

## 1 Basic information

**Name:** Weir, David James  
**Date of CV:** 13th September 2019

### 1.1 Date and place of birth, nationality, current residence

**Date and place of birth:** 21st December 1985, Glasgow, United Kingdom  
**Citizenship:** British  
[Application for Finnish citizenship pending since 15.05.2018]

**Contact address:** Helsinki Institute of Physics  
PL 64 (Gustaf Hällströmin katu 2)  
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## 2 Current positions

Sep. 2019 - present: Associate Professor, University of Helsinki  
Academy Research Fellow, Helsinki Institute of Physics

### 2.1 Education and degrees

#### Academic degrees:

Oct. 2007 - Sept. 2011: PhD in Theoretical Physics, Imperial College London  
Supervisor: Arttu Rajantie  
Title: *Quantum mechanics of topological solitons*  
Examiner: Philippe de Forcrand

Oct. 2003 - June 2007: MSci Physics with Theoretical Physics, Imperial College London  
Dissertation Supervisor: Andrew Parry  
Abdus Salam Prize (best student in year); 1st Class Honours

#### Docentship:

June 2018: Title of Docent in Theoretical Physics, University of Helsinki

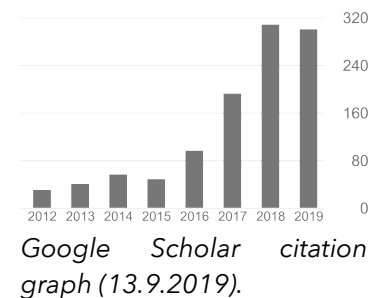
### 2.2 Previous employment

Apr. - Aug. 2019: STFC Ernest Rutherford Fellow, University of Nottingham  
(90% full time)  
May 2018 - Aug. 2019: University Researcher, Helsinki Institute of Physics  
(10% full time Apr. - Aug. 2019)  
Sept. 2016 - Apr. 2018: Postdoctoral Researcher, Department of Physics  
University of Helsinki  
Sept. 2014 - Aug. 2016: Marie Curie fellow, Institute of Mathematics and Natural Sciences  
University of Stavanger  
Sept. 2011 - Aug. 2014: Postdoctoral Researcher, Helsinki Institute of Physics  
University of Helsinki  
July 2007 - Sept. 2007: OpenLab summer studentship, Department of Computing, CERN

### 3 Qualifications in research and doctoral training

#### 3.1 Scope of publications

- 29 published or submitted refereed journal articles.
- 3 papers accepted or published in *Physical Review Letters*.
- 3 single-author publications, one of which is a review.
- 9 articles in conference proceedings.
- On Google Scholar, 1116 citations in total, and  $h$ -index of 16.
- My work has been featured on the front cover of *Physical Review Letters* as well as in the popular press, on the cover of *New Scientist*.



#### 3.2 International activities

[Since 2015 I have been a member of the LISA Cosmology Working Group, and was appointed to the LISA Consortium as a full member in 2018.]

International invited talks and lectures, in addition to invited seminars to research groups (five in 2018) and contributed talks at international meetings (four in 2018):

- 2019 Opportunities at Future High Energy Colliders workshop, IFT Madrid (forthcoming)
- 2019 Amsterdam Cosmology Meeting, Amsterdam (forthcoming)
- 2018 ECT\* composite dark matter workshop, Trento
- 2018 Prospects for charged Higgs discovery at colliders, Uppsala
- 2018 Aspen Center for Physics, Aspen, Colorado
- 2017 Chinese Spring School on Gravitational Waves, KITP China, Beijing
- 2017 Royal Society Theo Murphy meeting, Kavli Royal Society Centre, England
- 2016 CERN Theory Workshop ('The Big Bang and the little bangs'), CERN, Geneva
- 2016 MIAPP Topical Workshop ('Why is there more matter than antimatter?'), Munich
- 2015 SFB/Transregio 55 ('Hadron Physics from Lattice QCD') Workshop, Wuppertal

[all invited talks and lectures have concerned gravitational waves in the early universe]

Organisation of international events:

- 2018 Co-organiser, Fifth LISA Cosmology Working Group workshop, Helsinki
- 2017 Co-organiser, Amherst Center for Fundamental Interactions workshop ('Making the Electroweak Phase Transition (Theoretically) Strong'), UMass Amherst
- 2016 Strong and Electroweak Matter 2016 local organising committee, Stavanger
- 2015 Main organiser, Second LISA Cosmology Working Group workshop, Stavanger

International event attendance:

- 2019 Invited attendee, Science Foo Camp 2019, Google X, Mountain View (forthcoming)
- 2019 Invited attendee, Sixth LISA Cosmology Working Group workshop, Madrid
- 2018 Invited attendee, Science Foo Camp 2018, Google X, Mountain View
- 2017 Invited attendee, Fourth LISA Cosmology Working Group workshop, Mainz
- 2017 Invited attendee, Science Foo Camp 2017, Google, Mountain View
- 2016 Invited attendee, Third LISA Cosmology Working Group workshop, DESY

### 3.3 External research funding and projects

In addition to an internal University of Helsinki Three-Year Project Grant for the years 2018-2020 (150 000 euros), and faculty support funding for 2018 based on a high grade for my last Academy of Finland application (35 000 euros):

- Academy Research Fellow, Sep. 2019 - Aug. 2024  
(personal advanced fellowship; value 439 000 euros)  
**Topic:** 'LISA and the electroweak phase transition'
- STFC Ernest Rutherford Fellowship, Apr. 2019 - Mar. 2024  
(personal advanced fellowship; approx. value 500 000 euros; will vacate Aug. 2019)  
**Topic:** 'Gravitational wave cosmology for LISA'
- European Commission Marie Curie intra-European Fellowship, Sep. 2014 - Aug. 2016  
(personal fellowship; value 231 000 euros)  
**Topic:** 'Electroweak phase transition beyond the Standard Model'  
**Results:** Ten papers directly resulting from the fellowship  
**Impact:** Coverage in popular press, hosted international workshop on gravitational waves
- Academy Postdoctoral Researcher, Sep. 2014 - Aug. 2017  
(declined in favour of Marie Curie fellowship; value 252 000 euros)  
**Topic:** 'Electroweak phase transition beyond the Standard Model'

In total, nearly 1.5 million euros of funding granted in the past five years.

Peer-reviewed national and international high performance computing projects:

- CSC (Finnish centre for high performance computing) Grand Challenge grant  
'Simulations of cosmic networks' (May 2017 - Apr. 2018)  
Principal Investigator; 10M computer hours
- Partnership for Advanced Computing in Europe Tier-0 grant  
'Gravitational waves from early universe phase transitions' (Apr. 2015 - Mar. 2016)  
Principal Investigator; 17.6M computer hours

### 3.4 National and international research collaboration

Full member of LISA Mission Consortium and LISA Cosmology Working Groups.

Other current international scientific collaborations include:

- Hiren Patel and Michael Ramsey-Musolf, UMass Amherst: Gravitational waves and phase transitions in the triplet-extended Standard Model.
- Chiara Caprini and Dani Steer, APC, Université Paris 7: Turbulence after a first-order phase transition in the early universe.

### 3.5 Postdoctoral supervision

- Oliver Gould, Postdoctoral researcher, June. 2018 - present: Main supervisor

### 3.6 Postgraduate supervision

[Completed prior to summer 2018: one Bachelors, two Masters and two Doctoral theses.]

Current Masters and doctoral students:

- Jani Dahl, Doctoral thesis, Sept. 2018 - present: Co-supervisor
- Lauri Niemi, Doctoral thesis, Sept. 2018 - present: Co-supervisor
- Daniel Cutting, Doctoral thesis, Sept. 2016 - present: Co-supervisor
- Anna Kormu, Masters thesis, Sept. 2018 - present: Main supervisor
- Severino Zeni, Erasmus masters student, Sept. 2018 - present: Main supervisor

## 4 Teaching qualifications

### 4.1 Teaching experience

- 2017 Invited lecture course in gravitational waves, KITP China Spring School (Beijing)
- 2017 Developed and taught 2 credit course:  
Gravitational waves and cosmology (Helsinki)
- 2014 Taught 10 credit Master's course:  
Quantum Mechanics II (Helsinki)
- 2010-13 Annual short Masters course in lattice field theory (Imperial)
- 2009 Teaching assistant, Quantum Field Theory (Imperial)
- 2008-09 Teaching assistant, Undergraduate Laboratory (Imperial)
- 2008 Teaching assistant, Real Analysis (Imperial)

### 4.2 Production of teaching materials

- Concept, syllabus and material for 'Gravitational waves and cosmology' course.
- Complete set of typeset lecture notes for 'Quantum Mechanics II' course.

## 5 Other academic merits

### 5.1 Other activities

- 2016 Co-organiser of particle physics and cosmology exhibition,  
Vitenfabrikken Science Museum, Sandnes, Norway
- 2015- Public talks and lectures on gravitational waves (Stavanger and Helsinki)
- 2015- Member of LISA Cosmology Working Group
- 2013- Referee for Physical Review Letters, Physics Letters B, Physical Review D,  
Journal of Cosmology and Astroparticle Physics, and Europhysics Letters

### 5.2 Membership of university committees

- 2018- Member, Helsinki Institute of Physics Communications Group
- 2017- Member, Organising Committee, Departmental Colloquia, Helsinki
- 2017- Member, Departmental Wellbeing Committee, Helsinki

## Other information

### Language skills

English - Native; Finnish - B1/B2; French - B1; Norwegian - A2.

**David J. Weir - Publication List**

List current as of 13th September 2019.

**A: Peer-reviewed scientific articles****Journal articles**

- [A1] Lauri Niemi, Hiren H. Patel, Michael J. Ramsey-Musolf, Tuomas V. I. Tenkanen and David J. Weir, *Electroweak phase transition in the  $\Sigma$ SM - I: Dimensional reduction*, *Phys. Rev. D* **100** 035002 (2019) [arXiv:1802.10500].
- [A2] Tyler Gorda, Andreas Helset, Lauri Niemi, Tuomas V.I. Tenkanen and David J. Weir, *Three-dimensional effective theories for the two Higgs doublet model at high temperature*, *JHEP* **1902** 081 (2019), [arXiv:1802.05056].
- [A3] Mark Hindmarsh, Anna Kormu, Asier Lopez-Eiguren and David J. Weir, *Scaling in necklaces of monopoles and semipoles*, *Phys. Rev. D* **98** 103533 (2018), [arXiv:1809.03384].
- [A4] Jens O. Andersen, Tyler Gorda, Andreas Helset, Lauri Niemi, Tuomas V. I. Tenkanen, Anders Tranberg, Alekski Vuorinen and David J. Weir, *Nonperturbative analysis of the electroweak phase transition in the Two Higgs Doublet Model*, *Phys. Rev. Lett.* **121** 191802 (2018), [arXiv:1711.09849].
- [A5] Ray J. Rivers, Danièle A. Steer, Chi-Yong Lin, Da-Shin Lee and David J. Weir, *When are two fermions a simple boson? New Gross-Pitaevskii actions for cold Fermi condensates*, *Ann. Phys. (N.Y.)* **396** 495 (2018), [arXiv:1609.05435].
- [A6] Daniel Cutting, Mark Hindmarsh and David J. Weir, *Gravitational waves from vacuum first-order phase transitions: from the envelope to the lattice*, *Phys. Rev. D* **97** 123513 (2018), [arXiv:1802.05712].
- [A7] Anders Tranberg, Sara Tähtinen and David J. Weir, *Gravitational waves from non-abelian gauge fields at a tachyonic transition*, *JCAP* **1804** 012 (2018), [arXiv:1706.02365].
- [A8] David J. Weir, *Gravitational waves from a first order electroweak phase transition: a brief review*, *Phil. Trans. Roy. Soc. A* **376** 0126 (2018), [arXiv:1705.01783].
- [A9] Mark Hindmarsh, Stephan J. Huber, Kari Rummukainen and David J. Weir, *Shape of the acoustic gravitational wave power spectrum from a first order phase transition*, *Phys. Rev. D* **96** 103520 (2017), [arXiv:1704.05871].
- [A10] Mark Hindmarsh, Kari Rummukainen and David J. Weir, *Numerical simulations of necklaces in SU(2) gauge-Higgs field theory*, *Phys. Rev. D* **95** 063520 (2017), [arXiv:1611.08456].
- [A11] Tomáš Brauner, Tuomas V. I. Tenkanen, Anders Tranberg, Alekski Vuorinen and David J. Weir, *Dimensional reduction of the Standard Model coupled to a new singlet scalar field*, *JHEP* **1703** 007 (2017), [arXiv:1609.06230].
- [A12] Mark Hindmarsh, Kari Rummukainen and David J. Weir, *New solutions for non-Abelian cosmic strings*, *Phys. Rev. Lett.* **117** 251601 (2016), [arXiv:1607.00764].
- [A13] David J. Weir, *Revisiting the envelope approximation: gravitational waves from bubble collisions*, *Phys. Rev. D* **93** 124037 (2016), [arXiv:1604.08429].
- [A14] Chiara Caprini et al., *Science with the space-based interferometer eLISA. II: Gravitational waves from cosmological phase transitions*, *JCAP* **1604** 001 (2016), [arXiv:1512.06239].
- [A15] Kari Enqvist, Sami Nurmi, Stanislav Rusak and David J. Weir, *Lattice calculation of the decay of the primordial Higgs condensate*, *JCAP* **1602** 057 (2016), [arXiv:1506.06895].

- [A16] Mark Hindmarsh, Stephan J. Huber, Kari Rummukainen and David J. Weir, *Numerical simulations of acoustically generated gravitational waves at a first order phase transition*, *Phys. Rev. D*, **92** 123009 (2015), [arXiv:1504.03291].
- [A17] Mark Hindmarsh, Kari Rummukainen, Tuomas V.I. Tenkanen and David J. Weir, *Improving cosmic string network simulations*, *Phys. Rev. D* **90** 043539 (2014), [arXiv:1406.1688].
- [A18] Anders Tranberg and David J. Weir, *On the quantum stability of Q-balls*, *JHEP* **1404** 184 (2014), [arXiv:1310.7487].
- [A19] Mark Hindmarsh, Stephan J. Huber, Kari Rummukainen and David J. Weir, *Gravitational waves from the sound of a first order phase transition*, *Phys. Rev. Lett.* **114** 041301 (2014), [arXiv:1304.2433].
- [A20] David J. Weir et al., *Gaussianity revisited: Exploring the Kibble-Zurek mechanism with superconducting rings*, published in a special section ('Condensed matter applications of cosmology') of *J. Phys.: Cond. Matter* **25** 404207 (2013), [arXiv:1302.7296].
- [A21] David J. Weir, Roberto Monaco and Ray J. Rivers, *Defect formation in superconducting rings: external fields and finite-size effects*, *J. Low Temp. Phys.* **171** 788 (2013), [arXiv:1208.3426].
- [A22] Arttu Rajantie, Kari Rummukainen and David J. Weir, *Form factor and width of a quantum string*, *Phys. Rev. D* **86** 125040 (2012), [arXiv:1210.1106].
- [A23] Carl M. Bender and David J. Weir, *PT phase transition in multidimensional quantum systems*, *J. Phys. A* **45** 425303 (2012), [arXiv:1206.5100].
- [A24] Jutho Haegeman et al., *Variational matrix product ansatz for dispersion relations*, *Phys. Rev. B* **85** 100408 (2012) [arXiv:1103.2286].
- [A25] Arttu Rajantie and David J. Weir, *Nonperturbative study of the 't Hooft-Polyakov monopole form factors*, *Phys. Rev. D* **85** 025003 (2012), [arXiv:1109.0299].
- [A26] Arttu Rajantie and David J. Weir, *Soliton form factors from lattice simulations*, *Phys. Rev. D* **82** 111502 (2010), [arXiv:1006.2410].
- [A27] David J. Weir, *Studying a relativistic field theory at finite density using the density matrix renormalization group*, *Phys. Rev. D* **82** 025003 (2010), [arXiv:1003.0698].
- [A28] Arttu Rajantie and David J. Weir, *Quantum kink and its excitations*, *JHEP* **0904** 068 (2009), [arXiv:0902.0367].

### Conference proceedings

- [A29] David J. Weir, *Acoustic waves and the detectability of first-order phase transitions by eLISA*, *J. Phys.: Conf. Ser.* **840** 012031 (2017).
- [A30] Joni M. Suorsa et al., *Mass anomalous dimension of SU(2) with  $N_f = 8$  using the spectral density method*, *PoS LATTICE2015* (2015) 247, [arXiv:1511.03468].
- [A31] Teemu Rantalaiho et al., *Investigating the Sharpe-Singleton scenario on the lattice by direct eigenvalue computation*, *PoS LATTICE2013* (2014) 118, [arXiv:1311.1680].
- [A32] Simon Catterall, Dhagash Mehta and David J. Weir, *Eigenvalue spectrum of lattice  $\mathcal{N} = 4$  super Yang-Mills*, *PoS LATTICE2013* (2014) 093, [arXiv:1311.3676].
- [A33] Carlos Aguado Sanchez et al., *Volunteer Clouds and citizen cyberscience for LHC physics*, *J. Phys.: Conf. Ser.* **331** 062022 (2011).

- [A34] David J. Weir and Ray J. Rivers, *Fluxoid formation: size effects and non-equilibrium universality*, *J. Phys.: Conf. Ser.* **286** 012056 (2011), [arXiv:1105.2349].
- [A35] Ben Segal *et al.*, *LHC cloud computing with CernVM*, *PoS ACAT2010* (2010) 004.
- [A36] Ben Segal *et al.*, *Building a volunteer cloud*, Conferencia Latinoamericana de Computación de Alto Rendimiento (2009).
- [A37] Carl M. Bender, Joshua Feinberg, Daniel Hook and David J. Weir, *Proceedings of PHHQP VIII, Complex systems in chaotic phase space*, *Pramana* **73** (2009) 453-470, [arXiv:0809.1975].

**B: Non-refereed scientific articles [preprints available on arXiv, submitted to journals]**

- [B1] Daniel Cutting, Mark Hindmarsh and David J. Weir, *Vorticity, kinetic energy, and suppressed gravitational wave production in strong first order phase transitions*, preprint arXiv:1906.00480.
- [B2] Oliver Gould, Jonathan Kozaczuk, Lauri Niemi, Michael J. Ramsey-Musolf, Tuomas V. I. Tenkanen and David J. Weir, *Nonperturbative analysis of the gravitational waves from a first-order electroweak phase transition*, preprint arXiv:1903.11604.

**G: Theses**

- [G1] David J. Weir, *Quantum mechanics of topological solitons*, Imperial College London, 2011. PhD. thesis.