

# Taeho Ryu - <http://taehoryu.com>

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## CONTACT INFORMATION

The Max-Planck Institute for Astrophysics,  
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*Phone:* +1 5515740406, +49 1743130001  
*Citizenship :* Korean citizen  
U.S. legal permanent resident

## RESEARCH

**Primary interests:** Time domain astronomy, multi-messenger transients, tidal disruption events, gravitational waves, formation of runaway/hypervelocity stars, supermassive black hole binaries, formation and interaction of black holes in the early universe - AGN & high-mass X-ray binaries, dynamics of stellar clusters, exoplanets.

**Methods:** Relativistic and Newtonian hydrodynamics simulation,  $N$ -body simulations, time-dependent Fokker-Planck integrator, stellar evolution simulation

## PROFESSIONAL EXPERIENCE

**The Max-Planck Institute for Astrophysics - MPA**, Germany 2021 – present  
MPA prize fellow

**Johns Hopkins University - JHU**, USA 2018 – 2021  
Postdoctoral research fellow

## EDUCATION

**Stony Brook University - SBU**, USA 2012 – 2018  
Ph.D., Physics, 2018 (Advisor: Professor Rosalba Perna)  
M.A., Physics, 2014

**Korea Institute for Advanced Study - KIAS**, South Korea 2011 – 2012  
Research assistant to Professor Kimyeong Lee (Department of Physics)

**Seoul National University - SNU**, South Korea 2005 – 2011  
B.S. in Chemistry & Physics (Double-major/Cum Laude)  
Teaching practicum in Chemistry  
★2 years of mandatory military service

## HONORS, AWARDS AND AFFILIATION

**Junior Member** of the International Astronomical Union 06/2022 - present

**Member** of LISA consortium 11/2022 - present

**Member** of the Korean Science-Engineering Association 09/2014 - present

**Dresden Prize** (for outstanding theoretical thesis), SBU 05/2018

**Peter B. Kahn Fellowship**, SBU 05/2016

**SNUANY Scholarship Award**, Seoul National University Alumni Association of Greater New York 11/2014

**SNUANY Scholarship Award**, SNUANY 12/2013

**Benjamin Lee Award**, SBU 05/2013

**SNU Outstanding Student award** (Twice winner), SNU 2009 - 2010

**National Scholarship for Science & Engineering** (Thrice winner) 2009 - 2010

**Scholarship for Superior Academic Performance** (Five-time winner), SNU 2005 - 2007

SUPERCOMPUTING ALLOCATIONS	<p><b>Principal Investigator:</b> <i>HLRS</i> (Stuttgart tier 1), project name : <i>Global Relativistic Magneto-hydrodynamics Simulations of the Long-term Evolution of Tidal Debris in Tidal Disruption Events of Stars</i>, amount : <b>55M</b> cpu hours on Hawk</p> <p><b>Project Manager (Principal Investigator: Volker Springel):</b> <i>NHR@FAU</i> (tier 2), project name : <i>Transient formation in three-body encounters between stars and black holes</i>, amount : <b>3.6M</b> cpu hours on Fritz</p>	
COMPUTATIONAL EXPERIENCE	<p><b>Computing skills:</b> Fortran, C/C++, Python</p> <p><b>Code:</b> development of multi-domain infrastructure PATCHWORKMDH, usage of GRMHD code HARM3D, Moving-mesh magnetodyhanics code AREPO (<a href="https://arepo-code.org/">https://arepo-code.org/</a>), Newtonian AMR hydrodynamics code CASTRO (<a href="https://amrex-astro.github.io/Castro/">https://amrex-astro.github.io/Castro/</a>)</p> <p><b>Analysis:</b> python, Matplotlib, Paraview, mathematica, GNUplot</p> <p><b>High Performance computing:</b> the US (Frontera, Stampede, Rockfish, Seawulf), Germany (Hawk hrs, SuperMUC Leibniz, Cobra, Raven, Freya)</p>	
INVITED TALKS	<p><b>Special Seminar</b>, New York University, USA 09/2023</p> <p><b>Astronomy Seminar</b>, Columbia, USA 09/2023</p> <p><b>Astronomy Seminar</b>, Stony Brook University, USA 09/2023</p> <p><b>Special Seminar</b>, Northwestern University(CIERA), USA 08/2023</p> <p><b>MPA/Kavli summer program seminar</b>, MPA, Germany 06/2023</p> <p><b>HUJI Astrophysics Seminar</b>, HUJI, Isreal 03/2023</p> <p><b>2022 MIAPP Conference “The Fundamental Role of Stellar Multiplicity in Stellar Dynamics and Evolution”</b>, MIAPP, Germany 11/2022</p> <p><b>Department Colloquium</b>, University of Tübingen, Germany 07/2022</p> <p><b>Black hole workshop</b>, the Niels Bohr Institute, Denmark 06/2022</p> <p><b>MPA Seminar</b>, MPA, Germany 10/2021</p> <p><b>Astro UdeC Seminar</b>, the Universidad de Concepción, Chile 04/2021</p> <p><b>CTC Seminar</b>, University of Maryland, USA 06/2019</p> <p><b>Wine&amp;Cheese Seminar</b>, Johns Hopkins University, USA 04/2019</p> <p><b>Department Seminar</b>, SBU, USA 04/2018</p> <p><b>Numerical Scattering Workshop</b>, the Flatiron Institute, USA 12/2017</p> <p><b>Black Hole Network Workshop</b>, the Flatiron Institute, USA 12/2016</p> <p><b>MODEST-16 NYC Gas and Gravitational Dynamics</b>, USA 09/2016</p> <p><b>Frontier Research in Astrophysics – II</b>, Italy 05/2016</p> <p><b>Astronomy Seminar</b> Columbia University, USA 05/2016</p>	
CONTRIBUTED TALKS	<p><b>Two in a million</b>, ESO, Germany 09/2023</p> <p><b>MODEST23</b>, Northwestern University, USA 08/2023</p> <p><b>European Astronomical Society Annual Meeting</b>, Krakow, Poland 07/2023</p>	

	<b>The Black Holes and Gravitational Waves Munich Day</b> , Germany	05/2023
	<b>Aspen Workshop “Extreme Black Hole”</b> , USA	03/2023
	<b>WE Heraeus-EAS Early Career Researchers in Astr. Workshop</b> , Germany	03/2023
	<b>XMM-Newton Workshop 2022</b> , Spain	06/2022
	<b>Growing Black Holes: Accretion and mergers</b> , Nepal	05/2022
	<b>SESTAS Meeting</b> , MPA	10/2021
	<b>HotSci@JHU/STScI</b> , STScI	08/2021
	<b>European Astronomical Society Annual Meeting</b> , Leiden	07/2021
	<b>Tidal Disruptions in Kyoto: Confronting Theory with Observations</b> , Kyoto University, Japan	01/2020
POSTERS	<b>Distorted Astrophysical disks</b> , University of Cambridge	05/2021
	<b>The 7<sup>th</sup> Annual Johns Hopkins Postdoctoral Conference</b> , JHU	04/2021
STUDENT SUPERVISION	Alonso Herrera (Master student, co-supervising with Prof. Nathan Leigh), Universidad de Concepción, Chile (2021-present)	
	José Pinto (Master student, co-supervising with Prof. Nathan Leigh), Universidad de Concepción, Chile (2021-present)	
	Kaitlyn Szekerczes (PhD student, Fulbright fellow, co-supervising with Prof. Sherry Suyu), TUM, Germany (2022-present)	
	Pavan Vynatheya (PhD student, co-supervising with Dr. Rüdiger Pakmor, Prof. Selma de Mink), MPA, Germany (2022-present)	
CERTIFICATION	Korean National Teacher Certification	2011
TEACHING EXPERIENCE	<b>AST200 course</b> (by Prof. Jin Koda, talk for undergradate students), SBU	02/2017
	<b>Teaching Assistant</b> , Department of Physics and Astronomy, SUNY, USA	2012-2014
	<b>Teaching Practicum</b> , Seoul National University Girls’ Middle School, South Korea	Spring 2011
	<b>Teaching Assistant</b> , Language Education Institute, SNU, South Korea	Spring 2011
	<b>Teaching Assistant</b> , Central Library, SNU, South Korea	Spring 2009
	- Enhancing librarians’ grasp of basic scientific concepts in chemistry and physics	
	<b>Teaching Assistant</b> , Hansung high school, South Korea	Spring 2009
	- Volunteer work to each mathematics for high-school students	
PROFESSIONAL SERVICE	Referee for <i>Monthly Notices of the Royal Astronomical Society</i> , <i>The Astrophysical Journal</i> , <i>Publications of the Astronomical Society of the Pacific</i>	
	<b>NASA</b> (2023), member of panel review	
SCIENTIFIC OUTREACH EXPERIENCE	<b>Girls’ day</b> , MPA	04/2023

Preparation and execution of one of the five sessions where a group of high-school female students completes a given scientific task.

**SEDS Celestia**, BITS Pilani 01/2023  
Invited public lecture about black hole and tidal disruption event

**Member of the MPA planetarium team** 04/2022 - present  
Present a planetarium show, lecture or talk to students visiting MPA

**Making a movie in collaboration with NASA for the annual event “Black Hole Friday”**  
0.3M views on YouTube in less than a week  
(<https://www.youtube.com/watch?v=ALnIzCzRoQDY&t=23s>)

**The Johns Hopkins Korean Graduate Student Association**, JHU 09/2019  
Invited public talk for Networking night (annual event)

LEADERSHIP  
EXPERIENCE

**Organizer of AREPO tutorial workshop**, MPA 06/2022  
Role: Organize and conduct 1-day AREPO tutorial workshop (20 participants) for stellar astrophysics application of AREPO, consisting of lectures for the introduction to hydrodynamics simulations and exercise

**Seminar organizer**, the Stellar Department at MPA 09/2021 - 09/2022  
Role: invite speakers (typically two speakers for each week), schedule seminars and chair the sessions for talks and discussions (along with two other organizers)

**Department of Chemistry**, SNU, South Korea 2005 - 2006  
Department Activities Representative and Organizer  
(Student competitions, membership training, freshmen welcoming, etcetera)

**SNU Campus Life and Culture Center**, SNU, South Korea 2010 - 2011  
Mentor-team Manager in SNU Compliance/Mentoring Program  
Elected Leader (30 members, My team chosen Best Team of the Year)

NON-SCIENTIFIC  
OUTREACH  
EXPERIENCE

**SNU Obstacle Person Support Center**, SNU Spring 2009  
Assistant to a hearing-impaired student, and provider of study aid

**Kyujanggak Institute for Korean Studies**, SNU Spring 2011  
Docent  
Program: Improving public understanding of Documentary Heritage of Chosun Dynasty

**Museum of Art**, SNU Spring 2011  
Docent  
Program: Improving public understanding of interactive media art in The Garden of Forking Paths

**MILITARY SERVICE** **Military Required Service**, South Korea 2007 – 2009  
Honorably Discharged as a Sergeant  
Served inter alia in Food/Water Inspectorate (Laboratory) plus assist. mgmt.

## References

Professor Rosalba Perna (Associate Department Chair)  
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Email: jhk@jhu.edu

Professor Tsvi Piran (Schwartzman Chair for Theoretical Physics)  
Racah Institute for Physics, The Hebrew University of Jerusalem  
Edmond J. Safra Campus, Jerusalem 9190401, Israel  
Telephone: +972 26584233  
Email: tsvi.piran@mail.huji.ac.il

## Publications

### Articles in refereed Journals

29. **Ryu, T.**, Amaro Seoane, P., Taylor, A., Ohlmann, S., *Collisions of red giants in galactic nuclei*, submitted to MNRAS (2023), arXiv: 2307.07338
28. **Ryu, T.**, de Mink, S., Farmer, R., Pakmor, R., Perna, R., Springel, V., *Close encounters of star-black hole binaries with single stars*, submitted to MNRAS (2023), arXiv:2307.03097
27. Avara, M., Krolik, J., Campanelli, M., Noble, S., Bowen, D., **Ryu, T.**, *Accretion onto a Supermassive Black Hole Binary Before Merger*, submitted to ApJ (2023), arXiv:2305.18538
26. **Ryu, T.**, Krolik, J., Piran, T., Noble, S., Avara, M., *Shocks power Tidal Disruption Events*, accepted for publication in ApJ (2023), arXiv:2305.05333
25. **Ryu, T.**, Valli, R., Pakmor, R., Perna, R., de Mink, S., Springel, V., *Close encounters of black hole-star binaries with stellar-mass black holes*, MNRAS in press (2023), arXiv:2304.01792
24. Franchini, A., Bonetti, M., Lupi A., Miniutti, G., Bortolas, E., Giustini, M., Dotti, M., Sesana, A., Arcodia, R., **Ryu, T.** *QPEs from impacts between the secondary and a rigidly precessing accretion disc in an EMRI system*, A&A, 675, 100 (2023), Arxiv: 2304.00775
23. Xin, C., H. Haiman, Z., Perna, R., Wang, Y., **Ryu, T.** *Tidal Peeling Events: low-eccentricity tidal disruption of a star by a stellar-mass black hole*, submitted to ApJ, Arxiv: 2303.12846
22. Bortolas, E., **Ryu, T.**, Broggi, L., Sesana, A. *Partial stellar tidal disruption events and their rates*, MNRAS, 524, 3026 (2023), Arxiv: 2211.02734
21. **Ryu, T.**, Perna, R., Parkmor, R., Ma, J., Farmer, R., de Mink, S. *Close Encounters of Tight Binary Stars with Stellar-mass Black Holes*, MNRAS, 519, 5787 (2023), arXiv: 2211.02734
20. **Ryu, T.**, Krolik, J., Piran, T. *Extremely Relativistic Tidal Disruption Events*, ApJL, 946, 33 (2023), arXiv: 2211.00059
19. **Ryu, T.**, Perna, R., Wang, Y. *Close Encounters of Stars with Stellar-mass Black Hole Binaries*, MNRAS, 516, 2204 (2022), arXiv: 2206.00603
18. **Ryu, T.**, Trani, A. A., Leigh, N.W.C. *Tidal Disruption Events by Compact Supermassive Black Hole Binaries*, MNRAS, 515, 2430 (2022), arXiv: 2202.07668
17. McKernan, B., Ford, K.E.S., Cantiello, M., Graham, M.J., Jermyn, A.S., Leigh, N.W.C., **Ryu, T.**, Stern, D. *Starfall: A heavy rain of stars in 'turning on' AGN*, MNRAS, 514, 3 (2022), arXiv: 2110.03741
16. **Ryu, T.**, Krolik, J., Piran, T. *The Impact of Shocks on the Vertical Structure of Eccentric Disks*, ApJ, 920.2, 130, arXiv: 2105.09434 (2021)
15. **Ryu, T.**, Krolik, J., Piran, T. *Measuring stellar and black hole masses of tidal disruption events*, ApJ, 904.1, 73 (2020), arXiv: 2007.13765
14. Krolik, J., Piran, T., **Ryu, T.** *Tidal Disruptions of Main Sequence Stars – V. The Varieties of Disruptions*, ApJ, 904.1, 68 (2020), arXiv: 2001.03234
13. **Ryu, T.**, Krolik, J., Piran, T., Noble, N. *Tidal Disruptions of Main Sequence stars – IV. Relativistic effects and dependence on black hole mass*, ApJ, 904.2, 101 (2020), arXiv: 2001.03504

12. **Ryu, T.**, Krolik, J., Piran, T., Noble, N. *Tidal Disruptions of Main Sequence stars – III. Stellar mass dependence of the character of partial disruptions*, ApJ, 904.2, 100 (2020), arXiv: 2001.03503
11. **Ryu, T.**, Krolik, J., Piran, T., Noble, N. *Tidal Disruptions of Main Sequence stars – II. Simulation methodology and stellar mass dependence of the character of full tidal disruptions*, ApJ, 904.2, 99 (2020), arXiv: 2001.03502
10. **Ryu, T.**, Krolik, J., Piran, T., Noble, N. *Tidal Disruptions of Main Sequence Stars – I. Observable Quantities and their Dependence on Stellar and Black Hole Mass*, ApJ, 904.2, 98 (2020), arXiv: 2001.03501
9. **Ryu, T.**, Zingale, M., Perna, R. *Turbulence-driven thermal and kinetic energy in the atmospheres of hot Jupiters*, MNRAS, 481, 5517 (2018)
8. Ibragimov, T., Leigh, N., W. C., **Ryu, T.**, Panurach, T., Perna, R. *When do star clusters become multiple star systems? II. Toward a half-life formalism for arbitrary particle masses*, MNRAS, 477, 4213 (2018)
7. **Ryu, T.**, Perna, R., Haiman, Z., Ostriker, J. P., Stone, N. C. *Interactions between multiple supermassive black holes in galactic nuclei: a solution to the final parsec problem*, MNRAS, 473, 3410 (2018)
6. Belczynski, K., **Ryu, T.**, Perna, R., Berti, E., Tanaka, T. L., Bulik, T. *On the likelihood of detecting gravitational waves from Population III compact object binaries*, MNRAS, 471, 4702 (2017)
5. **Ryu, T.**, Leigh, N., W. C., Perna, R. *Formation of runaway stars in a star-cluster potential*, MNRAS, 470, 3049 (2017)
4. **Ryu, T.**, Leigh, N., W. C., Perna, R. *An analytic method for identifying dynamically-formed runaway stars*, MNRAS, 470, 2 (2017)
3. **Ryu, T.**, Leigh, N. W. C., Perna, R. *Numerical study of the  $N = 4$  binary-binary scatterings in a background potential*, MNRAS, 467, 4447 (2017)
2. **Ryu, T.**, Tanaka, T. L., Perna, R., Haiman, Z. *Intermediate-mass black holes from Population III remnants in the first galactic nuclei*, MNRAS, 460, 4122 (2016)
1. **Ryu, T.**, Tanaka, T. L., Perna, R. *Formation, disruption and energy output of Population III X-ray binaries*, MNRAS, 456, 223 (2016)

#### Articles in conference proceedings

1. **Ryu, T.**, Tanaka, T. L., Perna, R. *Population III X-Ray Binaries*, in “Frontier Research in Astrophysics – II”, Italy, (2016).