

Zachary Picker

Curriculum Vitae

School of Physics, University of Sydney
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January, 2024

CV updated regularly at zacpicker.com

Academic history

2022–

Postdoctoral scholar, *University of California, Los Angeles, USA*, Theory of Elementary Particles and AstroParticle Physics (TEPAPP).

Advisors: Alexander Kusenko and Graciela Gelmini

Education

2022

Ph.D., *The University of Sydney, Australia*.

Supervisors: Prof. Archil Kobakhidze, Prof. Celine Boehm,

Thesis: The gravity of particle physics: dark matter, black holes, and axions

Education: as well as regular coursework, participated in pedagogical journal clubs on advanced astrophysics and particle physics topics such as the path-integral formalism, cosmology, neutrino physics, Non-Abelian QFT, topology and group theory, etc.

2019

Bachelor of Science (Honours), *The University of Sydney, Australia*.

First Class Honours (mark: 91%, ~top 5 in physics)

Supervisor: Archil Kobakhidze

Thesis: Gravitational waveforms with higher curvature corrections

Prizes and awards: John Coutts Prize (~top 3 in science faculty of ~2000), Julius Sumner Miller Prize, Walter Burfitt Scholarship, Physics Foundation Scholarship, Dean's List, Academic Merit Prize, Science Scholarship

2015

Papers

My research interests lie in the intersection of fundamental theory with astro-particle phenomenology, focusing in particular on black holes, dark matter, gravity, and axions. (Most) author lists are in alphabetical order.

2023

Feeding plankton to whales: high-redshift supermassive black holes from tiny black hole explosions, *Y. Lu, Z. S. C. Picker, A. Kusenko*.

arXiv:2312.15062 [astro-ph.GA]

2023

Explaining the GeV excess with exploding black holes, *Z. S. C. Picker, A. Kusenko*.

arXiv:2305.13434 [astro-ph.HE], DOI: <https://doi.org/10.1016/j.physletb.2023.138175>, Phys.Lett.B 845 (2023)

2023

Constraints on late-forming exploding black holes, *Z. S. C. Picker, A. Kusenko*.

arXiv:2305.13429 [astro-ph.CO], DOI: 10.1103/PhysRevD.108.023012, Phys.Rev.D 108 (2023) 2, 2

2022

Effects of Hawking evaporation on PBH distributions, *M. Mosbech, Z. S. C. Picker*.

arXiv:2203.05743 [astro-ph.HE], DOI: 10.21468/SciPostPhys.13.4.100, SciPost Phys. 13 (2022), 100

2022

Apparent horizons of the Thakurta spacetime and the description of cosmological black holes, *A. Kobakhidze, Z. S. C. Picker*.

arXiv:2112.13921 [gr-qc], DOI: 10.1140/epjc/s10052-022-10312-1, Eur.Phys.J.C 82 (2022) 4, 347

2021

Cosmology of the companion-axion model: dark matter, gravitational waves, and primordial black holes, *Z. Chen, A. Kobakhidze, C. A. J. O'hare, Z. S. C. Picker, G. Pierobon*.

arXiv:2110.11014 [hep-ph]

- 2021 **Phenomenology of the companion-axion model: photon couplings**, Z. Chen, A. Kobakhidze, C. A. J. O'hare, Z. S. C. Picker, G. Pierobon.
arXiv:2109.12920 [hep-ph], DOI: 10.1140/epjc/s10052-022-10909-6, Eur.Phys.J.C 82 (2022) 10, 940
- 2021 **Comment on: Cosmological black holes are not described by the Thakurta metric**, C. Boehm, A. Kobakhidze, C. A. J. O'hare, Z. S. C. Picker, M. Sakellariadou, 2021.
arXiv:2105.14908 [astro-ph.CO]
- 2021 **Navigating the asteroid field: New evaporation constraints for primordial black holes as dark matter**, Z. S. C. Picker.
arXiv:2103.02815 [astro-ph.CO]
- 2021 **Eliminating the LIGO bounds on primordial black hole dark matter**, C. Boehm, A. Kobakhidze, C. A. J. O'hare, Z. S. C. Picker, M. Sakellariadou.
arXiv:2008.10743 [astro-ph.CO], DOI: 10.1088/1475-7516/2021/03/078
JCAP 03 (2021), 078
- 2021 **Probing Quadratic Gravity with Binary Inspirals**, Y. Kim, A. Kobakhidze, Z. S. C. Picker.
arXiv:1906.12034 [gr-qc], DOI: 10.1140/epjc/s10052-021-09138-0
Eur.Phys.J.C 81 (2021) 4, 362

Talks and Presentations

More slides and recordings can be found at zacpicker.com/physics.

Invited Talks

- 2023 **Australian Institute of Physics Summer Meeting**, *Australia National University*, 25 mins.
'2Blast2Sagittarius: Exploding black holes in the galactic center'
- 2023 **Santa Cruz Center for Particle Physics Seminars**, *University of California, Santa Cruz*, 60 mins.
'The art of making black holes'
- 2023 **Sydney Consortium for Particle Physics and Cosmology Seminar Series**, *University of Sydney*, 50 mins.
'Late-forming primordial black holes'
- 2021 **Second Centre Annual Workshop**, *ARC Centre of Excellence for Dark Matter Particle Physics*, 20 mins.
'Saving the axion from gravity: the "companion axion" and its phenomenology'
- 2021 **Sydney Consortium for Particle Physics and Cosmology Seminar Series**, *University of Sydney*, 30 mins.
'Probing the universe at the intersection of gravity and particle physics'
- 2021 **Dark Matter Lecture Series**, *ARC Centre of Excellence for Dark Matter Particle Physics*, 50 mins.
'The Strong CP Problem'
- 2021 **School of Physics Colloquium**, *University of Sydney*, 25 mins.
'Black holes as dark matter in the early universe'
- 2021 **Sydney Consortium for Particle Physics and Cosmology Seminar Series**, *University of Sydney*, 50 mins.
'Cosmological PBHs as Dark Matter'

Other Presentations

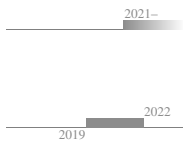
- 2023 **New Horizons in Primordial Black Holes**, *University of Naples Federico II, INFN, University of Durham*, 20 mins.
'Should we care about cosmological black holes?'

2021	Dark Sectors of AstroParticle Physics 2021 , <i>Kavli IPMU, University of Tokyo</i> , 20 mins. 'The Companion Axion'
2021	Australian Institute of Physics Summer Meeting 2021 , <i>Brisbane</i> , 15 mins. 'Cosmological black holes as dark matter'
2021	AAPPS-DACG Workshop 2021 on Astrophysics, Cosmology and Gravitation , <i>Pohang University of Science and Technology</i> , 15 mins. 'The Companion Axion'
2021	Asia-Pacific Workshop on Particle Physics and Cosmology , <i>Yonsei University</i> , 15 mins. 'Cosmological PBHs as Dark Matter'
2021	Second European Physical Society Conference on Gravitation , <i>King's College London</i> , 10 mins. 'Probing Quadratic Gravity with Binary Inspirals'
2021	Interconnections Between Particle Physics and Cosmology XIV , <i>University of Oklahoma</i> , 15 mins. 'Cosmological PBHs as Dark Matter'
2021	Sydney CPPC 3rd meeting , <i>University of New South Wales</i> , 15 mins. 'Dunking PBHs in Cosmological Baths: Prank Gone Wrong!'
2020	Less Travelled Paths of Dark Matter , <i>International Centre for Theoretical Sciences</i> , 15 mins. 'Eliminating the LIGO Bounds on Primordial Black Hole Dark Matter'
2020	Sydney CPPC 2nd meeting , <i>University of Sydney</i> , 15 mins. 'Microlensing: MACHOs and Modified Gravity'
2019	Cracow School of Theoretical Physics , <i>Jagiellonian University</i> , 15 mins. 'Probing Quadratic Gravity with Binary Inspirals'

Outreach and Other Content

2022	University of Sydney Physics Society , <i>University of Sydney</i> , 50 mins. 'The theory of theory: a theoretical guide to writing your own theoretical physics paper (special 'black holes as dark matter' worked solutions included)'
2022	Dark Chatter , <i>Episode 10</i> , 50 mins, Interviewer. 'Primordial black holes in theories with extra dimensions'
2021	Cosmological Black Holes , <i>poster</i> . Black Holes Inside and Out, 2021 Second Centre Annual Workshop, ARC Centre of Excellence for Dark Matter Particle Physics, 2021 Dark Sectors of AstroParticle Physics 2021
2021	Dark Chatter , <i>Episode 9</i> , 30 mins, Interviewer. 'Simulating axion-like particles'
2021	Dark Chatter , <i>Episode 6</i> , 30 mins, Interviewer. 'Muon anomalies'
2020	Dark Chatter , <i>Episode 3</i> , 30 mins, Interviewer. 'Massive neutrinos in N-body simulations'
2020	Dark Chatter , <i>Episode 1</i> , 30 mins, Interviewee. 'Primordial black holes'
2019	Tibeas , <i>Guest, Youtube video</i> . 'Physics students react to 1888 exam'
	Virtual School of Physics . Recreation of the entire School of Physics at the University of Sydney in the Gather-Town virtual conferencing program.

Teaching and Academic Duties



Referee.

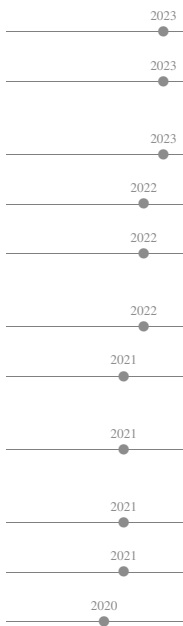
Physical Review D (PRD)
European Physical Journal C (EPJ C)

University Tutor, *The University of Sydney*, Australia.

Quantum mechanics, 3rd year course
Astronomy modules, 1st-3rd year courses: 'Earth to exoplanets', 'Stars to black holes', 'Big bang to darkness'
High Energy Physics, 3rd year course
Special Relativity and Cosmology, 2nd year course
Dalyell Showcase, 1st year course (project supervision)
Apocalypses in Science and Culture, 1st-3rd year course

Other Work

Published writing



'What happened to all their stuff', *Grain*, Volume 50.5.

'Very-Smart Lyrics: Crazy Paving by Ruthorford Bee Haze', *Exposition Review*, Volume VIII.

'RollerCoaster Tycoon and the art of niche hobbies', *Overland*.

'Clippings', *Going Down Swinging*.

'Besamim', *Soft Stir*, Issue 2.

'All prayers flow to the stormdrain', ambient album with narration, in collaboration with Ayala

'Interiors', *Island*.

'Fifteen', *Verge Gallery*.

Winner, USU Creative Awards 2021

'Good and Nowhere', *Honi Soit*.

Winner, Honi Soit writing competition 2021

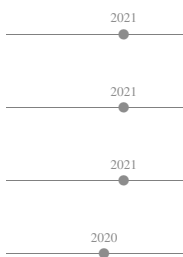
'Score for ordinary washing machines', *Aniko Pres*, Issue 2.

'Small and slippery and semi-transparent', *Curieuse*, Issue 1.

'Rhoticity /r/', *Going Down Swinging*.

Winner, Swinburne microfiction contest 2020

Audiovisual artwork



Starlings.

Real-time starling flocking simulation. Interacts with sound as an audiovisual art installation

Drifting 11-09-21.

Randomized 'Drifting' render for Ayala

Concrete Dreams, Mothership Studios.

'Drifting', live-generated audiovisual installation accompanying live music and fiction narration

'One' single launch, Ayala's Cleveland Street Studio.

'Substrate', generative audiovisual program incorporating live audio input and Markov text creation

Et Cetera

Machine learning and generative text projects in Python.

'Folk-Bot', generates folk songs with playable chord structures. Also 'Prophecy-Bot', uses GPT2 to simulate funny biblical prophecies to publish on [twitter](#)

Theme park design.

Rollercoaster Tycoon world champion and parkmaker of the year 2019, Spotlight 2021, other achievements

Music.

Guitar, banjo, kazoo,...

Scuba diving.

Advanced open water certification

Citizenships.

USA, Australia, UK

Date of birth.

January 2, 1995

References

Prof. Alexander Kusenko, *University of California Los Angeles*.

kusenko@g.ucla.edu

Prof. Graciela Gelmini, *University of California Los Angeles*.

gelmini@physics.ucla.edu

Prof. Celine Boehm, *University of Sydney*.

celine.boehm@sydney.edu.au

Prof. Archil Kobakhidze, *University of Sydney*.

archil.kobakhidze@sydney.edu.au