Sambit K. Giri

Center for Cosmology and Theoretical Astrophysics,
Institute for Computational Science, University of Zurich,
Winterthurerstrasse 190, 8057 Zurich, Switzerland

+41 779706320 • +46 790243943
sambit.giri@gmail.com, sambit.giri@ics.uzh.ch
https://sambit-giri.github.io/ • orcid.org/0000-0002-2560-536X

Research Interests

Cosmology: the cosmic dawn, reionization, the intergalactic medium, large-scale structure of the Universe, 21-cm line of neutral hydrogen and extracting non-Gaussian information.
Methods: image processing, machine learning, Bayesian inference using monte carlo markov chain

Education

Academic Qualifications

- **Institute for Computational Science, University of Zurich** — **Zurich, Switzerland**
  Postdoctoral researcher, Department of astronomy — *Jan 2020 –*

- **Department of Astronomy, Stockholm University** — **Stockholm, Sweden**
  Postdoctoral researcher, Department of astronomy — *Apr 2019 – Dec 2019*

- **Department of Astronomy, Stockholm University** — **Stockholm, Sweden**
  Doctorate in astronomy, Supervisor: Prof. Garrelt Mellema — *Oct 2015 – Apr 2019*
  Thesis: The tomographic study of the 21 cm signal during reionization

- **Indian Institute of Technology (Banaras Hindu University)** — **Varanasi, India**
  Integrated master of technology, Engineering physics — *Jul 2010 – May 2015*
  Gold Medallist (Grade: 8.84/10), *equivalent to summa cum laude*
  Master's thesis: Study of dynamic events on the solar photosphere
  Bachelor's thesis: Diagnostics of Magnetohydrodynamic (MHD) Waves

- **D.A.V. Public School, Chandrasekharpur** — **Bhubaneswar, India**
  Higher Secondary Certificate — *2010*
  (Grade: 95.4/100)

- **D.A.V. Public School, Chandrasekharpur** — **Bhubaneswar, India**
  Secondary School Certificate — *2008*
  (Grade: 92.0/100)

Summer/Winter Schools

- **3rd OBSPM/LAM Summer School** — **Spetses, Greece**
  Galaxy Formation and Evolution in a Cosmological Context — *May 2017*
- **Canary Islands Winter School of Astrophysics** — **Tenerife, Spain**
  Big Data Analysis in Astronomy — *November 2018*

Computer Skills

- **Programming**
  - Extensive knowledge of Python, C, C++, IDL, Matlab, Mathematica, Fortran, Javascript and HTML
  - Well versed with the image processing and machine learning techniques
  - Experienced in using version control software such as Github
- **Code development**
  - Developed a python package, Tools21cm, to analyse and understand 21 cm signal data
  - Developed a machine learning framework to identify high Lyman continuum leaking galaxies at high redshifts
  - Developed a Bayesian framework to extract astrophysical parameters using 21 cm simulations from the observations
- **Parallel computing**
  - Experience running massively parallel code, C^2Ray
  - Experience with MPI and openMP

Collaborations

- **SKA** Involved in the SKA reionization science team
- **LOFAR** Involved in the reionization theory and simulations
- **Euclid** Involved in theory and simulations working group

Grants

- **GRC Travel Grants, University of Zurich** — 2020
  Granted expenses for two month long research visit
- **Knut and Alice Wallenberg's Foundation** — 2018
  Granted expenses for two research travel
- **Alva and Lennart Dahlmark research grant** — 2018, 2019
  Granted expenses for two research travel
- **C F Liljevalch J:ors travel grant** — 2018
  Granted expenses for a research travel
- **IAU travel grant** — 2017
  Granted expenses for attending IAU symposium 333
- **Stockholm University donation stipend** — 2016, 2017, 2018
  Granted expenses for three research travels
- **Alva and Lennart Dahlmark research grant** — 2016
  Granted expenses for a workstation
- **Swedish National Infrastructure for Computing** — 2018

Named collaborator (Project leader: Garrelt Mellema)
450000 core hours on Beskow for running 1D RT simulations

- **Swedish National Infrastructure for Computing** 2016
  Named collaborator (Project leader: Garrelt Mellema)
  3600000 core hours on Beskow for running 3D RT simulations
- **Swedish National Infrastructure for Computing** 2015
  Named collaborator (Project leader: Garrelt Mellema)
  4800000 core hours on Beskow for running 3D RT simulations

Teaching and Supervision

- **Chrishon Nilanthan** **ETH Zurich**
  Co-supervising MSc project *Nov 2020 – May 2021*
  Title: 1D radiative transfer for reionization simulations
- **Zhongnan Cai** **University of Zurich**
  Co-supervising MSc project *Sept 2020 – Feb 2021*
  Title: Mass accretion history and halo-matter bias study at high redshift
- **Astronomy laboratory** **Stockholm University**
  Upgrading the laboratory materials *Sept 2019 – Dec 2019*
  Courses: Astrophysical radiation processes, Stellar structure and evolution
- **Ancel Larzul** **École Normale Supérieure**
  Co-supervising MSc project *Feb 2019 – Aug 2019*
  Title: Cosmology from the 21-cm signal through the Alcock-Paczynzski effect
- **Eric Fredriksson** **Stockholm University**
  Co-supervised BSc thesis *2018*
  Title: Investigation of the evolution of linear biases on large scale reionization simulations
- **Thomas Aldheimer** **Stockholm University**
  Co-supervised BSc thesis *2017*
  Title: The sizes and shapes of late neutral regions during reionization
- **Mechanics Laboratory** **Indian Institute of Technology (BHU)**
  Teaching Assistant *2015*
- **Electromagnetic Theory & Wave Guides** **Indian Institute of Technology (BHU)**
  Teaching Assistant *2014*

Presentations

Invited

- **Institute Institute of Technology** **Hyderabad, India**
  Modelling baryonic effects in cosmological surveys *1 Sept 2021*
- **RISU (Reionizing-Indore-Stockholm-Uppsala) meeting** **Indore/Stockholm/Uppsala**
  Characterising the topology of ionized regions with the Betti numbers *18 Jan 2021*
- **Institute for computational science, UZH** **Zurich, Switzerland**
  Probing cosmic reionization with the 21-cm signal *27 Mar 2020*
- **Institute for Particle Physics and Astrophysics, ETH Zurich** **Zurich, Switzerland**
  Tomographic study of 21-cm signal during reionization *10 Feb 2020*

- **Observing the First Billion Years of the Universe** — **Indore, India**
  Image analysis techniques for 21-cm tomography of the CD-EoR — *20-24 Jan 2020*

Contributed

- **Swiss SKA Days** — **Lausanne, Switzerland**
  Tools21cm: a user-friendly package to create mock SKA observations — *8 Sept 2021*
- **Next-Generation Cosmology with Next-Generation Radio Telescopes: II** — **Sesto, Italy**
  Parameter inference from 21-cm images during reionization — *27-31 Jan 2020*
- **SKA Science Meeting (Breakout session)** — **Manchester, UK**
  Constructing emulators for reionization simulations — *12 Apr 2019*
- **PhD defence** — **Stockholm, Sweden**
  Tomographic study of the 21-cm signal during reionization — *03 Apr 2019*
- **Friday seminar (Department of astronomy)** — **Stockholm, Sweden**
  Tomographic study of the 21-cm signal during reionization — *08 Mar 2019*
- **Rise and shine: galaxies in the epoch of reionization** — **Strasbourg, France**
  Squeezed-limit bispectrum of 21-cm observations — *18 Jun 2018*
- **LOFAR EoR KSP meeting** — **Groningen, Netherlands**
  Astrophysical parameter estimation from 21-cm signal — *01 Feb 2018*
- **Licentiate defence** — **Stockholm, Sweden**
  Tomographic study of the 21-cm signal during reionization — *20 Jan 2018*
- **IAU Symposium 333** — **Dubrovnik, Croatia**
  Constraining the Lyman Continuum escape using machine learning — *02 Oct 2017*
- **LOFAR EoR KSP meeting** — **Haifa, Israel**
  Position dependent 21-cm power spectra during reionization — *04 Apr 2017*
- **SKA CD/EoR ST meeting** — **Pisa, Italy**
  Bubble identification in 21-cm tomography — *14 Mar 2017*

Achievements

Scientific

- Authored **24 publications** in international peer-reviewed journals with **8 as first author, 6 as second author**
- Authored **3 conference papers** with 1 as first author
- h-index: 11 (retrieved from The SAO/NASA Astrophysics Data System on 20 July 2021)
- Completed my PhD 6 months before the scheduled time
- **Regular reviewer** for Monthly Notices of the Royal Astronomical Society and Journal of Open Source Software
- Visited **Imperial college London** and **Cambridge University** for research work during the PhD time

Others

- Awarded gold medal (equivalent to summa cum laude) during Integrated Master's degree (2015)
- Summer Research fellowship from Indian Academy of Sciences (2013)
- National Talent Search Examination, scholarship from the Government of India (2008)
- Qualified the Graduate Aptitude Test in Engineering (GATE), conducted by department of higher

education (Government of India), to receive scholarship during the master's degree programme

Publications

Published (Journals)

1. **Giri, S.K.**, Mellema, G., Dixon, K.L. and Iliev, I.T., 2018. Bubble size statistics during reionization from 21-cm tomography. *Monthly Notices of the Royal Astronomical Society*, 473(3), pp.2949-2964.
2. Ghara, R., Mellema, G., **Giri, S.K.**, Choudhury, T.R., Datta, K.K. and Majumdar, S., 2018. Prediction of the 21-cm signal from reionization: comparison between 3D and 1D radiative transfer schemes. *Monthly Notices of the Royal Astronomical Society*, 476(2), pp.1741-1755.
3. **Giri, S.K.**, Mellema, G. and Ghara, R., 2018. Optimal identification of HII regions during reionization in 21-cm observations. *Monthly Notices of the Royal Astronomical Society*, 479(4), pp.5596-5611.
4. Watkinson C.A., **Giri S. K.**, Ross H. E., Dixon K. L., Iliev I. T., Mellema G., Pritchard J. R., 2019, The 21cm bispectrum as a probe of non-Gaussianities due to X-ray heating. *Monthly Notices of the Royal Astronomical Society*, 482(2), pp.2653-2669.
5. **Giri, S.K.**, D'Aloisio, A., Mellema, G., Komatsu, E., Ghara, R., Majumdar, S., 2019. Position-dependent power spectra of the 21-cm signal from the epoch of reionization. *JCAP*, 2019(02), p.058.
6. **Giri, S.K.**, Mellema, G., Aldheimer, T., Dixon, K.L. and Iliev, I.T., 2019. Neutral island statistics during reionization from 21-cm tomography. *Monthly Notices of the Royal Astronomical Society*, 489(2), pp.1590–1605.
7. **Giri, S.K.**, Zackrisson, E., Binggeli, C., Pelckmans, K. and Cubo, R., 2020. Identifying reionization-epoch galaxies with extreme levels of Lyman continuum leakage in James Webb Space Telescope surveys. *Monthly Notices of the Royal Astronomical Society*, 491(4), pp.5277-5286.
8. Zackrisson, E.,..., **Giri, S. K.** and others, 2020. Bubble mapping with the Square Kilometer Array-I. Detecting galaxies with Euclid, JWST, WFIRST and ELT within ionized bubbles in the intergalactic medium at $z > 6$. *Monthly Notices of the Royal Astronomical Society*, 493(1), pp.855-870.
9. Ghara, R., **Giri, S.K.**, Ciardi, B., Mellema, G., Zaroubi, S., Iliev, I. T., Koopmans, L. V. E. and others, 2020. Constraining the intergalactic medium at $z \approx 9.1$ using the LOFAR epoch of reionization observation. *Monthly Notices of the Royal Astronomical Society*, 493(4), pp.4728-4747.
10. Mertens, F. G.,..., **Giri, S.K.** and others, 2020. Improved upper limits on the 21-cm signal power spectrum of neutral hydrogen at $z \approx 9.1$ from LOFAR. *Monthly Notices of the Royal Astronomical Society*, 493(2), pp.1662-1685.
11. **Giri, S. K.**, Mellema, G. and Jensen, H., 2020. Tools21cm: A python package to analyse the large-scale 21-cm signal from the Epoch of Reionization and Cosmic Dawn. Journal of Open Source Software, 5(52), 2363, https://doi.org/10.21105/joss.02363.
12. Mondal, R.,..., **Giri, S.K.** and others, 2020. Tight Constraints on the Excess Radio Background at $z = 9.1$ from LOFAR. *Monthly Notices of the Royal Astronomical Society*, 498(3), pp.4178-4191.
13. Ross, H. E., **Giri, S.K.**, Mellema, G., Dixon, K. L., Ghara, R., Iliev, I. T., 2021. Redshift-space distortions in simulations of the 21-cm signal from the cosmic dawn. *Monthly Notices of the Royal Astronomical Society*, 506(3), pp.3717-3733.
14. Schneider, A., **Giri, S.K.** and Mirocha, J., 2021. A halo model approach for the 21-cm power

spectrum at cosmic dawn. *Physical Review D*, 103(8), 083025.

15. **Giri, S.K.**, Mellema, G., 2021. Measuring the topology of reionization with Betti numbers. *Monthly Notices of the Royal Astronomical Society*, 505(2), 1863-1877.
16. Hothi, I.,..., **Giri, S.K.** and others, 2020. Comparing Foreground Removal Techniques for Recovery of the LOFAR-EoR 21cm Power Spectrum. *Monthly Notices of the Royal Astronomical Society*, 500(2), pp.2264-2277.
17. Greig, B., Mesinger, A., Koopmans, L. V., Ciardi, B., Mellema, G., Zaroubi, S., **Giri, S. K.** and others, 2021. Interpreting LOFAR 21-cm signal upper limits at z 9.1 in the context of high-z galaxy and reionisation observations. *Monthly Notices of the Royal Astronomical Society*, 501(1), pp.1-13.
18. Bianco, M., Iliev, I.T., Ahn, K., **Giri, S.K.**, Mao, Y., Park, H., Shapiro, P.R., 2021. The impact of inhomogeneous subgrid clumping on cosmic reionization II: modelling stochasticity. *Monthly Notices of the Royal Astronomical Society*, 504(2), 2443-2460.
19. Bianco, M., **Giri, S.K.**, Iliev, I.T.; Mellema, G., 2021. Deep learning approach for identification of HII regions during reionization in 21-cm observations. *Monthly Notices of the Royal Astronomical Society*, 505(3), 3982-3997.
20. Ghara, R., **Giri, S.K.**, Ciardi, B., Mellema, G., Zaroubi, S., 2021. Constraining the state of the intergalactic medium during the Epoch of Reionization using MWA 21-cm signal observations. *Monthly Notices of the Royal Astronomical Society*, 503(3), 4551-4562.
21. Hubert, J., Schneider, A., Potter, D., Stadel, J., **Giri, S. K.**, 2021. Decaying Dark Matter: Simulations and Weak-Lensing Forecast. Accepted for publication in *Journal of Cosmology and Astroparticle Physics*, arXiv:2104.07675.
22. Parimbelli, G., Scelfo, G., **Giri, S. K.**, Schneider, A., Archidiacono, M., Camera, S., Viel, M., 2021. Mixed dark matter: matter power spectrum and halo mass function. Submitted to journal, arXiv:2106.04588
23. **Giri, S. K.**, Schneider, A., 2021. Emulation of baryonic effects on the matter power spectrum and constraints from galaxy cluster data. Submitted to journal, arXiv:2108.08863
24. Mevius, M.,..., **Giri, S.K.** and others, 2021. A numerical study of 21-cm signal suppression and noise increase in direction-dependent calibration. Submitted to journal.

Published (Conference proceedings)

1. **Giri, S.K.**, Zackrisson, E., Binggeli, C., Pelckmans, K., Cubo, R. and Mellema, G., 2017. Constraining Lyman continuum escape using Machine Learning. Proceedings of the International Astronomical Union, 12(S333), pp.254-258.
2. Mellema, G., **Giri, S.** and Ghara, R., 2017. Analysis of 21-cm tomographic data. Proceedings of the International Astronomical Union, 12(S333), pp.26-29.
3. Ghara, R., Choudhury, T.R., Datta, K.K., Mellema, G., Choudhuri, S., Majumdar, S. and **Giri, S.K.**, 2017. Prospects of detection of the first sources with SKA using matched filters. Proceedings of the International Astronomical Union, 12(S333), pp.122-125.