee

No

F4. Please name any Commonwealth-funded Research Centres that you will be associated with as at 1 January 2015.

	Full Legal Name of Centre	Start Date	Cessation Date	Centre Role
1	not applicable			

	Centre Role if Other
1	

F5. Are you an Indigenous Participant?

Indigenous Participant

No

F6. PhD Qualification

F6.1. Do you hold a PhD or expect to be awarded a PhD qualification in the near future?

PhD Yes/No

Yes

F6.2. If you hold a PhD or expect to be awarded a PhD qualification in the near future, please enter the date your PhD has been awarded or the date your thesis will be submitted, respectively.

Date of Award

01/05/2010

F7. Qualifications

	Degree/Award	Year	Discipline/Field	Organisation Name
1	PhD	2010	Theoretical Physics	Stockholm University, Sweden
2	Licentiate of Philosophy (Fil. Lic.)	2008	Theoretical Physics	Stockholm University, Sweden
3	BSc (Double Hons)	2005	Astrophysics, Neuroscience, Theoretical Physics	The Australian National University

	Country
1	Sweden
2	Sweden
3	Australia

F8. Current and previous appointment(s)/position(s) – during the past 10 years

	Position	Organisation Name	Department	Year Appointed
1	STFC Ernest Rutherford Fellow	Imperial College London	Department of Physics	2014
2	Canadian Tri-Agency Research Councils NSERC Banting Fellow	McGill University, Canada	Department of Physics	2012
3	Trottier Astrophysics Fellow / Institute for Particle Physics Theory Fellow	McGill University, Canada	Department of Physics	2010

	Continuity	Employment Kind	Current
1	Contract	Full Time	No
2	Contract	Full Time	Yes
3	Contract	Full Time	No

F9. Organisational affiliations for eligibility purposes for this Proposal

(Name of the organisation you will be associated with for the purposes of satisfying the eligibility requirements for your nominated role in undertaking the proposed research (i.e. for a CI this will usually be the Eligible Organisation at which they will employed or hold an adjunct appointment as at 1 January 2015 and beyond; for PIs it will generally be their main employer as at 1 January 2015).)

Organisation Name

Imperial College London

Type of Affiliation

Employee

F10. What is your time commitment (%FTE) to this Project?

25

F11. Are you requesting an International Collaboration Award?

(Note: If you are an Australian-based PI, you must choose 'No'. Also, if you are a PI working in an Australian Eligible Organisation overseas campus you must choose 'No'.)

International Collaboration Award

Yes

F12. Research Opportunity and Performance Evidence (ROPE)

F12.1. Details on your career and opportunities for research over the last 10 years

(Write a maximum of 5250 characters (approx. 750 words). Please detail your career and opportunities over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

(i) I received my PhD in Theoretical Physics from Stockholm University in May 2010.

(ii) My research career originally began in astrophysics as an Honours student at Mt Stromlo Observatory. I realised that I wished to study theoretical particle and astroparticle physics, but that these fields barely existed in Australia at the time. On the advice of mentors Martin Asplund and Brian Schmidt, I moved to Stockholm University to pursue my PhD in late 2006, under the supervision of Joakim Edsjö and Lars

Bergström. Moving from astrophysics to particle theory is rare, and challenging both from technical and cultural perspectives; moving in the other direction is far more common. With no background to speak of in particle physics at the time, I started significantly behind other students in Stockholm on a technical level -- but significantly ahead in terms of research techniques, thanks to my period at Mt Stromlo. I quickly obtained the relevant skills in quantum field theory, particle and astroparticle physics, and went on to complete my PhD in 3.5yr, at least half a year early by the Swedish PhD timetable (4 is considered fast, 5 normal). I benefited greatly from the interdisciplinary environment at the Oskar Klein Centre (OKC) in Stockholm, also learning much about statistics and experimental astroparticle physics, and then successfully combining these with my newly-obtained theoretical background to produce a number of seminal papers in global fit phenomenology.

In 2010 I won the Trottier Astrophysics and Canadian Institute for Particle Physics Theory Fellowships, to work in the High Energy Physics Theory Group at McGill University. I turned down 4 other offers, including a named fellowship at Harvard. I later won the prestigious Banting Fellowship from the Canadian Tri-Agency Research Councils (roughly equivalent to a DECRA, but more sought after), providing 2 years additional funding to expand my global fit work at McGill. In 2012 at the International Conference on High Energy Physics in Melbourne, I began forming the GAMBIT Collaboration with CI White. In 2013, I was awarded a 5-year UK Sciences and Technology Facilities Council (STFC) Rutherford Fellowship to carry on work on GAMBIT at Imperial College London (ICL) from April 2014. At the conclusion of that fellowship, I will transition into a regular permanent lectureship at ICL.

(iii) My position at ICL is officially pure research for the next 5 years. I will spend 60% of my time on research, 20% on administration (including duties in my capacity as leader of GAMBIT), and 20% on teaching and supervision (other than that which is directly research-productive). Teaching is not officially required, but necessary for maintaining my case for the promised transferral to a lectureship. The FTE commitment I make to this Discovery Project refers to the fraction of my time that will be spent engaging directly in the expanded GAMBIT activities of the Adelaide node; this includes a third of my research time and a quarter of my administrative time.

My PhD time (2006-2010) was 10% tutoring, 10% administration and 80% research. At McGill (2010-2014), although officially I was in pure research positions, supervision and voluntary teaching occupied 20% of my time, administration 20%, and research 60%.

(iv) I have had no career interruptions.

(v) I have had the enviable opportunity to work at some of the world's top research institutes in high energy theory (McGill), high energy experiment (OKC Stockholm, McGill), astroparticle theory (OKC Stockholm), astroparticle experiment (OKC Stockholm, McGill) and astrophysics (Mt Stromlo Observatory, OKC Stockholm). I have collaborated with a phenomenal range of experts from other institutes when measured against my career stage. This breadth of experience has granted me an equally broad range of mentors, from theoretical cosmology (Robert Brandenberger) to quantum field theory (Jim Cline, Guy Moore, PI Edsjö, Fawad Hassan), statistical methods (PI Conrad, Roberto Trotta), high energy experiment (PI Conrad, Jenni Adams, Ken Ragan), dark matter (PIs Edsjö and Conrad, Lars Bergström, Malcolm Fairbairn, Paolo Gondolo), stellar physics and spectroscopy (Martin Asplund, Nicolas Grevesse), observational cosmology (Roberto Trotta, Gil Holder, Brian Schmidt) and computational methods (PI Edsjö, Roberto Trotta, Martin Asplund).

At ICL, I will have Roberto Trotta at hand, microwave background expert Andrew Jaffe, leading direct dark matter detection group LUX/ZEPLIN and the ICL CMS group, one of the largest LHC groups anywhere in the world. I will have priority access to over 10,000 cores of in-house supercomputing hardware, which will be used extensively for the activities we outline here.

(vi) Founding and getting the GAMBIT Collaboration off the ground in the last 18 months, particularly writing much of the underlying computer code, has had a non-trivial impact on my publication rate. That rate is high enough under more 'natural' conditions that this is probably not immediately noticeable, however.

F12.2. Recent significant research outputs and ARC grants (since 2004)

(Please attach a PDF with a list of your recent significant research outputs and ARC grants most relevant to the Proposal (20 pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Dr Pat Scott: Recent significant research outputs and ARC grants (since 2004)

1 Recent significant research outputs (since 2004)

Summary, Feb 6 2014 via NASA ADS

- Publications: 39
- Citations: 2017
- h-index: 17

(i) Scholarly books

None.

(ii) Scholarly book chapters

None.

(iii) Refereed journal articles

[1*] **P. Scott** and A. C. Vincent, *Thermal conduction by dark matter with velocity and momentum-dependent cross-sections*, *JCAP* (2014) in press, [arXiv:1311.2074].

[2*] **P. Scott**, J. M. Cline, K. Kainulainen and C. Weniger, *Update on scalar singlet dark matter*, *Phys. Rev. D* **88** (2013) 055025, [arXiv:1306.4710].

[3*] **P. Scott** and J. M. Cline, *Dark matter CMB constraints and likelihoods for poor particle physicists*, *JCAP* **3** (2013) 44, [arXiv:1301.5908].

[4] **P. Scott**, S. Shandera, A. L. Erickcek and J. Yana Galarza *Number Counts and Non-Gaussianity*, *Phys. Rev. D* (2013) in press, [arXiv:1211.7361].

[5*] **P. Scott**, H. Silverwood, M. Danninger, C. Savage, J. Edsjö, J. Adams, A. M. Brown and K. Hultqvist, *Sensitivity of IceCube-DeepCore to neutralino dark matter in the MSSM-25*, *JCAP* **3** (2013) 27, [arXiv:1210.0844].

[6] **P. Scott**, E. Zackrisson *et al.*, *Hunting for dark halo substructure using submilliarcsecond-scale observations of macrolensed radio jets*, *MNRAS* **431** (2013) 2172–2183, [arXiv:1208.5482].

[7*] **P. Scott**, C. Savage, J. Edsjö and the IceCube Collaboration: R. Abbasi et al., *Use of event-level neutrino telescope data in global fits for theories of new physics*, *JCAP* **11** (2012) 57, [arXiv:1207.0810].

[8] **P. Scott**, A. C. Vincent and R. Trampedach, *Light bosons in the photosphere and the solar abundance problem*, *MNRAS* **432** (2013) 3332–3339, [arXiv:1206.4315].

[9*] **P. Scott**, *Pippi – painless parsing, post-processing and plotting of posterior and likelihood samples*, *Eur. Phys. J. Plus* **127** (2012) 138, [arXiv:1206.2245].

[10] **P. Scott**, C.-E. Rydberg, E. Zackrisson and P. Lundqvist, *Detection of isolated Population III stars with the James Webb Space Telescope*, *MNRAS* **429** (2013) 3658–3664, [arXiv:1206.0007].

[11] **P. Scott**, A. I. Cowan and C. Stricker, *Quantifying impacts of short-term plasticity on neuronal information transfer*, *Phys. Rev. E* **85** (2012) 041921, [arXiv:1204.3270].

[12*] **P. Scott**, C. Strege, R. Trotta, G. Bertone and A. H. G. Peter, *Fundamental statistical limitations of future dark matter direct detection experiments*, *Phys. Rev. D* **86** (2012) 023507, [arXiv:1201.3631].

[13] **P. Scott**, T. Bringmann and Y. Akrami, *Improved constraints on the primordial power spectrum at small scales from ultracompact minihalos*, *Phys. Rev. D* **85** (2012) 125027, [arXiv:1110.2484].

[14] **P. Scott**, A. Venkatesan, E. Roebber, P. Gondolo, E. Pierpaoli and G. Holder, *Impacts of Dark Stars on Reionization and Signatures in the Cosmic Microwave Background*, *ApJ* **742** (2011) 129, [arXiv:1107.1714].

[15*] **P. Scott**, J. Ripken and J. Conrad, *Implications for constrained supersymmetry of combined H.E.S.S. observations of dwarf galaxies, the Galactic halo and the Galactic centre*, *JCAP* **04** (2011) 012, [arXiv:1012.3939].

[16*] **P. Scott**, Y. Akrami, C. Savage, J. Conrad and J. Edsjö, *How well will ton-scale dark matter direct detection experiments constrain minimal supersymmetry?*, *JCAP* **4** (2011) 12, [arXiv:1011.4318].

[17*] **P. Scott**, Y. Akrami, C. Savage, J. Conrad and J. Edsjö, *Statistical coverage for supersymmetric parameter estimation: a case study with direct detection of dark matter*, *JCAP* **7** (2011) 2, [arXiv:1011.4297].

[18] **P. Scott**, E. Zackrisson, C.-E. Rydberg, F. Iocco, S. Sivertsson, G. Östlin, G. Mellema, I. T. Iliev and P. R. Shapiro, *Observational constraints on supermassive dark stars*, *MNRAS* **407** (2010) L74–L78, [arXiv:1006.0481].

[19] **P. Scott**, E. Zackrisson, C.-E. Rydberg, F. Iocco, B. Edvardsson, G. Östlin, S. Sivertsson, A. Zitrin, T. Broadhurst and P. Gondolo, *Finding High-redshift Dark Stars with the James Webb Space Telescope*, *ApJ* **717** (2010) 257–267, [arXiv:1002.3368].

[20*] **P. Scott**, Y. Akrami, J. Edsjö, J. Conrad and L. Bergström, *A profile likelihood analysis of the Constrained MSSM with genetic algorithms*, *JHEP* **4** (2010) 57, [arXiv:0910.3950].

[21*] **P. Scott**, J. Conrad, J. Edsjö, L. Bergström, C. Farnier and Y. Akrami, *Direct constraints on minimal supersymmetry from Fermi-LAT observations of the dwarf galaxy Segue 1*, *JCAP* **1** (2010) 31, [arXiv:0909.3300].

[22] **P. Scott**, M. Asplund, N. Grevesse, A. J. Sauval, *The chemical composition of the Sun*, *ARA&A* **47** (2009) 481–522, [arXiv:0909.0948].

[23] **P. Scott** and S. Sivertsson, *Gamma rays from ultracompact primordial dark matter minihalos*, *Phys. Rev. Lett.* **103** (2009) 211301, [arXiv:0908.4082].

[24] **P. Scott**, M. Asplund, N. Grevesse and A. J. Sauval, *On the Solar Nickel and Oxygen Abundances*, *ApJ* **691** (2009) L119–L122, [arXiv:0811.0815].

[25] **P. Scott**, M. Fairbairn and J. Edsjö, *Dark stars at the Galactic Centre - the main sequence*, *MNRAS* **394** (2009) 82–104, [arXiv:0809.1871].

[26] **P. Scott**, M. Fairbairn and J. Edsjö, *The zero age main sequence of WIMP burners*, *Phys. Rev. D* **77** (2008) 047301, [arXiv:0710.3396].

[27] **P. Scott**, M. Asplund, N. Grevesse and A. J. Sauval, *Line formation in solar granulation. VII. CO lines and the solar C and O isotopic abundances*, *A&A* **456** (2006) 675–688, [astro-ph/0605116].

(iv) Refereed conference papers (proceedings)

[28] **P. Scott**, N. Grevesse, M. Asplund and J. Sauval, *Why GN93 should not be used anymore*, in *40th Liège International Astrophysical Colloquium. Ageing Low Mass Stars: From Red Giants to White Dwarfs* (J. Montalbán, A. Noels, and V. Van Grootel, eds.), *European Physical Journal Web of Conferences* **43** (2013) 1004.

[29] **P. Scott**, N. Grevesse, M. Asplund, A. J. Sauval, *The New Solar Chemical Composition – from $Z = 0.02$ to $Z = 0.013$*, in *Progress in Solar/Stellar Physics with Helio- and Asteroseismology* (H. Shibahashi, M. Takata, and A. E. Lynas-Gray, eds.), *Astronomical Society of the Pacific Conference Series* **462** (2012) 41.

[30] **P. Scott**, T. Bringmann, and Y. Akrami, *Constraints on small-scale cosmological perturbations from gamma-ray searches for dark matter*, in *Proceedings of TAUP 2011* (G. Raffelt et. al., ed.), *J. Phys. Conf. Series* **375** (2012) 032012, [arXiv:1205.1432].

[31*] **P. Scott**, C. Blázas *et al.*, *DLHA: Dark Matter Les Houches Agreement*, in *Les Houches 2011: Physics at TeV Colliders New Physics Working Group Report* (Brooijmans, G. et. al., ed.) (2012) [arXiv:1203.1488].

[32] **P. Scott**, *Dark stars: structure, evolution and impacts upon the high-redshift Universe*, in *Cosmic Radiation Fields: Sources in the early Universe* (M. Raue, T. Kneiske, D. Horns, D. Elsaesser, & P. Hauschildt, ed.) (2011) *PoS*(**CRF 2010**)021, [arXiv:1101.1029].

[33] **P. Scott**, C. E. Rydberg and E. Zackrisson, *Can the James Webb Space Telescope detect isolated population III stars?*, in *Cosmic Radiation Fields: Sources in the early Universe* (M. Raue, T. Kneiske, D. Horns, D. Elsaesser, & P. Hauschildt, ed.) (2011) *PoS*(**CRF 2010**)026, [arXiv:1103.1377].

[34] **P. Scott**, N. Grevesse, M. Asplund and A. J. Sauval, *The New Solar Composition and the Solar Metallicity*, in *The Sun, the Solar Wind, and the Heliosphere* (M. P. Miralles and J. Sánchez Almeida, eds.), *IAGA Special Sopron Book Series* **4** (2011) 51–60.

[35] **P. Scott**, N. Grevesse, M. Asplund and A. Sauval, *The chemical composition of the sun*, in *10th International Colloquium on Atomic Spectra and Oscillator Strengths for Astrophysical and Laboratory Plasmas*, *Can. J. Phys.* **89** (2011) 327–331.

[36] **P. Scott**, N. Grevesse, M. Asplund and A. J. Sauval, *The chemical composition of the Sun*, in *Synergies between solar and stellar modelling*, *Ap&SS* **328** (2010) 179–183.

[37] **P. Scott**, J. Edsjö, and M. Fairbairn, *The DarkStars code: a publicly available dark stellar evolution package*, in *Dark Matter in Astroparticle and Particle Physics: Dark 2009* (H. V. Klapdor-Kleingrothaus & I. V. Krivosheina, ed.), World Scientific, Singapore (2010) 320–327, [arXiv:0904.2395].

[38] **P. Scott**, M. Fairbairn, and J. Edsjö, *Impacts of WIMP dark matter upon stellar evolution: main-sequence stars*, in *Identification of dark matter 2008* (2008) *PoS*(**idm2008**)073, [arXiv:0810.5560].

[39] **P. Scott**, J. Edsjö, and M. Fairbairn, *Low mass stellar evolution with WIMP capture and annihilation*, in *Dark Matter in Astroparticle and Particle Physics: Dark 2007* (H. K. Klapdor-Kleingrothaus and G. F. Lewis, eds.), World Scientific, Singapore (2008) 387–392, [arXiv:0711.0991].

(v) Other (popular science)

[40] **P. Scott**, *Med mörk materia som drivmedel*, *Populär Astronomi* **3** (2008) 11. In Swedish; title translates as "Fuelled by dark matter".

2 ARC grants (since 2004)

None.

F12.3. Ten career-best research outputs

(Please attach a PDF with a list of your ten career-best research outputs (five pages maximum). Please refer to the Instructions to Applicants for the required content and formatting.)

Attached PDF

Dr Pat Scott: Ten career-best research outputs

[1*] **P. Scott**, J. M. Cline, K. Kainulainen and C. Weniger, *Update on scalar singlet dark matter*, *Phys. Rev. D* **88** (2013) 055025, [arXiv:1306.4710].
The current state-of-the art analysis of the simplest theory for physics beyond the Standard Model. Includes full collider, direct and indirect dark matter constraints. 25 citations.
ARC grant: *Not applicable*

[2*] **P. Scott**, C. Savage, J. Edsjö and the IceCube Collaboration: R. Abbasi et al., *Use of event-level neutrino telescope data in global fits for theories of new physics*, *JCAP* **11** (2012) 57, [arXiv:1207.0810].
The first paper to fully include neutrino telescope data (event and energy information) in global fits to beyond the Standard Model theories. 9 citations.
ARC grant: *Not applicable*

[3] **P. Scott**, T. Bringmann and Y. Akrami, *Improved constraints on the primordial power spectrum at small scales from ultracompact minihalos*, *Phys. Rev. D* **85** (2012) 125027, [arXiv:1110.2484].
An analysis of dark matter clump formation that produced the strongest limits to date on cosmological perturbations at scales smaller than the microwave background. 25 citations.
ARC grant: *Not applicable*

[4] **P. Scott**, E. Zackrisson, C.-E. Rydberg, F. Iocco, B. Edvardsson, G. Östlin, S. Sivertsson, A. Zitrin, T. Broadhurst and P. Gondolo, *Finding High-redshift Dark Stars with the James Webb Space Telescope*, *ApJ* **717** (2010) 257–267, [arXiv:1002.3368].
The first (and most comprehensive) analysis of the detectability of stars influenced by dark matter annihilation ("dark stars"). 31 citations.
ARC grant: *Not applicable*

[5*] **P. Scott**, Y. Akrami, J. Edsjö, J. Conrad and L. Bergström, *A profile likelihood analysis of the Constrained MSSM with genetic algorithms*, *JHEP* **4** (2010) 57, [arXiv:0910.3950].
The first application of genetic algorithms to supersymmetry and global fits in general. Showed that existing fits with other algorithms were statistically flawed. 43 citations.
ARC grant: *Not applicable*

[6*] **P. Scott**, J. Conrad, J. Edsjö, L. Bergström, C. Farnier and Y. Akrami, *Direct constraints on minimal supersymmetry from Fermi-LAT observations of the dwarf galaxy Segue 1*, *JCAP* **1** (2010) 31, [arXiv:0909.3300].

The paper that pioneered the inclusion of data from indirect searches for dark matter in supersymmetric global fits. 71 citations.
ARC grant: *Not applicable*

[7] **P. Scott**, M. Asplund, N. Grevesse, A. J. Sauval, *The chemical composition of the Sun*, *ARA&A* **47** (2009) 481–522, [arXiv:0909.0948].
The first comprehensive determination of abundances of all the elements in the Sun (I obtained results for Z=11[Na]–92[U]). Original research, despite the publication location. 1341 citations.
ARC grant: *Not applicable*

[8] **P. Scott** and S. Sivertsson, *Gamma rays from ultracompact primordial dark matter minihalos*, *Phys. Rev. Lett.* **103** (2009) 211301, [arXiv:0908.4082].
The first prediction of gamma-ray fluxes from a new class of proposed dark matter substructure, ultracompact minihalos (UCMHs). 32 citations.
ARC grant: *Not applicable*

[9] **P. Scott**, M. Fairbairn and J. Edsjö, *Dark stars at the Galactic Centre - the main sequence*, *MNRAS* **394** (2009) 82–104, [arXiv:0809.1871].
Comprehensive analysis of the theoretical aspects and prospects for detecting dark stars in our Galaxy. The first treatment of main-sequence stellar evolution with dark matter capture and annihilation. 48 citations.
ARC grant: *Not applicable*

[10] **P. Scott**, M. Asplund, N. Grevesse and A. J. Sauval, *Line formation in solar granulation. VII. CO lines and the solar C and O isotopic abundances*, *A&A* **456** (2006) 675–688, [astro-ph/0605116].
The first 3D analysis of carbon monoxide line formation in the Sun. Included measurement of the solar carbon and oxygen isotopic compositions (important for understanding planet formation). 47 citations.
ARC grant: *Not applicable*

Citation counts taken from HEP-inSPIRE and NASA ADS.

F12.4. Further evidence in relation to research impact and contributions to the field over the last 10 years most relevant to this Proposal

(Write a maximum of 7500 characters (approx. 1000 words). Please detail further evidence in relation to research impact and contributions to the field over the last 10 years. Please refer to the Instructions to Applicants for the required content and formatting.)

Prizes & Awards

2010: The Sigrid Arrhenius Prize, Stockholm University, best PhD thesis in Natural Sciences.
2005,06: The University Medal (twice), ANU.
2006: The Sir Grafton Elliot Smith Prize, Australian Neuroscience Society, best Hons, MSc or PhD student manuscript (as Hons student).
2005: The Bok Prize, Astronomical Society of Australia, best Hons/Master thesis in astrophysics.

Grants and Personal Fellowships

2014-19: Ernest Rutherford Fellowship, Science and Technology Facilities Council, UK, $850k.
2014: International Research Collaboration Award, University of Sydney, $15k.
2012-14: Banting Fellowship, Tri-Agency Research Council, Government of Canada, $150k.
2010-12: Theory Fellowship, Canadian Institute for Particle Physics, $45k.
2010-12: Trottier Fellowship in Astrophysics, McGill University, $75k.
2010: CfA Fellowship (declined), Harvard-Smithsonian Center for Astrophysics, $300k.
2009: G & E Kobbs Foundation Grant, $9k.
2009: Helge Axelsson Johnsons Foundation Grant, $2k.
2009: CF Liljevalchs Foundation Travel Grant, $1k.
2008: G & E Kobbs Foundation Grant, $3k.
2008: European Network for Theoretical Astroparticle Physics ILIAS/N6 Travel Grant, $1k.
2008: Helge Axelsson Johnssons Foundation Grant, $3k.
2007: IAU Exchange of Astronomers Grant, International Astronom. Union Commission 46, $3k.
2006-2010: HEAC (High Energy Astrophysics and Cosmology Centre) Doctoral Fellowship, AlbaNova University Centre, Stockholm, $148k.

Non-Publication Research Communication

Invited
7 plenaries
9 other conference talks
13 colloquia / seminars
10 invited talks booked in the next 2 months whilst visiting Australia.
Non-invited
69 seminars, conference presentations or similar.

Professional Activities: Scientific & Professional Leadership
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late 2012-->: Collaboration Leader and Core/Theory Working Group Co–convenor, Global And Modular BSM Inference Tool (GAMBIT) Collaboration
2011-->: Associate member of the IceCube Collaboration
2008-->: Affiliated member of the Fermi Large Area Telescope (LAT) Collaboration
2013,14: Guest editor, Physics of the Dark Universe (Elsevier), issue “New Searches and Tools in the Hunt for Dark Matter”
2013: Session chair, Identifying and Characterizing Dark Matter, KITP, Santa Barbara, USA
2013: Session chair, CosmoStats13, Banff, Canada
2012: PhD thesis opponent, Jordi Casanellas, IST Lisbon
2012: Session chair, The LHC, Particle Physics and the Cosmos, Auckland, NZ
2012: Convenor & session chair, Particle Astrophysics and Cosmology Track, International Conference on High Energy Physics (ICHEP), Melbourne
2012-14: Founder & committee chair, McGill Astroparticle Seminar Series
2011: Discussion leader, Dark Matter, Northeast Cosmology Workshop, Montreal

2011: Chair of organising committee, Dark Matter From Every Direction, McGill U, 27 attendees
2010: Co-chair of organising committee, PROSPECTS Conference, Stockholm U, 42 attendees
2009: Session chair, Dark2009, Christchurch, NZ
2009–2010: Member of Stockholm U. Physics Departmental Computing Committee
Referee for JHEP, JCAP, Phys Rev Lett, Phys Lett B, ApJ Lett, MNRAS Lett, Europhys Lett, Astronomy & Astrophysics and Statistical Analysis & Data Mining

Professional Activities: Research Student Supervision

Primary supervision
MSc: Hamish Silverwood (Canterbury, 2012), Philippe Giguere (McGill, 2013)
Hons: Madeleine Athonisen (McGill 2013)

Assistant supervision / mentoring
PhD: Yashar Akrami (Stockholm, 2010), Aaron Vincent (McGill, 2012), Elinore Roebber, Grace Dupuis (both McGill, 2015)
MSc: Elinore Roebber, Grace Dupuis (both McGill, 2012)

Professional Activities: Software Development

GAMBIT: Founding Author. An upcoming second-generation public package for global fits in any theory beyond the Standard Model.
pippi: Sole author. A public package for parsing, post-processing and plotting samples from MCMCs and related sampling algorithms.
FLATLib: Sole Author. A public package for fast convolution with the Fermi-LAT instrumental response.
DarkStars: Sole Author. A public package for computing the effects of dark matter on the evolution of stars.
SuperBayeS: Development Author. A first-generation public package for performing supersymmetric global fits.

(ii) Research Impact

Research programs that I have carried out, and their impacts on their respective disciplines, include:

Creation of detailed astroparticle likelihood functions for global fits to beyond-the-Standard Model theories [3,4,15,21 in F12.2]
I showed the advantages of (and developed the core techniques for) including indirect searches for dark matter, and event-level neutrino telescope data, in global fits to new physics.

Statistical methods in beyond-the-Standard-Model parameter scans [12,17,20]
I showed that existing scans were statistically flawed due to the scanning techniques they employed, and demonstrated the utility of genetic algorithms as an alternative. I discovered in what situations statistical coverage is correct and incorrect in such scans, and provided practical strategies for improving it.

Indirect dark matter constraints and predictions [21]
I carried out the first official Fermi-LAT Collaboration derivation of limits on dark matter annihilation into gamma-rays, which tested a number of previously-favoured supersymmetric dark matter models. I also carried out the most complete prediction to date of the expected sensitivity of the upcoming Cherenkov Telescope Array to dark matter annihilation, allowing its design to be further refined and optimised for this search (arXiv:1401.7330, accepted by JCAP).

Development of the theory and implications of ultracompact minihalos (UCMHs) of dark matter [4,6,13,23]
I calculated the predicted gamma-ray signals of UCMHs, allowing Fermi-LAT data to be used to limit their abundance. This ruled out cosmological perturbations on small scales at levels 5 orders of magnitude better than previous limits, placed limits on non-Gaussianities, and ruled out some models of inflation.

A comprehensive update of the viable parameter space of scalar singlet extensions of the Standard Model as dark matter [2]
I provided the current state-of-the-art in terms of theoretical predictions and present constraints on this model.

Determination of the chemical composition of the Sun [22,24,27]
I redetermined the abundances of all elements in the Sun up to uranium, doing so in a consistent way for all elements, with a 3D model atmosphere, for the first time. This result has become a fundamental reference in astroparticle and astrophysics. According to NASA ADS, [22] is the 8th most cited article published in 2009, and amongst the 700 most cited articles of all time. The citations it received in 2013, were they counted for topcites purposes in INSPIRE, would make it the 18th most cited paper in 2013.

Particle physics solutions to the solar abundance problem [1,8]
I ruled out the only photospheric solution to this problem so far proposed, and proposed the only particle solution that is still viable.

Impacts of dark matter on stellar structure and evolution [1,14,18,19,25,26]
I provided the best understanding to date of the impacts of dark matter annihilation and energy transport on stars, and the most detailed optical, infra-red and reionisation/microwave background limits on theories giving rise to such effects.

F12.5. A statement on your most significant contributions to the research field of this Proposal

(Write a maximum of 3750 characters (approx. 500 words). Please refer to the Instructions to Applicants for the required content and formatting.)

My papers include some of the most rigorous and original global fit work on new particle theories to date. I pioneered the use of data from indirect searches for dark matter in global fits [2,3,5,7,15,21]. This significantly improved constraints on supersymmetric dark matter, and was only possible through dedicated collaborations between myself and the relevant experiments. My paper with gamma-ray data from the Fermi-LAT [21] was the first to include results from direct or indirect searches for dark matter in a global supersymmetric fit, and the first published dark matter result from Fermi. This paper demonstrated how DM searches could be used in supersymmetric global fits, without compromising on any of the technical aspects of the astronomical analysis. The community recognised that such analyses are indeed ``the right way to go'' (the referee's words). Other important examples were my papers with HESS [15], then with IceCube neutrino events [5,7].

I have also helped substantially improve the optimisation and statistical methods used by the global fitting community [9,12,16,17,20]. One of these papers [20] focussed on the interplay of scanning algorithms and statistics. We found very many good fits that had been missed in previous analyses, showing that previous analyses were starkly deficient in their scanning practices. This lead to a significant shift in those practices throughout the community. In other papers [12,16], we showed that under- and over-coverage in beyond-the-Standard-Model global fits are the rule rather than the exception. We went on to show that the most reliable way to avoid these problems is to make the relationship mapping parameters to observables as close to linear possible, by e.g. choosing a different basis in which to express the parameters of the model being scanned.

The GAMBIT research program is big, bold and highly interdisciplinary. I bring a uniquely varied background to the project, with the requisite experience in astrophysics [6,10,14,18,19,22,24-27] and particle physics [1-5,7,8,12,13,15-17,20,21,22,25,26], theory [1-5,8,12-14,16,17,20,23,25,26] and experiment [7,15,21], DM phenomenology [1-3,5,7,8,12,13,15-17,21,23,25,26], cosmology [3,4,13,23] and statistical and numerical methods [7,9,12,17,20] to contribute to all areas of the program. I am the recognised leading authority on integrating indirect searches for dark matter into global fits, and have worked more closely with the relevant experiments than any other global fitter. I have the ability to communicate and collaborate equally fluidly with both theorists [e.g. 2,3,13,16,21] and experimentalists [e.g. 7,15,21], a skill that will be essential for the successful completion of the multi-disciplinary work in this Proposal.

I also bring strong leadership and organisational qualities necessary to bring this highly ambitious plan to fruition, having formed the Collaboration with CI White in the first place, and co-led it with Dr White since its inception. In this sense I am the best possible person to
a) make sure that the specific work within this Proposal has the maximal possible impact on GAMBIT as a global collaboration, and on its scientific outputs and software/data products
b) identify and bring in relevant expertise from elsewhere in the Collaboration, particularly the Scanner and Core/Model software frameworks, as I am alone amongst the CIs/PIs in being directly involved in these GAMBIT working groups, and co-lead both of them.

PART G - Research Support (DP150100963)

G1. Research support for all participants

(For each participant on this Proposal, provide details of research funding (ARC and other agencies in Australia and overseas) for the years 2013 to 2017 inclusive. That is, list all projects/proposals/awards/ fellowships awarded or requests submitted involving that Participant for funding. Please refer to the Instructions to Applicants for submission requirements.)

G. Research support for all participants

Description	Same Research Area (Yes/No)	Support Status (Requested/Current/Past)	Proposal/ Project ID	2013 ($'000)	2014 ($'000)	2015 ($'000)	2016 ($'000)	2017 ($'000)
Dr Paul Jackson, Dr Martin White, Professor Joakim Edsjo, Professor Jan Conrad, Dr Andrew Buckley, Dr Pat Scott "Data mining for the particle physics of Dark Matter", ARC Discovery Project 2015.	Yes	R	DP150100963	–	–	151	189	218
Dr Martin White, "A comprehensive approach to dark matter searches: the Cherenkov Telescope Array, IceCube and the Large Hadron Collider", ARC, Future Fellowships 2014.	Yes	R	FT140100244	–	189	186	192	190
Prof V Gibson, Dr PD Jackson, "The Royal Society (UK) International Exchanges Scheme", travel funds between Cambridge and Adelaide	No	R		–	10	10	–	–
Dr PD Jackson, Dr C Rogan, "Australia-Harvard Fellowship 2014", for collaborative research between Harvard University and University of Adelaide	No	C		–	15	–	–	–
Dr Paul Jackson, "Probing the experimental frontier of particle physics with high-precision and high-energy collisions", ARC, Future Fellowships 2013.	No	C	FT130100018	89.5	182.8	186.7	183.2	89.8

Description	**Same Research Area** (Yes/No)	**Support Status** (Requested/Current/Past)	**Proposal/ Project ID**	**2013** ($'000)	**2014** ($'000)	**2015** ($'000)	**2016** ($'000)	**2017** ($'000)
Prof Joakim Edjso, "Cosmoparticle Physics at the Oskar Klein Centre", Oskar Klein Centre, Stockholm University	No	C		129	129	129	129	129
Dr Andrew Buckley, Royal Society "University Research Fellowship", University of Edinburgh	No	C		136.8	133.5	133.5	133.5	–
Dr Pat Scott, "The astroparticle road to new physics", STFC Advanced Fellowship, ST/K00414X/1, Imperial College London,	Yes	C		–	181	169	172	169
Prof Jan Conrad, "Wallenberg Academy Fellowship", Oskar Klein Centre, Stockholm University	No	C		–	161	161	161	161
Dr Pat Scott, "Enhancing the search for physics beyond the Standard Model by combining terrestrial and astrophysical measurements", Office of the DVC-R, University of Sydney, IRCA-G162448	Yes	C		–	15	–	–	–
Prof Jan Conrad, "Grant holder for the Swedish Fermi, HESS and CTA consortia"	No	C		200	200	200	–	–
Dr Pat Scott, "Discovery and discrimination of models for new physics with combined terrestrial and astrophysical data", NSERC, BPDF-424460-2012	Yes	P		71	–	–	–	–
Dr Andrew Buckley "CERN Scientific Staff Associateship", CERN, Geneva, Switzerland	No	P		88	–	–	–	–

PART H - Statements on Progress on ARC-funded Projects (DP150100963)

H1. For each participant on this Proposal, please attach a statement detailing progress for each Project/Award/Fellowship involving that participant who has been awarded funding for 2013 under the ARC Discovery Projects, Discovery Indigenous, Discovery Early Career Researcher Award, Linkage Projects schemes or any ARC Fellowship scheme.

	Project ID	First named investigator	Scheme	Statement
1	FT130100018	Dr Paul Jackson	FT 2013-2017	

H. Statement on Progress

- **Project ID**: FT130100018
- **First named investigator (Project Leader)**: Dr PD Jackson
- **Scheme**: Future Fellowship 2013-2017

Dr Jackson began a Future Fellowship in January 2014 titled "Probing the experimental frontier of particle physics with high-precision and high-energy collisions". Some key developments have already occurred in the early stages of the Fellowship award.

- Dr Jackson has guided the University of Adelaide High Energy Physics group into membership of the Belle II experiment at the KEK laboratory in Tsukuba, Japan. As one of the key aspects of the proposal Dr Jackson has made rapid progress at gaining admission to this international collaboration.
- Dr Jackson has been approved to follow the project goals outlined in the Belle II component of the Future Fellowship application, namely the development of readout techniques to be used by the Belle II experiment, and the pursuit of rare decays with missing energy final states. Contacts with relevant experts has already been made.
- An honours student has been assigned to work on the project relating to DAQ hardware development for the longer term upgrade of the ATLAS experiment at the Large Hadron Collider.
- Both an honours and an MSc student have been assigned to the development of analysis techniques to be used at the upgraded ATLAS experiment.
- An international PhD student has been awarded a full scholarship to study under Dr Jackson on kinematic variables to be used for new analysis techniques in relation to the physics outlined in the Future fellowship award.
- Dr Jackson has been awarded the Executive Dean of Sciences "Order of Merit for Excellence in Research" since the award of the Future Fellowship.

PART I - Additional Details (DP150100963)

I1. Other agencies

Have you submitted or do you intend to submit a similar Proposal to any other agency?

Other Agency Submission

No

If Yes, please select one of the following:

Other Agency Name

Not applicable for this candidate

If Other is selected above, please enter the full name of the agency:

Not applicable for this candidate