Curriculum Vitae
HAMSA PADMANABHAN

CONTACT INFORMATION:

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SHORT BIOGRAPHY:

Hamsa Padmanabhan has been Collaboratrice Scientifique II and principal investigator of the Swiss National Science Foundation (SNSF) Ambizione Grant at the University of Geneva, Switzerland. She was previously a CITA Fellow at the Canadian Institute for Theoretical Astrophysics, Toronto, Canada and a Tomalla post-doctoral fellow at the Institute for Particle Physics and Astrophysics, ETH Zurich, Switzerland. She graduated from IUCAA, Pune, India with a Ph.D. in Physics in December 2015.

She has a wide breadth of research expertise, ranging from theoretical investigations (in quantum field theory and relativity) to data-intensive, observation-oriented astronomy and astrophysics. She is a member of the Editorial Board of the European Physical Journal C (EPJC), and was the co-lead of the chapter on Cosmic Dawn and Reionization for the White paper on Fundamental Physics with the Square Kilometre Array (SKA), one of the biggest astrophysics projects of the coming decades.

Hamsa has received several prestigious awards and fellowships throughout her career. She was selected as a Goldman Sachs Global Leader by the Institute of International Education (IIE) and the Goldman Sachs Foundation, and is one of the few in the world who has the honour of a minor planet in the solar system being named after her.

PROFESSIONAL EXPERIENCE / CAREER SUMMARY:

- Collaboratrice Scientifique II and PI, Swiss National Science Foundation (SNSF) Ambizione Grant, Université de Genève (2020 - 2024)
- Associate, Dunlap Institute for Astronomy and Astrophysics, Toronto (2019 - 2021)
- CITA Fellow, Canadian Institute for Theoretical Astrophysics, Toronto (2019 - 2020)[1]
- Tomalla / post-doctoral fellow, ETH Zurich, Switzerland (2016 - 2019)
- CSIR Shyama Prasad Mukherjee Fellow(ship)[2] for Ph. D. in Physics at Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, India, (2012 - 2016) [Thesis defense on 17 November 2015, degree awarded 14 December 2015]
- M.Sc. Physics, University of Pune (2010-2012) Perfect GPA (6.0 out of 6.0) in all four semesters; *gold medallist*, First Rank in the university.
- B.Sc. Physics, Fergusson College, University of Pune (2007-2010) First Rank in the university among *all disciplines*.

SCIENTIFIC COLLABORATIONS:

- Member, COMAP (CO Mapping Array Pathfinder) Collaboration, 2015-present
- Member, SKA (Square Kilometre Array) Collaboration:
  (a) Member, Cosmology Science Working Group, 2017-present
  (b) Member, SKA Communications and Outreach Network (SKACON), 2020-present
  (c) Co-Chair, SKACH (SKA Switzerland) Communications and Outreach Program, 2022-present
- Member, MWA (Murchison Widefield Array) Collaboration, 2019 - present

[1] Awarded for a period of three years from March 2019 to March 2022.

[2] This Special Fellowship is given to the top four rank holders (out of $\sim$ 25000) each year in the National Eligibility Test (NET), conducted by the Council of Scientific and Industrial Research (CSIR), India, for pursuing Ph.D. programmes.

- Member, Cosmic Visions 21 cm Collaboration, 2019 - present
- Member, GBT-Parkes HI Intensity Mapping Collaboration, 2019 - present
- Member, Atacama Large Aperture Submillimetre Telescope (AtLAST) collaboration, 2020 - present
- Member, DESI (Dark Energy Spectroscopic Instrument) Collaboration, 2016-2023

SELECTED AWARDS, HONORS (in reverse chronological order):

1. PI, Swiss National Science Foundation (SNSF) Ambizione Career Grant (selected among all disciplines), $\sim$ CHF (= USD) 562,000 for the project *"Probing the universe: through reionization and beyond"*.
2. CITA Fellowship, 2018 (at the Canadian Institute for Theoretical Astrophysics, Toronto)
3. International Astronomical Union (IAU) junior Membership, 2018
4. Tomalla Fellowship, 2016 at ETH, Zurich[3]
5. Shyama Prasad Mukherjee (SPM) Fellowship, 2012 in Physical Sciences.
6. Third Rank at National level in the National Eligibility Test (NET), 2011.
7. Fifth Rank at National level in the Joint Entrance Screening Test (JEST), 2010 and First Rank amongst the B.Sc. candidates.
8. Goldman Sachs Global Leaders Award,[4] Class of 2009
9. Represented India at the Intel International Science and Engineering Fair,[5] 2006 held at Indianapolis, Indiana, USA during 6-12 May 2006, and won several awards.
10. Minor Planet (21575) is named after Hamsa Padmanabhan[6]
11. KVPY Fellowship[7] 2005
12. National Talent Search Scholarship[8] 2005
13. Gold Medal for First Rank at National level in All-India Test of Scholastic Skills (ASSET) conducted by Educational Initiatives, 2004.

TEACHING AND RESEARCH SUPERVISION:

- Lecturer [including course design and development], course 16P021 "Observing the Cosmic Dawn: How did the first stars and galaxies form?", University of Geneva, March - May 2022 and September - November 2023
- Co-supervisor, Masters thesis, Tobias Nadolny, University of Geneva, August 2020 - April 2021
  Thesis title: *The Cosmic Matter Dipole*
- University of Toronto Astro 101 Summer Undergraduate Research Program (SURP) lecturer, August 2020
- Co-supervisor, Masters semester thesis: Matteo Nicoli, ETH Zurich, September-December 2018
  Thesis title: *Clustering of ALFALFA Galaxies*
- Co-supervisor, undergraduate thesis: Yannick Bormuth, ETH Zurich, March-May 2018
  Thesis title: *Comparison of different models for cosmic neutral hydrogen in dark matter haloes*
- Co-supervisor, undergraduate thesis: Nicola Stoira, ETH Zurich, March-May 2017
  Thesis title: *Simulating maps of the neutral hydrogen distribution at moderate redshifts*
- Substitute lecturer, Astrophysics I, ETH Zurich, Fall 2016

[3] For pursuing post-doctoral research at ETH Zurich.

[4] An award given to 150 students from around the world every year, by the Institute of International Education in collaboration with the Goldman Sachs Foundation, in recognition of superior academic achievement and leadership potential.

[5] This is the world's largest international pre-college science competition, held in USA every year.

[6] *Minor Planet (21575) Padmanabhan*, one of the minor planets in the solar system, is named after Hamsa Padmanabhan by the Massachusetts Institute of Technology (MIT) Lincoln Laboratory. This honour is in recognition of outstanding performance at the Intel International Science and Engineering Fair, 2006.

[7] This fellowship is given by the Department of Science and Technology, India for pursuing science career to about 100 students in the whole country, and carries the highest amount of scholarship.

[8] Awarded by the National Council of Educational Research and Training, India.

- Substitute lecturer, Astrophysics I, ETH Zurich, Fall 2017
- Teaching involvement, Physics I and Physics II, ETH Zurich, Spring 2018 and Fall 2018
- Lectures at Canadian Institute for Theoretical Astrophysics (CITA) Blackboard Talks and Cosmology Talks series (to broad audiences of undergraduate and graduate students)
- First Prize Winner, Physics Lecture Competitions, Indian Physics Association (Pune Chapter), January 2009 and December 2007.

SELECTED SCIENTIFIC LEADERSHIP AND REVIEWING:

- Member of Editorial Board, European Physical Journal C (May 2024 - present)
- External expert reviewer:
  (i) European Research Council Advanced Grant
  (ii) University of Cambridge Early Career Fellowships
  (iii) United States-Israel Binational Science Foundation grants
  (iv) French National Research Agency (Agence nationale de la recherche) grants
  (v) Royal Society Newton International Fellowships, UK
- External jury member (reviewer/examiner), thesis defense:
  (i) Ivelin Georgiev, Stockholm University, Ph.D, June 2024
  (ii) Athanasia Gkogkou, Laboratoire d'Astrophysique de Marseille, Ph.D, November 2023
  (iii) Louis-Philippe Ghanadian, U. of Geneva, M.Sc., August 2021
- Science lead, CHIME-CIRADA 21 cm absorption line project, 2019-2020
- Invited co-lead, SKA White Paper chapter on Cosmic Dawn and Reionization, following the workshop on *Fundamental Physics with the SKA*, Flic-en-Flac, Mauritius, May 2017.
- Group representative for Institute of Astronomy task-force at Scientifica 2017, a joint public event by ETH Zurich and University of Zurich.
- Co-organizer, Swiss SKA Commmunications and Outreach Network mini-campaign for the launch of the SKA Observatory (SKAO), February 2021
- Co-organizer and speaker, Workshop on Study of the Universe By Line Intensity Mapping Experiments (SUBLIME), 14 October 2021

PUBLICATION SUMMARY (for full list, see page 4; citation data at this link)[9]:

- I have 62 refereed journal papers (59 published/in press, 3 under review), of which *35 as lead or single author*.
- I have over 4000 citations with over 300 total *normalized* citations (= citations/authors) *as lead or single author*. For lead author papers, see **this link**.

COMPUTATIONAL EXPERIENCE:

- Proficiency in FORTRAN90, Python, IDL, Mathematica
- Experience with High Performance Computing (HPC) cluster environments performing large (256 cores) parallel cosmological hydrodynamical simulations using the SPH code GADGET-2, and Markov Chain Monte Carlo (MCMC) simulations using COSMOHAMMER
- Google group owner (2013-2015) for discussions regarding the HPC cluster environment at IUCAA, Pune.
- Group IT responsible (March-May 2017) at the Institute for Astronomy, ETH Zurich.

CONFERENCE TALKS AND COLLOQUIA:

I have given more than 55 invited talks (in conferences, and as seminars and colloquia in India, Europe, the USA and Canada). For a list of my talks, see page 8. The blue underlined items indicate links to my talk videos online.

[9]Citation counts are from Google Scholar and the NASA Astrophysics Data System.

List of publications
HAMSA PADMANABHAN

SIX SELECTED PUBLICATIONS:

1. **Hamsa Padmanabhan**, Alexandre Refregier, Adam Amara (2017), *A halo model for cosmological neutral hydrogen : abundances and clustering*, MNRAS 469 (2), 2323, arXiv:1611.06235 [astro-ph.CO].

2. **Hamsa Padmanabhan**, T. Roy Choudhury, Alexandre Refregier (2015), *Theoretical and observational constraints on the HI intensity power spectrum*, MNRAS 447, 3745, arXiv:1407.6366 [astro-ph.CO].

3. **Hamsa Padmanabhan**, Alexandre Refregier, *Constraining a halo model for cosmological neutral hydrogen*, MNRAS, 464, 4, 4008 (2017), arXiv:1607.01021 [astro-ph.CO].

4. **Hamsa Padmanabhan** (2019), *Constraining the evolution of CII intensity through the end stages of reionization*, MNRAS 488, 3, 3014, arXiv:1811.01968.

5. **Hamsa Padmanabhan** (2018), *Constraining the CO intensity mapping power spectrum at intermediate redshifts*, MNRAS 475 (2), 1477, arXiv:1706.01471 [astro-ph.GA].

6. *Fundamental Physics with the Square Kilometre Array* [10], Weltman, A.[†], Bull, P.*, Camera, S.*, Kelley, K.*, **Padmanabhan, H.***, Pritchard, J.*, . . . Gaensler, B.[‡] (2020), Publications of the Astronomical Society of Australia, 37, E002. doi:10.1017/pasa.2019.42, arXiv:1810.02680

OTHER PUBLICATIONS:

(A) ***Lead author/single author refereed journal papers***:

7. **Hamsa Padmanabhan**, Abraham Loeb, *Intergalactic Lyman-α haloes before reionization are detectable with JWST*, JCAP 10, 59 (2024), arXiv:2404.18998.

8. **Hamsa Padmanabhan**, Abraham Loeb, *Intensity mapping of intergalactic Lyman-α haloes before reionization*, submitted, arXiv:2408.16820.

9. **Hamsa Padmanabhan**, Abraham Loeb, *Constraints on Supermassive Black Hole Binaries from JWST and NANOGrav*, A&A, 684 (2024) L15, arXiv:2401.01161.

10. **Hamsa Padmanabhan**, Abraham Loeb, *Constraining the AGN luminosity function from JWST with the X-ray Background*, ApJL 958, L7 (2023), arXiv:2310.08633.

11. **Hamsa Padmanabhan**, Abraham Loeb, *Alleviating the need for exponential evolution of JWST galaxies in $10^{10} M_{\odot}$ haloes at $z > 10$ by a modified ΛCDM power spectrum*, ApJL 953, L4 (2023), arXiv:2306.04684.

12. **Hamsa Padmanabhan**, Roy Maartens, Obinna Umeh, Stefano Camera, *The HI intensity mapping power spectrum: insights from recent measurements*, submitted, arXiv:2305.09720.

13. **Hamsa Padmanabhan**, *Synergizing 21 cm and sub-millimetre surveys during reionization: new empirical insights*, MNRAS 523, 3 (2023), arXiv:2212.08077.

14. **Hamsa Padmanabhan**, Abraham Loeb (2023), *A new limit on intergalactic magnetic fields on sub-kpc scales from fast radio bursts*, ApJL 946 L18 (2023), arXiv:2301.08259.

15. **Hamsa Padmanabhan**, Abraham Loeb, *Unravelling the formation of the first supermassive black holes with the SKA pulsar timing array*, A&A 676 (2023), A115, arXiv:2207.14309

16. **Hamsa Padmanabhan**, Abraham Loeb (2022), *Signatures of Population III supernova at Cosmic Dawn: the case of GN-z11-flash*, General Relativity and Gravitation, Volume 54, Issue 3, 24, arXiv:2101.12222

[10] [†]: editor, *: co-lead, [‡]: convenor

17. **Hamsa Padmanabhan**, Abraham Loeb (2021), *Distinguishing AGN from starbursts as the origin of double peaked Lyman-Alpha Emitters in the reionization era*, A&A Letters, 646, 10, arXiv:2012.00014.

18. **Hamsa Padmanabhan**, Abraham Loeb (2020), *Constraining the host galaxy halos of massive black holes from LISA event rates*, JCAP 11, 055, arXiv:2007.12710.

19. **Hamsa Padmanabhan**, Abraham Loeb (2022), *Signatures of binary black holes on maser systems*, MNRAS 513, 1, arXiv:2202.03437

20. **Hamsa Padmanabhan**, Patrick Breysse, Adam Lidz and Eric. R. Switzer, *Intensity mapping from the sky: synergizing the joint potential of [OIII] and [CII] surveys at reionization*, MNRAS 515 (2022) 4, 5813, arXiv: 2105.12148 [astro-ph.GA]

21. **Hamsa Padmanabhan**, Abraham Loeb (2020), *New empirical constraints on the cosmological evolution of gas and stars in galaxies*, MNRAS 496, 2, 1124, arXiv:2002.01489.

22. **Hamsa Padmanabhan**, Abraham Loeb (2021), *Contribution of Flares from Tidal Disruption of Stars to high-redshift AGN*, A&A 656, A47 (2021), arXiv:2003.07365.

23. **Hamsa Padmanabhan**, Alexandre Refregier, Adam Amara (2020), *Cross-correlating 21 cm and galaxy surveys: implications for cosmology and astrophysics*, MNRAS, 495, 4, 3935, arXiv:1909.11104.

24. **Hamsa Padmanabhan**, Abraham Loeb (2020), *It is Feasible to Directly Measure Black Hole Masses in the First Galaxies*, JCAP 03, 032, arXiv:1912.05555

25. **Hamsa Padmanabhan**, Alexandre Refregier, Adam Amara (2019), *Impact of astrophysics on cosmology forecasts with 21 cm surveys*, MNRAS 485 (3), 4060, arXiv:1804.10627 [astro-ph.CO]

26. **Hamsa Padmanabhan**, Girish Kulkarni (2017), *Constraints on the evolution of the relationship between HI mass and halo mass in the last 12 Gyr*, MNRAS 470 (1), 340, arXiv:1608.00007 [astro-ph.GA].

27. **Hamsa Padmanabhan**, T. Roy Choudhury, Alexandre Refregier (2016), *Modelling the cosmic neutral hydrogen from DLAs and 21 cm observations*, MNRAS 458, 781, arXiv:1505.00008 [astro-ph.CO].

28. **Hamsa Padmanabhan**, R. Srianand, T. Roy Choudhury (2015), *Measuring the equation of state of the high$-z$ intergalactic medium using curvature statistics*, MNRAS Letters 450, L29-L33, arXiv:1502.05140 [astro-ph.CO].

29. **Hamsa Padmanabhan**, T. Roy Choudhury, R. Srianand (2014), *Probing reionization using quasar near-zones at redshift $z \sim 6$*, MNRAS 443, 3761, arXiv:1403.0221 [astro-ph.CO].

30. **Hamsa Padmanabhan**, Aditya Rotti, Tarun Souradeep (2013), *Comparison of CMB lensing efficiency of gravitational waves and large scale structure*, Phys.Rev. D 88, 063507, arXiv:1307.2355 [astro-ph.CO].

31. **Hamsa Padmanabhan**, T. Padmanabhan (2013), *CosMIn: The Solution to the Cosmological Constant Problem*, IJMPD 22, 1342001, arXiv:1302.3226 [astro-ph.CO]. [11]

32. **Hamsa Padmanabhan**, T. Padmanabhan (2011), *Nonrelativistic limit of quantum field theory in inertial and noninertial frames and the principle of equivalence*, Phys. Rev. D 84, 085018, arXiv:1110.1314 [gr-qc].

33. **Hamsa Padmanabhan**, T. Padmanabhan (2010), *Aspects of electrostatics in a weak gravitational field*, General Relativity and Gravitation, Volume 42, Issue 5, 1153, arXiv:0910.0926 [gr-qc].

34. **Hamsa Padmanabhan** (2009), *A simple derivation of the electromagnetic field of an arbitrarily moving charge*, Am. J. Phys. 77, 151, arXiv:0810.4246

(B) *Forthcoming book chapter*:

Hamsa Padmanabhan (2024), *Cosmology with HI*, Invited book chapter for the Encyclopedia of Astrophysics, 1st Edition (forthcoming), to be published by Elsevier, arXiv: 2411.08113

(C) *Invited review articles*:

[11] The essay, based on this work, received the Honorable mention in the 2013 Gravity Research Foundation Essay Competition.

35. **Hamsa Padmanabhan** (2021), *A multi-messenger view of Cosmic Dawn: conquering the final frontier*, Invited review, Int. Jour. Mod. Phys. D. Vol. 30, Issue 14, 2130009-395 (2021), arXiv:2109.00003

36. T. Padmanabhan, **Hamsa Padmanabhan** (2014), *Cosmological Constant from the Emergent Gravity Perspective*, Invited review, Int. Jour. Mod. Phys. D. Vol. 23, No. 6, 1430011, arXiv:1404.2284 [gr-qc].

(D) ***Co-authored refereed journal papers:***

37. Prabhakar Tiwari, Dominik J. Schwarz, Gong-Bo Zhao, Ruth Durrer, Martin Kunz, **Hamsa Padmanabhan**, *An Independent Measure of the Kinematic Dipole from SDSS*, The Astrophysical Journal, Volume 975, Number 2, 279 (2024), arXiv:2409.09946

38. Lunde et al. (including **Hamsa Padmanabhan**) *COMAP Pathfinder – Season 2 results I. Improved data selection and processing*, Astronomy & Astrophysics, 691, A335 (2024), arXiv:2406.07510

39. Stutzer et al. (including **Hamsa Padmanabhan**) *COMAP Pathfinder – Season 2 results II. Updated constraints on the CO(1-0) power spectrum* (2024), Astronomy & Astrophysics, 691, A336 (2024), arXiv:2406.07511

40. Chung et al. (including **Hamsa Padmanabhan**) *COMAP Pathfinder – Season 2 results III. Implications for cosmic molecular gas content at* $z \sim 2-3$, Astronomy & Astrophysics, 691, A337 (2024), arXiv:2406.07512

41. Dunne et al. (including **Hamsa Padmanabhan**) (2024), *COMAP Early Science VIII. A Joint Stacking Analysis with eBOSS Quasars*, ApJ 965,1, arXiv:2304.09832

42. Chung et al. (including **Hamsa Padmanabhan**) (2023), *The deconvolved distribution estimator: enhancing reionisation-era CO line-intensity mapping analyses with a cross-correlation analogue for one-point statistics*, MNRAS 520(4) 5305, arXiv:2210.14890

43. Emily Tyhurst, **Hamsa Padmanabhan**, Ue-Li Pen, *Redshift space distortions in Lagrangian space and the linear large scale velocity field of dark matter*, PRD in press, arXiv:2202.08435

44. Cleary et al. (including **Hamsa Padmanabhan**), *COMAP Early Science I. Overview*, The Astrophysical Journal, 933, 182, arXiv:2111.05927

45. Lamb et al. (including **Hamsa Padmanabhan**), *COMAP Early Science II. Pathfinder Instrument*, The Astrophysical Journal, 933, 183, arXiv:2111.05928

46. Foss et al. (including **Hamsa Padmanabhan**), *COMAP Early Science III. CO Data Processing*, The Astrophysical Journal, 933, 184, arXiv:2111.05929

47. Ihle et al. (including **Hamsa Padmanabhan**), *COMAP Early Science IV. Power Spectrum Methodology and Results*, The Astrophysical Journal, 933, 185, arXiv:2111.05930

48. Chung et al. (including **Hamsa Padmanabhan**), *COMAP Early Science V. Constraints and Forecasts at* $z \sim 3$, The Astrophysical Journal, 933, 186, arXiv:2111.05931

49. Breysse et al. (including **Hamsa Padmanabhan**), *COMAP Early Science VII. Prospects for CO Intensity Mapping at Reionization*,The Astrophysical Journal, 933, 188, arXiv:2111.05933

50. Silva et al. (including **Hamsa Padmanabhan**), *Synergies between the COMAP CO Line Intensity Mapping mission and a Ly*α *galaxy survey*, submitted, arXiv:2111.05354

51. Tobias Nadolny, Ruth Durrer, Martin Kunz, **Hamsa Padmanabhan**, *A new way to test the Cosmological Principle: measuring our peculiar velocity and the large scale anisotropy independently*, JCAP 11 (2021), 009, arXiv: 2106.05284 [astro-ph.CO]

52. Chung et al. (including **Hamsa Padmanabhan**), *A model of spectral line broadening in signal forecasts for line-intensity mapping experiments*, ApJ, 923, 188 (2021), arXiv:2104.11171[astro-ph.CO].

53. Obinna Umeh, Roy Maartens, **Hamsa Padmanabhan** and Stefano Camera, *The effect of finite halo size on the clustering of neutral hydrogen*, JCAP 06 (2021) 027, arXiv:2102.06116[astro-ph.CO].

54. Jurek Bauer, David Marsh, Renée Hložek, **Hamsa Padmanabhan**, Alex Laguë (2020), *Intensity Mapping as a Probe of Axion Dark Matter*, MNRAS 500, 3, 3162, arXiv:2003.09655[astro-ph.CO].

55. Stefano Camera and **Hamsa Padmanabhan** (2020), *Beyond ΛCDM with HI intensity mapping: robustness of cosmological constraints in the presence of astrophysics*, MNRAS 496, 4115, arXiv:1910.00022 [astro-ph.CO].

56. Chung et al. (including **Hamsa Padmanabhan**), *Cross-correlating Carbon Monoxide Line-intensity Maps with Spectroscopic and Photometric Galaxy Surveys*, The Astrophysical Journal 872 (2), 186, arXiv:1809.04550 [astro-ph.GA].

57. Ihle et al. (including **Hamsa Padmanabhan**), *Joint power spectrum and voxel intensity distribution forecast on the CO luminosity function with COMAP*, The Astrophysical Journal 871 (1), 75, arXiv:1808.07487 [astro-ph.CO].

58. Square Kilometre Array Cosmology Science Working Group : Bacon et al. (including **Hamsa Padmanabhan**), *Cosmology with Phase 1 of the Square Kilometre Array; Red Book 2018: Technical specifications and performance forecasts*, *Publ. Astron. Soc. Austral.* 37 (2020) e007, arXiv:1811.02743

59. T. Padmanabhan, **Hamsa Padmanabhan**, *Cosmic Information, the Cosmological Constant and the Amplitude of primordial perturbations*, Phys. Letts. B 773 (2017) 81 - 85, arXiv:1703.06144 [gr-qc]

60. T. Padmanabhan, **Hamsa Padmanabhan**, *Quantum gravity at Hubble scales determines the cosmological constant and the amplitude of primordial perturbations*, Int. Jour. Mod. Phys., D 26, 1743002 (2017) [12]

61. Aseem Paranjape, T. Roy Choudhury, **Hamsa Padmanabhan**, *Photon number conserving models of HII bubbles during reionization*, MNRAS 460(2), 1801-1810 (2016), arXiv:1512.01345 [astro-ph.CO].

62. Barun Kumar Pal, **Hamsa Padmanabhan**, Supratik Pal, *Towards reconstruction of unlensed, intrinsic CMB power spectra from lensed map*, MNRAS 439 (2014), 3022, arXiv:1309.1827 [astro-ph.CO].

(E) *Collaboration white papers:*

63. *Inflation and Early Dark Energy with a Stage II Hydrogen Intensity Mapping experiment* (2019), Cosmic Visions 21 cm Collaboration : Ansari et al. (including **Hamsa Padmanabhan**), arXiv:1810.09572

64. *Packed Ultra-wideband Mapping Array (PUMA): A Radio Telescope for Cosmology and Transients* (2019), Bandura et al. (including **Hamsa Padmanabhan**), arXiv:1907.12559

65. *The DESI Experiment Part I: Science,Targeting, and Survey Design*, DESI Collaboration: Aghamousa et al. (including **Hamsa Padmanabhan**), arXiv:1611.00036

66. *The DESI Experiment Part II: Instrument Design*, DESI Collaboration: Aghamousa et al. (including **Hamsa Padmanabhan**), arXiv:1611.00037

67. *Astrophysics and Cosmology with Line-Intensity Mapping*, Kovetz et al. (including **Hamsa Padmanabhan**), Astro2020 Science white paper (2019), arXiv:1903.04496

68. *Inflation and Dark Energy from spectroscopy at $z > 2$*, Ferraro et al. (including **Hamsa Padmanabhan**), Astro2020 Science white paper (2019), arXiv:1903.09208

69. *Primordial non-Gaussianity*, Meerberg et al. (including **Hamsa Padmanabhan**), Astro2020 Science white paper (2019), arXiv:1903.04409

70. *Dark Matter Science in the Era of LSST*, Bechtol et al. (including **Hamsa Padmanabhan**), Astro2020 Science white paper (2019), arXiv:1903.04425

(F) *Conference proceedings:*

71. **Hamsa Padmanabhan**, *Neutral hydrogen in the post-reionization universe*, ***invited talk*** at the IAU Symposium 333 'Peering towards Cosmic Dawn', in the Proceedings of the International Astronomical Union, Volume 333, pp. 216-221, arXiv:1712.01296 [astro-ph.CO]

72. **Hamsa Padmanabhan**, *Intensity mapping: a new window into the cosmos*, ***invited talk*** at the Quantum Theory and Symmetries (QTS-XI), Montreal, July 2019, in Quantum Theory and Symmetries, Proceedings of the 11th International Symposium, Montreal, Canada (2021), arXiv:1910.14059 [astro-ph.CO]

[12] The essay, based on this work, received the Honorable mention in the 2017 Gravity Research Foundation Essay Competition and is published in this Special Issue.

List of talks: HAMSA PADMANABHAN

(A) Invited/contributed talks at conferences:

*Invited talks are marked by *.*

∗ **1.** Plenary lecture at the 33rd meeting of the Indian Association of General Relativity and Gravitation (IAGRG)-2025, BITS-Pilani, India, 2-4 January 2025

∗ **2.** Plenary lecture at the 43rd meeting of the Astronomical Society of India (ASI)-2025, NIT Rourkela, India, 15-19 February 2025 (forthcoming)

∗ **3.** *Line intensity mapping and the physics of cosmic reionization*, invited overview talk at the Fourth Symposium of the European Consortium for Astroparticle Theory, CERN, Geneva, Switzerland, 14-16 May 2024

∗ **4.** *The HI intensity mapping power spectrum: insights from recent measurements*, at the Advanced 21-cm Cosmology workshop, National Institute of Science Education and Research (NISER), Bhubaneswar, India, 19 December 2023

∗ **5.** *New empirical constraints on the cosmological evolution of gas and stars and galaxies*, Invited talk at the XXXIst General Assembly of the International Astronomical Union (IAU) Div J meeting, Busan, Korea, 1-12 August 2022

∗ **6.** *Deciphering the baryonic Universe: a new window into the cosmos*, Keynote talk at the Canadian Association of Physicists (CAP) conference, Hamilton, Ontario, Canada, 9 June 2022

∗ **7.** *Mapping the baryonic Universe: a new window into the cosmos*, at the Cosmology workshop, International Conference on Gravitation and Cosmology (ICGC 2023), IIT Guwahati, India, 6 December 2023

∗ **8.** *Deciphering Cosmic Dawn: A conquest of the Final Frontier*, at the Annual Physics Symposium, Ernakulam, Kerala, India, 14 Dec 2023

∗ **9.** *A multimessenger view of the baryonic Universe out to the epoch of Reionization*, at the 'Frontiers in Cosmology' conference, RRI Bengaluru, India, 20-24 February 2023

∗ **10.** *Getting the most out of large cosmological surveys: synergies in Intensity Mapping*, at the 'Largest Cosmological Surveys and Big Data Science' Workshop, ICTS Bengaluru, India, 9-12 May 2023

∗ **11.** *A multimessenger view of the baryonic Universe out to the epoch of reionization*, at the two-day workshop on Astronomy and Cosmology, Astronomical Observatory, University of Kerala, Thiruvananthapuram, India, 3-4 August 2023

12. *Double peaked Lyman-alpha emitters at reionization: starbursts or hidden AGN?*, talk at the First Light and Reionization session, UK National Astronomy Meeting, Warwick, 11-15 July 2022

13. *Fuelling the first black holes: the role of tidal disruption events*, at the conference "What Drives the Growth of Black Holes?", Reykjavik, Iceland, September 26-30, 2022

14. *Synergizing the joint potential of future and intensity mapping experiments at the EoR*, at the Lorentz workshop "Mapping the Invisible Universe", Leiden, the Netherlands, August 29 - September 1, 2022

∗ **15.** *A multi-messenger view of the first black holes in the Universe*, at the conference "Astrophysics in the next Decade: from the first stars to Intelligent Life", Martha's Vineyard, USA, June 7, 2022

∗ **16.** *Fundamental physics with the SKA: efforts in Switzerland*, at the Swiss SKA Days 2021, September 7-8, 2021, Lausanne, Switzerland

∗ **17.** *Intensity mapping from the sky: [CII] and [OIII] from the Epoch of Reionization*, at the SUBLIME - Study of the Universe By Line Intensity Mapping Experiments, 14 October 2021

∗ **18.** *A multi-messenger view into Cosmic Dawn*, EPFL-CERN-UniGE days 2021, Switzerland, 11 February 2021

∗ **19.** *Intensity mapping: a new window into the cosmos*, XIth International Conference on Quantum Theory and Symmetries, University of Montreal, Canada, 1 July 2019

∗ **20.** *A halo model for the baryonic universe: through reionization and later*, CASTLE - Cosmological and Astrophysical Synergies: Tactics for the Latest Era, Piedmont, Italy, September 9-12, 2018

∗ **21.** *Evolution of baryons in the high-redshift universe*, Workshop on The Reionization History of the Universe, University of Bielefeld, Germany, March 8-9, 2018

∗ **22.** *Neutral hydrogen in the post-reionization universe*, IAU Symposium 333 'Peering Towards Cosmic Dawn', October 2-6, 2017, Dubrovnik, Croatia

23. *A halo model for cosmological neutral hydrogen*, talk at (i) Advances in Theoretical Cosmology in Light of Data, Stockholm, Sweden, 24-28 July 2017, (ii) at Workshop on *Fundamental Physics with the SKA*, Flic-en-Flac, Mauritius, 1-5 May 2017.

∗ **24.** *A halo model for cosmological neutral hydrogen*, Workshop on Aspects of Gravity and Cosmology, Pune, India, 7-9 March 2017

25. *A halo model for cosmological neutral hydrogen*, at (i) Swiss Cosmology Days meeting 2017, University of Basel, Switzerland, 6-7 February 2017, and (ii) Workshop on Cosmology with Neutral Hydrogen, Berkeley, California, USA, 11-13 January 2017

26. *Probing the universe: through reionization and later*, talk at the 33rd meeting of the Astronomical Society of India (ASI), National Centre for Radio Astrophysics (NCRA), Pune, 17-20 February 2015.

∗ **27.** *Probing the universe: through reionization and later*, at the international conference on Matters of Gravity and the Universe, at Centre for Theoretical Physics, Jamia Millia Islamia, New Delhi, 27-29 October 2014.

∗ **28.** *Electrostatics in a weak gravitational field*, at the 2nd Indo-Japan workshop on Gravitation and Cosmology, Centre for Theoretical Physics, Jamia Millia Islamia, New Delhi, December 29-30, 2009.

(B) Invited seminars and colloquia:

∗ **29.** *Unravelling the growth of the first black holes using JWST and PTAs*, seminar at the Observatoire astronomique de Strasbourg (CNRS and Strasbourg University), 21 May 2024

∗ **30.** *Mapping the baryonic universe: a new window into the cosmos*, Seminar at the Astrophysics and Cosmology Research Unit, University of the Western Cape, South Africa, 15 September 2023

∗ **31.** *Unravelling Cosmic Dawn : Conquest of the Final Frontier*, Scholar Talk, jointly organized by the IQAC, Astronomical Observatory and Department of Physics, University of Kerala, Thiruvananthapuram, India, 8 August 2023

∗ **32.** *A new window towards Cosmic Dawn : the sub-millimetre frontier*, seminar at IUCAA, Pune, India, 28 March 2023

∗ **33.** *Deciphering Cosmic Dawn: A Conquest of the Final Frontier*, colloquium at Ashoka University, India, 3 May 2023

∗ **34.** *Mapping the baryonic Universe: a new window into the cosmos*, State of the Universe seminar at TIFR, Mumbai, India, 16 May 2023

∗ **35.** *Mapping the baryonic Universe: a new window into the cosmos*, seminar at IISER, Pune, India, 23 March 2023

∗ **36.** *A new window towards Cosmic Dawn : the sub-millimetre frontier*, Colloquium at Scuola Normale Superiore, Pisa, Italy, 26 January 2022

∗ **37.** *Deciphering the baryonic Universe: a new window into the cosmos*, colloquium at Yunnan university, SWIFAR, China, 28th June 2023

∗ **38.** *Deciphering Cosmic Dawn: A Conquest of the Final Frontier*, seminar at Korea Astronomy and Space Science Institute (KASI), Daejeon, Korea, 9th August 2022

∗ **39.** *A new window towards Cosmic Dawn : the sub-millimetre frontier*, astrophysics seminar at Indian Institute of Science (IISc), Bangalore, India, 17 November 2021

∗ **40.** *A multi-messenger view of Cosmic Dawn*, Seminar, IAC, Tenerife, Spain, 15 September 2021

∗ **41.** *A multi-messenger view of Cosmic Dawn*, CfA Colloquium, Centre for Astrophysics, Harvard University and Smithsonian Astrophysical Observatory, USA, 6 May 2021

∗ **42.** *A multi-messenger view into Cosmic Dawn*, Seminar, International Centre for Theoretical Sciences (ICTS), Bengaluru, India, 31 March 2021

∗ **43.** *A multimessenger view into the first black holes in the Universe*, Seminar, IUCAA, Pune, India, 24 December 2020

∗ **44.** *Deciphering the baryonic universe: from Cosmic Dawn to today*, at (i) Seminar, Queen's University, Kingston, Ontario, 9 March 2020, (ii) Physics and Astronomy colloquium, Western University, London, Ontario, 28 November 2019, (iii) Seminar, University of Victoria, BC, Canada, 21 November 2019

∗ **45.** *Mapping the baryonic universe: from reionization to present-day galaxies*, at (i) Astronomy seminar at the University of Pennsylvania, Philadelphia, USA, 10 May 2019, (ii) Cosmology seminar, Perimeter Institute for Theoretical Physics, Waterloo, Canada, 21 May 2019, (iii) Seminar at McGill Space Institute, Montreal, Canada, 25 June 2019

∗ **46.** *A halo model for the baryonic universe: intensity mapping through the epoch of reionization*, Seminar at University of Geneva, 9 November 2018

∗ **47.** *Probing the baryonic universe: from reionization to present-day galaxies*, Joint Astrophysical Colloquium, Department of Physics and Astronomy, Institute of Radio Astronomy and Observatory of Astrophysics and Space science, Bologna, Italy, 13 September 2018

∗ **48.** *A halo model for the baryonic universe: from astrophysics to cosmology*, seminar at (i) ITA, University of Heidelberg, 25 September 2018 and (ii) Max-Planck Institute for Astronomy (MPIA), Heidelberg, Germany, 27 September 2018

∗ **49.** *A halo model for the baryonic universe: through reionization and beyond*, seminar at the European Southern Observatory (ESO), Garching, Germany, 12 June 2018

∗ **50.** *Neutral hydrogen in the post-reionization universe*, at Cosmology and particle physics seminar, University of Geneva, Geneva, Switzerland, 3 June 2016 and 20 October 2017

∗ **51.** *A halo model for cosmological neutral hydrogen*, at Indian Institute of Science (IISc) astro seminar, IISc, Bengaluru, India, 14 March 2017

∗ **52.** *A halo model for cosmological neutral hydrogen*, at Theoretical Astrophysics seminar, University of Zurich, Switzerland, 3 February 2017

∗ **53.** *Evolution of baryons in the high-redshift universe*, at:

(i) Theoretical Astrophysics and Relativity (TAPIR) seminar, California Institute of Technology, USA, 23 October 2015

(ii) Jet Propulsion Laboratory (JPL) - Caltech, Pasadena, USA, 26 October 2015

∗ **54.** *Neutral hydrogen in the post-reionization universe*, at Raman Research Institute (RRI), Banglalore, 4 June 2015.

∗ **55.** *Measuring the temperature of the high-redshift intergalactic medium*, for the IISc astro seminar, Indian Institute of Science (IISc) Bangalore, 2 June 2015.

∗ **56.** *Measuring the temperature of the high-redshift intergalactic medium*, seminar at the Tata Institute of Fundamental Research (TIFR), Mumbai, 7 April 2015.

(C) Other talks and seminars:

57. *Going beyond ΛCDM with HI intensity mapping*, ITC Lunch, Harvard University, USA, 24 October 2019

58. *The halo model for the baryonic universe: through reionization and later*, Seminar, LOFAR EoR Science group, Groningen, the Netherlands, 2 July 2018

59. *Evolution of baryons in the high-redshift universe*, at (i) Cosmology seminar, Max-Planck Institute for Astrophysics (MPA), Garching, 13 March 2018, and (ii) talk at EPFL LASTRO, Geneva Observatory, Versoix, Switzerland, 27 February 2018

60. *Neutral hydrogen in the post-reionization universe*, Lunch Talk, Observatories of the Carnegie Institution for Science, Pasadena, USA, 15 December 2017

61. *A halo model for cosmological neutral hydrogen*, at (i) Cosmology seminar, Institute for Theoretical Astrophysics, University of Oslo, Norway, 22 June 2017, (ii) Astronomy Tea Talk, California Institute of Technology, USA, 17 January 2017

62. *Evolution of baryons in the high-redshift universe*, talk at at Galaxies discussion group, Kavli Institute for Cosmology, Institute of Astronomy, Cambridge, UK, 9 October 2015

63. *Evolution of baryons in the high-redshift universe*, talk at School of Physics and Astronomy, University of Nottingham, Nottingham, UK, 6 October 2015

64. *Measuring the temperature of the high-redshift intergalactic medium*, talk at Science meeting, ETH Zurich, 25 September 2015

65. *Probing reionization using quasar near-zones at redshift 6*, talk at Science meeting, ETH Zurich, 14 May 2014.

66. *Some aspects of the nonrelativistic limit of quantum field theory*, seminar at the Institute of Mathematical Sciences (IMSc), Chennai, February 16, 2012.

(D) Public talks / interviews:

67. Public Lecture on *Deciphering Cosmic Dawn: Mysteries from the Invisible Universe* at the Planetarium, Kerala State Science and Technology Museum, Thiruvananthapuram, India, 3 August 2023

68. *Deciphering Cosmic Dawn: Mysteries from the Invisible Universe*, Public Lecture at Nehru Planetarium, Worli, Mumbai, 14 May 2023

69. *Deciphering Cosmic Dawn: Mysteries from the Invisible Universe*, online lecture demonstration at IISER Pune Science Activity Centre, 26 March 2023

70. *First Light in the Universe : End of the Cosmic Dark Ages*, Public Lecture at Nehru Planetarium, Worli, Mumbai, 5 April 2015.

71. *Big Data in the Invisible Radio Universe*, public lecture at the Scientifica, ETH Zurich and the University of Zurich, September 2017.

72. *Unlocking Cosmic Mysteries with the Invisible Radio Universe*, public lecture at the University of Toronto AstroTours (a public outreach activity organized by graduate students of the Department of Astronomy and Astrophysics), March 2020.

73. I have given several (online) interviews and pedagogical talks about my work. A few notable ones are:

    (i) in May 2020, I gave an online talk in the Cosmology Talks YouTube channel hosted by Shaun Hotchkiss, which was an overview of my recent research aimed at cosmologists outside the field.

    (ii) in September 2021, I gave an interview on the channel of the 'Universe Today' magazine publisher on my recent review article, 'A multi-messenger view of Cosmic Dawn'.

    A news article based on this interview is on the Universe Today website at:
    https://www.universetoday.com/152469/cosmic-dawn-holds-the-answers-to-many-of-astronomys-greatest-questions/

    (iii) In April 2023, I gave the Copernicus Webinar on *Mapping the baryonic Universe: a new window into the cosmos*.

    (iv) In August 2023, I gave an interview (in two parts) aired on the Kerala Infrastructure and Technology for Education (KITE India) VICTERS TV channel, covering aspects of current research as well as ways to enable physics education at the school and higher levels.