

Dr. Daryl Joe D. Santos

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EDUCATION

Max Planck Institute for Extraterrestrial Physics/Ludwig Maximilian University of Munich, Germany

PhD, Astrophysics

Supervisor: Prof. Reinhard Genzel (2020 Nobel Laureate in Physics)

2021-2025

& Dr. Taro Shimizu

Thesis: Understanding the Physics of Broad Line Region (BLR) with GRAVITY at the Very Large Telescope Interferometer (VLTI)

DOI: 10.5282/edoc.35659

National Tsing Hua University, Taiwan

Masters in Astronomy

2019-2021

Supervisor: Prof. Tomotsugu Goto

Thesis: Environmental Effects on AGN Activities via Extinction-Free Mid-Infrared Census

De La Salle University, Philippines

BS Physics with specialization in Materials Science

Summa cum Laude

Supervisor: Prof. Shirley T. Palisoc & Prof. Michelle T.

2015-2019

Natividad

Thesis: Fabrication of Borohydride-Based Electrolyte System for Solid-State Magnesium-Persulfate (Mg//MgS₂O₈) Based Rechargeable Battery

RESEARCH

Statement: I am interested in the physics of active galactic nuclei (AGNs) and studying them through various techniques, such as interferometry, spectroscopy, and photometry, to shed light on the coevolution of supermassive black holes (SMBHs) and their host galaxies across cosmic time.

Keywords: AGNs, galaxy formation and evolution, high-angular resolution astronomy, science education

Computing Languages: Python, Fortran

AWARDS

NTHU Physics Department Outstanding Teaching Assistant Award 2020

Three Minute Thesis (3MT) Competition Finalist 2020

NTHU Sustainable Development Goals Finalist 2020

Best Student Oral Presentation Award 2020

NTHU International Student Scholarship Award 2019

Jose Rizal Honors Society Member 2019

Outstanding Thesis Award 2019

DLSU Vaugirard Scholarship Program 2015

Department of Science and Technology (DOST) RA 7687 Scholarship 2015

TEACHING EXPERIENCE

Teaching Assistant, FutureLearn Online Class	2020
Teaching Assistant, General Physics B (I), General Physics B (II)	2019
Part-time Tutor, Tutoring Club Rockwell, Philippines	2019

INVITED TALKS

- *Invited Talk* Aug. 2025
1st Philippine Space Science and Astronomy Research Conference (PSSARC)
-- Topic: *Tinimbang Ka Ngunit Kulang*: Measuring Supermassive Black Hole Masses with GRAVITY(+)
- *Invited Talk* May 2024
Special Colloquium, De La Salle University, Manila, Philippines
-- Topic: How is it being a Filipino Astronomer?
Understanding the Physics of Black Holes with GRAVITY(+)
- *Invited Talk* May 2024
Special Colloquium, University of the Philippines Diliman, Quezon City, Philippines
-- Topic: Understanding the Physics of the Broad Line Region around Black Holes with GRAVITY(+)
- *Invited Talk* Jan. 2024
Special Colloquium, National Tsing Hua University, Hsinchu, Taiwan
-- Topic: Resolving the BLR with VLTI/GRAVITY
- *Plenary Speaker/Invited Talk* Sept. 2021
2nd Philippine Association of Physics and Science Instructors (PAPSI) International 3-Day Research Conference (remote), Philippines
-- Topic: Why is Astronomy important for you and me?

PRESENTATIONS

- *Contributed Talk* Sept. 2025
K-12 Astro Asia Conference
- *Contributed Talk* June 2025
European Astronomical Society (EAS) 2025 Annual Meeting
- *Poster Presentation* June 2025
European Astronomical Society (EAS) 2025 Annual Meeting
- *Contributed Talk* July 2024
Committee on Space Research (COSPAR) 2024 45th Scientific Assembly, Busan, South Korea
- *Contributed Talk* Jun. 2023
The Restless Nature of AGN: 10 years later, Naples, Italy
- *Poster Presentation* Oct. 2022
Observing the Universe in Motion: 5 Years of GRAVITY, Ringberg Castle, Germany
- *Poster Presentation* Dec. 2020
2020 NTHU Physics Department Poster Competition, NTHU, Taiwan
- *Contributed Talk* Nov. 2020
North Ecliptic Pole (NEP) Conference 2020, Academia Sinica, Taipei, Taiwan

- *Contributed Talk* Nov. 2020
2020 International Conference on Educational Innovation, NTHU Nanda Campus, Hsinchu, Taiwan
- *Poster Presentation* Oct. 2020
1st NTHU Sustainable Development Goals (SDGs) Thesis Poster Contest, Hsinchu
- *Contributed Talk* Sept. 2020
Virtual Annual Meeting of the German Astronomical Society (remote), Germany
- *Poster Presentation* Sept. 2020
Royal Astronomical Society (RAS) Early Career Poster Exhibition 2020 (remote), United Kingdom
- *Contributed Talk* Sept. 2020
The Astronomical Society of the Republic of China (ASROC) 2020 Annual Meeting, Academia Sinica, Taipei, Taiwan
- *Contributed Talk* May 2020
2020 International Conference on Universities of Innovation Teaching Demonstration (Online), Taiwan
- *Contributed Talk* Feb. 2020
2020 Annual Meeting of the Physical Society of Taiwan, National Pingtung University, Taiwan
- *Poster Presentation* Dec. 2019
2019 NTHU Physics Department Poster Competition, Taiwan

FIRST-/CORRESPONDING AUTHOR PUBLICATIONS

37. “*Spectroscopic AGN Survey at $z \sim 2$ with NTT/SOFI for GRAVITY+ Observations*”
D. J. D. Santos et al. (2024), A&A, 696, A30
-- To prepare for GRAVITY+ observations of high- z AGNs to shed light on the black hole-galaxy coevolution, we observed a sample of 29 $z \sim 2$ AGNs with NTT/SOFI to estimate their interferometric signals and investigate their BLR structure via their Balmer lines.
32. “*The size-luminosity relation of local active galactic nuclei from interferometric observations of the broad-line region*”
GRAVITY Collaboration + **D. J. D. Santos** et al. (2024), A&A, 684, A167
-- I used interferometry with the four 8-m telescopes of the VLTI to measure BH masses in 4 low-redshift AGN. I combined these with other published data to derive the first size-luminosity relation independent from RM. Our results show smaller BLR sizes than expected at higher luminosities, which challenges our knowledge of BLR physics.
24. “*Can luminous Lyman alpha emitters at $z \sim 5.7$ and $z \sim 6.6$ suppress star formation?*”
D. J. D. Santos et al. (2022), MNRAS, 516 (4), 5601-5610
-- I find that the number density of Lyman alpha emitters (LAEs) decreases with increasing luminosity of the central LAE. However, the expected UV intensities of the LAEs in the sample suggest that their isotropic background UV radiation is insufficient to explain such underdense regions.
17. “*Borohydride-based Electrolyte System for Magnesium-Persulfate ($Mg//MgS_2O_8$) Rechargeable Battery*”
Natividad, M. T., **Santos, D. J. D.**, Palisoc, S. T. (2021), Ain Shams Engineering Journal, 12(3), 3021
-- I evaluated the feasibility of a new magnesium-based compound as a coin-cell battery's main component, which could serve as a safer and more energy-efficient alternative to lithium-based batteries.

16. “*Environmental Effects on AGN Activities from an Extinction-Free Mid-Infrared Census*”
Santos, D. J. D. et al. (2021), MNRAS, 507(2), 3070
-- I fitted the spectral energy distribution (SED) of mid-infrared selected AGNs, and showed that the AGN activities of host galaxies with higher infrared luminosity are more sensitive to galaxy number density. This effect varies at different epochs, suggesting a more unique evolution pathway for such objects.
14. “*Investigative Study on Preprint Journal Club as an Effective Method of Teaching Latest Knowledge in Astronomy*”
Santos, D. J. D. et al. (2021), PRPER, 17(1), 010145
-- Our group identified the essential factors that constitute a successful astronomy journal club by conducting an international survey and testing our hypotheses with our own journal club.

OTHER PUBLICATIONS

36. “*First Resolution of Microlensed Images of a Binary-Lens Event*”
Wu, Z. + **D. Santos** et al. (2024), arXiv: 2409.13015
35. “*VLTI/GRAVITY interferometric measurements of the innermost dust structure sizes around active galactic nuclei*”
A. Amorim +, **D. J. D. Santos** et al. (2024), 690, A76
34. “*GATOS: missing molecular gas in the outflow of NGC 5728 revealed by JWST*”
R. Davies + **D. J. D. Santos** et al. (2024), A&A, 689, A263
33. “*Effects of galaxy environment on merger fraction*”
W. J. Pearson, **D. J. D. Santos** et al. (2024), A&A, 686, A94
31. “*Broad-line region geometry from multiple emission lines in a single-epoch spectrum*”
L. Kuhn + **D. J. D. Santos** et al. (2024), A&A, 684, A52
30. “*A dynamical measure of the black hole mass in a quasar 11 billion years ago*”
R. Abuter + **D. J. D. Santos** et al. (2024), **Nature**, 627, 281–285
29. “*The Core of the Matter—Spatially Resolving Active Galactic Nuclei with GRAVITY*”
Sturm, E. + **D. J. D. Santos** et al. (2022), The Messenger, 188, 20-25
28. “*Confronting a Thin Disk-wind Launching Mechanism of Broad-line Emission in Active Galactic Nuclei with GRAVITY Observations of Quasar 3C 273*”
Long, K. + **D. Santos** et al. (2023), ApJ, 953(2), 184
27. “*Toward measuring supermassive black hole masses with interferometric observations of the dust continuum*”
GRAVITY Collaboration + **D. J. D. Santos** et al. (2023), A&A 669, A14
26. “*Subaru High- z Exploration of Low-Luminosity Quasars (SHELLQs) – XV. Constraining the cosmic reionization at $5.5 < z < 7$* ”
Lu, T.Y. + **D. J. D. Santos** et al. (2022), MNRAS, 517 (1), 1264-1281
25. “*Constraining the Hubble constant and its lower limit from the proper motion of extragalactic radio jets*”
Hsiao, T. Y. Y. + **D. J. D. Santos** et al. MNRAS, 517 (1), 447-457
23. “*ALMA Detections of [O III] and [C II] Emission Lines From A1689- z D1 at $z=7.13$* ”
Wong, V. Y. H. + **D. J. D. Santos** et al. (2022), ApJ, 929 (2), 161
22. “*Energy functions of fast radio bursts derived from the first CHIME/FRB catalogue*”
Hashimoto, T. + **Santos, D. J. D.** et al. (2022), MNRAS, 511(2), 1961
21. “*Upper limits on Einstein’s weak equivalence principle placed by uncertainties of dispersion measures of fast radio bursts*”
Hashimoto, T. + **Santos, D. J. D.** et al. (2021), Phys. Rev. D 104, 124026
20. “*Constraining violations of the weak equivalence principle Using CHIME FRBs*”
Sen, K. + **Santos, D. J. D.** et al. (2022), MNRAS, 509(4), 5636-5640
19. “*Uncloaking hidden repeating fast radio bursts with unsupervised machine learning*”
Chen, B. H. + **Santos, D. J. D.** et al. (2022), MNRAS, 509(1), 1227-1236

17. *"The evolution of merger fraction of galaxies at $z < 0.6$ depending on the star formation mode in the AKARI NEP-Wide Field"*
Kim, E. + **Santos, D. J.** et al. (2021), MNRAS, 507(3), 3113-3124
15. *"Optically detected galaxy cluster candidates in the AKARI North Ecliptic Pole field based on photometric redshift from the Subaru Hyper Suprime-Cam"*
Huang, T. C. + Santos, D. J. D. et al. (2021), MNRAS, 506(4), 6063-6080
13. *"Photometric Redshifts in the North Ecliptic Pole Wide Field based on a Deep Optical Survey with Hyper Suprime-Cam"*
Ho, S. C. C. + **Santos, D. J. D.** et al. (2020), MNRAS, 502(1), 140-156.
12. *"Revealing the cosmic reionization history with fast radio bursts in the era of Square Kilometre Array"*
Hashimoto, T. + **Santos, D. J. D.** et al. (2021), MNRAS, 502(2), 2346-2355.
11. *"An Active Galactic Nucleus Recognition Model based on Deep Neural Network"*
Chen, B. H. + **Santos, D. J. D.** et al. (2021), MNRAS, 501(3), 3951-3961.
10. *"Identification of AKARI infrared sources by Deep HSC Optical Survey: Construction of New Band-Merged Catalog on the North Ecliptic Pole Wide (NEPW) field"*
Kim S. J. + **Santos, D. J.** et al. (2020), MNRAS, 500(3), 4078-4094.
9. *"Extinction-free Census of AGNs in the AKARI/IRC North Ecliptic Pole Field from 23-band infrared photometry from Space Telescopes"*
Wang, T. W. + **Santos, D. J. D.** et al. (2020), MNRAS, 499(3), 4068-4081.
8. *"CFHT MegaPrime/MegaCam u-band source catalogue of the AKARI North Ecliptic Pole Wide field"*
Huang, T. C. + **Santos, D. J. D.** et al. (2020), MNRAS, 498(1), 609-620.
7. *"No redshift evolution of non-repeating fast radio-burst rates"*
Hashimoto, T. + **Santos D. J. D.** et al. (2020), MNRAS, 498(3), 3927-3945.
6. *"Search for Optically Dark Infrared Galaxies without Counterparts of Subaru Hyper Suprime-Cam in the AKARI North Ecliptic Pole Wide Survey Field"*
Toba, Y. + **Santos, D. J. D.** et al. (2020), ApJ, 899(1), 35.
5. *"Fast radio bursts to be detected with the Square Kilometre Array"*
Hashimoto, T. + **Santos, D. J. D.** et al. (2020), MNRAS, 497(4), 4107-4116.
4. *"Far-infrared star-formation rates of six GRB host galaxies with ALMA"*
Hsiao, T. Y.-Y + **Santos, D. J. D.** et al. (2020), MNRAS, 496(4), 4405-4419
3. *"What determines the maximum stellar surface density of galaxies?"*
Ling, C.-T + **Santos, D. J. D.** et al. (2020), MNRAS, 496(1), 864-869
2. *"Subaru Medium-resolution Spectra of a QSO at $z = 6.62$: Three Resolution Tests"*
Lu, T.-Y. + **Santos, D. J. D.** (2020), ApJ, 893(1), 69.
1. *"Luminosity-duration relations and luminosity functions of repeating and non-repeating fast radio bursts"*
Hashimoto, T + **Santos, D. J. D.** (2020), MNRAS, 494(2), 2886-2904

OUTREACH

Founding Member

Philippine Society of Space Science and Astronomy Research (PSSAR)	Sept. 2025
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Local Organizing Committee (LOC) Member

1 st Philippine Space Science and Astronomy Research Conference (PSSARC)	Aug. 2025
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Presenter/Tour Guide

MPE Student Tours	Feb. 2025 May 2025
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Presenter

MPE Open Day 2024	Oct. 2024
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Member

Committee on Space Research (COSPAR)
Panel on IDEA (Inclusion, Diversity, Equity, and
Accessibility) Initiative (PIDEA)

Jul. 2024 –

Adviser/Upskill Group Instructor/Speaker

Students for the Exploration and Development of Space
in the Philippines (SEDS Philippines)

Jul. 2021 –

REFERENCES

Dr. Taro Shimizu

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