



Rafael S. de Souza, Ph.D.

Chair: Cosmostatistics Initiative

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 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, \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>


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: “Galaxy Classification with torchvision”*.
 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–  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]
- 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* 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











Talks (continued)

- 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. 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

Citation Record

📖 Major contribution publications: ~ 52 (out of 64)

📖 Total number of citations: ~ 2000

📖 h-index: 24 i10 index: 42

Research Publications

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

- 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.
[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*, *under review*. [arXiv:2202.11472](https://arxiv.org/abs/2202.11472)
- 62 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)
- 61 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
- 60 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)
- 59 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)
- 58 Dálya, G., Díaz, R., Bouchet, F. R., Frei, Z., Jasche, J., Lavaux, G., ... Raffai, P. (2021). Glade+: An extended galaxy catalogue for multimessenger searches with advanced gravitational-wave detectors. *MNRAS*, *under review*. [arXiv:2110.06184](https://arxiv.org/abs/2110.06184)
- 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](#) 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](#) 10.1051/0004-6361/202141198
- 53 Molino, A., Costa-Duarte, M. V., Sampedro, L., Herpich, F. R., Sodré, 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](#) 10.1093/mnras/staa1586. [arXiv: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.
[doi](#) 10.3847/1538-4357/ab88aa
- 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.
[doi](#) 10.1093/mnras/stz1985. [arXiv:1907.01567](#)
- 46 Moews, B., & **de Souza, R. S.** and Ishida, E. E. O. and Malz, A. I. and Heneka, C. and Vilalta, R. and Zuntz, J. (2019). Stress testing the dark energy equation of state imprint on supernova data. *Phys. Rev. D*, 99, 123529.
[doi](#) 10.1103/PhysRevD.99.123529
- 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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- 41 González-Gaitán, **de Souza, R. S.**, Krone-Martins, A., Cameron, E., Coelho, P., Galbany, L., ... for the COIN collaboration. (2019). Spatial field reconstruction with INLA: Application to IFU galaxy data. *MNRAS*, *482*(3), 3880–3891.
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- 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.
[doi](https://doi.org/10.1093/mnras/sty3015) 10.1093/mnras/sty3015. [arXiv:1804.03765](https://arxiv.org/abs/1804.03765)
- 39 Dály, 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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- 38 Long, J. P., & **de Souza, R. S.** (2018). Wiley statsref: Statistics reference online, 1–11.
[doi](https://doi.org/10.1002/9781118445112.stat07996) 10.1002/9781118445112.stat07996. [arXiv:1707.05834](https://arxiv.org/abs/1707.05834)
- 37 Vilalta, R., Ishida, E. E. O., Beck, R., Sutrisno, R., **de Souza, R. S.**, & Mahabal, A. (2017). Photometric redshift estimation: An active learning approach. *2017 IEEE Symposium Series on Computational Intelligence (SSCI)*, 1–8.
[doi](https://doi.org/10.1109/SSCI.2017.8285192) 10.1109/SSCI.2017.8285192
- 36 Beck, R., Lin, C.-A., Ishida, E. E. O., Gieseke, F., **de Souza, R. S.**, Costa-Duarte, M. V., ... Krone-Martins, A. (2017). On the realistic validation of photometric redshifts. *MNRAS*, *468*, 4323–4339.
[doi](https://doi.org/10.1093/mnras/stx687) 10.1093/mnras/stx687
- 35 **de Souza, R. S.**, Dantas, M. L. L., Costa-Duarte, M. V., Feigelson, E. D., Killedar, M., Lablanche, P.-Y., ... Gieseke, F. (2017). A probabilistic approach to emission-line galaxy classification. *MNRAS*, *472*(3), 2808–2822.
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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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- 32 **de Souza, R. S.**, Dantas, M. L. L., Krone-Martins, A., Cameron, E., Coelho, P., Hattab, M. W., ... COIN Collaboration. (2016). Is the cluster environment quenching the Seyfert activity in elliptical and spiral galaxies? *MNRAS*, *461*, 2115–2125.
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- 31 Sasdelli, M., Ishida, E. E. O., Vilalta, R., Agüena, M., Busti, V. C., Camacho, H., ... Mazzali, P. A. (2016). Exploring the spectroscopic diversity of Type Ia supernovae with DRACULA: a machine learning approach. *MNRAS*, *461*, 2044–2059.
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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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- 28 **de Souza, R. S.**, Cameron, E., Killedar, M., Hilbe, J., Vilalta, R., Maio, U., ... Riggs, J. D. (2015). The overlooked potential of Generalized Linear Models in astronomy, I: Binomial regression. *Astronomy and Computing*, 12, 21–32.
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- 26 Elliott, J., **de Souza, R. S.**, Krone-Martins, A., Cameron, E., Ishida, E. E. O., & Hilbe, J. (2015). The overlooked potential of Generalized Linear Models in astronomy-II: Gamma regression and photometric redshifts. *Astronomy and Computing*, 10, 61–72.
[doi](https://doi.org/10.1016/j.ascom.2015.01.002) 10.1016/j.ascom.2015.01.002. [arXiv:1409.7699](https://arxiv.org/abs/1409.7699)
- 25 Koopmans, L., Pritchard, J., Mellema, G., Aguirre, J., Ahn, K., Barkana, R., ... Trott, C. (2015). The Cosmic Dawn and Epoch of Reionisation with SKA. *Advancing Astrophysics with the Square Kilometre Array (AASKA14)*, 1. [arXiv:1505.07568](https://arxiv.org/abs/1505.07568)
- 24 Krone-Martins, A., Ishida, E. E. O., & **de Souza, R. S.** (2014). The first analytical expression to estimate photometric redshifts suggested by a machine. *MNRAS*, 443, L34–L38.
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- 23 **de Souza, R. S.**, Ishida, E. E. O., Whalen, D. J., Johnson, J. L., & Ferrara, A. (2014). Probing the stellar initial mass function with high-z supernovae. *MNRAS*, 442, 1640–1655.
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- 22 **de Souza, R. S.**, Maio, U., Biffi, V., & Ciardi, B. (2014). Robust PCA and MIC statistics of baryons in early minihaloes. *MNRAS*, 440, 240–248.
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- 21 Ishida, E. E. O., Abdalla, F. B., & **de Souza, R. S.** (2014). Improved KPCA for supernova photometric classification. *306*, 326–329.
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- 19 **de Souza, R. S.**, Ishida, E. E. O., Johnson, J. L., Whalen, D. J., & Mesinger, A. (2013). Detectability of the first cosmic explosions. *MNRAS*, 436, 1555–1563.
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