

# Gonzalo Herrera

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## RESEARCH INTERESTS

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**Dark matter, neutrinos**, astroparticle physics, cosmology, statistical methods, fine-tuning.

## EDUCATION/EMPLOYMENT

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**10.2023-Present**    **Postdoctoral Associate: Virginia Tech Center for Neutrino Physics**  
**07.2024-08.2024**    **Visitor: CERN**  
**12.2020-09.2023**    **PhD: Technical University of Munich / Max-Planck Institute for Physics**  
Thesis: [Particle attenuation within dark matter spikes](#)  
Advisor: Alejandro Ibarra  
10.2018 - 10.2020    MSc: Technical University of Munich / Max-Planck Institute for Physics  
Thesis: Halo-independent interpretation of dark matter searches with CRESST  
**Award: Best Master Thesis of the Collaborative Research Center “Neutrinos and Dark Matter in Astro- and Particle Physics” (SFB 1258)**  
2014-2018    BSc (Physics): Complutense University of Madrid / Technical University of Munich  
2017-Present    BScs (Mathematics, Philosophy): National University of Distance Education  
2021-Present    Schools: [Cargese 2022](#), [Les Houches Dark Matter 2021](#)  
Coding: Python, Mathematica, CalcHep, FeynCalc, CVXPY, DDCalc, DarkELF, ...  
Languages: Spanish (native), English (fluent) and German (B2, Goethe Institute)

## RECENT SEMINARS AND TALKS

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03/2024    **KICP seminar, U. Chicago**  
*Boosted dark matter and attenuated cosmic rays around black holes*  
02/2024    **CPC seminar, Fermilab**  
*Scatterings of dark matter and relic neutrinos off cosmic rays near supermassive black holes*  
03/2024    **LPPC Seminar, Harvard**  
*Scatterings of dark matter and relic neutrinos off cosmic rays near black holes*  
05/2024    **CCAPP Astroparticle Lunch, Ohio State University**  
*Probing light dark matter and the cosmic neutrino background with cosmic rays*  
07/2024    **Theory Cosmo Coffee Seminar, CERN**  
*Probing light dark matter and the cosmic neutrino background with cosmic rays*  
04/2024    **YITP Seminar, Stony Brook**  
*A neutrino floor for the Migdal effect*  
04/2024    **GAPP Seminar, Penn State University**  
*Light dark matter detection: from the laboratory to the vicinity of supermassive black holes*  
09/2024    **CNP Seminar, Virginia Tech**  
*Learning new physics through neutrino observations: from the laboratory to high redshifts*  
04/2024    **DM+nu forum, Tsung Dao Lee Institute**  
*Particle attenuation within dark matter spikes*  
03/2024    **Particle Physics-Astrophysics-Cosmology Seminar, Nanjing Normal University**  
*A neutrino floor for the Migdal effect*  
09/2024    **Invited talk at NuFact, Argonne National Laboratory**  
*Probing new physics from neutrinos at dark matter direct detection experiments*  
10/2024    **Invited talk at BLV, Karlsruhe Institute for Technology**  
*Direct detection of light dark matter*  
04/2024    **Invited talk at workshop on neutrino and science applications at HFIR**  
*Migdal effect*  
05/2024    **Parallel talk at PHENO workshop, U. Pittsburgh**  
*A neutrino floor for the Migdal effect*

# PUBLICATIONS

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## Published papers

1. *Probing light dark matter through cosmic ray cooling in active galactic nuclei.* Gonzalo Herrera and Kohta Murase, [Phys.Rev.D 110 \(2024\) 1, L011701](#)
2. *A neutrino floor for the Migdal effect.* Gonzalo Herrera, [JHEP 05 \(2024\) 288](#)
3. *Upper limits on the cosmic neutrino background from cosmic rays.* Mar Císcar-Monsalvatje, Gonzalo Herrera and Ian M. Shoemaker [Phys.Rev.D 110 \(2024\) 6, 063036](#)
4. *Tidal disruption events and dark matter scatterings with neutrinos and photons.* Motoko Fujiwara and Gonzalo Herrera, [Phys.Lett.B 851 \(2024\) 138573](#)
5. *New constraints on the dark matter-neutrino and dark matter-photon scattering cross sections from TXS 0506+056.* Francesc Ferrer, Gonzalo Herrera and Alejandro Ibarra, [JCAP 05 \(2023\) 057](#)
6. *Enhanced prospects for direct detection of inelastic dark matter from a non-galactic diffuse component.* Gonzalo Herrera, Alejandro Ibarra and Satoshi Shirai [JCAP 04 \(2023\) 026](#)
7. *Direct detection of non-galactic light dark matter.* Gonzalo Herrera and Alejandro Ibarra, [Phys.Lett.B 820 \(2021\) 136551](#)
8. *Complementarity of experiments in probing the non-relativistic effective theory of dark matter-nucleon interactions.* Anja Brenner, Gonzalo Herrera, Alejandro Ibarra, Sunghyun Kang, Stefano Scopel and Gaurav Tomar, [JCAP 06 \(2022\) 06, 026](#)
9. *Direct detection of light dark matter charged under a  $L_\mu - L_\tau$  symmetry.* Pablo Figueroa, Gonzalo Herrera and Fredy Ochoa, [Phys.Rev.D 110 \(2024\) 9, 095018](#)

## Papers available on arXiv, still in publication process:

10. *Diffuse boosted cosmic neutrino background.* Gonzalo Herrera, Shunsaku Horiuchi and Xiaolin Qi, [2405.14946](#)
11. *Plausible constraints and inflationary production of dark photons.* James M. Cline and Gonzalo Herrera, [2409.13818](#)
12. *Anapole moment of neutrinos and radioactive sources near liquid xenon detectors.* Gonzalo Herrera and Patrick Huber, [2408.11904](#)
13. *Cosmic-ray cooling in active galactic nuclei as a new probe of inelastic dark matter.* R. Andrew Gustafson, Gonzalo Herrera, Mainak Mukhopadhyay, Kohta Murase and Ian M. Shoemaker, [2408.08947](#)
14. *Clarity through the Neutrino Fog: Constraining New Forces in Dark Matter Detectors.* Pablo-Blanco Mas, Pilar Coloma, Gonzalo Herrera, Patrick Huber, Joachim Kopp, Ian M. Shoemaker and Zahra Tabrizi, [2411.14206](#)
15. *Precise interpretations of traditional fine-tuning measures.* Andrew Fowlie and Gonzalo Herrera, [2408.08947](#)
16. *Information divergences to parametrize astrophysical uncertainties in dark matter direct detection.* Gonzalo Herrera and Andreas Rappelt, [2403.04959](#)
17. *Polarization measurements as a probe of axion-photon coupling: a study of GRB 221009A.* Boris Bètan-court Kamenetskaia, Nissim Fraija, Gonzalo Herrera, [2408.07352](#)
18. *Dark neutrino moments from light loops.* Gonzalo Herrera and Ian M. Shoemaker, [2406.08663](#)

## Proceedings and white papers:

19. *Implications of non-galactic dark matter for sub-GeV direct detection searches.* Gonzalo Herrera and Alejandro Ibarra, [J.Phys.Conf.Ser. 2156 \(2021\) 012040](#), [PoS EPS-HEP2021 \(2022\) 161](#)
20. *Impact of operator interference in dark matter direct detection experiments.* Anja Brenner, Gonzalo Herrera, Alejandro Ibarra, Sunghyun Kang, Stefano Scopel and Gaurav Tomar, [J.Phys.Conf.Ser. 2156 \(2021\) 1, 012069](#), [PoS EPS-HEP2021 \(2022\) 061](#)
21. *Snowmass2021 Cosmic Frontier: The landscape of low-threshold dark matter direct detection in the next decade,* [2203.08297](#)

## TEACHING AND SUPERVISION EXPERIENCE

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### Virginia Tech

11.2023-11.2023 **Quantum Mechanics**  
Substitute teacher in one main lecture

### Technical University of Munich

10.2020-03.2021 **Quantum Mechanics II**  
Tutorials 2 hours per week, plus weekly students exercises and exam grading.  
03.2021-10.2021 **Relativity, particles and fields**  
Tutorials 2 hours per week, plus weekly exercises and exam preparation and grading.  
10.2021-03.2022 **Nuclear, particle and astrophysics I**  
Tutorials 2 hours per week, plus exam preparation and grading.  
10.2021-03.2022 **Weakly interacting particles**  
Exam grading.  
03.2022-10.2022 **Astroparticle Physics II**  
Tutorials 2 hours per week.  
03.2022-03.2023 **Co-supervision of a Master Thesis**  
Yu Chen, "*Direct detection of cosmic-ray boosted dark matter*"

### National University of Colombia

03.2021-03.2022 **Co-supervision of a Bachelor Thesis**  
Pablo Figueroa, "*Direct detection of light dark matter under a minimal  $U(1)$  extension of the Standard Model*"

## OTHER PROFESSIONAL ACTIVITIES

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06.2024-Present Referee of various journals: Physical Review, Journal of Cosmology and Astroparticle Physics and European Physics Journal  
01.2023-Present Organisation and invitation of speakers for the CNP seminar at Virginia Tech  
03.2022-Present Journal Club organiser of t30d research group at TUM and the Center of Neutrino Physics at Virginia Tech  
10.2018-10.2020 Contributor to the software package DDCalc (GAMBIT).  
10.2018-03.2019 Working Student at the CRESST Dark Matter Experiment.  
03.2019-10.2020 Night Job at Augustinum Centrum. Care of autistic adults.

## REFERENCES

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### Ian M. Shoemaker

Associate professor  
Virginia Tech  
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### Patrick Huber

Professor  
Virginia Tech  
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### Shunsaku Horiuchi

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### Kohta Murase

Professor  
Penn State University  
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