



Rafael S. de Souza, Ph.D.

Chair: Cosmostatistics Initiative

 Shanghai Astronomical Observatory, Chinese Academy of Sciences



 drsouza@shao.ac.cn

 0000-0001-7207-4584






 <https://www.rafaelsdesouza.com>

 RafaelSdeSouza



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





Professional Experience

- 2020 – . . .  **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.


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.


Research Areas (continued)

Machine Learning	 Supervised, unsupervised and active learning, convolutional neural networks, variational auto-encoders, 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, gravitational waves.
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, L^AT_EX, 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>


In the Media

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>

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

International Astrostatistics Association  Vice-President (2016 – ...)




The Cosmostatistics Initiative  Chair (2014 – ...)

Professional Service (continued)






- 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.

(Co-) Supervision Activities

Graduate Students





- MS 2021–  Quanfeng Xu, *Project title: “Low-rank factorization with GPU acceleration”*, Research packaged published.
-  Zhihao Mu, *Project title: “Effects of galaxy morphology on Quenching of galaxies”*.
- PhD 2016– 2020  Maria Luiza Dantas, *Thesis title: “UV bright red-sequence galaxies: a comparative study between UV upturn and UV weak systems”*.

Undergraduate Students








- 2021–  Yash Gondhalekar, *Image segmentation and masking*, Research packaged published.
-  Peng Chen, *Low-Rank data denosing 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]
- 2018, Summer  Yeoh Jun Kai, *Nucleosynthesis simulation visualizations*. [Exchange student from University of Singapore]

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* XXX IAU General Assembly, Vienna, Austria
- Jul 28, 2018  *A review of Generalized Linear models in Astronomy* Joint Statistical Meetings Vancouver, Canada











Talks (continued)

- Jun 14, 2018  *Astrostatistics* MIAPP, The Extragalactic distance scale in the Gaia era, Munich, Germany
- Jun 28, 2017  *Probabilistic Approach for Galaxy Classification* European Weak 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. Eric Feigelson  Penn State University  e5f@psu.edu
- Prof. Jogesh Babu  Penn State University  babu@psu.edu
- Prof. Christian Iliadis  University of North Carolina at Chapel Hill  iliadis@physics.unc.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 (69 total; 57 major contribution)

Citations: ~ 2000

h-index: 24 iio index: 42

Journal Articles

-  **69** Dálya, 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.
 [10.1093/mnras/stac1443](https://doi.org/10.1093/mnras/stac1443).  [2110.06184](https://arxiv.org/abs/2110.06184)
-  **68** **de Souza, R. S.**, Quanfeng, X., Shen, S., Peng, C., & Mu, Z. (2022). qrpca: A Package for Fast Principal Component Analysis with GPU Acceleration. *A&C*, under review.  [2206.06797](https://arxiv.org/abs/2206.06797)
-  **67** Delli Veneri, M., **de Souza, R. S.**, Krone-Martins, A., Ishida, E. E. O., Dantas, M. L. L., & Kennamer, N. (2022). How have astronomers cited other fields in the last decade? *Research Notes of the AAS*, 6(6), 113.
 [10.3847/2515-5172/ac74c7](https://doi.org/10.3847/2515-5172/ac74c7)
-  **66** 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.

[doi](https://doi.org/10.3847/2515-5172/ac780b) 10.3847/2515-5172/ac780b. [arXiv:2206.06787](https://arxiv.org/abs/2206.06787)

- 65 Kuhn, M. A., Saber, R., Povich, M. S., **de Souza, R. S.**, Krone-Martins, A., Ishida, E. E. O., ... Zhou, X. (2022). Spectroscopic Confirmation of a Population of Isolated, Intermediate-Mass YSOs. *AJ*, *under review*. [arXiv:2206.04090](https://arxiv.org/abs/2206.04090)
- 64 Chen, P., & **de Souza, R. S.** (2022a). Yonder: A python package for data denoising and reconstruction. *Research Notes of the AAS*, *6*(3), 51.
[doi](https://doi.org/10.3847/2515-5172/ac5c57) 10.3847/2515-5172/ac5c57
- 63 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*, *in press*. [arXiv:2202.11472](https://arxiv.org/abs/2202.11472)
- 62 **de Souza, R. S.**, Thorp, S., Galbany, L., Ishida, E. E. O., González-Gaitán, S., Schmitz, M. A., ... Peters, C. (2022). A graph-based spectral classification of type ii supernovae. *A&C*, *under review*.
[arXiv:2206.14335](https://arxiv.org/abs/2206.14335)
- 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.
[doi](https://doi.org/10.3847/1538-4357/ac1db0) 10.3847/1538-4357/ac1db0. [arXiv:2109.00049](https://arxiv.org/abs/2109.00049)
- 60 Zanatta, E. J. B., Sánchez-Janssen, R., Chies-Santos, A. L., **de Souza, R. S.**, & Blakeslee, J. P. (2021). A high occurrence of nuclear star clusters in faint Coma galaxies, and the roles of mass and environment. *Monthly Notices of the Royal Astronomical Society*, *508*(1), 986–998.
[doi](https://doi.org/10.1093/mnras/stab2348) 10.1093/mnras/stab2348
- 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.
[doi](https://doi.org/10.3847/1538-4365/abe465) 10.3847/1538-4365/abe465. [arXiv:2011.12961](https://arxiv.org/abs/2011.12961)
- 58 Moews, B., Schmitz, M. A., Lawler, A. J., Zuntz, J., Malz, A. I., **de Souza, R. S.**, ... COIN Collaboration. (2021). Ridges in the Dark Energy Survey for cosmic trough identification. *MNRAS*, *500*(1), 859–870.
[doi](https://doi.org/10.1093/mnras/staa3204) 10.1093/mnras/staa3204. [arXiv:2005.08583](https://arxiv.org/abs/2005.08583)
- 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.
[doi](https://doi.org/10.3847/2515-5172/ac205e) <https://doi.org/10.3847/2515-5172/ac205e>
- 56 **de Souza, R. S.**, & S. Berger, G. (2021). Fallopian tube anatomy predicts pregnancy and pregnancy outcomes after tubal reversal surgery. *Statistical Methods in Medical Research*, *30*(8), 2004–2014. PMID: 34232836.
[doi](https://doi.org/10.1177/09622802211023543) 10.1177/09622802211023543
- 55 Feigelson, E. D., **de Souza, R. S.**, Ishida, E. E. O., & Jogesh Babu, G. (2021). 21st Century Statistical and Computational Challenges in Astrophysics. *Annual Review of Statistics and Its Application*, *8*(1), 493–517.
[doi](https://doi.org/10.1146/annurev-statistics-042720-112045) 10.1146/annurev-statistics-042720-112045
- 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.
[doi](https://doi.org/10.1051/0004-6361/202141198) 10.1051/0004-6361/202141198
- 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*.
[doi](https://doi.org/10.1093/mnras/staa1586) 10.1093/mnras/staa1586. [arXiv:1907.06315](https://arxiv.org/abs/1907.06315)

- 52 **de Souza, R. S.**, Kiat, T. H., Coc, A., & Iliadis, C. (2020). Hierarchical Bayesian Thermonuclear Rate for the ${}^7\text{Be}(n,p){}^7\text{Li}$ Big Bang Nucleosynthesis Reaction. *The Astrophysical Journal*, 894(2), 134.
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- 51 Dantas, M. L. L., Coelho, P. R. T., **de Souza, R. S.**, & Gonçalves, T. S. (2020). UV bright red-sequence galaxies: how do UV upturn systems evolve in redshift and stellar mass? *MNRAS*, 492(2), 2996–3011.
doi 10.1093/mnras/stz3609. [arXiv:1908.06775](#)
- 50 Boucaud, A., Huertas-Company, M., Heneka, C., Ishida, E. E. O., Sedaghat, N., **de Souza, R. S.**, ... Collaboration COIN. (2020). Photometry of high-redshift blended galaxies using deep learning. *MNRAS*, 491(2), 2481–2495.
doi 10.1093/mnras/stz3056. [arXiv:1905.01324](#)
- 49 Villarroel, B., Soodla, J., Comerón, S., Mattsson, L., Pelckmans, K., López-Corredoira, M., ... Ward, M. J. (2020). The Vanishing and Appearing Sources during a Century of Observations Project. I. USNO Objects Missing in Modern Sky Surveys and Follow-up Observations of a Missing Star. *AJ*, 159(1), 8.
doi 10.3847/1538-3881/ab570f
- 48 Kennamer, N., Ishida, E. E. O., Gonzalez-Gaitan, S., **de Souza, R. S.**, Ihler, A. e., Ponder, K., ... Galbany, L. (2020). Active learning with respect: Resource allocation for extragalactic astronomical transients. *2020 IEEE Symposium Series on Computational Intelligence (SSCI)*, 3115–3124.
doi 10.1109/SSCI47803.2020.9308300
- 47 Mendes de Oliveira, C., Ribeiro, T., Schoenell, W., Kanaan, A., Overzier, R. A., Molino, A., ... et al., d. (2019). The Southern Photometric Local Universe Survey (S-PLUS): improved SEDs, morphologies and redshifts with 12 optical filters. *MNRAS*, 489, 241–267.
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- 45 Cantat-Gaudin, T., Krone-Martins, A., Sedaghat, N., Farahi, A., **de Souza, R. S.**, R. S., ... Trindade, A. M. M. (2019). Gaia DR2 unravels incompleteness of nearby cluster population: new open clusters in the direction of Perseus. *A&A*, 624, A126.
doi 10.1051/0004-6361/201834453. [arXiv:1810.05494](#)
- 44 Hattab, M. W., **de Souza, R. S.**, Ciardi, B., Paardekooper, J.-P., Khochfar, S., & Dalla Vecchia, C. (2019). A case study of hurdle and generalized additive models in astronomy: the escape of ionizing radiation. *MNRAS*, 483, 3307–3321.
doi 10.1093/mnras/sty3314. [arXiv:1805.07435](#)
- 43 **de Souza, R. S.**, Iliadis, C., & Coc, A. (2019a). Astrophysical S-factors, thermonuclear rates, and electron screening potential for the ${}^3\text{He}(d,p){}^4\text{He}$. *ApJ*, 872(1), 75.
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- 42 **de Souza, R. S.**, Boston, R. S., Coc, A., & Iliadis, C. (2019b). Thermonuclear fusion rates for tritium + deuterium using bayesian methods. *Phys. Rev. C*, 99, 014619.
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doi 10.1093/mnras/sty2881. [arXiv:1802.06280](#)
- 40 Ishida, E. E. O., Beck, R., Gonzalez-Gaitan, S., **de Souza, R. S.**, Krone-Martins, A., Barrett, J. W., ... for the COIN collaboration. (2019). Optimizing spectroscopic follow-up strategies for supernova photometric classification with active learning. *MNRAS*, 483(1), 2–18.

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- 39 Dályá, G., Galgóczi, G., Dobos, L., Frei, Z., Heng, I. S., Macas, R., ... **de Souza, R. S.** (2018). GLADE: A galaxy catalogue for multimessenger searches in the advanced gravitational-wave detector era. *MNRAS*, *479*, 2374–2381.
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- 34 Ripple, W. J., Wolf, C., Newsome, T. M., Galetti, M., Alamgir, M., Crist, E., ... **de Souza, R. S.**, ((2017). World scientists warning to humanity: A second notice. *BioScience*, *67*(12), 1026–1028.
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- 33 Gupta, K. D., Pampana, R., Vilalta, R., Ishida, E. E. O., & **R. S. de Souza.** (2016). Automated supernova Ia classification using adaptive learning techniques. *2016 IEEE Symposium Series on Computational Intelligence (SSCI)*, 1–8.
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- 29 **de Souza, R. S.**, Hilbe, J. M., Buelens, B., Riggs, J. D., Cameron, E., Ishida, E. E. O., ... Killedar, M. (2015). The overlooked potential of generalized linear models in astronomy - III. Bayesian negative binomial regression and globular cluster populations. *MNRAS*, *453*, 1928–1940.
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