

CURRICULUM VITAE

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Present Address

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Personal Data

Nationality: Indian

Gender: Male

Place of Birth: Santiniketan, India

Date of Birth: 13 January, 1982

Academic Records

<i>Degree</i>	<i>University/Institute</i>	<i>Year</i>	<i>Marks</i>	<i>Subjects</i>
<i>Ph.D.</i>	Physical Research Laboratory, Ahmedabad, India (<i>affiliated to Mohan Lal Sukhadia University, Udaipur, India</i>)	2011	—	<i>Science with specialization in Upper Atmospheric Physics</i>
<i>M.Sc.</i>	Visva-Bharati, Santiniketan, India	2005	65.72 %	<i>Physics with specialization in Particle Physics</i>
<i>B.Sc. (Hons.)</i>	Visva-Bharati, Santiniketan, India	2003	75.70 %	<i>Physics with Mathemat- ics and Chemistry</i>

Additional Academic Qualifications (National Level)

- JEST (Joint Entrance Screening Test) (2005) Percentile: 96.87%, All India Rank: 148.
- NET (National Eligibility Test) (CSIR JRF) (June-2005), Jointly conducted by CSIR-UGC (Council of Scientific and Industrial Research and University Grants Commission).
- GATE (Graduate Aptitude Test in Engineering) (2005), Percentile: 91.87%, All India Rank: 290.
- JEST (2006), Percentile: 95.46%, All India Rank: 125.

Academic Pursuit

RESEARCH STUDENT: August, 2005–October, 2010 at Space and Atmospheric Sciences Division, Physical Research Laboratory, Ahmedabad, India

THESIS TITLE: **Upper Atmospheric Investigations using Radio and Optical Techniques**

THESIS SUPERVISOR: **Prof. Ramanathan Sekar**

SUBMISSION DATE: **(October, 2010).**

AWARD DATE: **(April, 2011).**

Research Experience

- Post doctoral fellow working with **Prof. Ramanathan Sekar** at Space and Atmospheric Sciences Division, **Physical Research Laboratory, Ahmedabad, India (October, 2010–May, 2011).**
- Post doctoral fellow working with **Prof. John D. Mathews** at **The Pennsylvania State University, Pennsylvania, USA** and visiting scientist at **Arecibo Observatory, Arecibo, Puerto Rico, USA (May, 2011–August, 2013).**
- Research Associate at **The Pennsylvania State University, Pennsylvania, USA** and visiting scientist at **Arecibo Observatory, Arecibo, Puerto Rico, USA (August, 2013–February, 2014).**
- Post doctoral Researcher working with **Dr. Jeong-Han Kim** and **Dr. Geonhwa Jee** at **Korea Polar Research Institute, South Korea (April, 2014–June, 2014).**
- Visiting Scientist working with **Prof. Jorge L. Chau** at **Leibniz-Institute of Atmospheric Physics (IAP), Germany (May–June, 2017).**
- Assistant Professor, **Indian Institute of Technology Roorkee, Roorkee, India (August, 2014–Present).**

Teaching Experience

- **Plasma Physics**, Integrated M.Sc. (3^{rd} Year), Autumn Semester 2014-15 & 2015-16, **IIT Roorkee, India.**
- **Electromagnetic Theory**, B.Tech. (1^{st} Year), Spring Semester 2014-15 & 2017-18, **IIT Roorkee, India.**
- **Space Science and Technology**, B.Tech. (3^{rd} Year), Spring Semester 2015-16 & 2016-17, **IIT Roorkee, India.**
- **Mechanics**, B.Tech. (1^{st} Year), Autumn Semester 2016-17 & 2017-18, **IIT Roorkee, India.**
- **Advanced Atmospheric Physics**, M.Sc. (2^{nd} Year) & Integrated M.Sc. (5^{th} Year), Autumn Semester 2018-19, **IIT Roorkee, India.**

Administrative Experience

- Officer in-Charge in Atmospheric Physics Laboratory, 2016–Present, **Department of Physics, IIT Roorkee, India.**
- Member in Annual Reports & Website Committee, 2016–Present, **Department of Physics, IIT Roorkee, India.**
- Coordinator in M.Sc. & Int. M.Sc. Program, 2018–Present, **Department of Physics, IIT Roorkee, India.**

Master Thesis Supervised

- Master Thesis entitled “Extraction of Gravity Wave Parameter using Airglow Images” by Yamini Khodia, IIT Roorkee, Spring–2015.
- Summer Project Dissertation for Kishore Vaigyanik Protsahan Yojana (KVPY) entitled “Investigation of Kelvin Helmholtz Instabilities in the Upper Mesosphere and Lower Thermosphere” by Jay Agarwal, IIT Roorkee, Autumn–2015.
- Master Thesis entitled “Investigation of Kelvin Helmholtz Instabilities in the Upper Mesosphere and Lower Thermosphere” by Jay Agarwal, IIT Roorkee, Spring–2016.
- Master Thesis entitled “Two-Dimensional Spectral Analysis of Mesospheric Airglow Images” by Apoorva Arora, IIT Roorkee, Spring–2016.
- Master Thesis entitled “Effect of Prandtl number and Reynolds number on the Lifetime of KH Billow” by Om Prakash Birda, IIT Roorkee, Spring–2017.
- Master Thesis entitled “Spectral Analysis of Planetary Atmospheres” by Vijay Singh, IIT Roorkee, Spring–2018.

Ph.D. Thesis Supervised (Ongoing/Completed)

- Ph.D. Thesis entitled “Investigation of Upper Atmosphere using Optical Techniques” by Subarna Mondal, IIT Roorkee [Ongoing].

Sponsored Research Projects (Ongoing/Completed)

- Principal Investigator of an Extramural Research Grant (EMR/2016/000247) entitled “**Investigation of Earth’s Upper Atmosphere using Optical Imaging Techniques**” [Total budget: INR 74.5 Lacs (7.45 Million) for the period of 2017-20] by **Science and Engineering Research Board, Department of Science and Technology (DST-SERB)**, India [Ongoing].
- Co-Principal Investigator of an Extramural Research Grant (EMR/2017/005188) entitled “**Study of thermospheric and mesospheric cooling by using Nitric Oxide radiative emissions**” [Total budget: INR 33.79520 Lacs (3.379520 Million) for the period of 2018-21] by **Science and Engineering Research Board, Department of Science and Technology (DST-SERB)**, India [Ongoing].

Awards / Honors

- A paper entitled “On the role of collisions in the sodium airglow process” by **Sarkhel et al.** was awarded the **Second Prize in 16th National Space Science Symposium (NSSS 2010)** sponsored by **Indian Space Research Organisation (ISRO)** held at Rajkot, India.
- Principle author of a collaborative proposal (**AGS 1241407**; PIs: John D. Mathews, The Pennsylvania State University and Shikha Raizada, Arecibo Observatory, SRI International) entitled “**Collaborative Research: New Directions in Optical-Instrument-Driven Aeronomy at Arecibo Observatory**” is approved for full funding (Total budget: US\$ 759,643 for 5 years) by **National Science Foundation (NSF)**, USA.

Invited Talks / Colloquia

- “Identification of large scale billow-like structures in the neutral sodium layer over Arecibo” on **30 January, 2012** at **Physical Research Laboratory, Ahmedabad, India.**
- “New directions in understanding the origin of unusual structures in the MLT region using active and passive remote sensing techniques” on **10 February, 2014** at **Physical Research Laboratory, Ahmedabad, India.**
- “Upper atmospheric investigation using active and passive remote sensing techniques” on **08 May, 2014** at **Chungnam National University, Daejeon, South Korea.**
- “Physics in the Upper Atmosphere (Active and Passive Remote Sensing Techniques)” on **16 October, 2014** at **Indian Physics Association (Roorkee Chapter), IIT Roorkee, India.**
- “Physics in the Upper Atmosphere (Understanding the origin of unusual phenomena using active and passive remote sensing techniques)” on **08 July, 2015** at **Indian Institute of Astrophysics, Bengaluru, India.**

- “Does Meteoric Metals Exist in the Martian Atmosphere?” on **24 May, 2016** at **ISRO Satellite Centre, Bengaluru, India.**

Schools / Workshop / Conference / Symposium

- Attended **International School on Atmospheric Radar (ISAR-NCU 2006)**, **Chung-Li, Taiwan** and delivered a talk entitled “Mesosphere-lower ionosphere investigations using Indian MST radar and optical techniques.”
- Presented a paper entitled “Simultaneous sodium airglow and sodium lidar observations from Gadanki”
by **S. Sarkhel**, R. Sekar, D. Chakrabarty, R. Narayanan and Y. Bhavani Kumar.
in **15th National Space Science Symposium (NSSS 2008)**, **Ooty, India.**
- Presented a paper entitled “On the role of collisions in the sodium airglow process”
by **S. Sarkhel**, R. Sekar, D. Chakrabarty, R. Narayanan, and S. Sridharan.
in **16th National Space Science Symposium (NSSS 2010)**, **Rajkot, India.**
- Presented a paper entitled “Sodium Airglow Observations from India”
by **S. Sarkhel**, R. Sekar, D. Chakrabarty, R. Narayanan, and S. Sridharan.
in **Asia Oceania Geosciences Society 2010**, **Hyderabad, India.**
- Presented a paper entitled “Mesospheric Gravity Waves over Indian Regions using Sodium Airglow Measurements”
by **S. Sarkhel**, R. Sekar, D. Chakrabarty, and R. Narayanan.
in **COSPAR Scientific Assembly 2010**, **Bremen, Germany.**
- Presented a paper entitled “Identification of large scale billows-like structure in the neutral Na layer over Arecibo”
by **S. Sarkhel**, Shikha Raizada, Craig A. Tepley, Sixto Gonzalez, and John D. Mathews.
in **American Geophysical Union, Fall Meeting, 2011**, **San Francisco, USA.**
- Presented a poster entitled “Penn State Airglow Imagers at Arecibo Observatory: Operation and Image Analyses”
by **S. Sarkhel**, John D. Mathews, Shikha Raizada, and Craig A. Tepley.
in **CEDAR 2012**, **Santa Fe, USA.**
- Presented a paper entitled “A study of an unusual event observed in the Na layer over Arecibo”
by **S. Sarkhel**, Shikha Raizada, John D. Mathews, Steve Smith, Craig A. Tepley, Francisco J. Rivera, and Sixto A. Gonzalez.
in **CEDAR 2012**, **Santa Fe, USA.**
- Presented a paper entitled “New directions in understanding the origin of an unusual structure in the MLT region using active and passive remote sensing techniques”
by **S. Sarkhel**, John D. Mathews, Shikha Raizada, R Sekar, D. Chakrabarty, A. Guharay, Geonhwa Jee, Jeong-Han Kim, Robert B. Kerr, Geetha Ramkumar, S. Sridharan, Qian Wu, Martin G. Mlynchzak, and James M. Russell III.
in **KSSS Spring Meeting, 2014**, **South Korea.**

- Presented a paper entitled “Investigation on Meteoric Metals in the Martian Atmosphere using Airglow Emissions”
by **S. Sarkhel**.
in **MOM Data Analysis Workshop (04-05 September, 2015)**, Physical Research Laboratory, Ahmedabad, India.
- Invited presentation entitled “Exploration of the Venus Atmosphere using Hyper-spectral imaging of Optical and Infrared emissions”
by **S. Sarkhel**.
in **Symposium on Vision & Explorations for Planetary Sciences in Decades 2020-2060 Brain Storming Session (8-10 November, 2017)**, Physical Research Laboratory, Ahmedabad, India.

List of Publications

Papers Submitted/Under Preparation in Refereed Journals

1. A Review on the Upper Atmospheric Sodium Observations from India: Insights; **S. Sarkhel**, S. Mondal, R Sekar, D. Chakrabarty, and S. Sridharan, *Under Review, Advances in Space Research*, 2018.
2. On the life-time of Kelvin-Helmholtz billows in the mesosphere and lower thermosphere region; **S. Sarkhel**, S. Mondal, Jay Agarwal, D. Chakrabarty, R Sekar, Tao Yuan, Xuguang Cai, Alan Z. Liu, Satonori Nozawa, Martin G. Mlynczak, and James M. Russell III, *to be submitted to J. Geophys. Res.*, 2018.

Papers Accepted/Published in Refereed Journals

1. Multi-Instrument Observations of MSTIDs and Source Determination; Ross Dinsmore, J. D. Mathews, Anthea Coster, and S. Sarkhel, *2018 2nd URSI Atlantic Radio Science Meeting (AT-RASC)*, Gran Canaria, Spain, 2018, pp. 1-4. doi:10.23919/URSI-AT-RASC.2018.8471550, 2018. **Impact Factor: 9.23, Citations: 0.**
2. The ionospheric impact of a CME driven sheath region over Indian and American sectors in the absence of a typical geomagnetic storm; Diptiranjan Rout, D. Chakrabarty, **S. Sarkhel**, R. Sekar, B. G. Fejer, G. D. Reeves, Atul S. Kulkarni, Nestor Aponte, Mike Sulzer, John D. Mathews, Robert B. Kerr, and John Noto, *J. Geophys. Res.*, 123, doi:10.1029/2018JA025334, 2018. **Impact Factor: 3.42, Citations: 0.**
3. Erratum to: Dependence of mesospheric Na and Fe distributions on electron density at Arecibo; Shikha Raizada, Craig Tepley, Qihou Zhou, **S. Sarkhel**, John Mathews, Nestor Aponte, Ilgin Seker, Robert Kerr, Edvier Cabassa, *Earth Planets Space*, 67:202, doi:10.1186/s40623-015-0371-3, 2015. **Impact Factor: 1.87, Citations: 0.**
4. Dependence of mesospheric Na and Fe distributions on electron density at Arecibo; Shikha Raizada, Craig Tepley, Qihou Zhou, **S. Sarkhel**, John Mathews, Nestor Aponte, Ilgin Seker, Robert Kerr, Edvier Cabassa, *Earth Planets Space*, 67:146, doi: 10.1186/s40623-015-0322-z, 2015. **Impact Factor: 1.87, Citations: 3.**

5. Erratum to: A case study on occurrence of an unusual structure in the sodium layer over Gadanki, India; **S. Sarkhel**, Mathews JD, Shikha R, Ramanathan S, Dibyendu C, Amitava G, Geonhwa J, Jeong-Han K, Kerr RB, Geetha R, Sundararajan S, Qian W, Mlynczak MG, Russell JM, *Earth Planets Space*, 67:145, doi:10.1186/s40623-015-0276-1, 2015. **Impact Factor: 1.87, Citations: 1.**
6. A case study on occurrence of an unusual structure in the sodium layer over Gadanki, India; **S. Sarkhel**, John D. Mathews, Shikha Raizada, R Sekar, D. Chakrabarty, A. Guharay, Geonhwa Jee, Jeong-Han Kim, Robert B. Kerr, Geetha Ramkumar, S. Sridharan, Qian Wu, Martin G. Mlynczak, and James M. Russell III, *Earth, Planets and Space*, 67:19, doi:10.1186/s40623-015-0183-5, 2015. **Impact Factor: 1.87, Citations: 3.**
7. Investigation of the intraseasonal oscillations over a Brazilian equatorial station: a case study; A Guharay, P. P. Batista, B. R. Clemesha, **S. Sarkhel**, and R. A. Buriti, *Earth, Planets and Space*, 66:145, doi:10.1186/s40623-014-0145-3, 2014. **Impact Factor: 1.33, Citations: 2.**
8. Response of the extra-tropical middle atmosphere to the September 2002 major stratospheric sudden warming; A. Guharay, P. P. Batista, B. R. Clemesha, **S. Sarkhel**, *Adv. Space Res.*, 53, 257–265, doi:10.1016/j.asr.2013.11.002, 2014. **Impact Factor: 1.36, Citations: 1.**
9. On the variability of the terdiurnal tide over a Brazilian equatorial station using meteor radar observations; A. Guharay, P. P. Batista, B. R. Clemesha, **S. Sarkhel**, R. A. Buriti, *J. Atmos. Sol. Terr. Phys.*, 104, 87–95, doi:10.1016/j.jastp.2013.08.021, 2013. **Impact Factor: 1.47, Citations: 6.**
10. Identification of large scale billows-like structure in the neutral Na layer over Arecibo, **S. Sarkhel**, S. Raizada, J. D. Mathews, S. M. Smith, C. A. Tepley, F. J. Rivera, S. A. Gonzalez, *J. Geophys. Res.*, 117, A10301, doi:10.1029/2012JA017891, 2012. **Impact Factor: 3.17, Citations: 11.**
11. Investigation on Mesospheric Gravity Waves over Indian Low Latitude Stations using Sodium Airglow Observations and A Few Case Studies Based on Thermal and Wind Structures; **S. Sarkhel**, R. Sekar, D. Chakrabarty, and A. Guharay, *J. Atmos. Sol. Terr. Phys.*, 86, 41–50, doi:10.1016/j.jastp.2012.06.008, 2012. **Impact Factor: 1.42, Citations: 3.**
12. A Case Study on the Possible Altitude-Dependent Effects of Collisions on Sodium Airglow Emission; **S. Sarkhel**, R. Sekar, D. Chakrabarty, and S. Sridharan, *J. Geophys. Res.*, 115, A10306, doi:10.1029/2010JA015251, 2010. **Impact Factor: 3.30, Citations: 5.**
13. Simultaneous sodium airglow and lidar measurements over India: a case study; **S. Sarkhel**, R. Sekar, D. Chakrabarty, R. Narayanan, and S. Sridharan, *J. Geophys. Res.*, 114, A10317, doi:10.1029/2009JA014379, 2009. **Impact Factor: 3.08, Citations: 10.**
14. Identifications of active fossil bubbles based on coordinated VHF radar and airglow measurements; R. Sekar, D. Chakrabarty, **S. Sarkhel**, A. K. Patra, C. V. Devasia and M. C. Kelley, *Ann. Geophys.*, 25, 2099–2102, doi:10.5194/angeo-25-2099-2007, 2007. **Impact Factor: 1.43, Citations: 25.**

Other Publications

1. The Coordinated Sodium Airglow and Lidar Observations over India; **S. Sarkhel**, R. Sekar, D. Chakrabarty, R. Narayanan, and S. Sridharan, Abstract # SA33A-02, *American Geophysical Union*, Spring Meeting, 2009.
2. Sodium Airglow Emission from Terrestrial Mesosphere; **Sumanta Sarkhel**, *PRL News*, Volume 25, Issue 1, July 2010.
3. Mesospheric Gravity Waves over Indian Regions using Sodium Airglow Measurements; **S. Sarkhel**, R. Sekar, D. Chakrabarty, R. Narayanan, 38th COSPAR Scientific Assembly. Held 18-15 July 2010, in Bremen, Germany, p.5, 2010.
4. Observations of the Intra-seasonal oscillations in the tropical MLT and lower atmosphere; A Guharay, **S. Sarkhel**, PP Batista, AGU Fall Meeting 2011, abstract id. A51A-0205, 2011.
5. Lidar observations of mesospheric metals and electron densities over Arecibo; S Raizada, B Williams, J Friedman, **S. Sarkhel**, C Tepley, Q Zhou, N Aponte, 39th COSPAR Scientific Assembly. Held 14-22 July 2012, in Mysore, India. Abstract F3.1-5-12, p.1557, 2012.
6. Characteristics of Mesospheric Na Distribution over Arecibo, Puerto Rico, S Raizada, E Garcia, C Garnett Marques Brum, **S Sarkhel**, E Cabassa-Miranda, Q Zhou, CA Tepley, AGU Fall Meeting 2013, abstract id.SA11B-1927, 2013
7. Influence of Sporadic E layers on Mesospheric Na and Fe Layers over Arecibo; S Raizada, CA Tepley, Q Zhou, **S Sarkhel**, JD Mathews, N Aponte, R Kerr, AGU Fall Meeting 2014, abstract id.SA41A-4049, 2014.

Research Interests

My research interest encompasses the investigations of upper atmosphere using mainly ground-based nighttime airglow photometer and imager. The airglow data are supplemented by data from VHF radar, Na resonant lidar and satellite borne measurements.

- To measure the Na D_2/D_1 airglow intensity ratio, investigate its variability and its impact on sodium airglow emission process.
- Investigating planetary airglow emissions using ground based astronomical optical telescope.
- Investigating the generation of ubiquitous omnipresent Medium Scale Travelling Ionospheric Disturbances (MSTIDs) using airglow imager.
- Investigation of meteoroid ablation processes and associated phenomena using the airglow imager at different wavelengths.
- Investigation of breaking of gravity waves near mesopause region using multi-wavelength airglow imager and satellite borne measurements and characterize secondary waves.
- Investigation of neutral instability processes at mesosphere lower thermospheric region using resonance lidars.

Other Proficiencies

- Was an active member of a team which has the experience to conceptualize and design different state-of-the-art optical instruments such as nighttime airglow photometers and spectrometers. An automatic multi-wavelength airglow imager is also designed and fabricated at Physical Research Laboratory (PRL), Ahmedabad, India in order to characterize mesospheric gravity waves in three dimensions along with Na lidar at Gadanki. It consists of several achromatic lens systems, a programmable motorized filter wheel with five filter slots and a cooled CCD detector. The fish-eye lens being an essential part of the lens system decides the field-of-view and the rays are channelled through a field lens decreasing the divergence. A collimating lens further reduces the divergence of the rays in order to pass through the interference filter. The interference filter selects the desired wavelength of emission and the filtered signals are further focused on the high sensitive CCD pixels using camera lens. The whole imaging system is completely automatic and the interfacing between the motorized filter wheel and the CCD camera was carried out in our laboratory. The imager is equipped with the capability of capturing signals at different wavelengths with different exposure times using a software program made in-house.
- Experience in operating in operating airglow imagers at the Arecibo Observatory (18.35° N, 66.75° W), Puerto Rico, USA operated by Penn State University, Pennsylvania, USA and analyzing near-real time raw images. An image processing module has been developed to process those raw images into geographically calibrated unwrapped images. This image processing module consists of several MATLAB subroutines developed specifically for processing those images which are designed for geographical calibration of images using standard star catalogue at 557.7 nm and 630.0 nm, and 777.4 nm wavelength. In addition, the module also calculates north-south and east-west keograms and movies for each filter. As a part of developing the image processing module, a web interface has also been designed for posting those process data online that can be accessed online to all users in near real-time. The web interface allows user to choose to view/download movies/keograms at any filter.

Also has significant experience of processing raw images of another airglow imager at the King Sejong Station, Antarctica (62.22° S, 58.78° W) that is operated by Korea Polar Research Institute, South Korea.

- Recently, we have installed an allsky multi-wavelength imaging system (557.7 and 630.0 nm filters) for the investigation of Earth's upper atmosphere at the Indian Astronomical Observatory (IAO), Hanle, Leh Ladakh (32.78° N, 78.96° E). The observatory is operated by the Indian Institute of Astrophysics, Bengaluru which is situated at 4200 meter altitude from mean sea level (at ~600 mb pressure level). The imaging system was procured under DST-SERB project (EMR/2016/000247). The purpose of the allsky imaging system is to understand the optical emissions from the Earth's upper atmosphere and its connection with the plasma irregularities at the ionosphere over the Himalayan region. The imager is installed inside a small (3 m × 2 m × 2 m) weather proof PUF container which was also constructed during installation of the imager. We have named of the building as "High Altitude Optical Aeronomy Observatory". We got the first light on 12 June, 2018 evening. The imaging system is fully automatic and will keep on taking observation during nighttime. ***This is the first of its kind of instrument that is ever installed at such an altitude in India.***
- Experience in handling Na resonance lidar at Arecibo Observatory, Puerto Rico, USA and analyzing raw data to derive neutral Na atom concentration.

- Can work in both Windows and UNIX environments.
- Knowledge in MATLAB programming. Brief knowledge in PERL and SHELL script.

I hereby declare that the above information is correct to the best of my knowledge.

Date: October 2, 2018

Sumanta Sarkhel

Place: Roorkee, India