

# Zachary Picker

## Curriculum Vitae

School of Physics, University of Sydney  
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April, 2024

CV updated regularly at [zacpicker.com](http://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. (Some) author lists are in alphabetical order.

2024

**Direct collapse supermassive black holes from relic particle decay**, *Y. Lu, Z. S. C. Picker, A. Kusenko*.

arXiv:2404.03909 [astro-ph.GA]

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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://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

- 2024 ● **Black Holes and Cosmology**, *University of Nassau*, 12 mins.  
'Feeding plankton to whales'
- 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**, *Kavli IPMU, University of Tokyo*, 20 mins.  
'The Companion Axion'
- 2021 ● **Australian Institute of Physics Summer Meeting 2021**, *Brisbane*, 15 mins.  
'Cosmological black holes as dark matter'
- 2021 ● **AAPPS-DACG Workshop 2021 on Astrophysics, Cosmology and Gravitation**, *Pohang University of Science and Technology*, 15 mins.  
'The Companion Axion'
- 2021 ● **Asia-Pacific Workshop on Particle Physics and Cosmology**, *Yonsei University*, 15 mins.  
'Cosmological PBHs as Dark Matter'
- 2021 ● **Second European Physical Society Conference on Gravitation**, *King's College London*, 10 mins.  
'Probing Quadratic Gravity with Binary Inspirals'
- 2021 ● **Interconnections Between Particle Physics and Cosmology XIV**, *University of Oklahoma*, 15 mins.  
'Cosmological PBHs as Dark Matter'
- 2021 ● **Sydney CPPC 3rd meeting**, *University of New South Wales*, 15 mins.  
'Dunking PBHs in Cosmological Baths: Prank Gone Wrong!'
- 2020 ● **Less Travelled Paths of Dark Matter**, *International Centre for Theoretical Sciences*, 15 mins.  
'Eliminating the LIGO Bounds on Primordial Black Hole Dark Matter'
- 2020 ● **Sydney CPPC 2nd meeting**, *University of Sydney*, 15 mins.  
'Microlensing: MACHOs and Modified Gravity'
- 2019 ● **Cracow School of Theoretical Physics**, *Jagiellonian University*, 15 mins.  
'Probing Quadratic Gravity with Binary Inspirals'

## Outreach and Other Content

- 2022 ● **University of Sydney Physics Society**, *University of Sydney*, 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**, *Episode 10*, 50 mins, Interviewer.  
'Primordial black holes in theories with extra dimensions'
- 2021 ● **Cosmological Black Holes**, *poster*.  
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**, *Episode 9*, 30 mins, Interviewer.  
'Simulating axion-like particles'
- 2021 ● **Dark Chatter**, *Episode 6*, 30 mins, Interviewer.  
'Muon anomalies'
- 2020 ● **Dark Chatter**, *Episode 3*, 30 mins, Interviewer.  
'Massive neutrinos in N-body simulations'
- 2020 ● **Dark Chatter**, *Episode 1*, 30 mins, Interviewee.  
'Primordial black holes'

2019

**Tibeas, Guest, Youtube video.**

'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

2021–

**Referee.**

Physical Review D (PRD)

European Physical Journal C (EPJ C)

2022  
2019

**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

2023

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

2023

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

2023

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

2022

**'Clippings', Going Down Swinging.**

2022

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

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

2022

**'Interiors', Island.**

2021

**'Fifteen', Verge Gallery .**

Winner, USU Creative Awards 2021

2021

**'Good and Nowhere', Honi Soit.**

Winner, Honi Soit writing competition 2021

2021

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

2021

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

2020

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

Winner, Swinburne microfiction contest 2020

### Audiovisual artwork

2021

**Starlings.**

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

2021

**Drifting 11-09-21.**

Randomized 'Drifting' render for Ayala

2021

**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