



TIMON EMKEN PhD

Theoretical Astroparticle Physicist

April 2022

SUMMARY

- 15 scientific publications (2 single-authored)
- 9 published research software tools and libraries
- teaching assistant for 11 university courses
- co-supervisor of 3 master and 1 PhD student
- 23 scientific talks at seminars and conferences (7 invited)
- research featured in the public media

CONTACT & INFO


 Larssons Berg 8
SE-43166 Mölndal


 +46 (0) 76 325 97 87


 timon.emken@gmail.com


 15.03.1988
in Bochum, Germany


LINKS


 timonemken.com

 ORCID iD
0000-0002-4251-2229

 Twitter
@TimonEmken

 Github
temken

 inSPIRE-HEP
T.Emken.1

 Google Scholar
Timon Emken

UNIVERSITY CAREER

2021 – now	Postdoctoral fellow	Stockholm University, Stockholm, Sweden Department: Group leader: Oskar Klein Centre, Department of Physics Prof. Jan Conrad
2021 – now	Guest researcher	Chalmers University of Technology, Göteborg, Sweden Department: Host: Department of Physics Prof. Riccardo Catena
2019 – 2021	Postdoctoral researcher	Chalmers University of Technology, Göteborg, Sweden Department: Group leader: Department of Physics Prof. Riccardo Catena
2018	Guest researcher	Stony Brook University, Stony Brook, NY, USA Department: Host: C.N. Yang Institute for Theoretical Physics Prof. Rouven Essig

ACADEMIC EDUCATION

2016 - 2019	Ph.D. (Physics)	University of Southern Denmark, Odense, Denmark Specialization: Thesis: Department: Supervisor(s): Theoretical Astroparticle Physics <i>Dark Matter in the Earth and the Sun – Simulating underground scatterings for the direct detection of low-mass dark matter</i> Centre for Cosmology and Particle Physics Phenomenology (CP ³ -Origins) Prof. Chris Kouvaris
-------------	------------------------	---

Results of the thesis were published in [2]-[6].

2014 - 2015	Ph.D. (discont.)	Julius-Maximilians-Universität, Würzburg, Germany Topic: Department: Supervisor(s): Astrophysical constraints on supersymmetric Pati-Salam models Faculty for Physics and Astronomy Prof. Werner Porod
-------------	-------------------------	---

2011 - 2013	Master of Science	Georg August Universität, Göttingen, Germany Specialization: Thesis: Department: Supervisor(s): Theoretical Particle Physics <i>Supergravity & Supernovae – Gravitino Phenomenology in Astrophysics</i> Institute for Theoretical Physics Prof. Laura Covi, Dr. Riccardo Catena
-------------	--------------------------	--

Results of the thesis were published in [1].

COMMUNITY SERVICE

Referee activity

- Physical Review Letters (PRL)
- Physical Review D (PRD)
- Journal for Cosmology and Astroparticle Physics (JCAP)
- Journal for High Energy Physics (JHEP)
- European Physical Journal C (EPJC)
- Journal of Open Source Software (JOSS)

Memberships

- Gambit community (since 2021)
- Svenska Fysikersamfundet (since 2021) incl. Kvinnor i fysik
- Deutsche Physikalische Gesellschaft (since 2007) incl. Working Group on Equal Opportunities (AKC)

Event organization

- 2019: Quantum Materials for Dark Matter Detection (QM4DM) (3-day workshop at Nordita)
- 2019: Bi-weekly QM4DM Journal Club
- 2017- 2018: Weekly CP³-Origins Journal Club

2010 **Research intern** German Aerospace Center, Köln, Germany
Department: Institute of Materials Physics in Space
Supervisor(s): Dr. Matthias Sperl

2008 - 2011 **Bachelor of Science** Georg August Universität, Göttingen, Germany
Thesis: *Static, axially symmetric Deformations of the Schwarzschild spacetime*
Department: Max Planck Institute for Dynamics and Self-Organization
Supervisor(s): Prof. Folkert Müller-Hoissen

TEACHING & SUPERVISION

Co-Supervisor

2020 – now	Einar Urdshals (PhD)	Chalmers
2020 – 2021	Jonas Frerick (Master)	RWTH Aachen
2020	Joakim Hagel (Master)	Chalmers
2020	Oskar Lindroos (Master)	Chalmers
2020	Bachelor Project	Chalmers

Substitute lecturer

Department for Physics, Chemistry and Pharmacy, Odense, Denmark

2017	Advanced Quantum Mechanics
2017	Introduction to Astrophysics and Cosmology

This involved independent preparation and holding of lectures in advanced theoretical physics over a few weeks.

Teaching assistant

Department for Physics, Chemistry and Pharmacy, Odense, Denmark

2017	Advanced Quantum Mechanics
2017	Introduction to Astrophysics and Cosmology
2017	Physics A
2016	Advanced Quantum Mechanics
2016	General Relativity and Cosmology

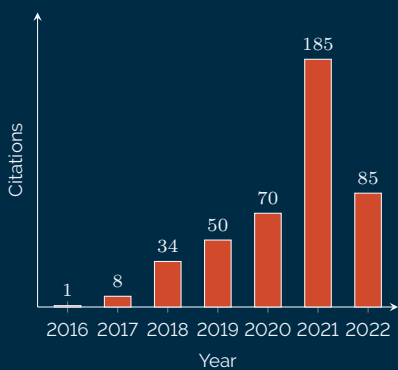
Faculty for Physics and Cosmology, Würzburg, Germany

2014	Theoretical Mechanics and Quantum Mechanics
------	---

Institute for Theoretical Physics, Göttingen, Germany

2013	Quantum Mechanics I
2012	Analytical Mechanics
2012	Mathematics for Physics I
2011	Analytical Mechanics
2011	Classical Electrodynamics

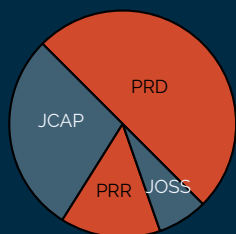
CITATIONS



(via Google Scholar, 04/22)

More citation statistics can be found on inSPIRE-HEP.

JOURNALS



OUTREACH

Social media outreach

Twitter account [↗](#) (>650 followers) dedicated to my work see e.g. this thread [↗](#).

Features in the media

Interviews & articles about my research, e.g. in [New Scientist](#) [↗](#).

Outreach article (2022)

"The dark side of the Sun" [↗](#) for department website of *Fysikum*.

Contributing author (2017)

Quantum Rascals web portal [Kvantebanditter](#) [↗](#)

Outreach article (2017)

"Detecting Dark Matter and Seeing the Invisible" [↗](#) for student newspaper *Hjerneblod*.

SCIENTIFIC PUBLICATIONS [\[inSPIRE-HEP profile ↗\]](#)

- [16] *A Next-Generation Liquid Xenon Observatory for Dark Matter and Neutrino Physics (White Paper)*
J. Aalbers et al. (incl. **Timon Emken**)
Submitted to New Journal of Physics. [\[arXiv:2203.02309\]](#)
- [15] *Skipper CCDs for the search of a daily modulation of Dark Matter signal in the DM-SQUARE experiment (TAUP2021 Conference proceedings)*
N. Ávalos, H. Arnaldi, I. Artola, X. Bertou, E. Estrada, M. Gómez Berisso, M. B. Lovino, M. Mantiñan, M. Sofo Haro, J. Tiffenberg, J. Estrada, T.-T. Yu, R. Essig, **Timon Emken**
Journal of Physics: Conference Series, 2156 (2021), 012074.
- [14] *Electron recoils from terrestrial upscattering of inelastic dark matter*
Timon Emken, Jonas Frerick, Saniya Heeba, Felix Kahlhoefer
Physical Review D, 105(05):055023, 2022. [\[arXiv:2112.06930\]](#)
- [13] *obscura: A modular C++ tool and library for the direct detection of (sub-GeV) dark matter via nuclear and electron recoils*
Timon Emken
Journal of Open Source Software, 6(68), 3725, 2021. [\[arXiv:2112.01489\]](#)
- [12] *Crystal responses to general dark matter-electron interactions*
Riccardo Catena, **Timon Emken**, Marek Matas, Nicola A. Spaldin, and Einar Urdshals
Physical Review Research, 3(3):033149, 2021. [\[arXiv:2105.02233\]](#)
- [11] *Solar reflection of light dark matter with heavy mediators*
Timon Emken
Physical Review D, 105(06):063020, 2022. [\[arXiv:2102.12483\]](#)
- [10] *Measuring the local Dark Matter density in the laboratory*
Bradley J. Kavanagh, **Timon Emken**, and Riccardo Catena
Physical Review D, 104(08):083023, 2021. [\[arXiv:2004.01621\]](#)
- [9] *Rejecting the Majorana nature of dark matter with electron scattering experiments*
Riccardo Catena, **Timon Emken**, and Julia Ravanis
Journal for Cosmology and Astroparticle Physics., 2020(06):056, 2020. [\[arXiv:2003.04039\]](#)
- [8] *Projected sensitivity to sub-GeV dark matter of next-generation semiconductor detectors*
Erik Andersson, Alex Bökmark, Riccardo Catena, **Timon Emken**, Henrik Klein Moberg, and Emil Åstrand.
Journal for Cosmology and Astroparticle Physics, 2020(05):036, 2020. [\[arXiv:2001.08910\]](#)
- [7] *Atomic responses to general dark matter- electron interactions*
Riccardo Catena, **Timon Emken**, Nicola Spaldin, and Walter Tarantino
Physical Review Research, 2:033195, 2020. [\[arXiv:1912.08204\]](#)
- [6] *Direct Detection of Strongly Interacting Sub-GeV Dark Matter via Electron Recoils*
Timon Emken, Rouven Essig, Chris Kouvaris, and Mukul Sholapurkar
Journal for Cosmology and Astroparticle Physics, 1909(09):070, 2019. [\[arXiv:1905.06348\]](#)
- [5] *How blind are underground and surface detectors to strongly interacting Dark Matter?*
Timon Emken and Chris Kouvaris
Physical Review D, 97(11):115047, 2018. [\[arXiv:1802.04764\]](#)
- [4] *The Sun as a sub-GeV Dark Matter Accelerator*
Timon Emken, Chris Kouvaris, and Niklas Grönlund Nielsen
Physical Review D, 97(6):063007, 2018. [\[arXiv:1709.06573\]](#)
- [3] *DaMaSCUS: The Impact of Underground Scatterings on Direct Detection of Light Dark Matter*
Timon Emken and Chris Kouvaris
Journal for Cosmology and Astroparticle Physics, 1710(10):031, 2017. [\[arXiv:1706.02249\]](#)

CODING & COMPUTING SKILLS

Programming languages

C++	5+ yrs
Mathematica	5+ yrs
LaTeX	5+ yrs
Python	3 yrs

Software development

- Version control (git & svn)
- Build systems (make & CMake)
- Continuous Integration (CI)
- High-performance computing
- Parallelization (MPI & openMP)

High performance computing

- 2022-now: Principal investigator of SNIC HPC project (SNIC 2022/22-38) 60000 core hrs on Tetralith.
- 2020-now: User of Vera, C3SE Göteborg, Sweden
- 2019-now: User of Tetralith, NSC Linköping, Sweden
- 2017-19: User of Abacus 2.0, DeiC National HPC Center, SDU, Odense, Denmark


[2] *Terrestrial effects on dark matter-electron scattering experiments*

Timon Emken, Chris Kouvaris, and Ian M. Shoemaker
Physical Review D, 96(1):015018, 2017. [[arXiv:1702.07750](#)]


[1] *Model independent limits on an ultralight gravitino from supernovae*

Riccardo Catena, Laura Covi, and **Timon Emken**
Physical Review D, 91:123524, 2015. [[arXiv:1410.0314](#)]

PUBLISHED RESEARCH SOFTWARE [\(Link to website ↗ \)](#)

(9) DarkART  (2021) – Dark Atomic Response Tabulator - C++ tool to supersede and improve the python tool DarkARC.


Timon Emken
[Code, v0.1.0], [DOI:10.5281/zenodo.6046224],

(8) obscura  (2021) – A C++ library for dark matter detection computations

Timon Emken
[Code, v1.0.0], [DOI:10.5281/zenodo.5665890],

(7) DaMaSCUS-SUN  (2021) – Dark Matter Simulation Code for Underground Scatterings - Sun edition

Timon Emken
[Code, v0.1.0], [DOI:10.5281/zenodo.4559874], [ascl:2102.018]

(6) libphysica  (2021) – Static C++ library collecting functions, variables, and classes for application in sci-entific codes

Timon Emken
[Code, v0.1.1], [DOI:10.5281/zenodo.4557118],

(5) comparXiv  (2020) – CLI tool to compare two versions of an arXiv preprint

Timon Emken
[Code, v0.1.8], ,

(4) Dirac-vs-Majorana  (2020) – Statistical discrimination of sub-GeV Majorana and Dirac dark matter


Timon Emken
[Code, v1.0], [DOI:10.5281/zenodo.3701262],

(3) DarkARC  (2019) – Dark Matter-induced Atomic Response Code

Timon Emken
[Code, v1.0], [DOI:10.5281/zenodo.3581334],

(2) DaMaSCUS-CRUST  (2018) – Dark Matter Simulation Code for Underground Scatterings - Crust edition

Timon Emken, Chris Kouvaris
[Code, v1.1], [DOI:10.5281/zenodo.2846401], [ascl:1803.001]

(1) DaMaSCUS  (2017) – Dark Matter Simulation Code for Underground Scatterings

Timon Emken, Chris Kouvaris
[Code, v1.1], [DOI:10.5281/zenodo.3726878], [ascl:1706.003]

CONFERENCE & SEMINAR TALKS [\[Link to website ↗ \]](#)

2021-10-29	Solar reflection of light dark matter	SOTU Seminar (Invited talk)	TIFR, Mumbai (remote)
2021-09-02	Solar reflection of sub-GeV dark matter	TAUP 2021	IFIC (remote)
2021-04-20	The particle accelerator in the Sky – Solar reflection of sub-GeV dark matter	Science seminar (Invited talk)	Lund University (remote)
2020-11-23	How atoms respond to general dark matter-electron interactions	Partikeldagarna 2020	(remote)
2020-01-15	Direct Detection of sub-GeV Dark Matter with General Electron Interactions	Theory Seminar, Chalmers	Göteborg, Sweden
2019-12-03	How atoms respond to general Dark Matter-electron interactions	QM4DM Workshop	Nordita, Stockholm, Sweden

LANGUAGE SKILLS

German	native
English	fluent
Danish	proficient
Swedish	basic

LEAVES

Parental leave

2020 - 2022: 6 months in total

REFERENCES

1. Prof. Riccardo Catena


 Chalmers University of Technology


 +46 3177 263 09

 catena@chalmers.se

2. Prof. Jan Conrad

 Stockholm University

 +46 8553 787 69

 conrad@fysik.su.se

3. Prof. Rouven Essig

 Stony Brook University

 +1 631 632 7990

 rouven.essig@stonybrook.edu

2019-10-31	Detecting low-mass Dark Matter after Scatterings in the Earth and Sun	LNGS Seminar (Invited talk)	INFN-LNGS L'Aquila, Italy
2019-10-30	How sensitive are direct detection experiments to strongly interacting light Dark Matter?	CRESST meeting (Invited talk)	Santo Stefano di Sessanio, Italy
2019-10-09	Direct Detection and Solar Reflection of sub-GeV Dark Matter	Theory Seminar (Invited talk)	University of Oslo, Norway
2019-10-02	Direct Detection of sub-GeV Dark Matter with strong Matter Interactions	Partikeldagarna 2019	Linköping, Sweden
2019-09-26	Direct Detection of sub-GeV Dark Matter with strong Matter Interactions	Seminar for Frank Wilczek's visit	Göteborg, Sweden
2019-09-18	How Scatterings affect the Dark Matter Velocity Distribution in the Laboratory	Autumn Institute 2019 (Invited talk)	INFN-LNF, Frascati, Italy
2019-08-12	Direct detection of sub-GeV dark matter with strong interactions through a light mediator	Light Dark World 2019 (Invited talk)	ESI, Vienna, Austria
2019-04-16	Detecting dark matter after scatterings inside the Earth or Sun	TSP seminar	Göteborg, Sweden
2019-02-28	Simulating Dark Matter in the Earth and the Sun	PhD defence	Odense, Denmark
2018-06-01	How sensitive are direct detection experiments to strongly interacting dark matter?	MASS2018	Odense, Denmark
2018-04-24	The Impact of Earth Scatterings on Light Dark Matter Detection	Theory Seminar	C.N. YITP, Stony Brook, USA
2017-08-29	Terrestrial Effects on Light Dark Matter Detection	DavCo 2017	Odense, Denmark
2016-07-14	Simulating Dark Matter Trajectories for Direct Detection Experiments	DTP 2016	ECT*, Trento, Italy
2013-11-28	Supergravity & Supernovae	GRK1147 seminar	Würzburg, Germany
2013-11-06	Gravitino Phenomenology with Supernovae	Cosmology seminar	Göttingen, Germany
2013-09-17	Gravitino Phenomenology with Supernovae	Theory Seminar	Würzburg, Germany
2013-07-08	Gravitino Phenomenology in Astrophysics	IMPRS Workshop	MPI, München, Germany

SCIENTIFIC WORKSHOPS

2019	Workshop	STRONG-DM	ESI, Vienna, Austria
2017	Workshop	Code Refinery	NelC, Aarhus, Denmark
2017	Winter school	9th Odense Winter School on Theoretical Physics	CP ³ -Origins, Odense, Denmark
2016	Summer school	Doctoral Training Program	ECT*, Trento, Italy
2014	Workshop	DESY Theory Workshop	DESY, Hamburg, Germany
2014	Workshop	Terascale C++ school	DESY, Hamburg, Germany
2013	Summer school	Summer school on particle physics	ICTP, Trieste, Italy
2013	Workshop	Computer Algebra in Particle Physics,	DESY, Zeuthen, Germany