Advances in design, calibration and modelling of space-based experiments

Dec 22-23 2025

Manipal Centre for Natural Sciences
Manipal Academy of Higher Education, Manipal

A short summary report

As part of the SPARC III program funded by the Ministry of Education, a special scientific meeting was organised at Manipal Centre for Natural Sciences, MAHE, Manipal on Dec 22 & 23 2025. This is executed jointly by the Manipal Centre for Natural Sciences and the Space Astronomy Group of URSC (U. R. Rao Satellite Centre), Bangalore, the two Indian teams involved in the SPARC III grant.

Goals:

- Discuss advances in charged particle detection in space and future plans for sustained radiation level monitoring capability.
- Discuss measurements planned under near-term program of ISRO's roadmap on high-energy astrophysics.
- Prepare plans to strengthen key areas linked to advances in calibration, response modelling and to establish multi-institutional expert teams for specialised activities
- Document these plans as a guideline for future programs

Participants:

Name	Affiliation
1. Ranjeev Misra	IUCAA
2. Gulab Dewangan	IUCAA
3. Chandreyee Maitra	IUCAA
4. Sudip Bhattacharya	TIFR
5. Pravata Mohanty	TIFR
6. Santosh Vadawale	PRL
7. Mithun	PRL
8. Aru Beri	IIA
9. Sankarasubramanian	SAG/URSC
10. Anuj Nandi	SAG/URSC
11. Rwitika Chaterjee	SAG/URSC
12. Srikar Pavan	SAG/URSC
13. Radhakrishna V	SAG/URSC
14. Koushal Vadodariya	SAG/URSC
15. Ankur Kushwaha	SAG/URSC
16. M.C. Ramadevi	SEPO/URSC
17. Vinay Kashyap	CfA, Harvard-Smithsonian
18. P.N.Bhat	Univ of Alabama at Huntsville
19. P.S. Athiray	Univ of Alabama at Huntsville
20. Dipankar Bhattacharya	Ashoka Univ
21. A. R Rao	Ex-TIFR
22. Dipankar Banerjee	VC, IIST
23. Ajit Kembhavi	Former Dir, IUCAA
24. A.S. Kiran Kumar	ISRO HQ
25. Debbijoy Bhattacharya	MCNS/MAHE
26. Sreejith Padinhatteeri	MCNS/MAHE
27. Kazuyuki Furuuchi	MCNS/MAHE
28. Ashwini U.	MCNS/MAHE
29. P. Sreekumar	MCNS/MAHE

Summary of conclusions from the meeting:

1. Previous studies suggest the need for a sustained particle measurements / experiments on multiple space platforms. Multi-point measurements are important for particle studies. Future designs should include particle counting along with identification of particle types and energy measurements

2. Development of compact, low-mass low and high-energy neutron counters and spectrometers as space payloads to be initiated for solar physics, space weather and planetary sub-surface studies.

3. Hardware design and development of more compact, wearable and easy deployment models can be taken up – useful for any future radiation monitoring under the human space flight and operational space weather programs

4. Setting up an integrated portal that brings together the solar system location, time of measurement, measured parameters, etc., of all current and future particle measurements, needs to be planned and executed as a near-term goal.

5. An early convergence of the ISRO roadmap for space science will enable progress on team formation and convergence of resources and expertise. Many of the proposed experiments require urgent progress in TRL levels towards meeting the proposed schedules; expanded teams could potentially help if the priority programs are worked out soon.

6. There is an urgent need to advance the electroforming progress on X-ray optics development process towards near-term applications for future missions.

7. There is unanimity on the importance of advancing our calibration activity level and for a more involved and early initiation of this as the projects are identified.

8. Areas requiring urgent strengthening include
    a. Absolute flux calibration (use of transfer standards or BESSY II synchrotron)
    b. Low-energy (< 2 keV) spectral response studies – experimental studies as well as SRF modeling
    c. New areas – x-ray optics – characterization and calibration – of direct relevance for improved .arf/.rmf file generation

9. Ongoing Monte Carlo simulation to be enhanced with induction of new members through training and advancing capabilities of expert teams.

10. A multi-institutional working group on calibration & simulation to be setup through mutual discussions.

Specific near-term steps that can be initiated:

Activity	Suggested Lead	Supporting team / members
Preparation of draft plan for initiating a renewed thrust on neutron studies in space	SAG	MCNS, TIFR, BARC
Preparing a draft plan for an integrated portal for solar system particles and fields from Indian missions – for solar science and for space weather studies.	MCNS	IIST & PRL
Prepare draft plan on next steps to involve non-ISRO teams after the Space Science roadmap is finalised within DOS	GH, SAG along with SSRF leads	
Planning next steps involving non-ISRO teams after convergence on X-ray optics development within DOS	PRL (hard X-rays) SAG (soft X-rays)	RRI
Formation of a Calibration Working Group (CWG) to address: • low-energy response of X-ray CCD/CMOS detectors • prepare a draft plan on steps for absolute calibration of X-ray detectors using Indian and global resources	GH, SAG	PRL & MCNS &IUCAA
Formation of team to prepare draft document on X-ray optics testing and characterisation: address facility needs	SAG	PRL
Formation of a SIMulation working group (SIMWG) to systematically address training and building expertise in instrument performance simulations / Modeling	PRL	SAG & MCNS

The above division of work is to be seen as a starting suggestion. Other teams who can commit to contribute to specific activities may indicate ; it is best if we all restrict each of our undertakings to areas where we can contribute the most

Program schedule

	Topic	Lead
Day 1 **Session 1**	**Scientific measurements needed for future charged and neutral particle studies**	
9:00 – 9:30	Opening discussions	
9:30 – 9:45	Findings from AstroSat charged particle detector (CPM) payload	A.R.Rao
9:45 – 10:00	Summary of high-energy particle measurements from Ch-2, Aditya-L1	Srikar Pavan
10:00 – 10:15	Summary of particle experiments planned on the Venus Orbiter Mission	M.C. Ramadevi
10:15 – 10:30	GBM / Fermi as a transient detector and future prospects	P.N.Bhat
10:30 – 10:45	Tea break	
10:45 – 11:15	Requirements of future particle detector experiments and developmental plans	Srikar Pavan (charged particle detectors) Pravatha Mohanty (neutron detector) – 15 min each
Day 1 **Session 2**	**Scientific measurements planned under near-term vision (x-ray / gamma-rays)**	
11:15 – 11:45	Summary of x-ray experiments under consideration in ISRO's roadmap	Anuj Nandi
11:45 – 13:00	Summary of performance specifications and new calibration requirements for proposed x-ray experiments	Radhakrishna (soft x-ray polarimetry) Santosh (hard x-ray polarimetry) Sreejith (Solar x-ray imaging spectrometry) Debbijoy (wide field imaging spectrometry) Sudip Bhattacharya (large area detector) - 15 min each
1300 – 14:00	Lunch	
14:00-14:45	Plans for development of x-ray optics	Radhakrishna (soft x-ray optics) – 15 min Ankur Kushwaha (soft x-ray optics-MPO) – 15 min Santosh (Hard x-ray optics) – 15 min
Day 1 **Session 3**	**Advances in instrument testing and calibration**	
14:45 – 15:00	Performance of imaging x-ray instruments	P.S. Athiray
15:00 – 15:15	Plans for testing x-ray optics	Kaushal Vadodariya
15:15 – 15:30	Future requirements for timing calibration	Dipankar Bhattacharya
15:30 – 16:00	Tea break	
16:00 – 16:15	Lessons learned from Chandra calibration	Vinay Kashyap
16:15 – 16:30	RRCAT beam line experience ; approach for future requirements	Mithun
16:30 – 17:00	Multi-instrument cross calibration experience	Aru Beri – AstroSat / NuStar (15 min) Chandreyee Maitra - eRosita (15 min)
17:00 – 17:30	Translating sensitivity requirements to instrument calibration requirements	Gulab (soft x-ray) – 15 min Ranjeev (hard x-ray) – 15 min

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Day 2 **Session 4**	**Refining instrument response modeling**	
9:00 – 9:15	Advances in Instrument response modeling	P.S. Athiray (15 min)
9:15-9:30	XSPECT response modeling	Rwitika Chatterjee (15 min)
10:00 – 10:30	Role of simulations in instrument response modeling	Srikar Pavan (15 min) Sreekumar (15 min)
10:30 – 11:00	Tea break	
Day2 **Session 5**	**Team building strategies**	
11:00 – 11: 30	Approaches for realization and steps to expand H/W development team	Coordinated by– S. Seetha & A.R.Rao
11:30 – 12:00	Discussion on setting up national teams to develop calibration expertise	Coordinated by Dipankar Bhattacharya & Ranjeev Misra)
12:00 – 12:30	Establishing multi-institutional simulation / modeling teams	Coordinated by Dipankar Banerjee & Sreekumar)
12:30 – 12:45	Discussion	
12:45 – 14:00	Lunch	
Day 2 **Session 6**	**Planning for next steps**	
14:00 – 14:30	Closing discussions • Summary of the findings from the meeting – Sreekumar (15 min) • Summary of plans for next steps – Sankarasubramanian (15 min)	
14:30 – 15:30	Open discussion (1 hr)	Chair / members - Apex Science Board and participants
15:30 – 16:30	High Tea	