

# Ryosuke Hirai

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## Curriculum Vitae

### Personal Information

Name Ryosuke Hirai (平井 遼介)  
Nationality Japanese  
Gender Male  
Date of Birth 12th August, 1989  
Email ryosuke.hirai@monash.edu

### Research Interests

2012– Binary stars and supernovae  
2015– Efficient numerical schemes for difference equations  
2018– Stellar mergers and triple dynamics  
2021– Wind accretion in close binaries

### Education

2014–2017 **Doctor of Science**, Waseda University, Advanced Research Institute of Science and Engineering.  
2012–2014 **Master of Science**, Waseda University, Advanced Research Institute of Science and Engineering.  
2008–2012 **Bachelor of Engineering**, Waseda University, School of Advanced Science and Engineering.

### Languages

Japanese	<b>Mother tongue</b>	
English	<b>Fluent</b>	<i>Spent 8.5 years of childhood in England</i>
Mandarin	<b>Basic</b>	<i>Basic words and phrases only</i>

### Research Experience

2019.12– **Research Fellow**, at School of Physics and Astronomy, Monash University.  
2017–2019 **JSPS Overseas Research Fellow**, at Department of Physics, University of Oxford.  
2017.4–10 **JSPS Research Fellow (PD)**, at Advanced Research Institute of Science and Engineering, Waseda University.

2016–2017 **JSPS Research Fellow (DC2)**, at *Advanced Research Institute of Science and Engineering*, Waseda University.

## Teaching Experience

2021–2022 **Facilitator**, *Astrophysics Book Club*, Monash University.

2020.7–10 **Teaching Assistant**, *PHS1022 (Waves and Quantum Physics)*, Monash University.

2014–2017 **Teaching Assistant**, *Introductory Physics*, Waseda University.

## Research Supervision

### PhD students

2021–2022 **Reinhold Willcox**, *Co-supervised with Ilya Mandel and Eric Thrane*, Monash University, Binary population synthesis, Stripped-envelope supernova fractions.

2020–2023 **Mike Lau**, *Co-supervised with Ilya Mandel and Daniel Price*, Monash University, Smoothed-particle hydrodynamics, Common-envelope evolution.

### Honours students

2021–2022 **Andrew Atta**, *Co-supervised with Ilya Mandel and Bernhard Müller*, Monash University, Partially stripped red supergiant appearances.

2022– **Lewis Picker**, *Co-supervised with Ilya Mandel*, Monash University, Implementing the two-stage common-envelope prescription into population synthesis codes.

### Undergraduate students

2022 **Alvaro Herrera**, *Co-supervised with Ilya Mandel*, Monash University, Searching for black hole binaries in Gaia DR3.

2021–2022 **Andrew Atta**, *Co-supervised with Ilya Mandel*, Monash University, Partially stripped red supergiant appearances.

2021 **Amir Kashapov**, *Co-supervised with Ilya Mandel*, Monash University, Radial evolution of naked helium stars.

2021 **Bayley Tranter**, *Co-supervised with Ilya Mandel*, Monash University, Three-body scattering.

## Grants and Awards

2023 **Best Presentation Prize (1st place)**, *Monash Science ECN Symposium*, 2000 AUD.

2023 **ANU 2.3 m Telescope time allocation (PI)**, 9 dark hours.

2023 **Adapter Allocation Scheme Q2**, *National Computational Infrastructure (NCI) Australia*, 208 KSU on NCI Gadi Supercomputer.

2018 **Hayakawa Satio Fund**, *Astronomical Society of Japan*, ~210000 JPY.

2016–2017 **JSPS Research Fellow (DC2)**, *Fellowship + Grant*, 1200000+1100000 JPY.

2015 **Research Grant for Young Scientists, Early Bird Program** from Waseda Research Institute for Science and Engineering, 400000 JPY.

## Invited Talks

- 2023.5 **Seminar**, *Orange pulsar meeting (online)*, Australia.
- 2022.11 **Invited talk**, *Supernovae in the Gravitational Wave Detection Era*, Australia.
- 2022.11 **Seminar**, *University of Melbourne*, Australia.
- 2022.10 **Seminar**, *University of Delaware (online)*, USA.
- 2022.9 **Seminar**, *Heidelberg Institute for Theoretical Studies*, Germany.
- 2022.9 **Seminar**, *Max Planck Institute for Astrophysics*, Germany.
- 2022.9 **Seminar**, *European Southern Observatory*, Germany.
- 2022.3 **Seminar**, *Rikkyo University*, Japan.
- 2022.3 **Seminar**, *Institute of Cosmic Ray Research, University of Tokyo*, Japan.
- 2021.6 **Seminar**, *Macquarie University (online)*, Australia.
- 2021.6 **Invited talk**, *European Astronomical Society Annual meeting 2021 (online)*, Netherlands.
- 2021.4 **Colloquium**, *Heidelberg (online)*, Germany.
- 2021.3 **Seminar**, *Technion (online)*, Israel.
- 2020.12 **Seminar**, *Hebrew University of Jerusalem (online)*, Israel.
- 2020.11 **Seminar**, *Kyoto University + Yukawa Institute (online)*, Japan.
- 2020.11 **Colloquium**, *SWIFAR, Yunnan University (online)*, China.
- 2020.11 **Colloquium**, *National Astronomical Observatory of Japan (online)*, Japan.
- 2020.10 **Invited talk**, *Stellar alchemy to galactic archaeology (online)*, Japan.
- 2020.5 **Seminar**, *RESCEU, University of Tokyo (online)*, Japan.
- 2020.4 **Colloquium**, *Monash University (online)*, Australia.
- 2020.2 **Invited talk**, *Phantom workshop*, Australia.
- 2019.11 **Colloquium**, *Tohoku University*, Japan.
- 2019.9 **Colloquium**, *JAXA*, Japan.
- 2019.9 **Seminar**, *Waseda University*, Japan.
- 2019.9 **Colloquium**, *University of Tokyo*, Japan.
- 2019.9 **Seminar**, *Peking University*, China.
- 2019.9 **Seminar**, *Yunnan National Astronomical Observatory*, China.
- 2019.4 **Seminar**, *Sheffield University*, UK.
- 2019.3 **Seminar**, *Anton Pannekoek Institute*, Netherlands.
- 2019.3 **Seminar**, *Heidelberg Institute of Theoretical Physics*, Germany.
- 2018.12 **Seminar**, *Chiba Institute of Technology*, Japan.
- 2018.10 **Seminar**, *Department of Earth Sciences, University of Oxford*, UK.
- 2018.9 **Seminar**, *University of Delaware*, USA.
- 2018.6 **Colloquium**, *Department of Physics, University of Oxford*, UK.
- 2018.1 **Seminar**, *Department of Physics, University of Oxford*, UK.
- 2017.12 **Seminar**, *Albert Einstein Institute*, Germany.

- 2017.11 **Seminar**, *Argelander Institute, University of Bonn, Germany.*
- 2017.10 **Colloquium**, *National Astronomical Observatory of Japan, Japan.*
- 2017.10 **Seminar**, *RIKEN, Japan.*
- 2017.5 **Colloquium**, *Institute of Cosmic Ray Research, University of Tokyo, Japan.*
- 2016.7 **Seminar**, *Kyoto University, Japan.*
- 2016.1 **Seminar**, *RESCEU, University of Tokyo, Japan.*
- 2015.7 **Seminar**, *KEK, Japan.*
- 2015.6 **Seminar**, *Kyoto University, Japan.*
- 2014.4 **Seminar**, *RIKEN, Japan.*

## Contributed talks/posters

- 2023.9 **Contributed talk**, *Australian LSST Workshop 2023, Australia.*
- 2023.3 **Contributed poster**, *eXtreme Black Holes, USA.*
- 2023.2 **Contributed talk**, *ANITA workshop 2023, Australia.*
- 2023.2 **Contributed talk**, *Phantom users workshop 2023, Australia.*
- 2022.12 **Contributed talk**, *Gravitational Wave Physics and Astronomy Workshop, Australia.*
- 2022.11 **Contributed talk**, *Supervirtual 2022, Fully online.*
- 2022.6 **Contributed talk**, *ASA Annual science meeting 2022, Australia.*
- 2022.3 **Contributed talk**, *Spring ASJ Annual meeting (online), Japan.*
- 2021.12 **Contributed talk**, *34th Rironkon Symposium (online), Japan.*
- 2021.10 **Contributed talk**, *Asymmetrical Post-main-sequence Nebulae 8 (online), Spain.*
- 2021.9 **Contributed talk**, *Autumn ASJ Annual meeting (online), Japan.*
- 2021.8 **Contributed talk**, *Neutron star workshop 2021 (online), Japan.*
- 2021.7 **Contributed talk**, *ASA Annual science meeting 2021 (online), Australia.*
- 2021.3 **Contributed talk**, *Spring ASJ Annual meeting (online), Japan.*
- 2021.3 **Contributed poster**, *Triple Evolution and Dynamics (online), Israel.*
- 2021.2 **Contributed talk**, *ANITA workshop 2021 (online), Australia.*
- 2021.1 **Contributed talk**, *Binary/Variable star workshop 2020 (online), Japan.*
- 2021.1 **Contributed poster**, *43rd COSPAR Assembly (online), Australia.*
- 2020.2 **Contributed talk**, *ANITA workshop 2020 (online), Australia.*
- 2019.9 **Contributed talk**, *Autumn ASJ Annual meeting, Japan.*
- 2019.5 **Contributed talk**, *FOE19 Fifty-one Erg, USA.*
- 2018.12 **Contributed poster**, *31st Rironkon Symposium, Japan.*
- 2018.11 **Contributed talk**, *Massive stars and supernovae, Argentina.*
- 2018.7 **Contributed talk**, *Frontiers of the Physics of Massive stars, Mexico.*
- 2017.9 **Contributed talk**, *Autumn ASJ Annual meeting, Japan.*
- 2017.7 **Contributed talk**, *Ringberg Workshop, Germany.*
- 2017.7 **Contributed poster**, *FOE17 Fifty-One Erg, USA.*
- 2017.3 **Contributed talk**, *Spring ASJ Annual meeting, Japan.*

- 2017.3 **Contributed talk**, *Ultraluminous X-ray source workshop*, Japan.
- 2017.1 **Contributed talk**, *Workshop on Transient Universe in the Big Survey Era*, Japan.
- 2016.12 **Contributed talk**, *29th Rironkon Symposium*, Japan.
- 2016.10 **Contributed talk**, *Binary/Variable star workshop 2016*, Japan.
- 2016.9 **Contributed talk**, *Autumn ASJ Annual meeting*, Japan.
- 2016.7 **Contributed talk**, *NAOJ-ECT workshop*, Japan.
- 2015.12 **Contributed poster**, *28th Rironkon Symposium*, Japan.
- 2015.9 **Contributed talk**, *Numazu workshop*, Japan.
- 2015.6 **Contributed talk**, *Fifty-One Erg*, USA.
- 2015.3 **Contributed talk**, *Spring ASJ Annual meeting*, Japan.
- 2014.12 **Contributed poster**, *27th Rironkon Symposium*, Japan.
- 2014.10 **Contributed talk**, *2nd DTA Symposium*, Japan.
- 2014.9 **Contributed poster**, *Binary systems, their evolution and environments*, Mongolia.
- 2014.9 **Contributed talk**, *Autumn ASJ Annual meeting*, Japan.
- 2014.2 **Contributed talk**, *Binary star workshop*, Japan.
- 2013.12 **Contributed poster**, *Multi-Messengers from Core-Collapse Supernovae*, Japan.
- 2013.9 **Contributed talk**, *Autumn ASJ Annual meeting*, Japan.

## Service

- 2023– **Referee**, *Physical Review Letters*.
- 2023– **JA representative**, *AAL Australian LSST Management Committee (ALManaC)*.
- 2022– **Referee**, *Astronomy & Astrophysics*.
- 2022– **Referee**, *The Astrophysical Journal*.
- 2021– **Referee**, *Publications of the Astronomical Society of Australia*.
- 2021– **Referee**, *The Astrophysical Journal Letters*.
- 2021–2023 **External Panelist**, *Hubble Space Telescope proposal review*.
- 2021– **Program chair**, *ARC Centre of Excellence for Gravitational Wave Discovery (Oz-Grav)*, *Relativistic Astrophysics program*.
- 2021– **Referee**, *Galaxies*.
- 2021.7 **Conference organiser**, *Nuclear burning in massive stars – towards the formation of binary black holes –*, (Monash hub leader).
- 2020–2022 **Seminar/Colloquia organiser**, *Monash University*.
- 2020– **Referee**, *Publications of the Astronomical Society of Japan*.
- 2019– **Referee**, *Monthly Notices of the Royal Astronomical Society*.
- 2018–2019 **SPI-MAX seminar series organiser**, *University of Oxford*.
- 2015–2017 **Seminar organiser**, *Waseda University*.

## Membership

- 2023– **Astronomical Society of Australia**.

- 2016– **Rironkon (Theoretical astrophysics society of Japan).**  
 2015– **Astronomical Society of Japan.**

## Outreach

- 2023.9 **Public event**, *Notting Hill Neighbourhood House Astronomy Night.*  
 2022.6 **Public Talk**, *Free Public Astronomy Lecture at Swinburne University of Technology.*  
 2022.5 **High School Talk**, *Melbourne High School.*  
 2021.8 **High School Talk**, *Hikawa High School.*  
 2021.3 **High School Talk**, *Waseda Jitsugyo High School.*  
 2019.7 **Public event**, *Cowley Road Carnival.*  
 2019.4 **Public Talk**, *Oxbridge Japanese Society meet-up.*  
 2019.1 **Public event**, *Stargazing Oxford 2019.*  
 2018.1 **Public event**, *Stargazing Oxford 2018.*  
 2015.6 **High School Talk**, *Waseda Jitsugyo High School.*

## Publications

### First Author

- [12] **Constraining mass-transfer and common-envelope physics with post-supernova companion monitoring**  
Ryosuke Hirai  
*Monthly Notices of the Royal Astronomical Society*, Volume 523, Issue 4, pp.6011-6019 (2023)
- [11] **A two-stage formalism for common-envelope phases of massive stars**  
Ryosuke Hirai, Ilya Mandel  
*The Astrophysical Journal Letters*, Volume 937, Issue 2, id.L42, 7 pp. (2022)
- [10] **Neutron stars colliding with binary companions: formation of hypervelocity stars, pulsar planets, bumpy superluminous supernovae and Thorne-Żytkow objects**  
Ryosuke Hirai, Philipp Podsiadlowski  
*Monthly Notices of the Royal Astronomical Society*, Volume 517, Issue 3, pp.4544-4556 (2022)
- [9] **Conditions for accretion disc formation and observability of wind-accreting X-ray binaries**  
Ryosuke Hirai, Ilya Mandel  
*Publications of the Astronomical Society of Australia*, Volume 38, article id. e056 (2021)
- [8] **Simulating the formation of  $\eta$  Carinae's surrounding nebula through unstable triple evolution and stellar merger-induced eruption**  
Ryosuke Hirai, Philipp Podsiadlowski, Stanley Owocki, Fabian R. N. Schneider, Nathan Smith  
*Monthly Notices of the Royal Astronomical Society*, Volume 503, Issue 3, pp.4276-4296 (2021)

- [7] **Formation pathway for lonely stripped-envelope supernova progenitors: implications for Cassiopeia A**  
Ryosuke Hirai, Toshiki Sato, Philipp Podsiadlowski, Alejandro Vigna-Gómez, Ilya Mandel  
*Monthly Notices of the Royal Astronomical Society*, Volume 499, Issue 1, pp.1154-1171 (2020)
  - [6] **Comprehensive study of ejecta-companion interaction for core-collapse supernovae in massive binaries**  
Ryosuke Hirai, Philipp Podsiadlowski, Shoichi Yamada  
*The Astrophysical Journal*, Volume 864, Issue 2, article id. 119, 17 pp. (2018)
  - [5] **The Origin of the Possible Massive Black Hole in the Progenitor System of iPTF13bvn**  
Ryosuke Hirai  
*Monthly Notices of the Royal Astronomical Society: Letters*, Volume 469, Issue 1, p.L94-L98 (2017)
  - [4] **Formation Scenario of the Progenitor of iPTF13bvn Revisited**  
Ryosuke Hirai  
*Monthly Notices of the Royal Astronomical Society*, Volume 466, Issue 4, p.3775-3783 (2017)
  - [3] **Hyperbolic Self-Gravity Solver for Large Scale Hydrodynamical Simulations**  
Ryosuke Hirai, Hiroki Nagakura, Hirotada Okawa, Kotaro Fujisawa  
*Physical Review D*, Volume 93, Issue 8, article id.083006 (2016)
  - [2] **Possible Signatures of Ejecta-Companion Interaction in iPTF 13bvn**  
Ryosuke Hirai, Shoichi Yamada  
*The Astrophysical Journal*, Volume 805, Issue 2, article id. 170, 7 pp. (2015)
  - [1] **The Outcome of Supernovae in Massive Binaries; Removed Mass, and its Separation Dependence**  
Ryosuke Hirai, Hidetomo Sawai, Shoichi Yamada  
*The Astrophysical Journal*, Volume 792, Issue 1, article id. 66, 15 pp. (2014)
- Co-Author
- [22] **SN 2022jli: a type Ic supernova with periodic modulation of its light curve and an unusually long rise**  
 Moore et al. (including R. Hirai)  
 accepted for publication in ApJL
  - [21] **The Impact of Angular Momentum Loss on the Outcomes of Binary Mass Transfer**  
 Reinhold Willcox, Morgan MacLeod, Ilya Mandel, Ryosuke Hirai  
 submitted to ApJL
  - [20] **Time-independent Simulations of Steady-State Accretion with Nuclear Burning**  
 Kaho Tse, Alexander Heger, Ryosuke Hirai, Duncan Galloway  
 submitted to ApJ

- [19] **Rapid population synthesis of black-hole high-mass X-ray binaries: implications for binary stellar evolution**  
Isobel M. Romero-Shaw, [Ryosuke Hirai](#), Arash Bahramian, Reinhold Willcox, Ilya Mandel  
*Monthly Notices of the Royal Astronomical Society*, Volume 524, Issue 1, pp.245-259 (2023)
- [18] **The Galactic underworld: The spatial distribution of compact remnants**  
David Sweeney, Peter Tuthill, Sanjib Sharma, [Ryosuke Hirai](#)  
*Monthly Notices of the Royal Astronomical Society*, Volume 516, Issue 4, pp.4971-4979 (2022)
- [17] **Common envelopes in massive stars II: The distinct roles of hydrogen and helium recombination**  
Mike Y. M. Lau, [Ryosuke Hirai](#), Daniel J. Price, Ilya Mandel  
*Monthly Notices of the Royal Astronomical Society*, Volume 516, Issue 4, pp.4669-4678 (2022)
- [16] **Common envelope binary interaction simulations between a thermally-pulsating AGB star and a low mass companion**  
Miguel González-Bolívar, Orsola De Marco, Mike Y. M. Lau, [Ryosuke Hirai](#), Daniel J. Price  
*Monthly Notices of the Royal Astronomical Society*, Volume 517, Issue 3, pp.3181-3199 (2022)
- [15] **An environmental analysis of the Type Ib SN 2019yvr and the possible presence of an inflated binary companion**  
Ning-Chen Sun, Justyn R. Maund, Paul Crowther, [Ryosuke Hirai](#), Amir Kashapov, Ji-Feng Liu, Liang-Duan Liu, Emmanouil Zapartas  
*Monthly Notices of the Royal Astronomical Society*, Volume 510, Issue 3, pp.3701-3715 (2022)
- [14] **Common envelopes in massive stars: The role of radiation pressure and recombination energy in ejecting red supergiant envelopes**  
Mike Lau, [Ryosuke Hirai](#), Miguel González-Bolívar, Daniel J. Price, Orsola De Marco and Ilya Mandel  
*Monthly Notices of the Royal Astronomical Society*, Volume 512, Issue 4, pp.5462-5480 (2022)
- [13] **Rapid stellar and binary population synthesis with COMPAS**  
Team COMPAS: Riley et al. (including [Ryosuke Hirai](#))  
*The Astrophysical Journal Supplement Series*, Volume 258, Issue 2, id.34, 30 pp. (2022)
- [12] **COMPAS: A rapid binary population synthesis suite**  
Team COMPAS: Riley et al. (including [Ryosuke Hirai](#))  
*Journal of Open Source Software*, vol. 7, issue 69, id. 3838 (2022)
- [11] **Stellar Core-Merger-Induced Collapse: new Formation Pathways for Black Holes, Thorne-Żytkow objects, Magnetars and Superluminous Supernovae**  
Iminhaji Ablimit, Philipp Podsiadlowski, [Ryosuke Hirai](#), James Wicker  
*Monthly Notices of the Royal Astronomical Society*, Volume 513, Issue 4, pp.4802-4813 (2022)



- [10] **Supernova explosions in active galactic nuclear discs**  
Evgeni Grishin, Alexey Bobrick, Ryosuke Hirai, Ilya Mandel, Hagai B. Perets  
*Monthly Notices of the Royal Astronomical Society*, Volume 507, Issue 1, pp.156-174 (2021)
- [9] **The observability of inflated companion stars after supernovae in massive binaries**  
Misa Ogata, Ryosuke Hirai, Kotaro Hijikawa  
*Monthly Notices of the Royal Astronomical Society*, Volume 505, Issue 2, pp.2485-2499 (2021)
- [8] **Wind Mass-loss Rates of Stripped Stars Inferred from Cygnus X-1**  
Coenraad J. Neijssel, Serena Vinciguerra, Alejandro Vigna-Gómez, Ryosuke Hirai, James C. A. Miller-Jones, Arash Bahramian, Thomas J. Maccarone, Ilya Mandel  
*The Astrophysical Journal*, Volume 908, Issue 2, id.118, 9 pp. (2021)
- [7] **Neutron Star Extreme Matter Observatory: A kilohertz-band gravitational-wave detector in the global network**  
Ackley et al. (including Ryosuke Hirai)  
*Publications of the Astronomical Society of Australia*, Volume 37, article id. e047 (2020)
- [6] **The sensitivity of presupernova neutrinos to stellar evolution models**  
Chinami Kato, Ryosuke Hirai, Hiroki Nagakura  
*Monthly Notices of the Royal Astronomical Society*, Volume 496, Issue 3, pp.3961-3972 (2020)
- [5] **A Subsolar Metallicity Progenitor for Cassiopeia A, the Remnant of a Type IIb Supernova**  
Toshiki Sato, Takashi Yoshida, Hideyuki Umeda, Shigehiro Nagataki, Masaomi Ono, Keiichi Maeda, Ryosuke Hirai, John P. Hughes, Brian J. Williams, Yoshitomo Maeda  
*The Astrophysical Journal*, Volume 893, Issue 1, id.49, 9 pp. (2020)
- [4] **Origins of Type Ibn SNe 2006jc/2015G in interacting binaries and implications for pre-SN eruptions**  
Ning-Chen Sun, Jusytn R. Maund, Ryosuke Hirai, Paul A. Crowther, Philipp Podsiadlowski  
*Monthly Notices of the Royal Astronomical Society*, Volume 491, Issue 4, p.6000-6019 (2020)
- [3] **Hydrodynamical simulations and similarity relations for eruptive mass loss from massive stars**  
Stanley P. Owocki, Ryosuke Hirai, Philipp Podsiadlowski, Fabian R. N. Schneider  
*Monthly Notices of the Royal Astronomical Society*, Volume 485, Issue 1, p.988-1000 (2019)
- [2] **The W4 method: a new multi-dimensional root-finding scheme for nonlinear systems of equations**  
Hirotada Okawa, Kotaro Fujisawa, Yu Yamamoto, Ryosuke Hirai, Nobutoshi Yasutake, Hiroki Nagakura, Shoichi Yamada  
*Applied Numerical Mathematics*, Volume 183, p.157-172 (2023)

- [1] **Formation pathway of Population III coalescing binary black holes through stable mass transfer**

Kohei Inayoshi, [Ryosuke Hirai](#), Tomoya Kinugawa, Kenta Hotokezaka

*Monthly Notices of the Royal Astronomical Society*, Volume 468, Issue 4, p.5020-5032 (2017)

Other Articles

- [3] **Roman CCS White Paper: Characterizing the Galactic population of isolated black holes**

C. Y. Lam et al. (including [R. Hirai](#))

arXiv: 2306.12514

- [2] **Science Cases for the Keck Wide-Field Imager**

J. Cooke et al. (including [R. Hirai](#))

arXiv: 2207.11698

- [1] **水素欠乏超新星の親星の起源(The Origin of the Progenitors of Stripped-Envelope Supernovae)**

平井 遼介 (Ryosuke Hirai)

天文月報(*The Astronomical Herald*), Volume 111, Issue 9, p.580-588 (2018)