Joe Philip Ninan

PRESENT ADDRESS
CM 28,
Dept. of Astronomy & Astrophysics
Tata Institute of Fundamental Research
1 Homi Bhabha Road, Colaba, Mumbai-400005, India.
(+91) 814-766-0472

PERMANENT ADDRESS
Vadakeparambil
Pullad P.O., Pathanamtitta (dist)
Kerala, 689548, India.
(+91) 0469-2660510

Email: joe.ninan@tifr.res.in

Nationality: Indian

APPOINTMENTS

Reader at Dept. of Astronomy & Astrophysics, Tata Institute of Fundamental Research, India. (2022 - present)
Assistant Research Professor at Dept. of Astronomy & Astrophysics, The Pennsylvania State University (PSU), USA. (2019 - 2021)
CEHW Postdoctoral Researcher at Dept. of Astronomy & Astrophysics, The Pennsylvania State University (PSU), USA. (2016 - 2019)

EDUCATION

Course	Year	Institute	Marks
Ph.D. (Astronomy)	2016	TIFR, Mumbai	
M.Sc. (Physics)	2012	TIFR, Mumbai	72.7 %
B.Sc. (PME)*	2010	Christ College, Bangalore	95.2 %
XII^{th}	2007	St Johns H.S.S., Eraviperoor	95.7 %
X^{th}	2005	St Johns H.S.S., Eraviperoor	92.5 %

**PME* stands for Physics, Mathematics and Electronics triple main B.Sc.

Ph.D. Thesis Title: *Episodic Accretion and Outflows in Young Stellar Objects & Near Infrared Instrumentation*
Thesis Advisor: Prof. D. K. Ojha, TIFR, Mumbai, India

HONORS AND AWARDS

NASA Group Achievement Award for work on NEID spectrograph (2020)

IAU Junior Member of International Astronomical Union (2019-).

INSA Medal for Young Scientist by Indian National Science Academy, New Delhi (2017).

Geeta Udgaonkar Award (Best Thesis Award) for the year 2016-17 by TIFR Alumni Association (TAA), TIFR (2017).

Ratanbai Jerajani award for best seminar in the area of Astronomy and Astrophysics at TIFR (2013).

JRF CSIR/UGC Junior Research Fellowship by Council of Scientific & Industrial Research (CSIR), India (2012).

1st Rank in B.Sc. (Gold Medal) (2010).

KVPY Fellow Kishore Vaigyanik Protsahan Yojana, DST, Govt. of India. (2009).

NIUS Fellow National Initiative on Undergraduate Science, HBCSE - TIFR, India (2008).

RESEARCH INTERESTS

- Exo-planets and their atmospheres.
- Star and Planet Formation.
- Protoplanetary Discs, Episodic Accretion & Outflows from young stars.
- Astronomical Instrumentation: Precision spectrograph and camera design, Photonics, Optical fiber based instruments.
- Astronomical data analysis and software design.

OBSERVING EXPERIENCE

- Optical Imaging and Spectroscopy (> 175 nights on 2-m HCT & IGO telescope, India, 0.5-m WIYN, USA)
- Many weeks of High Resolution Optical and Near-Infrared Spectroscopy (using 11-m HET, USA; 11-m SALT, South Africa; 3.5-m WIYN, USA)
- Near-Infrared Imaging and Spectroscopy (> 60 nights on 2-m HCT & IGO telescope, India)
- Radio Interferometry Observation (using GMRT, India)
- Sub-millimeter Heterodyne Observation (using APEX, Chile)

SUCCESSFUL PROPOSALS

- PI and Co-I of proposals for 11-m HET Telescope. (optical and near-IR)
- PI of long-term *MFES* program proposals for 2-m HCT and IGO Telescopes. (Optical & near-IR)
- Co-I of proposals for 11-m SALT Telescope. (optical)
- Co-I of proposals for 3.5-m WIYN Telescope. (optical)
- PI of two proposals for APEX, Chile. (sub-millimeter)
- PI and Co-I of proposals for GMRT, India (radio)
- Co-I of proposals for 1.3-m ARIES Telescope (optical)

TEACHING EXPERIENCE

- Guest Lecture on 'Optimal way to measure anything!' for Experimental Physics Course, Graduate Studies, TIFR (2022).
- Assisting Dr. Ana Matkovic in Programming Class for Astronomy Undergraduates at Dept. of Astronomy & Astrophysics, PSU (2019, 2020).
- Teaching Assistant for Electrodynamics course by Prof. Sudip Bhattacharyya for TIFR Graduate students (2013).

PUBLIC OUTREACH

- Lectures on Exoplanet Science for the NIUS Astronomy 2022 programme, HBCSE, TIFR, Mumbai (June 2022).
- Talk on Exo-planets and Biosignatures, Online event, Poetry of Reality, Kerala, India. (20^{th} March, 2022).
- Talk on Exo-planets atmospheres, K. E. College, Mannanam, Kerala, India. (11^{th} February, 2022).
- School year inaguration talk on exoplanets at St. Johns H.S. School, Eraviperoor, Kerala, India (1^{st} June, 2021).
- Talk on Exo-planets atmospheres for Inaguration of Physics and Electronics Association, Christ University, Bangalore, India (1^{st} October, 2020).

- Guest Lecture on Precision Astronomy Instrumentation for PSU Center for Nanotechnology Education and Utilization's, visiting summer undergraduate students, PSU, USA (13^{th} June, 2019).
- Managing astronomy stalls during Department AstroFest, Pennsylvania State University, USA (2017, 2018, 2020).
- Talk on Exo-planets and detection methods, Christ University, Bangalore, India (15^{th} December, 2017).
- Chai & Why, TIFR Outreach Talk on 'The eight wanderers of the Solar System', Ruparel College, Mumbai. (21^{st} June, 2015).
- Astronomy Outreach talk at St. Johns H.S.S. Eraviperoor, Kerala (December, 2013).
- Setting up telescopes during transits and other outreach events for TIFR Open Day (2011-2015).

TALKS, CONFERENCES, SCHOOLS & VISITS

- TIFR NSF Colloquium on 'Exoplanets to Protoplanetary discs: Building spectrographs to push the frontiers', TIFR, Mumbai, India, (2^{nd} November, 2022).
- Invited talk on 'Precision calibration of astronomy spectrographs using Laser Frequency Combs', SCOP-2022 Conference, Photonics Division, PRL, Ahmedabad, India, (30^{th} September, 2022).
- Seminar on 'Exoplanets to Protoplanetary discs: Building spectrographs to push the frontiers', Astronomy & Astrophysics Division, PRL, Ahamedabad, India, (27^{th} September, 2022).
- Talk on 'Exoplanets and Evaporating Atmospheres' at Dept of Astronomoy and Astrophysics, Nagoya University, Nagoya, Japan, (29^{th} June, 2022).
- Invited talk on 'Unlocking the mysteries of protoplanetary disc accretion via spectroscopy', 3rd Star Formation Conference, ARIES, Nanital, India, (7^{th} May, 2022).
- Poster and Haiku on 'Probing exosphere of Neptune size planets around M-dwarf using He10830', Cool Stars 20.5, Virtual, (2-4th , March, 2021).
- CEHW Seminar, 'Using He10830 as a probe to understand the evaporating atmospheres of exo-planets', The Pennsylvania State University, USA (24^{th} August, 2020).
- Invited talk on Evaporating atmospheres of Exoplanets, Sixth Regional Astronomy Meeting, Kerala, India, (July 10, 2020).
- Invited talk on the ongoing search for Exo-earths, St. Thomas College, Kozhencherry, Kerala, India (3^{rd} January, 2020).
- Invited review talk on The Habitable-zone Planet Finder, at Extremely Precise Radial Velocity (EPRV) IV Conference, Grindelwald, Switzerland (20^{th} March, 2019).
- Invited Talk and Organisation of Splinter Section on Extremely Precise Radial Velocity in Near-Infrared at EPRV IV Conference, Grindelwald, Switzerland (18^{th} March, 2019).
- Telluric Line Hack Week, Flatiron Institute, New York City, USA, (25^{th}-28^{th}, February, 2019).
- Poster on 'Correcting crosshatch pattern in H2RG for high precision near-infrared RV in HPF', Image Sensors for Precision Astronomy, Caltech, Pasadena, USA (3^{rd} December, 2018).
- Talk on 'Probing the Environments of Young Stars using HPF: A first look at V899 Mon with high resolution NIR spectroscopy', Emerging Researchers in Exoplanet Science VI (ERES VI), State College, USA, (21^{st} June, 2018).
- Poster on 'The Habitable-Zone Planet Finder: improved flux image generation algorithms for H2RG up-the-ramp data', SPIE Astronomical Telescopes + Instrumentation, Austin, USA (12^{th} June, 2018).
- Summer School in Astroinformatics, The Pennsylvania State University, USA (4^{th}-8^{th} June, 2018).

- Presented poster on 'The Habitable Zone Planet Finder: Precision NIR Radial Velocities during Testing & Commissioning', 231^{st} American Astronomical Society Meeting, Maryland, USA, (9^{th} January, 2018).
- ASET Colloquium on 'In search of Exo-earths: Development of next generation extreme precision radial velocity spectrographs', TIFR, Mumbai (19^{th} December, 2017).
- Presentation on 'Two dimensional Bandlimited interpolation technique for spectral rectification', Third Workshop on Extremely Precise Radial Velocities, Conference (EPRV III), State College, USA (14^{th} August, 2017).
- Talk on 'Understanding Episodic Accretion and Outflows in Young Stellar Objects', The Pennsylvania State University, USA (31^{st} January, 2017).
- Talk on 'Episodic Accretion and Outflows in Young Stellar Objects & Near Infrared Instrumentation', IIA, Bangalore, India (3^{rd} November, 2016).
- Talk on 'Near-infrared Astronomical Instrumentation at TIFR', TIFR, Mumbai (2^{nd} September, 2016).
- Talk on 'Understanding Episodic Accretion and Outflows in Young Stellar Objects', TIFR, Mumbai (1^{st} September, 2016).
- Talk on 'Constraining the episodic outflow mechanism and outburst period of young stellar objects', IUCAA, Pune, India (27^{th} July, 2016).
- Talk on 'Understanding the episodic accretion mechanisms in young stellar objects & Near Infrared Instrumentation', NCRA-TIFR, Pune, India (25^{th} July, 2016).
- ASET Colloquium on 'Ground-based Infrared Astronomy Activities at TIFR and Future Plans', TIFR, Mumbai (8^{th} July, 2016).
- Talk on 'Supervised and Unsupervised machine learning using scikit-python', Big Data, pre-ASI Workshop at 34^{th} ASI, Kashmir University, Srinagar, India, (9^{th} May, 2016).
- Presented poster on 'Hierarchical Bayesian model to constrain rate of rare episodic outbursts' at 34^{th} ASI, Kashmir University, Srinagar, India (10^{th}-13^{th} May, 2016).
- Talk on 'Episodic high velocity outflows from an outbursting YSO: V899 Mon', Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, Russia, (24^{th} March, 2016)
- 'Episodic accretion outbursts in protoplanetary discs and outflows', IISc Bangalore, Astro Seminar Talk, (10^{th} November, 2015).
- CLOUDY Workshop, IUCAA, Pune, India (21^{st}-26^{th} September, 2015)
- SALT Science 2015 Conference, South Africa. Poster on "SALT-HRS results showing structures in outflows during outburst" on 1^{st}-5^{th} June, 2015.
- Visited Max Planck Institute for Astronomy, Heidelberg, Germany from March 21^{st} to April 1^{st} 2015. Gave a talk on our results from V899 Mon in understanding FUors accretion in Planet and Star Formation group meeting.
- 45^{th} Saas-Fee Course, 2015 From Protoplanetary Disks to Planet Formation, Switzerland.(Poster: Understanding Disc Accretion from FUors/EXors), (15^{th}-20^{th} March, 2015)
- 33^{rd} ASI, NCRA-TIFR, Pune, 2015 (Poster: V899 Mon (IRAS06068-0641) : Understanding FUors/EXors Phenomenon).
- International workshop on "Current trends in Near Infrared Astronomy in India", Hyderabad, 2014. (Gave Talk on: FU Ori Type Outburst Sources in Young Low Mass Stars).
- 32^{nd} ASI, IISER Mohali, 2014. (Gave talk on : Episodic accretion events from a young stellar object IRAS 06068-0641. Also presented a poster on : TIRSPEC, TIFR Near Infrared Spectrometer and Imager).
- Python Programming in Astronomy, IUCAA, Pune, 2014. (Gave talk on "Astropy - FITS, WCS and Cosmology" and conducted hands-on sessions).
- IRC Workshop on Variable Sources in Astronomy, Thiruvalla, 2014 (Gave talk on: How to acheive 1% photometry).

- 4^{th} IIA - PennState Astrostatistics School, VBO, IIA, Kavalur, 2013.
- Radio Astronomy School NCRA-TIFR, Pune, 2013.
- Workshop on Research in Astronomy : Opportunities and Challenges, Thiruvalla, 2013. (Gave talk on "Outburst sources in YSOs").
- 31^{st} ASI, Trivandrum, 2013. (Gave talk on : Constraining models of accretion outbursts in low-mass YSOs).
- Sokendai Asian Winter School on Exoplanets, NAOJ, Mitaka, Japan, December 2012.
- ASTROCHEM 2012, Kolkata, 2012. (Poster on : Second outburst phase of a young eruptive star V1647 Orionis (McNeil's Nebula)).
- Winter School on Astronomical and Cosmological Surveys, TIFR, Mumbai, 2012.
- 27^{th} ASI, IIA, Bangalore, 2009. Poster on : Color method to study temperature distribution around Wolf-Rayet Stars.
- Asian Science Camp, Tsukuba, Japan, August, 2009. (Represented India as a team).

PUBLICATIONS

In Refereed Journals

Primary Six Publications

1. 'Evidence for He I 10830 Å absorption during the transit of a warm Neptune around the M-dwarf GJ 3470 with the Habitable-zone Planet Finder', **Ninan J. P.**, Stefansson, G., et al., ApJ, 894, 02, 2020.
2. 'Impact of crosshatch patterns in H2RGs on high precision radial velocity measurements: Exploration of measurement and mitigation paths with HPF', **Ninan J. P.**, Mahadevan S., et al., JATIS, 5(4), 041511, 2019.
3. 'Episodic High Velocity Outflows from V899 Mon: A Constraint On The Outflow Mechanisms', **Ninan J.P.**, Ojha D.K. & Philip N. S., ApJ 825, 65, 2016.
4. 'V899 Mon: An Outbursting Protostar With Peculiar Light Curve And Its Transition Phases', **Ninan J.P.**, Ojha D.K., et al., ApJ, 815, 4, 2015.
5. 'TIRSPEC: TIFR Near Infrared Spectrometer and Imager', **Ninan J.P.**, Ojha D.K., et al., Journal of Astronomical Instrumentation, 03, 1450006, 2014.
6. 'Re-appearance of McNeil's nebula (V1647 Orionis) and its outburst environment', **Ninan J.P.**, Ojha D.K. et al., ApJ, 778, 116, 2013.

Other Refereed Publications

7. 'Detection of p-mode Oscillations in HD 35833 with NEID and TESS', Gupta A.F., et al., **(including Ninan, J.P.)**, et al. AJ 164 (6), 254, 2022.
8. 'The Active Chromospheres of Lithium-rich Red Giant Stars', Sneden C., et al., **(including Ninan, J.P.)**, et al., ApJ 940 (1), 12, 2022.
9. 'TOI-5205b: A Jupiter transiting an M dwarf near the Convective Boundary', Kanodia S., et al., **(including Ninan, J.P.)**, et al., (arXiv:2209.11160) 2022.
10. 'GJ 3929: High-precision Photometric and Doppler Characterization of an Exo-Venus and Its Hot, Mini-Neptune-mass Companion', Beard C., et al., **(including Ninan, J.P.)**, et al., ApJ 936 (1), 55, 2022.
11. 'TANSPEC: TIFR-ARIES Near-infrared Spectrometer', Sharma S.,, Ojha D. K., Ghosh A., **Ninan, J.P.**, et al., PASP, 134 (1038), 085002, 2022.
12. 'TOI-3714 b and TOI-3629 b: Two Gas Giants Transiting M Dwarfs Confirmed with the Habitable-zone Planet Finder and NEID', Canas, C., et al., **(including Ninan, J.P.)**, et al., AJ 164 (2), 50, 2022.
13. 'The Warm Neptune GJ 3470b has a Polar Orbit', Stefansson, G. et al., **(including Ninan, J.P.)**, et al. ApJL, 931 (2), L15, 2022.
14. 'A close-in puffy Neptune with hidden friends: The enigma of TOI 620', Reefe M. A., et al, **(including Ninan, J.P.)**, et al., AJ 163 (6), 269, 2022.
15. 'TOI-1696 and TOI-2136: Constraining the Masses of Two Mini-Neptunes with the Habitable-Zone Planet Finder', Beard C., et al., **(including Ninan, J.P.)**, et al., AJ, 163 (6), 286, 2022.
16. 'TOI-3757 b: A low density gas giant orbiting a solar-metallicity M dwarf', Kanodia S., Libby-Roberts J., Canas C., **Ninan, J.P.**, et al., (arXiv:2203.07178) 2022.
17. 'Rotational modulation of spectroscopic Zeeman signatures in low-mass stars', Terrien, R.C., et al., **(including Ninan, J.P.)**, et al., ApJL, 927 (1), L11, 2022.
18. 'Evaluation of Controllers and Development of a new in-house Controller for the Teledyne HxRG Focal Plane Array for the IRSIS satellite payload', Naik M.B., et al., **(including Ninan, J.P.)**, (arXiv:2203.00202)

19. ‘H-band temperature and metallicity indicators for cool giants empirical relations in bayesian framework’, Ghosh, S., **Ninan, J.P.**, Ojha. D.K. MNRAS, 511 (1), 814-828, 2022.
20. ‘Gaia 20eae: A newly discovered episodically accreting young star’ , Ghosh, A., Sharma, S., **Ninan, J.P.**, et al., ApJ 926 (1), 68, 2022.
21. ‘NEID Rossiter-McLaughlin Measurement of TOI-1268b: A Young Warm Saturn Aligned with Its Cool Host Star’, Dong J., et al., **(including Ninan, J.P.)**, et al., ApJL, 926 (2), L7, 2022
22. ‘High-resolution Near-infrared Spectroscopy of a Flare around the Ultracool Dwarf vB 10’, Kanodia, S., et al., **(including Ninan, J.P.)**, et al., ApJ, 925 (2), 155, 2022.
23. ‘An eccentric Brown Dwarf eclipsing an M dwarf’, Canas, C., et al., **(including Ninan, J.P.)**, et al. AJ 163 (2), 89, 2022.
24. ‘Observing the Sun as a star: Design and early results from the NEID solar feed’, Lin, A. S. J, et al., **(including Ninan, J.P.)**, et al., AJ 163 (4), 184, 2022.
25. ‘A hot Mars-sized exoplanet transiting an M dwarf’, Canas, C., et al., **(including Ninan, J.P.)**, et al., AJ, 163 (1), 3, 2021.
26. ‘A Search for Planetary Metastable Helium Absorption in the V1298 Tau System’, Vissapragada, S. , et al., **(including Ninan, J.P.)**, et al., AJ 162 (5), 222, 2021.
27. ‘The Habitable-zone Planet Finder Detects a Terrestrial-mass Planet Candidate Closely Orbiting Gliese 1151: The Likely Source of Coherent Low-frequency Radio Emission from an Inactive Star’, Mahadevan, S., et al., **(including Ninan, J.P.)**, et al., ApJL 919 (1), L9, 2021.
28. ‘TOI-532b: The Habitable-zone Planet Finder confirms a Large Super Neptune in the Neptune Desert orbiting a metal-rich M-dwarf host’, Kanodia, S., AJ, 162 (4), 135, 2021.
29. ‘Optical and NIR spectroscopy of cool CEMP stars to probe the nucleosynthesis in low-mass AGB binary system’ Susmitha, A., et al., **(including Ninan, J.P.)**, et al., MNRAS, 506 (2), 1962-1977, 2021.
30. ‘Nondetection of Helium in the Upper Atmospheres of TRAPPIST-1b, e, and f’, Krishnamurthy, V., Hirano, T., Stefnsson, G., **Ninan, J.P.**, et al., AJ, 162 (3), 82, 2021.
31. ‘Stellar Activity Manifesting at a One Year Alias Explains Barnard b as a False Positive’,Lubin, J., et al., **(including Ninan, J.P.)**, et al., AJ, 162 (2), 61, 2021.
32. ‘New temperature and metallicity scale of cool giants from K-band spectra’, Ghosh, S., Ojha D.K., **Ninan, J.P.**, MNRAS, 501 (3), 4596-4609, 2021.
33. ‘Broadband stability of the Habitable Zone Planet Finder Fabry-Prot etalon calibration system:evidence for chromatic variation’, Terrien, R., **Ninan, J.P.**, et al., AJ,161 (6), 252, 2021.
34. ‘A Harsh Test of Far-field Scrambling with the Habitable-zone Planet Finder and the HobbyEberly Telescope’, Kanodia, S., Halverson S., **Ninan, J.P.**, et al., ApJ, 912 (1), 15, 2021.
35. ‘Target Prioritization and Observing Strategies for the NEID Earth Twin Survey’, Gupta, A., F., et al., **(including Ninan, J.P.)**, et al., AJ, 161 (3), 130, 2021.
36. ‘Chemical Compositions of Red Giant Stars from Habitable Zone Planet Finder Spectroscopy’, Sneden, C., et al., **(including Ninan, J.P.)**, et al., AJ, 161 (3), 128, 2021.
37. ‘The Epoch of Giant Planet Migration Planet Search Program. I. Near-infrared Radial Velocity Jitter of Young Sun-like Stars’, Tran, Q., H., et al., **(including Ninan, J.P.)**, et al., AJ, 161 (4), 173, 2021.
38. ‘[CII] emission properties of the massive star-forming region RCW 36 in a filamentary molecular cloud’ , T. Suzuki, et al., **(including Ninan, J.P.)**, A&A, 651, A30., 2021.
39. ‘A Mini-Neptune and a Radius Valley Planet Orbiting the Nearby M2 Dwarf TOI-1266 in Its Venus Zone: Validation with the Habitable-zone Planet Finder’, Stefansson, G., et al., **(including Ninan, J.P.)**, AJ, 160 (6), 259, 2020.
40. ‘Oxygen abundances of carbon-enhanced stellar population in the halo’, Susmitha, A. et al., **(including Ninan, J.P.)**, Journal of Astrophysics and Astronomy 41 (1), 1-6, 2020.

41. ‘A warm Jupiter transiting an M dwarf: A TESS single transit event confirmed with the Habitable-zone Planet Finder’, Canes, C., et al., **(including Ninan, J.P.)**, AJ, 160 (3), 147, 2020.
42. ‘TOI-1728b: The Habitable-zone Planet Finder confirms a warm super Neptune orbiting an M dwarf host’, Kanodia, S., et al., **(including Ninan, J.P.)**, ApJ, 899 (1), 29, 2020.
43. ‘The Habitable-zone Planet Finder Reveals A High Mass and a Low Obliquity for the Young Neptune K2-25b’, Stefansson, G., et al., **(including Ninan, J.P.)**, AJ, 160 (4), 192, 2020.
44. ‘Following the TraCS of exoplanets with Pan-Planets: Wendelstein-1b and Wendelstein-2b’, Steuer, J., et al., **(including Ninan, J.P.)**, A&A, 639, A130, 2020.
45. ‘Persistent starspot signals on M dwarfs: multi-wavelength Doppler observations with the Habitable-zone Planet Finder and Keck/HIRES’, Robertson, P., et al., **(including Ninan, J.P.)**, 897 (2), 125, ApJ, 2020.
46. ‘Solar Contamination in Extreme Precision Radial Velocity Measurements: Deleterious Effects and Prospects for Mitigation’, Roy, A., et al., **(including Ninan, J.P.)**, AJ, 159, 4, 2020.
47. ‘A sub-Neptune sized planet transiting the M2.5-dwarf G 9-40: Validation with the Habitable-zone Planet Finder’, Stefansson, G., et al., **(including Ninan, J.P.)**, AJ, 159, 100, 2019.
48. ‘Improving the Thermal Stability of a CCD Through Clocking’, Blake, C. H., et al., **(including Ninan, J.P.)** JATIS, 5(4), 041510, 2019.
49. ‘Stellar spectroscopy in the near-infrared with a laser frequency comb’, Metcalf, A. J., et al., **(including Ninan, J.P.)**, Optica 6 (2), 233-239, 2019.
50. ‘Ultrastable environment control for the NEID spectrometer: design and performance demonstration’, Robertson, P., et al., **(including Ninan, J.P.)**, JATIS, 5 (1), 015003, 2019 .
51. ‘Star Formation in the Sh 2-53 Region Influenced by Accreting Molecular Filaments’, Baug, T., et al., **(including Ninan, J.P.)**, 119B, 852, ApJ, 2018.
52. ‘The Astropy Project: Building an inclusive, open-science project and status of the v2. 0 core package’, Astropy Collaboration, Price-Whelan A. M. , et al., **(including Ninan, J.P.)**, AJ, 156, 123A, 2018.
53. ‘TIFR Near Infrared Imaging Camera-II on the 3.6 m Devasthal Optical Telescope’, Baug T., Ojha D.K., et al., **(including Ninan, J.P.)**, Journal of Astronomical Instrumentation 7 (01), 1850003, 2018.
54. ‘Near-Infrared Imaging of Barred Halo Dominated Low Surface Brightness Galaxies’, Honey M., Das M., **Ninan J.P.**, et al., MNRAS, 461, 2016.
55. ‘Star formation around Galactic bubble N37: Evidence of cloud-cloud collision’ Baug T., Dewangan L., Ojha D.K., **Ninan J.P.**, et al. , ApJ, 833, 85, 2016.
56. ‘Star formation activity in the neighbourhood of W-R 1503-160L star in the mid-infrared bubble N46’, Dewangan L., Baug T., et al., **(including Ninan, J.P.)**, ApJ, 826, 27, 2016.
57. ‘Optical and NIR observations of the nearby type Ia supernova SN 2014J’, Srivastav S., **Ninan J.P.**, et al., MNRAS, 457, 1000, 2016.
58. ‘A multi-wavelength study of star formation activity in the S235 complex’, Dewangan L., Ojha D. K., et al., **(including Ninan, J.P.)**, ApJ, 819, 66, 2016.
59. ‘Sh2-138: Physical environment around a small cluster of massive stars’, Baug T., Ojha D. K., et al., **(including Ninan, J.P.)**, MNRAS, 454(4): 4335-4356, 2015.
60. ‘Large-Scale Mapping of the Massive Star-Forming Region RCW38 in the [CII] and PAH Emission.’, Kaneda, H. et al., **(including Ninan, J.P.)**, A&A, 556, 2013.
61. ‘TIRCAM2: The TIFR Near Infrared Imaging Camera’, Naik M. B. et al., **(including Ninan, J.P.)**, BASI, 2012.

In SPIE Proceedings:

1. ‘Real-time exposure control and instrument operation with the NEID spectrograph GUI’, Gupta A.F., Bender C.F., **Ninan, J.P.**, et al., Software and Cyberinfrastructure for Astronomy VII 12189, 781-790, 2022.
2. ‘The NEID port adapter: on-sky performance’, Logsdon S.E. et al., **(including Ninan, J.P.)**, Ground-based and Airborne Instrumentation for Astronomy IX 12184, 1526-1532, 2022.
3. ‘Overview of the NEID fiber-feed: ultrastable instrument illumination for precision doppler velocimetry’, Kanodia S., et al., **(including Ninan, J.P.)**, Ground-based and Airborne Instrumentation for Astronomy IX 12184, 121841M, 2022.
4. ‘The NEID spectrometer: fibre injection system design’, Schwab, C., et al., **(including Ninan, J.P.)**, Ground-based and Airborne Instrumentation for Astronomy VIII 11447, 932-943, 2020.
5. ‘Constrained modelling of instrumental radial velocity drift in precision Radial Velocity Spectrometers: Application to HPF’, **Ninan, J.P.**, et al., Society of Photo-Optical Instrumentation Engineers (SPIE), 2020.
6. ‘Ghosts of NEIDs past’, Kanodia, S., **Ninan, J.P.**, et al., Ground-based and Airborne Instrumentation for Astronomy VIII 11447, 819-830, 2020.
7. ‘Time-variable differences between H2RG readout channels in high precision spectroscopy: a case study with the Habitable-zone Planet Finder’, Terrien, R. C., **Ninan, J.P.**, et al., X-Ray, Optical, and Infrared Detectors for Astronomy IX 11454, 114541T, 2020.
8. ‘The Habitable-Zone Planet Finder: improved flux image generation algorithms for H2RG up-the-ramp data’, **Ninan, J.P.**, Bender C.F., et al., High Energy, Optical, and Infrared Detectors for Astronomy VIII, SPIE, 10709, 107092U, 2018.
9. ‘Overview of the spectrometer optical fiber feed for the habitable-zone planet finder’, Kanodia, S., et al., **(including Ninan, J.P.)**, Ground-based and Airborne Instrumentation for Astronomy VII, SPIE, 10702, 107026Q, 2018.
10. ‘The NEID precision radial velocity spectrometer: project overview and status update’, Bender, C. F., et al., **(including Ninan, J.P.)**, Ground-based and Airborne Instrumentation for Astronomy VII, SPIE, 10702, 1070213, 2018.
11. ‘The habitable-zone planet finder: engineering and commissioning on the Hobby Eberly telescope‘, Mahadevan, S., et al., **(including Ninan, J.P.)**, Ground-based and Airborne Instrumentation for Astronomy VII, SPIE, 10702, 1070214, 2018.

In Conference Proceedings

A) AAS Meeting Abstracts:

1. ‘Overview and Current Status of the NEID Data Reduction Pipeline’, Bender C., **Ninan, J.P.**, et al., American Astronomical Society Meeting Abstracts 54 (6), 401.01, 2022
2. ‘The NEID Precision Radial Velocity Spectrometer: Characterization and Operation of the NEID CCD Detectors’, Giovinazzi, M., et. al, **(including Ninan, J.P.)**, American Astronomical Society, AAS Meeting 233, 140.27, 2019.
3. ‘Design and Performance of NEID Ultra-Stable Environmental Control System’, Lubar, E., et. al, **(including Ninan, J.P.)**, American Astronomical Society, AAS Meeting 233, 146.02, 2019.
4. ‘The NEID Precision Radial Velocity Spectrometer: Characterization and Operation of the NEID CCD Detectors’, Giovinazzi, M., et al., **(including Ninan, J.P.)**, American Astronomical Society, AAS Meeting 233, 140.27, 2019.
5. ‘The Habitable Zone Planet Finder: Precision NIR Radial Velocities during Testing & Commissioning’, **Ninan, J.P.**, Roy A., et al., American Astronomical Society Meeting Abstracts 231, 2018.

6. ‘HPF: The Habitable Zone Planet Finder at the Hobby-Eberly Telescope‘, Wright, J. T., et al., **(including Ninan, J.P.)**, American Astronomical Society Meeting Abstracts 231, 2018.
7. ‘NEID: A High Precision Radial Velocity Spectrograph for the WIYN 3.5-m Telescope‘, Allen, L. E, et al., **(including Ninan, J.P.)**, American Astronomical Society Meeting Abstracts 231, 2018.

B) Other Conference Proceedings and White papers:

8. ‘An Extensive Survey of Helium Outflows from Irradiated Exoplanets with the Hobby-Eberly Telescope’, Zhang Z., et al., **(including Ninan, J.P.)**, Bulletin of the American Astronomical Society 54 (5), 102.115, 2022
9. ‘The Epoch of Giant Planet Migration: A Near-Infrared RV Survey for Giant Planets Around Young Sun-like Stars’, Tran Q.H., et al., **(including Ninan, J.P.)**, Bulletin of the American Astronomical Society 54 (5), 102.97, 2022
10. ‘A 30 GHz laser frequency comb for high-precision radial velocity calibration and exoplanet searches‘, Fredrick, C., et al., **(including Ninan, J.P.)**, Bulletin of the American Physical Society, X08.00006, 2019.
11. ‘The Algorithms Behind the HPF and NEID Pipeline’, Kaplan, K. F., et al., **(including Ninan, J.P.)**, Astronomical Data Analysis Software and Systems XXVIII. ASP Conference Series, Vol. 523, 2019.
12. ‘Support the Python Numerical Core’, Harrington, J., et al., **(including Ninan, J.P.)**, Astro2020: Decadal Survey on Astronomy and Astrophysics, APC white papers, Bulletin of the American Astronomical Society, Vol. 51, Issue 7, id. 265, 2019.
13. ‘Extreme Precision Radial Velocity Working Group’, Gaudi, S., et al., **(including Ninan, J.P.)**, Astro2020: Decadal Survey on Astronomy and Astrophysics, APC white papers, Bulletin of the American Astronomical Society, Vol. 51, Issue 7, id. 232, 2019.
14. ‘Infrared Astronomical Spectroscopy for Radial Velocity Measurements with 10 cm/s Precision’, Metcalf, A. J., et al., **(including Ninan, J.P.)**, Conference on Lasers and Electro-Optics, OSA Technical Digest, Optical Society of America, paper JTh5A.1., 2018.
15. ‘Prospects for star formation studies with infrared instruments (TIRCAM2 and TANSPEC) on the 3.6-m Devasthal Optical Telescope’, Ojha, D. K., et al., **(including Ninan, J.P.)**, Bull. Soc. Royal Sci. Liege, 87, 58-67, 2018.
16. ‘Prospects of star formation studies with near-infrared instruments on 2-4 meter class Indian ground-based telescopes‘, Ojha, D. K., et al., **(including Ninan, J.P.)**, The Cosmic Wheel and the Legacy of the AKARI Archive: From Galaxies and Stars to Planets and Life, 257-260, 2018.
17. ‘Probing the Structure and Kinematics of Outflows in Episodic Accretion of YSOs’, **Ninan, J.P.**, Ojha, D.K., et al., SALT Science Conference 2015, SSC2015, PoS, 069, 2015.
18. ‘Second outburst phase of a young eruptive star V1647 Orionis (McNeils nebula)’, **Ninan, J.P.**, Ojha, D.K., et al., Astrochem2012, 1543, 1, 184-186, AIP Publishing, 2013.
19. ‘Constraining models of accretion outbursts in low-mass YSOs’ **Ninan, J.P.**, Ojha, D.K., et al., ASI Conference Series, 9, 78., 2013.
20. ‘The outburst and nature of young eruptive low mass stars in dark clouds’, **Ninan J.P.**, Ojha D.K. et al.,ASI Conference Series, Vol. 4, pp 1-8, 2012.
21. ‘Post-outburst phase of LDN 1415 nebula (IRAS 04376+5413)’, Pawade V. S. et al., **(including Ninan, J.P.)**, ASI Conference Series, Vol. 1, pp 243-244, 2010.
22. ‘Second outburst phase of McNeil’s nebula (V1647 Orionis)’, Kaurav, S. S. et al., **(including Ninan, J.P.)**, ASI Conference Series, Vol. 1, pp 237-238, 2010.
23. ‘ccdproc: CCD data reduction software’, Craig, M. W., et al., **(including Ninan, J.P.)**, Astrophysics Source Code Library, record ascl:1510.007, 2015.

Telegrams

1. 'Optical and NIR observations of SN 2014J', Srivastav S., **Ninan J.P.**, et al., ATel #5876, 2014.
2. 'Dust formation in Nova Cephei 2013', **Ninan, J.P.**, Ojha, D.K. et al., ATel #5269, 2013.
3. 'V1647 Orionis', **Ninan J.P.**, Ojha D.K. et al., CBET #3164, 2012.
4. 'Slow dimming in the brightness of V1647 Orionis', **Ninan J.P.**, Ojha D.K. et al., ATel #4237, 2012.

CONTRIBUTIONS TO ASTRONOMY COMMUNITY

Refereeing

Referee for various Astronomy Journals like The Astrophysical Journal, MNRAS, Astronomy & Astrophysics, etc.
Guest Editor for Proceedings for the Star Formation Conference published by JOAA. Referee for various Telescope Time Allocation Committees.
Served as NSF Panellist for NSF-ATI.

SOFTWARE CONTRIBUTIONS TO ASTRONOMY COMMUNITY

NEID Pipeline

Developed advanced algorithms for optimal processing of the state-of-the-art optical high resolution spectrograph (NEID) for precision radial velocity measurement, Instrumental drift modeling, automation, segmented least squares RV estimation etc.

HPF Pipeline

Developed advanced algorithms for optimal processing of the state-of-the-art Near-Infrared H2RG data, Bandlimited rectification, Instrumental drift modeling, automation, segmented least squares RV estimation etc.

HxRGproc

Python package for advanced processing of Near-infrared HxRG detector data, which can be easily extended for use across multiple instruments (Ninan et al., 2018).

TIRSPEC Pipeline

Developed Near-Infrared spectroscopy and photometry data reduction pipeline for TIFR Near-Infrared Imager and Spectrometer (TIRSPEC) camera. `https://indiajoe.github.io/TIRSPEC/`

Optical Spectro-Photometry Pipeline

Developed Multi Instrument Optical spectroscopy and photometry data reduction pipeline. It currently supports HFOSC instrument on 2-m HCT, as well as IFOSC instrument on 2-m IGO telescope. More instrument support to be added soon. `https://indiajoe.github.io/OpticalPhotoSpecPipeline/`

SALT-HRS

Python tool to reduce SALT Telescope's High Resolution Spectrograph (HRS) data. `https://github.com/indiajoe/SALTHRS`

HandyTools4Astronomers

Collection of various scripts and small tools for Astronomers. `https://indiajoe.github.io/HandyTools4Astronomers/`

ArXivSorter

Tool build on Machine learning algorithm to rank and sort daily arXiv papers based on subject interest. `https://github.com/indiajoe/ArXivSorter`

Other Contributions

astropy : Feature to load multi-aperture daophot files.
specutils : Feature to load IRAF Equispec spectrum.
ccdproc : Function to combine images under memory constraint.
Also contributed to **findutils** (11 yr old bug in parsing long arguments to *find* and *xargs*

Linux commands), **PyRAF** (special character parsing in filename completion), **TIFR FIR balloon-borne 100 cm telescope pipeline** and also to **JWST** data cube manipulation toolkit.

Github

Various other projects : `https://github.com/indiajoe?tab=repositories`

COMPUTATIONAL SKILLS

- Languages: Python, BASH, Julia, IRAF CL, Fortran, C, C++, Perl, Matlab, IDL
- Version control: Git, Hg
- Extensive experience with multi-node clusters at PSU (ACI & Cyberlamp).
- Server maintenance experience: NEID Server, HPF Server, TIFR IR Group's Owncloud Cloud data storage server, Wiki Server, GitLab Internal Code Hosting Server.
- Contribution to Porteus-ATMA astronomy oriented GNU/Linux distribution.

PAST INSTRUMENTATION & RESEARCH PROJECTS

INSTRUMENTATION PROJECTS

Ground based projects:

TIFR-MOONS

After joining TIFR as a Reader in 2022, I started development of a novel multi-object optical to near-infrared spectrograph. It is being designed for the 3.6m Devasthal Optical Telescope (DOT), ARIES, India. The goal of this instrument is to conduct the world's largest spectroscopic survey of young stellar objects. This spectrograph will be able to obtain simultaneous spectra of up to 8 stars in the 10x10 arcmin^2 FoV of the telescope, and it will simultaneously cover a very broad wavelength range of 380 nm to 2500 nm. Currently, the design of the front optics is going on.

NEID Spectrograph

As an Assistant Research Professor at Department of Astronomy & Astrophysics, The Pennsylvania State University, USA, I worked on NN-explore Exoplanet Investigations with Doppler spectroscopy (NEID) instrument. It is operated on at the 3.5-meter WIYN Telescope at Kitt Peak National Observatory in Arizona, USA. It is part of a joint effort between NASA and the NSF (NN-Explorer program). Building on the work I did for Habitable-Zone Planet Finder (HPF), I developed various instrument drift measurement models for analysing and troubleshooting the NEID's stability during the integration and verification stage of NEID at PSU. From first principles, I modelled the impact on wavelength solution due to the main physical causes of the instrumental drift. They will be presented at the upcoming SPIE meeting in June, 2020. These instrument drift models ultimately define the radial velocity precision floor of NEID spectrograph. I have developed fast algorithms to reduce the raw 9k×9k detector images. During the fabrication and alignment phase of NEID at PSU, I have been heavily involved in the identification of the origin of the optical ghosts and its mitigation in NEID, as well as optical design of certain subsets of the calibration units. I led the design and development of the flat fielding mechanism inside the NEID. This unit enabled us to take spectroscopically correct uniform flats for every pixel in the NEID spectrum without any edge effects of fiber traces. I also led the instrumental PSF optimisation to compensate for grating wavefront error, as well as the focusing and tip-tilt alignment and optimisation of the CCD detector used in NEID. Apart from the adaptation of HPF algorithms to NEID, new algorithms for fast extraction of 3×117 orders from the 9k ×9k detector were also developed. I developed algorithms for precision profilometry measurements of various optical fiber heads in NEID which are used for acquiring stars to 1 micron accuracy on the fiber. I developed the control system for the exposure meter of NEID, the NEID solar telescope, as well as various other sub-parts of the control system of the NEID. We successfully passed the pre-ship review by NASA in mid-September 2019. Our commissioning of the spectrograph at WIYN Telescope, Kitt Peak Observatory, Arizona, USA got delayed due to the pandemic. We demonstrated on sky RV precision better than the 29 cm/sec goal. We had a successful operations readiness review in May 2021. This instrument is now widely used by the entire astronomical community via competitive proposals.

The Habitable-Zone Planet Finder (HPF)

Since 2016, as a CEHW Postdoctoral Researcher at PSU, I worked on development of algorithms, statistical analysis, extreme precision radial velocity pipeline and instrument control system development for HPF. To achieve ∼1 m/s RV precision goal using the H2RG near-infrared (NIR) detector of HPF, we have to detect a Doppler shift of $1/2000^{th}$ of a pixel. Such an RV precision measurement has never been achieved using NIR detectors. In order to achieve this precision on the H2RG detector, I developed various algorithms to remove systematic and correlated signal artifacts, state-of-the-art bias and non-linearity correction, etc (Ninan et. al, 2018, 2019). Conventional rectification algorithms result in a small information loss due to finite order polynomial 2D interpolation.

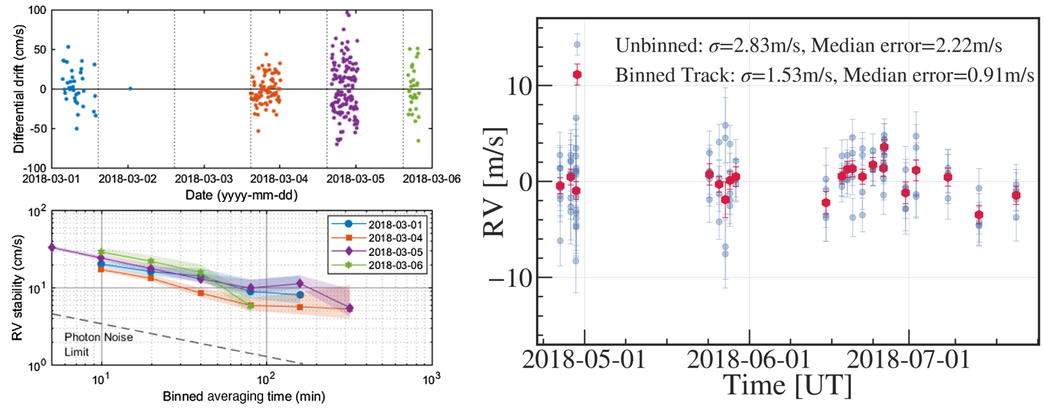

Figure 1: Figure on the left shows the internal stability of HPF over many days. The instrumental noise is less than 15 cm/sec. Plot on the right shows the on-sky performence of HPF. Bernard star RVs showing ∼1.5 m/sec over many months. This is to-date the highest demostrated on-sky stability in near-infrared.

For information preserving spectral rectification, I developed a 2-D band-limited interpolation based rectification method. This guarantees lossless rectification in band-limited 2D images. Various algorithms to precisely measure small instrumental drift using Laser Frequency Comb (LFC), Etalon, etc were also developed. HPF was found to have an instrumental drift which repeats daily with the LN2 fill everyday. I developed a model which predicts daily instrumental drift for any observation based on all the LFC taken one night, especially when simultaneous calibration is not taken along with an exposure of a star. This significantly reduced the bright calibration light contamination problem from affecting faint target observations. This model is currently used in automated drift corrected wavelength solutions of HPF data taken daily. To make use of the information content in the non-smoooth continuum of late type stars, a segmented least squares algorithm was developed for precise RV estimation. A simple, scalable, and powerful autonomous pipeline control system was also developed for connecting various modules of our complex pipeline together running across different computers and clusters. Apart from the pipeline development, during the assembly and fabrication of HPF at PSU, I was also heavily involved in the analysis of the data taken to align optics, and led the effort to optimise tip-tilt and focus of the detector. I was heavily involved in the design of the calibration system, alignment of super-continuum laser source for Etalon, and led the execution of the instrumental performance measurement and calibration setup during the assembly, troubleshooting, and verification phase of HPF at PSU. I co-developed various drivers and sections of the asynchronous instrument control system (named TIMS) for HPF. During the commissioning of HPF at the 10-m Hobby-Eberly Telescope (HET) at McDonald Observatory in Texas, USA, I did the modelling of the pointing of HPF fibers and effective pupil on the telescope, telescope communications, commissioning of LFC, instrumental drift measurements, etc. As of now, HPF has been online taking data daily since November 2017. We have achieved an internal fiber to fiber instrumental precision of less than 15 cm/sec, and on star less than 1.6 m/sec (see Figure 1, Metcalf et. al., 2019).

Impact of sub-pixel defects in H2RG for precision RV measurements 2016-

Unlike CCDs, near-infrared arrays suffer from various artifacts. One insidious artifact in Teledyne's HxRG detectors was the cross-hatch pattern. These are sub-pixel quantum efficiency (QE) variations, hence they will not get corrected in a normal flat fielding. I studied the impact of such sub-pixel QE defects in H2RG detectors for precision RV measurements in near-infrared. A simple model was developed for measuring the impact on radial velocity measurement due to sub-pixel variations in effective quantum efficiency. The Laser Frequency Comb (LFC) we commissioned on HPF was used to show how a correction algorithm can be implemented by scanning LFC or another spectrally rich light source across pixels. The technique to measure dimensions of these sub-pixel defects on the detector, modelling impact of these defects, as well as an algorithm to correct it, is published in Ninan et. al. (2019).

TIFR Near Infrared Spectrometer and Imager Camera (TIRSPEC)

During my PhD program at TIFR (2010-2016), I led the development, installation, calibration and upgrades of TIFR Near Infrared Spectrometer and Imager Camera (TIRSPEC) at TIFR IR lab, which we installed on the side port of the 2-meter Himalayan Chandra Telescope (HCT), Hanle, Ladakh, India. I developed various algorithms for troubleshooting and optimising the optics as well as the data acquisition mode of HAWAII-I PACE array used in TIRSPEC. This array compared to modern H1RG and H2RG arrays does not have any reference pixels and has many poorly understood anomalies like the reset anomaly, strong persistence, and fringes. I could demonstrate the non-thermal origin of the reset anomaly in these arrays, which enabled us to significantly improve the effective readout noise of the array. I developed fully automated procedures to characterise and correct the non-linearity, subarray readout capability for fast readout, gain variations, fringes, cosmic ray hit events, enhanced dynamic range, etc. of the instrument. I also did extensive optics study on symmetric out of focus measurements and wavefront modelling to improve and troubleshoot the star profile structure. This was crucial to obtain the atmospheric seeing limited profile which improved the faint source detection sensitivity of the instrument. Accurate field of view distortions were also measured and constrained to improve the photometry quality of the instrument. After obtaining the first light on telescope on 21^{st} June 2013, we had a few serious mechanical issues due to lower boiling point temperature of liquid N_2 at the 4500-m amsl high altitude observatory. By manually controlling the motor movements using custom written codes, I could troubleshoot the possible internal mechanism failure from the hall effect sensor output readings. After developing the strategy for repair at Mumbai, we went to remote Hanle site in September 2013, and repaired the instrument by setting up a temporary clean room. Our hypothesis was proven correct after opening and inspection of the dewar. During my initial engineering run observations, 10 arcsec slits were found to be inadequate for optimal sky removal. After analysing the instrumental constraints from the optics design, 50 arcsec slit was found to be ideal for observations. Along with two IR lab engineers, I went for a third upgrade mission to Hanle in May 2014, and upgraded the slits to 50 arcsec slits. In this mission, I could also solve another filter wheel slipping issue which was noticed during some nights of engineering observation runs. We also fixed a few other issues with calibration mirror movement stage, etc., in the third mission. Using the data from the initial engineering run I also did extensive site calibration studies of NIR sky at Hanle, which was crucial for both designing the strategy for optimal NIR observations as well as for future mega telescope projects planned at Hanle. These calibrations of the instrument as well as Hanle site are published in the instrumentation paper (Ninan et al., 2014). TIRSPEC is now released to public from 1^{st} May 2014. I also developed and released a pipeline for data reduction of this instrument. I later used this instrument extensively for the NIR monitoring of my outburst sources. TIRSPEC is also now heavily used by other astronomers using HCT. I am also currently taking care of the constant maintenance checks and optimisation for the operation as well as data reduction of the ongoing observations by the community.

TIFR-ARIES Near-Infrared Spectrograph (TANSPEC)

I was actively involved in the TIFR-ARIES Near-Infrared Spectrograph (TANSPEC) project for the 3.6-m Devasthal Optical Telescope (DOT), Nainital, India, from the design phase. Based on my experience with TIRSPEC, I could contribute in the mechanical design decisions of the wheel mechanisms, requirement of separate focusing stage in the spectrograph detector array, etc. I contributed in reducing the background significantly from the central black hole in the DOT's secondary mirror by using an Offner relay and blackening the footprint of the hole on the re-imaged secondary mirror of Offner relay. I also contributed in developing a more realistic optical components' tolerance estimation by incorporating correlated lens shifts in Monte Carlo simulation. One of the unique capabilities of TANSPEC is its ability to simultaneously cover the wide wavelength range from Optical to NIR. In order to achieve that, parallactic angle tracking by the telescope is crucial, else the diffraction in atmosphere will throw the short wavelength light outside the narrow slit. During the preliminary and critical design review meetings, I developed off-axis active parallactic angle tracking algorithm as well as optimal autoguider filter response for achieving this capability on DOT. TANSPEC is now being commissioned, and detailed calibrations are going on. I am heavily involved in the commissioning and troubleshooting of the issues. For example, identification of 180 degree clocked grating, non-optimal detector readout gain and clocking, etc.

TIFR Near-Infrared Imaging Camera-II (TIRCAM2)

I led the detector calibration and optimal data acquisition procedure for the Aladdin III Quadrant 512×512 InSb array based TIRCAM2 near-infrared imaging camera. InSb array is sensitive upto 5 μm. This puts a much stronger requirement to optimise the data in high background radiation regime. I developed optimal procedures from observations using 2-m IGO telescope and currently 3.6-m DOT in order to observe upto L' band (3.6 μm). We obtained the first L' band observations using TIRCAM2 from the IGO. This is the only imaging camera available in the country which can observe upto L' band in NIR (Naik et al., 2012; Baug et al., 2018). TIRCAM2 is currently mounted on the side port of 3.6-m DOT.

Space-based projects:

TIFR 100 cm FIR Balloon-borne Telescope

TIFR 100 cm Far-Infrared Balloon-borne Telescope was mostly observed in the sky chopped mode. However, more sensitive observations can be done in the fast spectral scan mode where sky chopping is not done. I developed a wavelet based signal processing step for the un-chopped signal from the optical photo diodes on the balloon-borne telescope. This, for the first time enabled us to generate optical maps of the scanned region, which we could then use to improve the telescope aspect and pointing. This was crucial for aligning and doing correlation studies using our FIR maps generated with other shorter wavelength maps of the region taken from different telescopes (Kaneda et al., 2013; Suzuki et al., 2020).

IRSIS and UVIT

Infrared Spectroscopic Imaging Survey (IRSIS) payload for an Indian small satellite is being developed, designed and fabricated by the IR astronomy group at TIFR. Using my experience in detector optimisation and characterisation, I developed a procedure for optimal readout and processing of the H2RG detector array used in IRSIS. I have also contributed in troubleshooting of the mirror holder stress pattern which was slightly deforming the primary mirror of IRSIS resulting in astigmatism aberration.

For the Ultra-Violet Imaging Telescope (UVIT) instrument onboard AstroSat, when the initial first light was obtained, we had to combine the UV readouts using the drifts obtained from the visible channel. I developed a procedure to estimate the achieved star profile width by simultaneously incorporating all the faint stars in the 2D field.

SCIENCE PROJECTS

Detection of meta-stable Helium in out-flowing atmospheres of exo-planets

The most promising hypothesis for observed deficiency of close-in super-Earth/sub-Neptune planets is the atmospheric evaporation. Exo-planets undergoing atmospheric evaporation should have extended exo-spheres. Hence, they can be probed via transmission spectroscopy. The conventional probe of exo-sphere using Lyα needs space-based observations and are not useful to study the low velocity base of the exo-spheres due to interstellar absorption. Recently, Oklopčić & Hirata (2018) suggested He 10830$\mathring{A}$ as an alternative probe which can be observed from ground. Using the high-resolution near-infrared capability of our newly commissioned Habitable Zone Planet Finder (HPF) on 10-m HET in Texas, USA, we observed the in-transit and out-of-transit of a selected few exo-planets with out-flowing atmospheres. We detected 10830$\mathring{A}$ meta-stable Helium absorption in GJ 3470b's exosphere. **This is the first M-dwarf planet with meta-stable Helium detection. (Ninan et al., 2020)** The recent 10830 $\mathring{A}$ absorption in exo-spheres (by our group as well as few other groups) opens up a new window to measure the atmospheric evaporation of the exo-planets. Based on Oklopčić & Hirata (2018)'s model, I implemented an exo-sphere composition model for GJ3470b, as well as for other targets in our list. Based on orbital velocity and hydrodynamic wind model, a line profile was generated to match the observations (Figure 2). Our observations were found to be consistent with these model predictions. We have a long-term ongoing observational program using HPF to constrain the outflows of various nearby exo-spheres based on our model prediction.

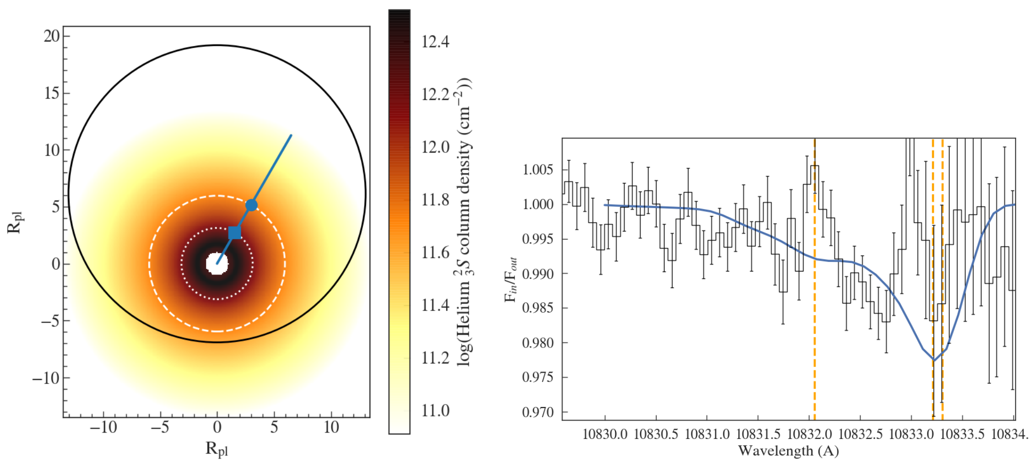

Figure 2: Figure on the left shows the column denisty of meta-stable Helium atoms predicted by our model around GJ3470b during its transit. Figure on the right shows the observed He 10830 signature using HPF in GJ3470b and the line profile predicted by our model.

Episodic accretion and outflow phenomena in YSOs 2012-

This project started with my PhD program at TIFR. I studied the outburst phenomenon in young stellar objects (YSOs) caused by the episodic increased accretion events in protoplanetary discs. I did multi-wavelength (optical, near-infrared, far-infrared and radio) long-term monitoring studies (a total of $\sim$ 175 nights) on a sample of these objects to constrain various stellar and circumstellar properties. Among this sample of outbursts, in our study of V1647 Ori, for the first time in this family of objects, I detected short time-scale episodic outflows. From the time-scales V1647 Ori spent in the intermediate quiescent phase between its two outbursts, I could also constrain and rule out certain basic disk instability models of this outburst phenomenon (Ninan et al. 2013). From my study of another peculiar outburst source, V899 Mon, I could monitor the transition of the source from the first outburst to quiescence and its return to a second outburst. This enabled me to simultaneously track the corresponding evolution in the accretion and outflow at various phases of this transition. For instance, from the evolution of outflow line profiles in our multi-epoch spectra I could detect heavy, high velocity outflows just before the source transitioned to quiescent state. After attaining quiescence, the strength of the outflow dropped below our detection limit. Hence, we reported the first direct detection of overall correlation of the outflows with accretion, and at the same time I could also detect independent short-term fluctuations in both outflow strength and velocity, indicating a more complex relation (Ninan et al. 2015). My high resolution spectroscopic observations using the HRS instrument on 11-m SALT telescope showed sudden changes in the high velocity components of outflow by large factors, which are difficult to explain by the magnetically driven steady disc winds or radiatively accelerated models of stellar winds. I could constrain the outflow mechanism based on these results from the multi-epoch high resolution spectra of heavily accreting YSOs (Ninan et al. 2016). Results from these three papers strongly argued for mechanisms which can temporarily pause magnetospheric accretion, without requiring the disc surface density to drop below a critical value (as required by various instability models) as well as magnetic instability driven outflows from the magnetosphere. I have also developed a hierarchical Bayesian model to incorporate all the photometric observations of star-forming regions to estimate these episodic accretion outburst frequencies. This model for the first time enables us to quantitatively analyse variations in the outburst phenomena across various age clusters of YSOs.

Recently, we observed a sudden outburst in V899 Mon in near-infrared using the high-resolution Habitable Zone Planet Finder (HPF) spectrograph we commissioned at 10-m HET, Texas, USA. We were able to detect clear signatures of the magnetospheric accretion, as well as possible detection of disk temperature inversion in protoplanetary disc. Astrophysical interpretations of this detection are currently going on.

FIR 158 μm [C II] line mapping of massive star-forming regions 2013-

Using a Fabry-Perot Spectrometer on TIFR Balloon-borne 100 cm FIR telescope, we have mapped wide area 158 μm [C II] line emission from nearby massive star-forming regions. I developed a pipeline which models the line emission profiles from the raster scan data and generates line strength and continuum flux maps of the region. Using these maps we studied and modelled the star-forming regions by correlating with other emissions from Polycyclic Aromatic Hydrocarbons (PAH) and continuum to understand the importance of various heating and cooling mechanisms.

Crater study using Chandrayan TMC data 2009

To estimate the age of surfaces on the moon, a crater distribution study was done by automatically identifying craters and their radii in ISRO's Chandrayan Terrain Mapping Camera (TMC) data. This work was done under Dr. B. S. Shylaja, JNP, Bangalore.

Study of Solar wind using Interplanetary Scintillations December 2008

As part of NIUS Astronomy Nurture Program, I did a project on study of solar wind using Interplanetary Scintillations, from Ooty Radio telescope, under Prof. P. Manoharan, in December 2008.

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