

Woosik Kang

PH.D. IN PHYSICS · SUNGKYUNKWAN UNIVERSITY

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Research Interests

Neutrino Astronomy and Astrophysics, Multi-messenger Astronomy and Astrophysics, Dark Matter and BSM Physics, Detector Calibration, Detector Hardware

Appointment

Graduate Research Assistant

DEPARTMENT OF PHYSICS, SUNGKYUNKWAN UNIVERSITY

September 2016 - February 2025

Graduate Teaching Assistant

DEPARTMENT OF PHYSICS, SUNGKYUNKWAN UNIVERSITY

September 2016 - August 2021

Undergraduate Research Assistant

DEPARTMENT OF PHYSICS, SUNGKYUNKWAN UNIVERSITY

January 2014 - August 2016

Education

Sungkyunkwan University

DOCTOR OF PHILOSOPHY, PHYSICS

Suwon, Rep. of Korea

September 2016 - February 2025

Sungkyunkwan University

BACHELOR OF SCIENCE, PHYSICS

Suwon, Rep. of Korea

March 2011 - August 2016

Professional Experience

BSM Physics Analysis

ICECUBE NEUTRINO OBSERVATORY (AS A MEMBER OF THE ICECUBE COLLABORATION)

2022 - Present

- Searching for interactions of Dark Matter with high-energy neutrinos from extragalactic astrophysical sources, a first dedicated experimental analysis.
- Design and development of the analysis framework.
- Analysis with two known astrophysical sources, TXS 0506+056 and NGC 1068.

Simulation Studies

ICECUBE NEUTRINO OBSERVATORY (AS A MEMBER OF THE ICECUBE COLLABORATION)

2014 - 2022

- Swedish Camera image analysis with GEANT4 simulations.
- Development of the 'CamSim - Camera Simulation framework' for the Antarctic ice property studies and the IceCube detector calibration.
- Preliminary simulation studies with the 'CamSim' for the Antarctic ice property studies and the IceCube detector calibration.

Calibration Hardware for IceCube Upgrade

ICECUBE NEUTRINO OBSERVATORY (AS A MEMBER OF THE ICECUBE COLLABORATION)

2014 - 2022

- Development of the 'IceCube Upgrade Camera System.'
- Mass production of the 'IceCube Upgrade Camera System.'
- Development of the in-lab Camera Acceptance Tests (CAT) procedure and the testing setup of the 'IceCube Upgrade Camera System.'
- In-lab Camera Acceptance Tests (CAT) of the 'IceCube Upgrade Camera System.'

Detector Simulation

COSINE-100 (AS A MEMBER OF THE COSINE-100 COLLABORATION)

2016-2017

- Verifying the detector design in GEANT4 simulations.
- Simulation studies on the backgrounds of the COSINE-100 detector with GEANT4.

Detector Construction

COSINE-100 (AS A MEMBER OF THE COSINE-100 COLLABORATION)

2015-2016

- Involvement in the COSINE-100 detector construction.

Academic Honours & Fellowships

2024	Outstanding Presentation Award in 2024 KPS Fall Meeting , Korean Physical Society	
	Outstanding Presentation Award in 2024 KPS Fall Meeting , Korean Physical Society	
2023	Outstanding Presentation Award in 2023 KPS Fall Meeting , Korean Physical Society	
	Outstanding Presentation Award in 2023 KPS Fall Meeting , Korean Physical Society	
2016	Outstanding Presentation Award in 2016 KPS Fall Meeting , Korean Physical Society	
	Overseas Training Grant for Undergraduates: RWTH Aachen (Germany) and IDM2016 (England) , Department of Physics, Sungkyunkwan University	3 weeks
2015	Overseas Training Grant for Undergraduates: Chiba University, University of Tokyo, and Kamioka Observatory - ICRR (Japan) , Department of Physics, Sungkyunkwan University	4 weeks

Teaching Experience

Spring 2021	Quantum Mechanics 2 for Graduates (PHY5001) , Teaching Assistant; Responsible for writing homework solutions, and grading assignments.
Spring 2020	Quantum Mechanics 2 for Graduates (PHY5001) , Teaching Assistant; Responsible for writing homework solutions, and grading assignments.
Spring 2019	Particle Physics 1 (PHY5152) , Teaching Assistant; Responsible for writing homework solutions, and grading assignments.
Autumn 2018	Quantum Mechanics 1 for Graduates (PHY7002) , Teaching Assistant; Responsible for writing homework solutions, and grading assignments.
Spring 2018	General Mechanics 1 (PHY2001) , Teaching Assistant; Responsible for conducting tutorials, writing homework solutions, and grading assignments.
Autumn 2017	Quantum Optics (PHY3005) , Teaching Assistant; Responsible for writing homework solutions, and grading assignments.
Spring 2017	General Physics Experiment 1 (GEDB009) , Teaching Assistant; Supervising laboratory experiments, and grading reports.

Seminar in Physics 1 (PHY4011), Teaching Assistant; Responsible for organising seminars, and grading assignments.

Autumn 2016

Special Topics in Physics 2: Recent Discoveries in Particle and Astroparticle Physics (PHY4015), Teaching Assistant; Responsible for organising seminars, and grading assignments.

Mentorship

Kim, Youngmin

Ajou University

SUMMER VISITING STUDENT, UNDERGRADUATE.

2024

Detector geometry measurement with IceCube Upgrade Camera System through camera simulation studies.

Park, Minje

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2023-present

Ice property measurements with IceCube Upgrade Camera System through camera simulation studies with ML. This work resulted in a contribution to the 2024 KPS Fall Meeting as an undergraduate contribution that was awarded an outstanding poster presentation award.

Kim, Yoonyoung

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2023-present

Characterising long exposure images of IceCube Upgrade Camera System through ML. This work became her undergraduate thesis topic.

Seo, Minyeong

Sungkyunkwan University

GRADUATE RESEARCH ASSISTANT.

2022-present

Admitted into the graduate school of SKKU. Detector geometry measurement with IceCube Upgrade Camera System through camera simulation studies and Bayesian inference. This work became her master thesis topic.

Choi, Seowon

Sungkyunkwan University

GRADUATE RESEARCH ASSISTANT.

2022-2024

Admitted into the graduate school of SKKU. Developed and managed the testing of mass-produced IceCube Upgrade Camera System modules after integrated in the new optical sensors for the IceCube Upgrade. This work became his master thesis topic.

Oh, Yubin

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2022-2024

Optimising configurations of a novel camera system for next-generation neutrino telescope. This work became her undergraduate thesis topic.

Shin, Minji

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2022-2024

Local ice property measurement with IceCube Upgrade Camera System through camera simulation studies. This work became her undergraduate thesis topic.

Kwon, Oseong

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2021-2023

Hardware testing for IceCube Upgrade Camera System. Ice property measurements with IceCube Upgrade Camera System through camera simulation studies.

Seo, Minyeong

University of Ulsan

SUMMER VISITING STUDENT, UNDERGRADUATE.

2021

Hardware testing for IceCube Upgrade Camera System. Ice property measurements with IceCube Upgrade Camera System through camera simulation studies.

Choi, Seowon

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2021-2022

Hardware testing for IceCube Upgrade Camera System. Characterising the noise behaviours of IceCube Upgrade Camera System. This work became his undergraduate thesis topic.

Lee, Jiwoong

Sungkyunkwan University

GRADUATE RESEARCH ASSISTANT.

2020-2023

Hardware testing for IceCube Upgrade Camera System. Bulk ice property measurement with IceCube Upgrade Camera System through camera simulation studies.

Kim, Danim

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2020-2021

Local ice property measurement with SPICEcore Camera System through camera simulation studies. This work became his undergraduate thesis topic.

Kim, Sangyeon

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2017-2018

Sensitivity study for various image sensors through lab measurements and camera simulation studies. This work became his undergraduate thesis topic.

Choi, Seokmin

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2017-2018

Developing scripts for camera tests for the IceCube Upgrade Camera System. Measuring noise characteristics of image sensors. This work became his undergraduate thesis topic.

Kim, Daehwan

Sungkyunkwan University

UNDERGRADUATE RESEARCH ASSISTANT.

2017-2018

Measuring seasonal variation of Radon concentration in Yangyang underground laboratory (Y2L) for COSINE-100 experiment. This work became his undergraduate thesis topic.

Outreach & Professional Development

OUTREACH

- 2024 **Lecture of University of Utah: 'Faculty Research Overview (PHY7820)'**, Public seminar talk on 'Neutrino Astronomy: A New Window into the Extreme Universe' along with Prof. *Carsten Rott* and Prof. *Shiqi Yu*.
- 2023 **Lecture of Sungkyunkwan University: 'Frontiers in High-energy Astrophysics (PHY4026)'**, Public seminar talk on 'IceCube Neutrino Observatory - Recent discoveries and activities in Korea.' at Prof. *Chang Dong Rho's* lecture.
- 2022-2023 **Annual SKKU Physics Student Workshops (Time-Leap)**, Talks for introduction to Prof. Carsten Rott's group and the IceCube Neutrino Observatory.
- 2021 **Special Exhibition at Hanyang University Museum: 'The Cosmonut: from Science to Art'**, Docent talk for an introduction to IceCube Neutrino Observatory and IceCube-Upgrade at the opening ceremony, Involved in preparing the exhibition with curators.
- 2020 **IceCube comic books: 'Adventures with Rosie & Gibbs: the lost penguins'**, Translation to Korean.

DEVELOPMENT

- 2024 **The 2nd K-IceCube Workshop**, Meeting organiser.
- 2024 **SKKU High-Energy Nuclear-Astro-Particle (NAP) Physics Groups Monthly Meeting**, Made the first proposal, Chair of the meeting organising committee.

- 2022 **23rd International Workshop on Neutrinos from Accelerators (NuFACT 2022)**, Session helper.
- 2016 **Workshop for Beyond the Standard Model with Neutrino Detectors (BSMND 2016)**, Scientific secretary, Workshop website developer and maintainer.

SERVICE

- 2015-Present **Prof. Carsten Rott's group**, Group website/server developer and maintainer.
- 2019-2022 **Rep. of Korea Army**, Alternative Military Service Personnel as a Science Research Specialist.
(Completed basic military training with the commendation of being the company's top marksman.)

PROFESSIONAL MEMBERSHIPS

- 2016-Present **Korean Physical Society**, Student Member.
- 2022 **American Astronomical Society**, Student Member.

References

- Rott, Carsten** *Associate Professor of Physics, Sungkyunkwan University*
ROTT@PHYSICS.UTAH.EDU *Professor and Department Chair of Physics & Astronomy, University of Utah*
- Ha, Chang Hyon** *Associate Professor of Physics, Chung-Ang University*
CHHA@CAU.AC.KR
- Rho, Chang Dong** *Assistant Professor of Physics, Sungkyunkwan University*
CDR397@SKKU.EDU
- Argüelles-Delgado, Carlos** *Assistant Professor of Physics, Harvard University*
CARGUELLES@FAS.HARVARD.EDU

Presentations

INVITED TALKS

- [1] "IceCube Neutrino Observatory - Recent discoveries and activities in Korea," *K-Neutrino Symposium 2023*, July 20 - 21, 2023, Seoul, Rep. of Korea.

CONTRIBUTED PRESENTATIONS

- [14] "Search for BSM interactions of Dark Matter with high-energy neutrinos from distant point sources in the IceCube Neutrino Telescope," *2024 KPS Fall Meeting*, October 22 - 25, 2024, Yeosu, Rep. of Korea. (Oral; Honoured with 'Outstanding Presentation Award')
- [13] "Search for the neutrino signals from distant sources that involve hints on BSM interactions of Dark Matter with the IceCube Neutrino Telescope," *2024 KPS Fall Meeting*, October 22 - 25, 2024, Yeosu, Rep. of Korea. (Oral; Honoured with 'Outstanding Presentation Award')
- [12] "Search for BSM interactions of Dark Matter with high-energy neutrinos from distant point sources in the IceCube Neutrino Telescope," *2024 KPS Spring Meeting*, April 23 - 26, 2024, Daejeon, Rep. of Korea. (Oral)
- [11] "Searches for dark matter signals with high-energy neutrinos in the IceCube Neutrino Telescope," *2023 KPS Fall Meeting*, October 24 - 27, 2023, Changwon, Rep. of Korea. (Oral; Honoured with 'Outstanding Presentation Award')

- [10] “Search for rare interactions of Dark Matter with high-energy neutrinos from distant point sources with the IceCube Neutrino Telescope,” *2023 KPS Fall Meeting*, October 24 - 27, 2023, Changwon, Rep. of Korea. (Oral; Honoured with 'Outstanding Presentation Award')
- [9] “Search for the rare interactions of neutrinos from distant point sources with the IceCube Neutrino Telescope,” *38th International Cosmic Ray Conference (ICRC2023)*, July 26 - August 3, 2023, Nagoya, Japan. (Poster)
- [8] “Search for interactions of neutrinos with Dark Matter from distant point sources with the IceCube Neutrino Telescope,” *16th International Conference on Interconnections between Particle Physics and Cosmology (PPC 2023)*, June 12 - 16, 2023, Daejeon, Rep. of Korea. (Oral)
- [7] “Search for the rare interactions of neutrinos from distant point sources with the IceCube Neutrino Telescope,” *2023 KPS Spring Meeting*, April 19 - 21, 2023, Daejeon, Rep. of Korea. (Oral)
- [6] “Search for interactions between neutrino and dark matter with the IceCube Neutrino Telescope,” *2022 KPS Fall Meeting*, October 18 - 21, 2022, Busan, Rep. of Korea. (Oral)
- [5] “The camera system for the IceCube Upgrade,” *23rd International Workshop on Neutrinos from Accelerators (NuFACT 2022)*, July 31 - August 6, 2022, Salt Lake City, UT, U.S.A. (Oral)
- [4] “Camera Calibration for the IceCube Upgrade and Gen2,” *37th International Cosmic Ray Conference (ICRC2021)*, July 12 - 23, 2021, Berlin, Germany. (Poster)
- [3] “The camera system for the IceCube Upgrade,” *2020 KPS Virtual Spring Meeting*, July 13 - 15, 2020, Online. (Poster)
- [2] “The camera system for the IceCube Upgrade,” *36th International Cosmic Ray Conference (ICRC2019)*, July 24 - August 1, 2019, Madison, WI, U.S.A. (Poster)
- [1] “Novel Camera System to Study Antarctic Ice Properties for Extensions to IceCube,” *2016 KPS Fall Meeting*, October 19 - 21, 2016, Gwangju, rep. of Korea. (Poster; Honoured with 'Outstanding Poster Presentation Award')

SEMINARS, WORKSHOPS, COLLOQUIUMS TALKS

- [5] “Search for BSM interactions of Dark Matter with neutrinos from distant point sources,” *The 2nd K-IceCube Workshop*, April 15, 2024, Sungkyunkwan University, Suwon, Rep. of Korea.
- [4] “Search for rare interactions of Dark Matter with high-energy neutrinos from distant point sources with the IceCube Neutrino Telescope.” *70th Workshop on Gravitational Waves and Numerical Relativity*, October 4 - 5, 2023, APCTP Headquarters, Pohang, Rep. of Korea.
- [3] “Search for the interactions between neutrinos and dark matter from distant sources using IceCube data,” *K-IceCube Workshop 2022*, July 4, 2022, Chung-Ang University, Seoul, Rep. of Korea.
- [2] “CamSim - Camera Simulations for the Camera Systems in the IceCube Neutrino Telescope,” *1st Workshop on Camera-systems and image analysis for neutrino detectors calibration, glaciology and deep sea exploration*, December 16 - 17, 2021, Online.
- [1] “CamSim: Camera Simulations,” *2021 Photon Propagation Workshop*, October 18 - 19, 2021, Online.

COLLABORATION MEETING TALKS

- [11] Autumn 2024. “Search for Neutrino - Dark Matter interactions with Point Sources,” *IceCube Collaboration Meeting*, Madison, WI., U.S.A.
- [10] Spring 2024. “Search for BSM interactions of Dark Matter with neutrinos from distant point sources,” *IceCube Collaboration Meeting*, Münster, Germany

- [9] Autumn 2023. "Search for the Rare Interactions of Dark Matter with High-Energy Neutrinos from Distant Point Sources," *IceCube Collaboration Meeting*, Grands Rapids, MI., U.S.A.
- [8] Spring 2023. "Search for the rare interactions of neutrinos from distant point sources," *IceCube Collaboration Meeting*, Aachen, Germany.
- [7] Autumn 2022. "Search for interactions between neutrino and dark matter from distance point sources," *IceCube Collaboration Meeting*, Madison, WI., U.S.A.
- [6] Spring 2020. "Camera acceptance testing summary and plans," *IceCube Virtual Collaboration Meeting*, Online.
- [5] Autumn 2019. "Simulation and Sensitivity Study of Upgrade Camera System," *IceCube Collaboration Meeting*, Chiba, Japan.
- [4] Spring 2019. "Updates on the Camera Simulation for IceCube Upgrade," *IceCube Collaboration Meeting*, Madison, WI., U.S.A.
- [3] Spring 2018. "CamSim: Camera Simulations," *IceCube Collaboration Meeting*, Atlanta, GA., U.S.A.
- [2] Spring 2017. "Light propagation Simulations to interpret Hole Ice and Swedish Camera data," *IceCube Collaboration Meeting*, Madison, WI., U.S.A.
- [1] Autumn 2016. "Prospects for understanding hole ice with camera measurements," *IceCube Collaboration Meeting*, Mainz, Germany.

Publications

AS A CO-AUTHOR

Note: Selected publications only. Entire publication list can be found at *Inspire HEP profile* or *Google Scholar profile*.

- [8] IceCube Collaboration, "Observation of high-energy neutrinos from the Galactic plane," *Science* 380 6652, adc9818, 2023.
- [7] IceCube Collaboration, "Evidence for neutrino emission from the nearby active galaxy NGC 1068," *Science* 378 6619, 538-543, 2022.
- [6] IceCube Collaboration, "Detection of a particle shower at the Glashow resonance with IceCube," *Nature* 591 7849, 220-224, 2021.
- [5] IceCube Collaboration, "Neutrino emission from the direction of the blazar TXS 0506+056 prior to the IceCube-170922A alert," *Science* 361 6398, 147-151, 2018.
- [4] IceCube Collaboration, "Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922A," *Science* 361 6398, eaat1378, 2018.
- [3] COSINE-100 Collaboration, "An experiment to search for dark-matter interactions using sodium iodide detectors," *Nature* 564 7734, 83-86, 2018.
- [2] IceCube Collaboration, "Measurement of the multi-TeV neutrino cross section with IceCube using Earth absorption," *Nature* 551 596-600, 2017.

- [1] LIGO Scientific and Virgo and Fermi GBM and INTEGRAL and IceCube and IPN and Insight-Hxmt and ANTARES and Swift and Dark Energy Camera GW-EM and DES and DLT40 and GRAWITA and Fermi-LAT and ATCA and ASKAP and OzGrav and DWF (Deeper Wider Faster Program) and AST3 and CAASTRO and VINROUGE and MASTER and J-GEM and GROWTH and JAGWAR and CaltechNRAO and TTU-NRAO and NuSTAR and Pan-STARRS and KU and Nordic Optical Telescope and ePESSTO and GROND and Texas Tech University and TOROS and BOOTES and MWA and CALET and IKI-GW Follow-up and H.E.S.S. and LOFAR and LWA and HAWC and Pierre Auger and ALMA and Pi of Sky and Chandra Team at McGill University and DFN and ATLAS Telescopes and High Time Resolution Universe Survey and RIMAS and RATIR and SKA South Africa/MeerKAT Collaborations and AstroSat Cadmium Zinc Telluride Imager Team and AGILE Team and 1M2H Team and Las Cumbres Observatory Group and MAXI Team and TZAC Consortium and SALT Group and Euro VLBI Team, “Multi-messenger Observations of a Binary Neutron Star Merger,” *Astrophys.J.Lett.* 848 2, L12, 2017.

CONFERENCE PROCEEDINGS

- [6] **Kang, W.**, Rott, C. on behalf of the IceCube Collaboration, “Search for the rare interactions of neutrinos from distant point sources with the IceCube Neutrino Telescope,” *PoS (ICRC2023)* 1380, 2023. (Contribution to 38th International Cosmic Ray Conference (ICRC2023))
- [5] **Kang, W.**, Lee, J., Rodan, S., Rott, C., Tönnis C. on behalf of the IceCube Collaboration, “The Camera System for the IceCube Upgrade,” *Phys. Sci. Forum*, 8(1) 49, 2023. (Contribution to 23rd International Workshop on Neutrinos from Accelerators (NuFACT 2022))
- [4] **Kang, W.**, Lee, J., Roellinghoff, G., Rott, C., Tönnis C. on behalf of the IceCube Collaboration, “Camera Calibration for the IceCube Upgrade and Gen2,” *PoS (ICRC2021)* 1064, 2022. (Contribution to 37th International Cosmic Ray Conference (ICRC2021))
- [3] **Kang, W.**, Rott, C., Tönnis C. on behalf of the IceCube Collaboration, “The camera system for the IceCube Upgrade,” *PoS (ICRC2019)* 928, 2021. (Contribution to 36th International Cosmic Ray Conference (ICRC2019))
- [2] Jeong, M., **Kang, W.**, Kim, J. on behalf of the IceCube Collaboration, “A camera system for IceCube-Gen2,” *PoS (ICRC2017)* 1040, 2018. (Contribution to 35th International Cosmic Ray Conference (ICRC2017))
- [1] Bose, D., Jeong, M., **Kang, W.**, Kim, J., Rott, C. on behalf of the IceCube Collaboration, “PINGU Camera System to Study Properties of the Antarctic Ice,” *PoS (ICRC2015)* 1145, 2016. (Contribution to 34th International Cosmic Ray Conference (ICRC2015))

PUBLIC MANUSCRIPTS

- [1] Rott, C., **Kang, W.** “The IceCube Neutrino Telescope,” *Physics and High Technology* by Korean Physical Society vol. 27, no. 12, 2018.