

Taeho Ryu

<http://taehoryu.com>

CONTACT INFORMATION	The Max-Planck Institute for Astrophysics, Karl-Schwarzschild-Str. 1 85748, Garching, Germany	<i>E-mail:</i> tryu@mpa-garching.mpg.de <i>Phone:</i> +1 5515740406, +49 1743130001 <i>Citizenship :</i> 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 magnetohydrodynamics simulation, N -body simulations, time-dependent Fokker-Planck integrator, stellar evolution simulation	
PROFESSIONAL EXPERIENCE	The Max-Planck Institute for Astrophysics - MPA, Germany MPA prize fellow	2021 – present
	Johns Hopkins University - JHU, USA Postdoctoral research fellow	2018 – 2021
	Korea Institute for Advanced Study - KIAS, South Korea Research assistant to Prof. Kimyeong Lee (Department of Physics)	2011 – 2012
EDUCATION	Stony Brook University - SBU, USA Ph.D., Physics, 2018 (Advisor: Prof. Rosalba Perna) M.A., Physics, 2014	2012 – 2018
	Seoul National University - SNU, South Korea B.S. in Chemistry & Physics (Double-major/Cum Laude) Teaching practicum in Chemistry ★2 years of mandatory military service	2005 – 2011
HONORS, AWARDS AND AFFILIATION	Dresden Prize (for outstanding theoretical thesis), SBU	05/2018
	Peter B. Kahn Fellowship , SBU	05/2016
	SNUANY Scholarship Award , SNU Alumni Association of Greater New York	11/2014
	SNUANY Scholarship Award , SNU Alumni Association of Greater New York	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	Principal Investigator: <i>HLRS</i> (Stuttgart tier 1), project name : <i>Global Relativistic Magnetohydrodynamics Simulations of the Long-term Evolution of Tidal Debris in Tidal Disruption Events of Stars</i> , amount : 55M cpu hours on Hawk	

★ annual report selected for presentation with publication in the proceedings of 2023 HLRS Review workshop.

Principal Investigator (Co-PI: Volker Springel): *NHR@FAU* (tier 2), project name : *Transient formation in three-body encounters between stars and black holes*, amount : **3.6M** cpu hours on Fritz

Project Manager (PI: Selma de Mink): *NHR@FAU* (tier 2), project name : *3D hydrodynamics simulations of mass transfer in interacting binaries*, amount : **3.4M** cpu hours on Fritz

INVITED TALKS

Department Colloquium , the University of Oklahoma, USA	3/2024
Department Colloquium , the University of Colorado, Boulder, USA	2/2024
Department Colloquium , the University of California, San Diego, USA	2/2024
Department Colloquium , the Institute for Astronomy at the University at Hawaii, USA	2/2024
Department Seminar , the Univeristy of the Balearic Islands, Spain	12/2023
Astronomy Seminar , the Univeristy of Nova Gorica, Slovenia	11/2023
Department Colloquium , Kyung Hee University, Korea	11/2023
Plasma Physics Seminar , Max Planck Institute for Plasma Physics, Germany	11/2023
Department Colloquium , SNU, Korea	10/2023
Colloquium , Korea Astronomy & Space Science Institute, Korea	10/2023
Lagrange Seminar , Lagrange Laboratoire, France	09/2023
Astronomy Seminar , Max-Planck Institute for Gravitational Physics(AEI), Germany	09/2023
Special Seminar , New York University, USA	09/2023
Astronomy Seminar , Columbia, USA	09/2023
Astronomy Seminar , Stony Brook University, USA	09/2023
Special Seminar , Northwestern University(CIERA), USA	08/2023
MPA/Kavli Summer Program Seminar , MPA, Germany	06/2023
HUJI Astrophysics Seminar , HUJI, Isreal	03/2023
2022 MIAPP Conference “The Fundamental Role of Stellar Multiplicity in Stellar Dynamics and Evolution” , MIAPP, Germany	11/2022
Department Colloquium , University of Tübingen, Germany	07/2022
Black Hole Workshop , Niels Bohr Institute, Denmark	06/2022
MPA Seminar , MPA, Germany	10/2021
Astro UdeC Seminar , the Universidad de Concepción, Chile	04/2021
CTC Seminar , University of Maryland, USA	06/2019
Wine& Cheese Seminar , JHU, USA	04/2019
Department Seminar , SBU, USA	04/2018
Numerical Scattering Workshop , Flatiron Institute, USA	12/2017
Black Hole Network Workshop , Flatiron Institute, USA	12/2016

	MODEST-16 NYC Gas and Gravitational Dynamics , USA	09/2016
	Frontier Research in Astrophysics – II , Italy	05/2016
	Astronomy Seminar , Columbia University, USA	05/2016
CONTRIBUTED TALKS	Korean Astronomical Society Fall Meeting , KAS, Korea	10/2023
	Two in a Million , ESO, Germany	09/2023
	MODEST23 , Northwestern University, USA	08/2023
	European Astronomical Society Annual Meeting , Krakow, Poland	07/2023
	The Black Holes and Gravitational Waves Munich Day , Germany	05/2023
	Aspen Workshop “Extreme Black Holes” , USA	03/2023
	WE Heraeus-EAS Early Career Researchers in Astr. Workshop , Germany	03/2023
	XMM-Newton Workshop 2022 , Spain	06/2022
	Growing Black Holes: Accretion and Mergers , Nepal	05/2022
	SESTAS Meeting , MPA	10/2021
	HotSci@JHU/STScI , STScI	08/2021
	European Astronomical Society Annual Meeting , Leiden	07/2021
	Tidal Disruptions in Kyoto: Confronting Theory with Observations , Kyoto University, Japan	01/2020
POSTERS	Distorted Astrophysical disks , University of Cambridge	05/2021
	The 7th Annual Johns Hopkins Postdoctoral Conference , JHU	04/2021
STUDENT SUPERVISION	Alonso Herrera (Master’s student, co-supervision with Prof. Nathan Leigh) → Master’s degree awarded	2021-present
	Institute: Universidad de Concepción, Chile Project: Identification of runaway stars using Gaia data Method: Analytic estimates for ejection velocity, analysis of Gaia data	
	Magdalena Andrea Vilaxa Campos (Master’s student, co-supervision with Prof. Nathan Leigh)	2022-present
	Institute: Universidad de Concepción, Chile Project: Stream penetration into mass accretor in Roche-lobe overflow in interacting binaries Method: Analytic estimates and hydrodynamics simulations	
	Kaitlyn Szekerczes (PhD student, co-supervision with Prof. Sherry Suyu)	2022-present
	Institute: formerly a fulbright fellow at MPA → PhD student at Pennsylvania State University Project: Estimate of strongly-lensed tidal disruption event detection rate by LSST Method: Monte-Carlo simulations for gravitational lensing	

	Pavan Vynatheya (PhD student, co-supervision with Dr. Rüdiger Pakmor, Prof. Selma de Mink)	2022-present
	Institute: Formerly a PhD student at MPA → Prize fellow at CITA Project: Remnant properties of partially disrupted stars by stellar-mass black holes Method: Stellar evolution and hydrodynamics simulations	
CERTIFICATION	Korean National Teacher Certification	2011
TEACHING EXPERIENCE	Lecturer , MPA, Germany Delievered a lecture for hydrodynamics at the MPA/Kavli Summer Program	08/2017
	Lecturer , MPA, Germany Delievered lectures for hydrodynamics and led tutorial sessions at a one-day workshop for hydrodynamics simulations at MPA	06/2017
	Guest lecturer , AST200 Course by Prof. Jin Koda, SBU, USA Delivered a lecture for black holes to undergraduate students	02/2017
	Teaching Assistant , Department of Physics and Astronomy, SBU, USA Prepared physics lab experiments and assisted students in conducting experiments	2012-2014
	Teacher , Seoul National University Girls' Middle School, South Korea Taught middle-school students chemistry as part of the teaching practicum course	Spring 2011
	Teaching Assistant , Language Education Institute, SNU, South Korea Volunteer work to assist students who are hearing impaired in their coursework.	Spring 2011
	Lecturer , Central Library, SNU, South Korea Voluneteer work to enhance librarians' grasp of basic scientific concepts in chemistry and physics	Spring 2009
	Lecturer , Hansung high school, South Korea Volunteer work to each mathematics for high-school students	Spring 2009
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> NASA (2023), member of panel review IMPRS (2023), member of PhD application review	
PRESS RELEASE	Close Encounters of stars with the black hole binaries kind - Astrobites: https://astrobites.org/2023/02/02/close-encounters-of-stars-with-the-black-hole-binaries-kind	2/2023
	Supercomputer Simulations Test Star-destroying Black Holes - Making a movie in collaboration with NASA for the annual event "Black Hole Friday" - Official webpage: https://svs.gsfc.nasa.gov/14000	11/2021

- ~0.3M views on YouTube in less than a week
(<https://www.youtube.com/watch?v=ALnlZcRoQDY&t=23s>)
- Articles in public science media: Phys.org, Sciencealert.com, the Jerusalem Post, SciTechDaily and so on.

SCIENTIFIC
OUTREACH
EXPERIENCE

- Girls' day, MPA** 04/2023
Preparation and execution of one of the five sessions where a group of high-school female students complete 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, public science lecture or talk to students visiting MPA
- 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** 06/2023
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 (20 members, My team chosen Best Team of the Year)

COMPUTATIONAL
EXPERIENCE

- Computing Skills:** Fortran, C/C++, Python
- Code:** code-testing of multi-domain infrastructure PATCHWORKMHD, usage of GRMHD code HARM3D, Moving-mesh magnetohydrodynamics code AREPO (<https://arepo-code.org/>), Newtonian AMR hydrodynamics code CASTRO (<https://amrex-astro.github.io/Castro/>)
- Analysis:** Python, Matplotlib, Paraview, Mathematica
- High Performance computing:** USA (Frontera, Stampede, Rockfish, Seawulf), Germany (Hawk hrs, SuperMUC Leibniz, Cobra, Raven, Freya)

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

NON-SCIENTIFIC OUTREACH EXPERIENCE	<p>SNU Obstacle Person Support Center, SNU Spring 2009 Assistant to a hearing-impaired student, and provider of study aid</p> <p>Kyujanggak Institute for Korean Studies, SNU Spring 2011 Docent Program: Improving public understanding of Documentary Heritage of Chosun Dynasty</p> <p>Museum of Art, SNU Spring 2011 Docent Program: Improving public understanding of interactive media art in the Garden of Forking Paths</p>
MILITARY SERVICE	<p>Military Required Service, South Korea 2007 – 2009 Honorably Discharged as a Sergeant Served inter alia in Food/Water Inspectorate (Laboratory) plus assist. mgmt.</p>

References

Professor Rosalba Perna (Associate Department Chair)
Department of Physics and Astronomy, Stony Brook University
Stony Brook, NY 11794-3800, USA
Telephone: +1 (631) 632 1550
Email: rosalba.perna@stonybrook.edu

Professor Selma de Mink (Scientific Director)
The Max Planck Institute for Astrophysics
Karl-Schwarzschild-Str. 1, 85748, Garching, Germany
Telephone: +49 89 30000 - 2201
Email: sedemink@MPA-Garching.MPG.DE

Professor Volker Springel (Scientific Director)
The Max Planck Institute for Astrophysics
Karl-Schwarzschild-Str. 1, 85748, Garching, Germany
Telephone: +49 89 30000 - 2195
Email: vspringel@MPA-Garching.MPG.DE

Professor Sherry Suyu
Technical University of Munich
TUM School of Natural Sciences, Department of Physics
James-Franck-Str. 1, 85748 Garching, Germany
Telephone: +49 (0)89 289 53620
Email: sherry.suyu@tum.de

Professor Zoltan Haiman
Department of Astronomy and Astrophysics, Columbia University
548 West 120th Street, Pupin Hall, Room 3128, New York, NY 10027
Telephone: +1 (212) 854 6822
Email: zh2007@columbia.edu

Professor Julian Krolik
Department of Physics and Astronomy, Johns Hopkins University
Bloomberg Center for Physics and Astronomy,
3400 N. Charles Street, Baltimore, MD 21218, USA
Telephone: +1 (410) 664 7077
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

ads link: <https://ui.adsabs.harvard.edu/user/libraries/mbdD-GljSZ-nQ6a7LbzzQw>

Books

40. **Ryu, T.**, Wever, T., *Tidal Disruption Events*, To appear in Chapter 5 in the review book *Black Holes in the Era of Gravitational Wave Astronomy*, ed. Arca Sedda, Bortolas, Spera, pub. Elsevier., arXiv: 2310.16879

Submitted Articles

39. Broggi, L., Stone, N., **Ryu, T.**, Bortolas, E., Dotti, M., Bonetti, M., Sesana, A., *Repeating partial disruptions and two-body relaxation*, submitted to A&A (2024), arXiv: 2404.05786
38. Lazzati, D., Perna, R., **Ryu, T.**, *Ephemeral Flaring Transients Following Supernova Explosions in Black-Hole Binary Systems*, submitted to ApJL (2024), arXiv:2403.18911
37. Szekeerczes, K., **Ryu, T.**, Suyu, S. H., Huber, S., Oguri, M., Dai, L. *Strong lensing of tidal disruption events: Detection rates in imaging surveys*, submitted A&A (2024), arXiv:2402.03443
36. 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

Articles in Refereed Journals

35. **Ryu, T.**, Perna, R., Cantiello, M., *Tidal Disruption Encores*, ApJ 965, 25 (2024), arXiv: 2402.15990
34. Liu, Z., **Ryu, T.**, Goodwin, A., Rau, A., Homan, D., Krumpe, M., Merloni, A., Grotova, I., Anderson, G., Malyali, A., Miller-Jones, J., *Rapid evolution of the recurrence time in the repeating partial tidal disruption event eRASSt J045650.3-203750*, A&A 683, 13 (2024), arXiv:2401.14091
33. Vynatheya, P., **Ryu, T.**, Pakmor, R., de Mink, S., Perets, H., *Simulating the Tidal Disruption of Stars by Stellar-mass Black Holes Using Moving-mesh Hydrodynamics*, A&A 685, 45 (2024), arXiv: 2310.14852
32. **Ryu, T.**, Amaro Seoane, P., Taylor, A., Ohlmann, S., *Collisions of Red Giants in Galactic Nuclei*, MNRAS 528, 6193 (2024), arXiv: 2307.07338
★ selected as the research highlight of the month in November 2023 by the Max Planck Institute for Astrophysics (<https://www.mpa-garching.mpg.de/1085421/hl202309>)
31. **Ryu, T.**, McKernan, B., Ford, K.E.S., Cantiello, M., Graham, M.J., Stern, D, Leigh, N.W.C. *In-plane Tidal Disruption of Stars in Disks of Active Galactic Nuclei*, MNRAS 527, 8103 (2024), arXiv: 2310.00610

30. **Ryu, T.**, de Mink, S., Farmer, R., Pakmor, R., Perna, R., Springel, V., *Close Encounters of Star-black Hole Binaries with Single Stars*, MNRAS 527, 2734 (2024), arXiv:2307.03097
29. Dessart, L., **Ryu, T.**, Amaro Seoane, P., Taylor, A., *Light curves and spectra for theoretical models of high-velocity red-giant star collisions*, A&A 682, 58 (2024), arXiv: 2310.07036
28. 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*, ApJ 961, 149 (2024), Arxiv: 2303.12846
27. Bellinger, E., Caplan, M., **Ryu, T.**, Bollimpalli, D., Ball, W., Kühnel, F., Farmer, R., de Mink, S., Christensen-Dalsgaard, J, *Solar evolution models with a central black hole*, ApJ 959, 113 (2023)
26. **Ryu, T.**, Krolik, J., Piran, T., Noble, S., Avara, M., *Shocks Power Tidal Disruption Events*, 957, 12 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 525, 5752 (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. Bortolas, E. , **Ryu, T.**, Broggi, L., Sesana, A. *Partial Stellar Tidal Disruption Events and Their Rates*, MNRAS 524, 3026 (2023), Arxiv: 2211.02734
22. **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
21. **Ryu, T.**, Krolik, J., Piran, T. *Extremely Relativistic Tidal Disruption Events*, ApJL 946, 33 (2023), arXiv: 2211.00059
20. **Ryu, T.**, Perna, R., Wang, Y. *Close Encounters of Stars with Stellar-mass Black Hole Binaries*, MNRAS 516, 2204 (2022), arXiv: 2206.00603
19. **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
18. 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
17. **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)
16. **Ryu, T.**, Krolik, J., Piran, T. *Measuring Stellar and Black Hole Masses of Tidal Disruption Events*, ApJ 904.1, 73 (2020), arXiv: 2007.13765
15. 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

14. **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
13. **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
12. **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
11. **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
10. **Ryu, T.**, Zingale, M., Perna, R. *Turbulence-driven Thermal and Kinetic Energy in the Atmospheres of Hot Jupiters*, MNRAS 481, 5517 (2018)
9. 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)
8. **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)
7. 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)
6. **Ryu, T.**, Leigh, N., W. C., Perna, R. *Formation of Runaway Stars in a Star-cluster Potential*, MNRAS 470, 3049 (2017)
5. **Ryu, T.**, Leigh, N., W. C., Perna, R. *An Analytic Method for Identifying Dynamically-formed Runaway Stars*, MNRAS 470, 2 (2017)
4. **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)
3. **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)
2. **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).