Dr. Sambaran Banerjee

Personal details

Name:	Sambaran Banerjee (he/him/his)
Date of birth:	06.04.1979
Nationality:	Indian (passport), German (permanent resident)
Office Address:	Argelander-Institut für Astronomie Auf dem Hügel 71, 53121 Bonn, Germany
E-mail:	sambaran@astro.uni-bonn.de
E-mail (alternative):	sambaran.banerjee@gmail.com
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Present position:	Independent researcher and principal investigator, Helmholtz-Instituts für Strahlen- und Kernphysik (HISKP) and Argelander-Institut für Astronomie (AIfA) University of Bonn, Germany
Personal webpage:	`https://astro.uni-bonn.de/~sambaran/index.html`
ORCiD ID:	`https://orcid.org/0000-0002-1254-2603`
WoS Researcher ID:	`AEQ-8353-2022`
IAU:	`https://www.iau.org/administration/membership/individual/19188/`

Academic career

- August 2018 - present, Independent researcher and principal investigator (DFG-funded "temporary position for principal investigator" on the project "The dynamics of stellar-mass black holes in dense stellar systems and their role in gravitational-wave generation"; project no. 405620641), Helmholtz-Instituts für Strahlen- und Kernphysik (HISKP) and Argelander-Institut für Astronomie (AIfA), University of Bonn, Germany. (Funding periods: August 2018 - July 2020, April 2023 -)
- December 2010 - June 2018, Postdoctoral researcher (Wissenschaftlicher Mitarbeiter), Argelander-Institut für Astronomie and Helmholtz-Instituts für Strahlen- und Kernphysik, University of Bonn, Germany.
- October 2008 - November 2010, Alexander von Humboldt (AvH) Fellow, Argelander-Institut für Astronomie, University of Bonn, Germany.
  (October 2008 - November 2008, Intensive German language course at Goethe-Institut Bonn-Bad Godesberg as part of AvH fellowship)
- August 2003 - May 2008, Senior Research Fellow, Tata Institute of Fundamental Research (TIFR), Mumbai, India.
- August 2001 - July 2003, Junior Research Fellow, TIFR, Mumbai, India.
- September 1998 – June 2001, B. Sc. in Physics, Presidency College, University of Calcutta, India.

Ph. D. thesis

Title:	Formation and evolution of X-ray binaries in globular clusters
Adviser:	Prof. Pranab Ghosh, Department of Astronomy & Astrophysics, Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai 400005, India.
Doctorate:	December 2008 (provisional degree certificate in August 2008)

M. Sc. thesis

Title:	Diagnostics of Milky Way's star formation history: global connections and birthrates of low-mass X-ray binaries and recycled pulsars
Adviser:	Prof. Pranab Ghosh, Department of Astronomy & Astrophysics, Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai 400005, India.
Graduation:	November 2006

Lectures

- Lectures on **"Dynamics of stellar mass black holes in dense stellar systems"** in the winter semester course *"The physics of dense stellar systems" (astro853)* at the Argelander-Institut für Astronomie, University of Bonn. Held in 2010, 2011, 2013, and 2015.
- *Invited lecture series "Selected chapters on astrophysics"* on the topic **"Dynamics of black holes in dense stellar systems"** at the Astronomical Institute of Charles University, Prague. Held during 4-6 November 2019 (three lectures).
  Lecture slides available on this page (see across 11/2019): `https://astro.mff.cuni.cz/chapters.html`

Supervision of students

Masters-level students

- Name: Shivani Harer (internship)
  Institution: University of Bonn
- Name: Kaila Nathaniel ("AstroSem" reading course)
  Institution: University of Bonn
- Name: Iffat Ilyas (internship)
  Institution: University of Bonn
- Name: Maria Tsedrik ("AstroSem" reading course)
  Institution: University of Bonn
- Name: Iffat Ilyas ("AstroSem" reading course)
  Institution: University of Bonn
- Name: Shafqat Riaz (masters thesis project; doctoral candidate at Fudan University, Shanghai)
  Institution: University of Bonn
- Name: Nina Brinkmann (masters thesis project; doctoral candidate at MPIfR, Bonn)
  Institution: Argelander-Institut für Astronomie, University of Bonn
- Name: Matthias Kruckow (masters thesis project; doctorate at AIfA, Bonn)
  Institution: Argelander-Institut für Astronomie, University of Bonn
- Name: Bhawna Motwani (internship; doctorate at Caltech, U.S.A.)
  Institution: Argelander-Institut für Astronomie, University of Bonn

Organization of scientific conferences/meetings

(copy the URL into your browser's address bar in case the link is broken)

"631. WE-Heraeus-Seminar: Stellar aggregates over mass and spatial scales", 5-9 December 2016, at *Physikzentrum Bad Honnef*, Germany.
Attended by *more than 70 (international including overseas) participants.*
Role: PI, primary scientific organizer
URL: `http://astro.uni-bonn.de/conferences/aggregates2016/index.html`

"The dance of stars: dense stellar systems from infant to old (MODEST 14)", 2 - 6 June 2014, at *Physikzentrum Bad Honnef*, Germany.
Attended by *more than 100 (international including overseas) participants.*
Role: PI, primary scientific organizer and primary local coordinator
URL: `http://www.astro.uni-bonn.de/~sambaran/DS2014/index.html`

"Third Aarseth N-body meeting", 11 - 13 December 2013, at *Argelander-Institut für Astronomie* and *Max-Planck-Institut für Radioastronomie*, Bonn, Germany.
Attended by about 25 international participants.
Role: primary scientific and local organizer
URL: `http://www.astro.uni-bonn.de/~sambaran/christmas_nbody2013/christmas_nbody2013.html`

"Second Aarseth N-body meeting", 3 - 5 December 2012, at *Argelander-Institut für Astronomie*, Bonn, Germany.
Attended by about 30 international participants.
Role: primary scientific and local organizer
URL: `http://www.astro.uni-bonn.de/~sambaran/christmas_nbody2012.html`

Successful grants as the Principal Investigator (PI)/Science PI/primary applicant

- **"The dynamics of stellar-mass black holes in dense stellar systems and their role in gravitational-wave generation"** (BA 4281/6-3)
  Type: Individual research grant (Eigene Stelle) from the *Deutsche Forschungsgemeinschaft (DFG; German Research Foundation)*
  Role: PI/Science PI/sole applicant
  Amount: approx. 321K Euro
  Year: 2022
  URL: `https://gepris.dfg.de/gepris/projekt/405620641`

- **"The dynamics of stellar-mass black holes in dense stellar systems and their role in gravitational-wave generation"** (BA 4281/6-1)
  Type: Individual research grant (Eigene Stelle) from the *Deutsche Forschungsgemeinschaft (DFG; German Research Foundation)*
  Role: PI/Science PI/sole applicant
  Amount: approx. 183K Euro
  Year: 2018
  URL: `https://gepris.dfg.de/gepris/projekt/405620641`

- **"Stellar aggregates over mass and spatial scales"**
  Type: Grant for organizing an international conference from the *Wilhelm und Else Heraeus-Stiftung*
  Role: PI/Science PI/primary applicant (co-applicants: Roberto Dolcetta, Stefan Gillessen, Susanne Pfalzner)
  Amount: approx. 43.5K Euro
  Year: 2016

- **"The dance of stars: dense stellar systems from infant to old (MODEST 14)"** (BA 4281/3-1)
  Type: Grant for organizing an international conference from the *Deutsche Forschungsgemeinschaft (DFG; German Research Foundation)*
  Role: PI/Science PI/primary applicant (co-applicant: Pavel Kroupa)
  Amount: approx. 25K Euro
  Year: 2013

- **"Compact binaries in dense stellar systems"**
  Type: Postdoctoral research fellowship of the *Alexander von Humboldt Foundation (AvH)*
  Role: PI/Science PI (prize fellow)/sole applicant
  Amount: Postdoctoral position for 2 years plus travel/publication costs (approx. 84K Euro)
  Year: 2008

Peer reviewing

- Referee for articles (at least 85 manuscripts; verifiable in Web of Science, formerly Publons, against id AEQ-8353-2022) in major astronomy-related journals, namely, MNRAS (36), A&A (5), ApJ (13), ApJ Letters (8), ApJ Supplement Series (2), Physical Review D (16), Physical Review Letters (2), PASJ (2), and Nature (1).
  [I have served as a referee for one of the LIGO-Virgo discovery papers published in 2020.]

- Merit Reviewer/Written Reviewer of grant proposals (5 so far) for the National Science Foundation of the U.S.A. (NSF individual grants; 1), the European Research Council (ERC starter and consolidator grants; 2), The Netherlands Organisation for Scientific Research (NWO Veni grants; 1), and the National Aeronautics and Space Administration (NASA research fellowships; 1).

- External reviewer for a doctoral thesis at the Sapienza University of Rome (Candidate: Dr. Sara Rastello).

Scientific editing

I am serving as a Guest Editor of the Special Issue entitled "Research Progress in Star Clusters and Stellar Systems" in the journal Galaxies.
URL: `https://www.mdpi.com/journal/galaxies/special_issues/star_clusters_stellar_systems`

Academic awards

- Individual research grant from the *Deutsche Forschungsgemeinschaft* (DFG): year 2022
- Individual research grant from the *Deutsche Forschungsgemeinschaft* (DFG): year 2018
- Grant for organizing an international conference from the *Wilhelm und Else Heraeus-Stiftung*: year 2016
- Grant from International Astronomical Union (IAU): year 2015 (for attending IAU General Assembly 2015)
- Grant from International Astronomical Union (IAU): year 2014 (for attending IAU Symposium 312; offered)
- Grant for organizing an international conference from the *Deutsche Forschungsgemeinschaft* (DFG): year 2013
- Summer visitor program at the Aspen Center for Physics (partly supported by the National Science Foundation): year 2012, (2017; offered)
- Alexander von Humboldt fellowship for young researchers: year 2008
- Grant from International Astronomical Union (IAU): year 2007 (for attending IAU Symposium 246)

Scientific publications

Refereed articles/book chapters with a major author contribution

1. **"Binary black hole mergers from young massive clusters in the pair-instability supernova mass gap"**, Sambaran Banerjee, 2022, *Astronomy & Astrophysics*, 665, A20

2. **"Black hole - black hole total merger mass and the origin of LIGO/Virgo sources"**, K. Belczynski, Z. Doctor, M. Zevin, A. Olejak, S. Banerjee, D. Chattopadhyay, 2022, *The Astrophysical Journal*, 935, 126

3. **"A Monte Carlo study of early gas expulsion and evolution of stars clusters: new simulations with the MOCCA code in the AMUSE framework"**, A. Leveque, M. Giersz, S. Banerjee, E. Vesperini, J. Hong, S. Portegies Zwart, 2022, *Monthly Notices of Royal Astronomical Society*, 514, 5739

4. **"Merger rate density of stellar-mass binary black holes from young massive clusters, open clusters, and isolated binaries: comparisons with LIGO-Virgo-KAGRA results"**, Sambaran Banerjee, 2022, *Physical Review D*, 105, 023004

5. **"Preparing the next gravitational million-body simulations: Evolution of single and binary stars in Nbody6++GPU, MOCCA and McLuster"**, Kamlah, A. W. H., Leveque, A., Spurzem, R., Arca Sedda, M., Askar, A., Banerjee, S., Berczik, P., Giersz, M., Hurley, J., Belloni, D., Kühmichel, L., Wang, L., 2022, *Monthly Notices of Royal Astronomical Society*, 511, 4060

6. **"Binary black hole mergers from young massive and open clusters: comparison to GWTC-2 gravitational wave data"**, Giacomo Fragione and Sambaran Banerjee, 2021, *The Astrophysical Journal Letters*, 913, L29

7. **"Stellar-mass black holes in young massive and open stellar clusters V: comparisons with LIGO-Virgo merger rate densities"**, Sambaran Banerjee, 2021, *Monthly Notices of Royal Astronomical Society*, 503, 3371

8. **"Stellar-mass black holes in young massive and open stellar clusters and their role in gravitational-wave generation IV: updated stellar-evolutionary and black hole spin models and comparisons with the LIGO-Virgo O1/O2 merger-event data"**, Sambaran Banerjee, 2021, *Monthly Notices of Royal Astronomical Society*, 500, 3002

9. **"LISA sources from young massive and open stellar clusters"**, Sambaran Banerjee, 2020, *Physical Review D*, 102, 103002

10. **"Demographics of neutron stars in young massive and open clusters"**, Giacomo Fragione and Sambaran Banerjee, 2020, *The Astrophysical Journal Letters*, 901, L16

11. **"On the formation of low-spinning 100 $M_\odot$ black holes"**, Krzysztof Belczynski and Sambaran Banerjee, 2020, *Astronomy & Astrophysics Letters*, 640, L20

12. **"BSE versus StarTrack: implementations of new wind, remnant-formation, and natal-kick schemes in NBODY7 and their astrophysical consequences"**, Sambaran Banerjee, Krzysztof Belczynski, Christopher L. Fryer, Peter Berczik, Jarrod R. Hurley, Rainer Spurzem, Long Wang, 2020, *Astronomy & Astrophysics*, 639, A41

13. **"Stellar-mass black holes in young massive and open stellar clusters and their role in gravitational-wave generation III: dissecting black hole dynamics"**, Sambaran Banerjee, 2018, *Monthly Notices of Royal Astronomical Society*, 481, 5123

14. **"Neutron stars and millisecond pulsars in star clusters: implications for the diffuse γ-radiation from the Galactic Centre"**, Giacomo Fragione, Václav Pavlík, and Sambaran Banerjee, 2018, *Monthly Notices of Royal Astronomical Society*, 480, 4955

15. **"Formation of Very Young Massive Clusters and implications for globular clusters"**, Sambaran Banerjee and Pavel Kroupa, 2018. Review chapter published in *The Birth of Star Clusters*, ed. S. Stahler, Astrophysics and Space Science Library, Volume 424, Springer International Publishing AG, 2018, p.143 (arXiv:1512.03074)

16. **"Stellar-mass black holes in young massive and open stellar clusters and their role in gravitational-wave generation - II"**, Sambaran Banerjee, 2018, *Monthly Notices of Royal Astronomical Society*, 473, 909

17. **"Stellar-mass black holes in young massive and open stellar clusters and their role in gravitational-wave generation"** , Sambaran Banerjee, 2017, *Monthly Notices of Royal Astronomical Society*, 467, 524

18. **"How can young massive clusters reach their present-day sizes?"**, Sambaran Banerjee and Pavel Kroupa, 2017, *Astronomy & Astrophysics*, 597, A28

19. **"The bound fraction of young star clusters"**, N. Brinkmann, S. Banerjee, B. Motwani, P. Kroupa, 2017, *Astronomy & Astrophysics*, 600, A49

20. **"The formation of NGC 3603 young starburst cluster: 'prompt' hierarchical assembly or monolithic starburst?"**, Sambaran Banerjee and Pavel Kroupa, 2015, *Monthly Notices of Royal Astronomical Society*, 447, 732

21. **"A Perfect Starburst Cluster made in One Go: The NGC 3603 Young Cluster"**, Sambaran Banerjee and Pavel Kroupa, 2014, *The Astrophysical Journal*, 787, 158

22. **"Did the Infant R136 and NGC 3603 Clusters Undergo Residual Gas Expulsion?"**, Sambaran Banerjee and Pavel Kroupa, 2013, *The Astrophysical Journal*, 764, 29

23. **"On the true shape of the upper end of the stellar initial mass function. The case of R136"**, Sambaran Banerjee and Pavel Kroupa, 2012, *Astronomy & Astrophysics*, 547, 23

24. **"The Emergence of Super-Canonical Stars in R136-Type Starburst Clusters"**, Sambaran Banerjee, Pavel Kroupa and Seungkyung Oh, 2012, *Monthly Notices of Royal Astronomical Society*, 426, 1416

25. **"Runaway Massive Stars from R136: VFTS 682 is Very Likely a 'Slow Runaway' "**, Sambaran Banerjee, Pavel Kroupa and Seungkyung Oh, 2012, *The Astrophysical Journal*, 746, 15

26. **"A New Type of Compact Stellar Population: Dark Star Clusters"**, Sambaran Banerjee and Pavel Kroupa, 2011, *The Astrophysical Journal Letters*, 741, L12

27. **"Stellar-mass Black Holes in Star Clusters: Implications for Gravitational Wave Radiation"**, Sambaran Banerjee, Holger Baumgardt and Pavel Kroupa, 2010, *Monthly Notices of Royal Astronomical Society*, 402, 371

28. **"Evolution of Compact Binary Populations in Globular Clusters: A Boltzmann Study. II. Introducing Stochasticity"**, Sambaran Banerjee and Pranab Ghosh, 2008, *The Astrophysical Journal*, 680, 1438

29. **"Evolution of Compact Binary Populations in Globular Clusters: A Boltzmann Study. I. The Continuous Limit"**, Sambaran Banerjee and Pranab Ghosh, 2007, *The Astrophysical Journal*, 670, 1090

30. **"Collisional hardening of compact binaries in globular clusters"**, Sambaran Banerjee and Pranab Ghosh, 2006, *Monthly Notices of Royal Astronomical Society*, 373, 1188

Note

In a few of the refereed articles with a major author contribution, as listed above, Dr. Banerjee is beyond the third author. In such cases, Dr. Banerjee has either contributed key research data or led key code developments.

In all other works listed above, Dr. Banerjee has solely taken care of every aspect of the work, including performing the direct N-body simulations (especially, in the single-authored papers), or has done the work, including the simulations, written the paper, and led addressing the reviewer reports (first-authored papers), or has performed key parts of the work/simulations and has helped in writing the paper and in addressing the reviewer reports (second- or third-authored papers).

Other refereed articles with minor author contribution

1. **"Black hole mergers in compact star clusters and massive black hole formation beyond the mass-gap"**, Rizzuto, F. P., Naab, T., Spurzem, R., Arca-Sedda, M., Giersz, M., Ostriker, J. P., Banerjee, S., 2022, *Monthly Notices of Royal Astronomical Society*, 512, 884
2. **"The bound mass of Dehnen models with centrally peaked star formation efficiency"**, Shukirgaliyev, B., Otebay, A., Sobolenko, M., Ishchenko, M., Borodina, O., Panamarev, T., Myrzakul, S., Kalambay, M., Naurzbayeva, A., Abdikamalov, E., Polyachenko, E., Banerjee, S., Berczik, P., Spurzem, R., Just, A., 2021, *Astronomy & Astrophysics*, 654, A53
3. **"Possible smoking-gun evidence for initial mass segregation in re-virialized post-gas expulsion globular clusters"**, Hosein Haghi, Akram Hasani Zonoozi, Pavel Kroupa, Sambaran Banerjee, Holger Baumgardt, 2015, *Monthly Notices of Royal Astronomical Society*, 454, 3872
4. **"R144: a very massive binary likely ejected from R136 through a binary-binary encounter"**, Seungkyung Oh, Pavel Kroupa and Sambaran Banerjee, 2014, *Monthly Notices of Royal Astronomical Society*, 437, 4000
5. **"A multiphysics and multiscale software environment for modeling astrophysical system"**, S. Portegies Zwart, S. McMillan, S. Harfst, et al. (including S. Banerjee), 2009, *New Astronomy*, 14, 369
6. **"A Multiphysics and Multiscale Software Environment for Modeling Astrophysical Systems"**, S. Portegies Zwart, S. McMillan, B. Ó Nualláin, D. Heggie, J. Lombardi, P. Hut, S. Banerjee, et al., 2008, *Lecture Notes in Computer Science*, 5102, 207

Un-refereed articles

1. **"On the formation of exotic, massive, stellar-remnant black holes at solar and sub-solar metallicities through evolution of massive binaries"**, Sambaran Banerjee, arXiv:1912.06022
2. **"Blue straggler formation at core collapse"**, Sambaran Banerjee, 2017, *Memorie della Societa Astronomica Italiana*, 87, 497
3. **"Initial conditions of formation of starburst clusters: constraints from stellar dynamics"**, Sambaran Banerjee, To appear in the proceedings of IAU Symposium 316 of the XXIXth IAU General Assembly, Hawaii, USA, "Formation, evolution and survival of massive star clusters", C. Charbonnel and A. Nota eds., arXiv:1510.06030 (preprint)
4. **"Very Massive Stars (VMS) in the Local Universe"**, J.S. Vink, A. Heger, M.R. Krumholz, J. Puls, S. Banerjee, et al., 2013, Proceedings of Joint Discussion 2 at XXVIIIth IAU General Assembly, Beijing, China, August 2012. To be published in Hightlights of Astronomy, ed. T. Montmerle. arXiv:1302.2021 (preprint)
5. **"Stellar mass black holes in star clusters: gravitational wave emission and detection rates"**, Sambaran Banerjee, Proceedings of *25th Texas Symposium on Relativistic Astrophysics - TEXAS 2010*, PoS (Texas 2010) 058 arXiv:1102.4614 (preprint)
6. **"Stellar-mass black holes in star clusters: implications for gravitational-wave radiation"**, Sambaran Banerjee, Holger Baumgardt and Pavel Kroupa, 2010, Proceedings of IAU Symposium 266 of the XXVIIth IAU General Assembly at Rio de Janerio, Brazil, August 2009, 213p
7. **"Evolution of compact binary population in dense stellar systems: a Boltzmann approach"**, Sambaran Banerjee and Pranab Ghosh, 2008, *Astronomische Nachrichten*, 329, 988
8. **"Evolution of Compact-Binary Population in Globular Clusters: A Boltzmann Study"**, Sambaran Banerjee and Pranab Ghosh, 2008, Proceedings of *Dynamical Evolution of Dense Stellar Systems* (IAU Symposium 246) at Capri, Italy, September 2007, 246p

Publication metrics

- Citations: 1468
- Normalized citations: 748.4
- h-index: 21
- number of papers exceeding 100 citations: 4
- number of single-authored, refereed papers: 8 (accepted/published), > 300 citations

Information from NASA ADS as of February 2023 (see the link below for updates):
`https://ui.adsabs.harvard.edu/public-libraries/xIIQFD5ZSjOMQNiymbTMvA`

Scientific talks

Selected talks at international conferences/workshops

1. **"Dynamical gravitational-wave sources in the Universe from young massive and open star clusters"**, at *Niels Bohr International Academy Workshop on Black Hole Dynamics*, June 2022, Copenhagen, Denmark. **(Invited)**
2. **" Merger rate density of stellar-mass binary black holes from young massive clusters, open clusters, and isolated binaries"**, at *Volkswagen Trilateral Project Meeting (virtual)*, September 2021 (online talk)
3. **"Dynamical binary black hole mergers in young and open clusters"**, at *Modest 21a virtual*, July 2021 (online talk; **Invited**)
4. **"Dynamical binary black hole mergers in young and open clusters: comparisons with LIGO-Virgo data and rates"**, at *Virtual meeting of the IAU Commission B1 (computational astrophysics)*, November 2020 (online talk; **Invited**)
5. **"Dynamical binary black hole mergers in young and open clusters: comparisons with LIGO-Virgo data"**, at *Virtual annual meeting of the German Astronomical Society*, September 2020 (online talk).
6. **"Black holes in dense stellar clusters"** `(blackboard talk)`, at *Tal Alexander meeting 2019*, August 2019, Alájar, Spain.
7. **"NBODY6/7: the story so far and what's next"**, at *First MIDAS workshop*, December 2018, Beijing, China. **(Invited)**
8. **"Stellar mass black holes in star clusters and their role in gravitational-wave generation"**, at *Cluster Dynamics workshop*, December 2018, CIERA, Northwestern University, U.S.A. **(Invited)**
9. **"Dynamical formation of relativistic triple (and higher-order-multiple) systems in stellar clusters"**, at *Triple Evolution and Dynamics Trendy-2 (Lorentz Center Workshop)*, September 2018, Leiden, Netherlands.
10. **"Stellar mass black holes in star clusters and their role in gravitational-wave generation"**, at *SFB 881 international workshop: Star clusters around the Milky Way and in the Local Group*, August 2018, Heidelberg. **(Invited)**
11. **"Stellar mass black holes in young massive and open clusters and their role in gravitational-wave generation"**, at *Dense Stellar Systems in the Era of Gaia, LIGO & LISA (MODEST 18)*, June 2018, Santorini.
12. **"Black holes and neutron stars in dense stellar systems"**, at *"M+2-nd Aarseth N-body Meeting"*, December 2017, Prague. **(Invited)**
13. **"Neutron stars and black holes in dense stellar systems"**, at *11th Bonn Workshop on Formation and Evolution of Neutron Stars*, December 2017, Bonn.
14. **"Stellar mass black holes in young massive and open clusters and their role in gravitational-wave generation"**, at *Modelling and Observing Dense Stellar Systems Under Prague's Starry Skies (MODEST 17)*, September 2017, Prague.

15. **"Stellar mass black holes in star clusters and their role in gravitational-wave generation"**, at *Program SFB international extended group meeting: Star Clusters - Dynamics and Observations*, June 2016, Heidelberg. **(Invited)**

16. **"Dynamical constraints on the assembly of young massive clusters"**, at *Workshop on High-mass stars and formation of massive star clusters*, June 2016, Prague. **(Invited)**

17. **"Blue straggler formation at core collapse"**, at *Star Clusters as Cosmic Laboratories for Astrophysics (MODEST 16)*, April 2016, Bologna.

18. **"Stellar collisions in dense stellar systems: super-canonical stars and blue stragglers"**, at *"M-th Aarseth N-body Meeting"*, December 2015, Prague. **(Invited)**

19. **"Star cluster chronology: from young massive clusters to black holes"**, at *"N-body workshop"*, September 2015, Lund, Sweden. **(Invited)**

20. **"Initial conditions of formation of starburst clusters: constraints from stellar dynamics"**, at *"Formation, evolution and survival of massive star clusters" (IAU Symposium 2016 of the XXIXth IAU General Assembly*, August 2015, Hawaii, U.S.A. **(Highlighted)**

21. **"Formation of very young massive clusters (starburst clusters)"**, at *Modelling and Observing Dense Stellar Systems (MODEST 15)*, March 2015, Concepcion, Chile. **(Invited)**

22. **"Formation of very young massive clusters: the case of NGC 3603 young cluster"**, at *The Early Life of Stellar Clusters: Formation and Dynamics*, November 2014, Copenhagen, Denmark. **(Invited)**

23. **"The formation of the NGC 3603 young cluster"** `(blackboard talk approx. 45 min)`, at *The Alájar meeting*, September 2014, Alájar, Spain.

24. **"The formation of the NGC 3603 starburst cluster: monolithic starburst or hierarchical assembly?"**, at *A critical look at globular cluster formation theories*, July 2014, Sexten, Italy.

25. **"Stellar mass black holes in dense stellar systems"** `(blackboard talk approx. 45 min)`, at *The Alájar meeting*, September 2013, Alájar, Spain. **(Invited)**

26. **"Did the R136 and NGC 3603 young star clusters form through single starbursts?"**, at *European Week of Astronomy and Space Science (EWASS 2013)*, July 2013, Turku, Finland.

27. **" 'Dark Star Clusters' and their implications on gravitational wave detection"**, at *European Week of Astronomy and Space Science (EWASS 2013)*, July 2013, Turku, Finland.

28. **"A new type of compact stellar population: Dark Star Clusters"**, at *Compact Binaries in Globular Clusters (Lorentz Center Workshop)*, September 2012, Leiden, Netherlands. **(Invited)**

29. **"The emergence of super-canonical stars in R136-type star-burst clusters"**, at *Joint Discussion on Very Massive Stars in the Local Universe (IAU XXVIIIth General Assembly)*, August 2012, Beijing, China.

30. **"Stellar mass black holes in star clusters"** `(blackboard talk approx. 1 hour)`, at *A window to the formation of the Milky Way (Aspen summer meeting)*, May 2012, Aspen, U.S.A. **(Invited)**

31. **"Stellar-mass black holes in star clusters: gravitational waves and the 'dark cluster remnants' "**, at *25th Symposium on Relativistic Astrophysics (TEXAS 2010)*, December 2010, Heidelberg, Germany.

32. **"Stellar-mass Black Holes in Star Clusters: Implications for Gravitational Wave Detection"**, at *Formation and Evolution of Black Holes (Aspen winter workshop)*, February 2010, Aspen, U.S.A.

33. **"Stellar-mass Black Holes in Globular Clusters: Implications for Gravitational Wave Radiation"**, at *Star clusters: basic galactic building blocks throughout time and space (IAU Symposium 266 of the XXVIIth IAU General Assembly)*, August 2009, Rio de Janerio, Brazil.

34. **"Evolution of Compact-Binary Populations in Globular Clusters: A Boltzmann Study"**, at *Dynamical Evolution of Dense Stellar Systems (IAU Symposium 246)*, September 2007, Capri, Italy.

Invited colloquia/seminars at academic institutions

1. **"Binary black hole mergers from young massive clusters, open clusters, and isolated binaries"**, October 2022, at *Beijing-Heidelberg Teeminar Series* (online talk)
2. **"Binary black hole mergers from young massive clusters, open clusters, and isolated binaries"**, December 2021, at *Astronomical Institute of the Charles University in Prague* (online talk)
3. **"Dynamical binary black hole mergers in young massive and open clusters"**, April 2021, at *CIERA, Northwestern University*, U.S.A. (online talk)
4. **"Dynamical binary black hole mergers in young and open clusters: comparisons with LIGO-Virgo data and rates"**, February 2021, at *School of Astronomy and Space Science, Nanjing University*, China. (online talk)
5. **"Star clusters: a versatile laboratory for astrophysical phenomena"**, April 2019, at *The Inter-University Centre for Astronomy and Astrophysics (IUCAA)*, Pune, India.
6. **"Star clusters: a versatile laboratory for astrophysical phenomena"**, April 2019, at *International Centre for Theoretical Sciences (ICTS)*, Bangalore, India.
7. **"Stellar-mass black holes in young massive and open clusters and their role in gravitational-wave generation"**, December 2018, at *National Astronomical Observatory of China (NAOC)*, Beijing, China.
8. **"Black holes in star clusters and their implications for gravitational-wave generation"**, July 2018, at *Presidency University*, Kolkata, India.
9. **"Star clusters: a versatile laboratory for astrophysical phenomena"**, July 2018, at *Raman Research Institute (RRI)*, Bangalore, India.
10. **"Star clusters: a versatile laboratory for astrophysical phenomena"**, July 2018, at *Institute of Mathematical Sciences (IMSc)*, Chennai, India.
11. **"Star clusters: a versatile laboratory for astrophysical phenomena"**, January 2018, at *Universidad de Concepcíon (UdeC)*, Chile. (online talk)
12. **"Ecology of stellar-mass black holes in globular clusters and implications for gravitational-wave radiation"**, April 2016, at *Helmholtz-Instituts für Strahlen- und Kernphysik (HISKP)*, University of Bonn, Germany.
13. **"The NGC 3603 young cluster: a starburst cluster made in one go"**, March 2014, at *Universitätssternwarte Wien*, Vienna, Austria.
14. **"Young bright and old dark star clusters"**, June 2013, at *Observatoire astronomique de Strasbourg*, Strasbourg, France.
15. **"Runaway massive stars from R136"**, February 2012, at *Max-Planck-Institut für Radioastronomie*, Bonn, Germany.
16. **"A new type of compact stellar population: dark star clusters"**, December 2011, at *Max-Planck-Institut für extraterrestrische Physik*, Garching, Germany.
17. **"A new type of compact stellar population: dark star clusters"**, October 2011, at *Max-Planck-Institut für Radioastronomie*, Bonn, Germany.
18. **"Dynamics of stellar-mass black holes in star clusters: implications for gravitational-wave detection"**, February 2010, at *Northwestern University*, Evanston, IL, U.S.A.

Public outreach (public talks/press releases/media blogs)

(copy the URL into your browser's address bar in case the link is broken)

- *Public talk:* **"Juggling black holes: gravitational waves and more"** at *Astronomy on Tap Bonn* event (February 26, 2019).
- **"Understanding black holes: young star clusters filling up gaps"** in *Oxford University Press blog (OUPblog)*
  URL: https://blog.oup.com/2021/01/understanding-black-holes-young-star-clusters-filling-up-gaps/

- **"Dance of black holes trembles our Universe"** in *Oxford University Press blog (OUPblog)*
  URL: https://blog.oup.com/2017/03/dance-of-black-holes/
- **"Sterne am Gummiband"** in *Deutschlandfunk* (dradio.de)
  URL: http://www.dradio.de/dlf/sendungen/sternzeit/2106324/
- **"300 Sonnenmassen: Simulation enträtselt gefräßige Riesensterne"** in *Spiegel Online*
  URL:http://www.spiegel.de/wissenschaft/weltall/300-sonnenmassen-simulation-entraetselt-gefraessige-riesensonnen-a-848865.html
- **"'Monster' stars are just misunderstood"** in *NewScientist*,
  URL: http://www.newscientist.com/article/dn22161-astrophile-monster-stars-are-just-misunderstood.html?
- **"The sticky star cluster that's mostly black hole"** in *NewScientist*,
  URL: http://www.newscientist.com/article/dn21081-astrophile-the-sticky-star-cluster-thats-mostly-black-hole.html
- **"Dark clusters could shed light on black hole creation"** in *Deutsche Welle* (DW-Online),
  URL: http://www.dw.de/dark-clusters-could-shed-light-on-black-hole-creation/a-15523851
- **"Black Holes in Star Clusters Stir Up Time and Space"** in *Science Daily*,
  URL: http://www.sciencedaily.com/releases/2009/12/091220175323.htm
- **"Black Holes in Star Clusters Stir Up Time and Space"** in *Royal Astronomical Society Press*,
  URL: http://www.ras.org.uk/news-and-press/68-news2009/1707-black-holes-in-star-clusters-stir-up-time-and-space

Other academic visits or services

Winter visitor at the Aspen Center for Physics: February 2010
Summer visitor at the Aspen Center for Physics: May-June 2012
Summer visitor at the Aspen Center for Physics: July-August 2017 (offered)
Winter visitor at the Aspen Center for Physics: January 2022 (offered)
Session chair: MODEST-17 (September 2017)
Panelist: session on "Astrophysical populations of compact objects" in 7th Physics and Astrophysics at the extreme (PAX-VII) workshop (August 2021, online)

Membership in academic societies

- Cosmic Explorer Consortium (2021 -)
- International Astronomical Union (IAU): individual member (2020 -)
  `https://iau.org/administration/membership/individual/19188/`
- Alexander von Humboldt Foundation: fellow (2009-2011), alumnus (2011 -)

Work skills

Languages

- Primary communication languages (in order of fluency): English, German
- Other languages (in order of fluency): Bengali, Hindi

Computer skills

- Opertaing systems:
  fluent: Linux, Mac OS, iOS
- Programming languages:
  fluent: Python, Fortran, Bourne Shell Script; familiar/past experience: C, C++
- Administration:
  fluent: Linux, Mac Os
  Management of production-quality, long-running (several months) high performance workstation jobs: fluent

Software

- NBODY6/7 (direct N-body integration program that uses Graphical Processing Units): fluent, familiarity with the source code, extensive experiences with troubleshooting, code development, and building of strategies, extensive experience in output data mining
- BSE (fast binary evolution program): fluent, familiarity with the source code, experiences with troubleshooting, code development, and building of strategies, experience in output data mining
- Software tool developments: I single handedly develop and use regularly in peer-reviewed publications elaborate tools/Apps for mining and population analyses of data-intensive (10s - 100s GB per simulation) outputs from NBODY6/7 and BSE
- Python packages: fluent: NumPy, matplotlib (matplotlib.pyplot and matplotlib.animation), SciPy, PyMC3, h5py, multiprocessing
- Gnuplot (versatile plotting and fitting program): fluent
- Latex (versatile typesetter): fluent
- HTML and website design: practical skills: HTML, CSS, and website organization
- Office and presentation suits: fluent: Keynote, Pages, Numbers, PDF Expert; practical skills: Openoffice, Excel
- Image/movie creating/editing: practical skills: Photos App, Preview, PDF Expert, iMovie

Hardware

- Computing on Graphical Processing Units (GPUs): practical skills
- Benchmarking GPUs and GPU based applications: practical skills

Management

- Management of international scientific conferences
- Hosting seminars/colloquia