




Dr. Rafael S. de Souza, Senior Lecturer in Data Science

Chair: The Cosmostatistics Initiative







 Centre for Astrophysics Research, University of Hertfordshire, UK
 0000-0001-7207-4584

 Rafael (Herts)



 RafaelSdeSouza

 rd23aag@herts.ac.uk







Professional Experience

- 2023 – ...  **Senior Lecturer**, Centre for Astrophysics Research, University of Hertfordshire, UK.
- 2020 – 2022  **Associate Professor**, Shanghai Astronomical Observatory, CAS, Shanghai, China.
- 2017 – 2020  **Postdoctoral Fellow** University of North Carolina, Chapel Hill, NC, USA.
- 2014 – 2016  **Postdoctoral Fellow** Eötvös Loránd University, Budapest, Hungary.
- 2012 – 2014  **Postdoctoral Fellow** KASI, Daejeon, South Korea.
- 2010 – 2011  **Postdoctoral Fellow** Kavli-IPMU, Kashiwanoha, Japan.





Education

- 2004 – 2009  **Ph.D. Astrophysics** University of Sao Paulo.
Thesis title: *Origin of Cosmic Magnetic Fields*.
Advisor: Reuven Opher.
- 1999 – 2004  **B.Sc. Astronomy** Federal University of Rio de Janeiro.
Thesis title: *Cosmic Acceleration*.
Advisor: Ioav Waga

Awards

- 2022  **Excellence in research**, by Shanghai Astronomical Observatory.
- 2018  **Prose Award**, Best book in Cosmology and Astronomy.
- 2017  **Marie Skłodowska-Curie fellowship**, by AstroFit.
- 2016  **International Astrostatistics Association Award**, Best paper in Astrostatistics.
- 2015  **MTA fellowship**, by Hungarian Academy of Sciences.
- 2014  **Excellence in research**, by Korean Astronomy and Space Science Institute.

Research Grants

- 2022 – 2025  **CAS Talents** Total amount: \$800,000. [PI.] Chinese Academy of Sciences
- 2021 – 2024  **MESCAL: Multidimensional Exploration of Stellar Clusters via Automated Learning** Total amount: \$32,000. [PI.] National Science Foundation of China
- 2017 – 2020  **Shanghai Talents** Total amount: \$120,000. [PI.] Shanghai Municipality
- 2016 – 2017  **FAPESP Visiting Professorship** Total amount: \$50,000. [PI.] University of Sao Paulo

Research Areas

Statistics	■ Hierarchical Bayesian Models, non-parametric regression, mixture models, likelihood-free inference, copulas, generalized linear and non-linear models, symbolic regression, spatial models, low-rank approximations, sparse models, denoising, optimal transport and information theory.
Machine Learning	■ Supervised, unsupervised and active learning, convolutional neural networks, variational auto-encoders, generative models, large language models, manifold learning, graph theory, information visualization.
Galactic Astrophysics	■ Open Clusters, young stellar objects, variable stars.
Extra-galactic Astrophysics	■ Extra-galactic Globular Clusters, Nuclear Star Clusters, Galaxy Evolution, IFS data.
Cosmology	■ Type Ia Supernova Cosmology, cosmic web, large-scale structures, cosmological simulations.
Nuclear Astrophysics	■ Bayesian estimation of nuclear reaction cross sections, astrophysical S-factors.

Coding Skills

■ R, Python, Torch, \LaTeX , Stan, JAGS, SQL, Keras, TikZ ...



Science Fiction

- Apr 14, 2022 ■ *Beyond the Rainbow*, Xuenan Cao & Rafael S. de Souza – "The story reflects the daily reality of apathy, stimulant abuses, and toxic competitions." <https://www.wattpad.com/story/307604331-beyond-the-rainbow>
- Dec 12, 2022 ■ *The City of Endless Time*, Rafael S. de Souza – "In a dystopian city where time travel has revolutionized education, babies are placed into Universities and returned as adults. Still, the rapid population growth strains the city's infrastructure and leads to chaos and despair." <https://www.wattpad.com/story/329017604-the-city-of-endless-time>


In the Media

- Jul 27, 2022 ■ *An interview by overleaf*, <https://www.overleaf.com/blog/an-interview-with-rafael-s-de-souza>
- Aug 17, 2021 ■ *Astronomers Find a Break in One of the Milky Ways Spiral Arms*, NASA Press Release, <https://www.nasa.gov/feature/jpl/astronomers-find-a-break-in-one-of-the-milky-way-s-spiral-arms>
- Dec 1, 2020 ■ *Mapping stellar nurseries in the Milky Way*, Phys.org, <https://phys.org/news/2020-12-stellar-nurseries-milky.html>
- Dec 2, 2020 ■ *Mapeando viveros estelares en la Vía Láctea*, europapress, <https://www.europapress.es/ciencia/astronomia/noticia-mapeando-viveros-estelares-via-lactea-20201202111012.html>

In the Media (continued)





- Jun 26, 2017  *Astronomia: Computação Galáctica*, Folha de S.Paulo, <https://messageirosideral.blogfolha.uol.com.br/2017/06/26/astronomia-computacao-galactica/>
- Apr 28, 2015  *As primeiras supernovas do Universo (The first supernovae in the Universe)*, Folha de S.Paulo, <https://messageirosideral.blogfolha.uol.com.br/2015/04/28/as-primeiras-supernovas-do-universo/>

Professional Service





- The Cosmostatistics Initiative  Chair (2014 – . . .)
- International Astrostatistics Association  Vice-President (2016 – 2023)
- Panel member  PhD Defense: Czech Technical University in Prague (2021), University of Sao Paulo, (2020); MS Defense: University of Lisbon (2021), University of Houston (2017)
- Meetings  Scientific Organizing Committee: Annual COIN Residence Program (2014 – present); European Week of Astronomy and Space Science, Prague, Czech Republic (2017)
- Journal Review  Astronomy and Astrophysics; Monthly Notices of the Royal Astronomical Society; Nature; New Astronomy Reviews; Physical Review Letters; Publications of the Astronomical Society of Australia; The Astrophysical Journal; The Astrophysical Journal Letters; The Astrophysical Journal Supplement Series; Astronomy and Computing.

Teaching Activities


Graduate Student Supervision

- MSc 2024  Mi Chen, *Project title: "Fitting galaxy profiles in GPUs"*,
- MSc 2023  Quanfeng Xu, *Project title: "Low-rank factorization with GPU acceleration"*, Research package published.
 Zhihao Mu, *Project title: "Effects of galaxy morphology on Quenching of galaxies"*.
- PhD 2020  Maria Luiza Dantas, *Thesis title: "UV bright red-sequence galaxies: a comparative study between UV upturn and UV weak systems"*.





Undergraduate Student Supervision

- 2021– 2024  Yash Gondhalekar, *Image segmentation and masking*, Research packaged published.
- 2021–2022  Peng Chen, *Low-Rank data denoising and reconstruction*, Research packaged published.
- 2019, Summer  Renan dos Santos Barbosa, *Uncertainty aware principal Components*, Research published in peer-reviewed paper. [Remote student from University of Sao Paulo]
 Tan Hong Kiat, *MCMC analysis of ${}^7\text{Be}(n,p){}^7\text{Li}$* . Research published in peer-reviewed paper. [Exchange student from University of Singapore]

Teaching Activities (continued)











- 2018, Summer  Yeoh Jun Kai, *Nucleosynthesis simulation visualizations*. [Exchange student from University of Singapore]

Courses




- 2023-2024, Sem A  *Statistical and Analysis* [master-level class] 30 students
 *Machine Learning and Neural Networks* [master-level class] 3000 students
- 2024, Sem B  *Machine Learning and Neural Networks* [master-level class] 3000 students
- 2023, Sem C  *Research Methods in Data Science* [master-level class] 250 students

Talks

Selected Invited Talks

- Jun 30, 2021  *Astrostatistics and the pathway to interdisciplinarity*, National Observatories of China Colloquium, Beijing, China
- Jul 26, 2019  *The Cosmostatistics Initiative: How to Catalize Interdisciplinarity*, ESO Workshop: Artificial Intelligence in Astronomy, Garching, Germany
- Sep 02, 2018  *A review of Statistical methods in the Gaia Era* IAU General Assembly, Vienna, Austria
- Jul 28, 2018  *A review of Generalized Linear models in Astronomy* Joint Statistical Meetings Vancouver, Canada
- Jun 14, 2018  *Astrostatistics MIAPP*, The Extragalactic distance scale in the Gaia era, Munich, Germany
- Jun 28, 2017  *Probabilistic Approach for Galaxy Classification* European Week of Astronomy and Astrophysics Prague, Czech Republic
- Jul 26, 2015  *The Cosmostatistics Initiative* World Statistics Congress, Rio de Janeiro, Brazil
- May 07, 2014  *Analysis of Multidimensional Astronomical Datasets* Bayes Forum-Max Planck Institute for Astrophysics, Garching, Germany
- Jan 10, 2014  *Probing the Pop-III IMF* Kyung Hee University, Suwon, South-Korea
- June 09, 2013  *Detectability of the Pop-III stars* Chungnam National University, Daejeon, South-Korea
- April 19, 2011  *Cosmic Explosions* Hong Kong University, Clear Water Bay, Hong Kong

Selected Invited Tutorials

- Dec 18 – 21 2017  *Bayesian Workshop* ESA/Estec, Noordwijk, Netherlands
- Jul 12 – 13, 2016  *Bayesian Methods for Astrophysics* Univ. Fed. Rio Grande do Sul, Porto Alegre, Brazil
- May 22 – 24, 2016  *Bayesian Methods for Astrophysics* Astronomical Data Analysis Summer School, Chania, Greece

References

- Prof. Christian Iliadis  University of North Carolina at Chapel Hill  iliadis@physics.unc.edu
- Prof. Eric Feigelson  Penn State University  e5f@psu.edu
- Prof. Alan Heavens  Imperial College London  a.heavens@imperial.ac.uk
- Prof. Jogesh Babu  Penn State University  babu@psu.edu
- Prof. Ricardo Vilalta  University of Houston  vilalta@cs.uh.edu
- Prof. Benedetta Ciardi  Max Planck Institute for Astrophysics  ciardi@mpa-garching.mpg.de

Publications

Citations: ~ 3000

h-index: 31 i10 index: 46

Books

- 1 Hilbe, J. M., **de Souza, R. S.**, & Ishida, E. E. O. (2017). *Bayesian Models for Astrophysical Data Using R, JAGS, Python, and Stan*, Cambridge University Press.
[doi](https://doi.org/10.1017/CB09781316459515) 10.1017/CB09781316459515

Journal Articles

- 84 Gondhalekar, Y., Chies-Santos, A. L., **de Souza, R. S.**, Queiroz, C., Lopes, A. R., Ferrari, F., ... Kanaan, A. (2024). Systematic analysis of jellyfish galaxy candidates in Fornax, Antlia, and Hydra from the S-PLUS survey: A self-supervised visual identification aid. *MNRAS*, 532(1), 270–294.
[doi](https://doi.org/10.1093/mnras/stae1410) 10.1093/mnras/stae1410. [arXiv:2406.04213](https://arxiv.org/abs/2406.04213)
- 83 Zanatta, E. J. B., Sánchez-Janssen, R., **de Souza, R. S.**, Chies-Santos, A. L., & Blakeslee, J. P. (2024). NSCs from groups to clusters: A catalogue of dwarf galaxies in the Shapley Supercluster and the role of environment in galaxy nucleation. *Monthly Notices of the Royal Astronomical Society*, 530(3), 2670–2687.
[doi](https://doi.org/10.1093/mnras/stae849) 10.1093/mnras/stae849. [arXiv:2403.14847](https://arxiv.org/abs/2403.14847)
- 82 Chen, M., **de Souza, R. S.**, Xu, Q., Shen, S., Chies-Santos, A. L., Ye, R., ... Cong, Y. (2024). Galmoss: A package for GPU-accelerated Galaxy Profile Fitting. *Astronomy and Computing*, 47, 100825.
[doi](https://doi.org/10.1016/j.ascom.2024.100825) <https://doi.org/10.1016/j.ascom.2024.100825>. [arXiv:2404.07780](https://arxiv.org/abs/2404.07780)
- 81 Kuhn, M. A., Hillenbrand, L. A., Connelley, M. S., Rich, R. M., Staels, B., Carvalho, A. S., ... Kasliwal, M. M. (2024). The 2022-2023 accretion outburst of the young star V1741 Sgr. *MNRAS*, 529(3), 2630–2646.
[doi](https://doi.org/10.1093/mnras/stae205) 10.1093/mnras/stae205. [arXiv:2401.09522](https://arxiv.org/abs/2401.09522)
- 80 Pessi, P. J., Durgesh, R., Nakazono, L., Hayes, E. E., Oliveira, R. A. P., Ishida, E. E. O., ... Vaughan, S. (2024). ELEPHANT: ExtragaLactic alErt Pipeline for Hostless AstroNomical Transients. *arXiv e-prints*, arXiv:2404.18165. [arXiv:2404.18165](https://arxiv.org/abs/2404.18165)
- 79 Xu, Q., Shen, S., **de Souza, R. S.**, Chen, M., Ye, R., She, Y., ... Durgesh, R. (2023). From Images to Features: Unbiased Morphology Classification via Variational Auto-Encoders and Domain Adaptation. *MNRAS*, 526(4), 6391–6400.
[doi](https://doi.org/10.1093/mnras/stad3181) 10.1093/mnras/stad3181. [arXiv:2303.08627](https://arxiv.org/abs/2303.08627)
- 78 Azevedo, G. M., Chies-Santos, A. L., Riffel, R., Gomes, J. M., Lassen, A. E., Benedetti, J. P. V., ... Xu, Q. (2023). Spatially resolved self-consistent spectral modelling of jellyfish galaxies from MUSE with FADO: trends with mass and stripping intensity. *MNRAS*, 523(3), 4680–4692.
[doi](https://doi.org/10.1093/mnras/stad1641) 10.1093/mnras/stad1641. [arXiv:2306.00049](https://arxiv.org/abs/2306.00049)
- 77 Malz, A. I., Dai, M., Ponder, K. A., Ishida, E. E. O., Gonzalez-Gaitain, S., Durgesh, R., ... Cosmostatistics Initiative, T. (2023). Are classification metrics good proxies for SN Ia cosmological constraining power? *arXiv e-prints*, arXiv:2305.14421.
[doi](https://doi.org/10.48550/arXiv.2305.14421) 10.48550/arXiv.2305.14421. [arXiv:2305.14421](https://arxiv.org/abs/2305.14421)
- 76 Kuhn, M. A., Benjamin, R. A., Ishida, E. E. O., **de Souza, R. S.**, Peloton, J., & Veneri, M. D. (2023). Repeating Outbursts from the Young Stellar Object Gaia23bab (=SPICY 97589). *Research Notes of the American Astronomical Society*, 7(3), 57.
[doi](https://doi.org/10.3847/2515-5172/acc4c9) 10.3847/2515-5172/acc4c9. [arXiv:2303.09409](https://arxiv.org/abs/2303.09409)
- 75 Dály, G., Bleuzé, S., Bécsy, B., **de Souza, R. S.**, & Szalai, T. (2023). Constraining Supernova Physics through Gravitational-Wave Observations. *arXiv e-prints*, arXiv:2302.11480.
[doi](https://doi.org/10.48550/arXiv.2302.11480) 10.48550/arXiv.2302.11480. [arXiv:2302.11480](https://arxiv.org/abs/2302.11480)

- 74 Kuhn, M. A., Saber, R., Povich, M. S., **de Souza, R. S.**, Krone-Martins, A., Ishida, E. E. O., ... Zhou, X. (2023). Spectroscopic Confirmation of a Population of Isolated, Intermediate-mass Young Stellar Objects. *AJ*, 165(1), 3.
[doi](https://doi.org/10.3847/1538-3881/ac9314) 10.3847/1538-3881/ac9314. [arXiv:2206.04090](https://arxiv.org/abs/2206.04090)
- 73 Biswas, B., Ishida, E. E. O., Peloton, J., Moller, A., Pruzhinskaya, M. V., **de Souza, R. S.**, & Muthukrishna, D. (2023). Enabling the discovery of fast transients: A kilonova science module for the Fink broker. *A&A*, 677, A77.
[doi](https://doi.org/10.1051/0004-6361/202245340) 10.1051/0004-6361/202245340
- 72 S. de Souza, R., Thorp, S., Galbany, L., E. O. Ishida, E., González-Gaitán, S., Schmitz, M., ... Peters, C. (2023). A graph-based spectral classification of type ii supernovae. *Astronomy and Computing*, 44, 100715.
[doi](https://doi.org/10.1016/j.ascom.2023.100715) <https://doi.org/10.1016/j.ascom.2023.100715>
- 71 Iliadis, C., Palanivelrajan, V., & **de Souza, R. S.** (2022). Bayesian Estimation of the S Factor and Thermonuclear Reaction Rate for $^{16}\text{O}(p,\gamma)^{17}\text{F}$. *Phys. Rev. C*, 106, 055802.
[doi](https://doi.org/10.1103/PhysRevC.106.055802) 10.1103/PhysRevC.106.055802
- 70 Zhang, Y., **de Souza, R. S.**, & Chen, Y.-C. (2022). Sconce: A cosmic web finder for spherical and conic geometries. *MNRAS*, 517(1), 1197–1217.
[doi](https://doi.org/10.1093/mnras/stac2504) 10.1093/mnras/stac2504. [arXiv:2207.07001](https://arxiv.org/abs/2207.07001)
- 69 Chies-Santos, A. L., **de Souza, R. S.**, Caso, J. P., Ennis, A. I., de Souza, C. P. E., Barbosa, R. S., ... Angulo, R. E. (2022). J-PLUS: A catalogue of globular cluster candidates around the M81/M82/NGC3077 triplet of galaxies. *MNRAS*, 516(1), 1320–1338.
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- 68 Kuhn, M. A., Hillenbrand, L. A., Connelley, M. S., Karambelkar, V. R., Fremling, C., Lee, E., ... Ishida, E. E. O. (2022). Photometric and spectroscopic evidence for the EX Lup nature of the ongoing outburst from V1741 Sgr. *The Astronomer's Telegram*, 15721, 1.
- 67 Dályá, G., Díaz, R., Bouchet, F. R., Frei, Z., Jasche, J., Lavaux, G., ... Raffai, P. (2022). Glade+: An extended galaxy catalogue for multimessenger searches with advanced gravitational-wave detectors. *MNRAS*, 514(1), 1403–1411.
[doi](https://doi.org/10.1093/mnras/stac1443) 10.1093/mnras/stac1443. [arXiv:2110.06184](https://arxiv.org/abs/2110.06184)
- 66 Delli Veneri, M., **de Souza, R. S.**, Krone-Martins, A., Ishida, E. E. O., Dantas, M. L. L., & Kenamer, N. (2022). How have astronomers cited other fields in the last decade? *Research Notes of the AAS*, 6(6), 113.
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- 65 Gondhalekar, Y., **de Souza, R. S.**, & Chies-Santos, A. L. (2022). galmask: A Python package for unsupervised galaxy masking. *Research Notes of the AAS*, 6(6), 128.
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- 64 Chen, P., & **de Souza, R. S.** (2022b). Yonder: A python package for data denoising and reconstruction. *Research Notes of the AAS*, 6(3), 51.
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- 63 **de Souza, R. S.**, Quanfeng, X., Shen, S., Peng, C., & Mu, Z. (2022b). Qrpca: A package for fast principal component analysis with gpu acceleration. *Astronomy and Computing*, 41, 100633.
[doi](https://doi.org/10.1016/j.ascom.2022.100633) <https://doi.org/10.1016/j.ascom.2022.100633>
- 62 Villarroel, B., Pelckmans, K., Solano, E., Laaksoharju, M., Souza, A., Dom, O. N., ... Ward, M. J. (2022). Launching the vasco citizen science project. *Universe*, 8(11).
[doi](https://doi.org/10.3390/universe8110561) 10.3390/universe8110561
- 61 Moscoso, J., **de Souza, R. S.**, Coc, A., & Iliadis, C. (2021). Bayesian Estimation of the $D(p,\gamma)^3\text{He}$ Thermonuclear Reaction Rate. *ApJ*, 923(1), 49.

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- 59 Kuhn, M. A., **de Souza, R. S.**, Krone-Martins, A., Castro-Ginard, A., Ishida, E. E. O., Povich, M. S., & Hillenbrand, L. A. (2021). SPICY: The Spitzer/IRAC Candidate YSO Catalog for the Inner Galactic Midplane. *ApJS*, 254(2), 33.
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- 57 **de Souza, R. S.**, Krone-Martins, A., Carruba, V., Domingos, R. C., Ishida, E. E. O., Aljbaae, S., ... Barletta, W. (2021). Probabilistic modeling of asteroid diameters from gaia dr2 errors. *Res. Notes AAS*, 5, 199.
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- 54 Kuhn, M. A., Benjamin, R. A., Zucker, C., Krone-Martins, A., **de Souza, R. S.**, Castro-Ginard, A., ... Hillenbrand, L. A. (2021). A high pitch angle structure in the sagittarius arm. *A&A*, 651, L10.
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- 53 Molino, A., Costa-Duarte, M. V., Sampedro, L., Herpich, F. R., Sodr e, J., L., Mendes de Oliveira, C., ... Abramo, L. R. (2020). Assessing the photometric redshift precision of the S-PLUS survey: the Stripe-82 as a test-case. *MNRAS*.
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