Sambit K. Giri

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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 *Jan 2020 –*

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

Department of Astronomy, Stockholm University **Stockholm, Sweden**
Doctorate in astronomy, Supervisor: Prof. Garrelt Mellema *Oct 2015 – Apr 2019*
Thesis: 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 – Jul 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)

○ **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 **25 publications** in international peer-reviewed journals with **8 as first author, 7 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. and 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. and 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. and 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.** and 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. and 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. and 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. and 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. and **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. and Viel, M., 2021. Mixed dark matter: matter power spectrum and halo mass function. Submitted to journal, arXiv:2106.04588

23. **Giri, S. K.** and 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.

25. Schneider, A., **Giri, S. K.**, Stefania, A. and Alexandre, R., 2021. Constraining baryonic feedback and cosmology with weak-lensing, X-ray, and kinematic Sunyaev-Zeldovich observations. Submitted to journal, arXiv:2110.02228

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.