



**Dr. ANIL BHARDWAJ**  
FNA, FASc, FNASc

**Director**

**Physical Research Laboratory**  
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**Research Area: Planetary & Space Sciences, and Space Exploration**

Theoretical and observational studies of the surfaces, atmospheres, ionospheres, and magnetospheres of planets and planetary bodies, and their interaction with solar electromagnetic radiation and solar wind, Solar system science.

Development of scientific experiments for planetary and space missions.

**Current Research Interest includes** – Aurora and airglow processes in planetary atmospheres, chemistry of planetary ionospheres, auroral plasma processes on comets and its implications on coma chemistry, Monte Carlo simulations of processes in atmosphere, solar wind-lunar interaction, ENA imaging of the lunar surface and Earth's magnetosphere-

ionosphere system, ground-based and space-based multi-wavelength (X-ray, UV, radio) imaging and spectroscopy of emissions from planetary bodies, and comparative planetology.

The planetary bodies investigated include: Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto, Galilean Satellites (Io, Europa, Ganymede), Titan, Triton, Io plasma torus, Rings of Saturn, Comets, and the Moon.

### **Academic Qualification :**

B.Sc.	Physics	1985	Lucknow University	Ist Class
M.Sc.	Physics	1987	Lucknow University	Ist Class
UG Diploma	German language	1989	Banaras Hindu University	
Ph. D.	Applied Physics	1992	Inst. of Tech., Banaras Hindu University	

*Ph. D. Thesis Title :* "Aurora and Airglow Processes on the Outer Planets and Comets".

### **Scientific Administration Positions held:**

Feb. 2017–present :	Director, Physical Research Laboratory, Ahmedabad
Feb. 2014 – Feb. 2017 :	Director, Space Physics Laboratory (SPL), Vikram Sarabhai Space Centre (VSSC), Indian Space Research Organization (ISRO), Trivandrum
Sept. 2007 – Feb. 2017 :	Head, Planetary Science Branch, SPL, VSSC, ISRO, Trivandrum
Feb. 2014 – Feb. 2017 :	Chairman, VSSC Central Level Monitoring Committee
2009 – 2014 :	Chairman, Academic Committee, SPL, VSSC

### **Professional Background :**

Feb. 2017–present :	Director, Physical Research Laboratory, Ahmedabad
Feb. 2014–Feb. 2017 :	Director, Space Physics Laboratory (SPL), VSSC, ISRO, Trivandrum
July 2015–Feb. 2017 :	Scientist H, Space Physics Laboratory, VSSC, Trivandrum
July 2012–June 2015 :	Scientist G, Space Physics Laboratory, VSSC, Trivandrum
July 2007–June 2012 :	Scientist SG, Space Physics Laboratory, VSSC, Trivandrum
July 2002–June 2007 :	Scientist-SF, Space Physics Laboratory, VSSC, Trivandrum
Jan. 1998–June 2002 :	Scientist-SE, Space Physics Laboratory, VSSC, Trivandrum
Aug. 1993–Dec. 1997 :	Scientist-SD, Space Physics Laboratory, VSSC, Trivandrum
July 1990–July 1993 :	CSIR Senior Research Fellow, IT, Banaras Hindu University
April 1988–June 1990 :	Research Fellow, Inst. of Tech., Banaras Hindu University

### **Abroad :**

Jan. 2004–Oct. 2005 :	National Academy of Science – Senior Research Associate, NASA Marshall Space Flight Center, Huntsville, USA
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### **Awards and Honours:**

1. **Shanti Swarup Bhatnagar Prize** (Earth and Planetary Sciences), 2007.
2. **Nehru Centenary Lecture** of the *Kerala Academy of Sciences*, 2007.
3. **ISRO Team Excellence Award** for Chandrayaan-1 Science and Mission, 2008.

4. **Indian Space Research Organization (ISRO) Merit Award**, 2012.
5. **Dr. P. R. Pisharoty Memorial Lecture** of the *Kerala Science Congress*, 2015.
6. **Distinguished Alumnus Award**, *Indian Institute of Technology (Banaras Hindu University)*, Varanasi, 2015.
7. **Vainu Bappu Memorial (International) Award** of *Indian National Science Academy*, 2016.
8. **Infosys Prize in Physical Sciences**, 2016.
9. **Outstanding Achievement Award** of *Indian Space Research Organization (ISRO)*, 2017.
10. **Decennial Award** of *Indian Geophysical Union*, 2017.
11. **Letter of Felicitation** by *Uttar Pradesh State Government* for Distinguished work in Science and Technology, 2018.
12. **Lunar and Planetary Society's Endowment Lecture** of *Gujarat Science Academy*, 2018.

#### International

13. **NRC Senior Research Associateship** by USA National Academy of Sciences, 2003.
14. **Indo-Swedish Project Award** for 3-years (2010-2012) for International Space Research and Cooperation from *Swedish Research Council SIDA*, Sweden.
15. **Indo-Swiss Joint Research Programme (ISJRP) Fellowship**, 2010.
16. **Fellowship grant**, United Nations Office of Outer Space Affairs (UN-OOSA), Vienna, Austria, 1996.
17. *Invited Subject Expert*, **International Space Science Institute, Switzerland**, 2012–2014.
18. **Distinguished Lecture** (Planetary Sciences), *Asia Oceania Geosciences Society*, Japan, 2014.

#### **Fellowships of Academy/Union:**

1. **Elected Fellow**, National Academy of Sciences, India, 2014.
2. **Elected Fellow**, Kerala Academy of Sciences, Trivandrum 2013.
3. **Elected Fellow**, Indian National Science Academy, 2010.
4. **Elected Fellow**, Indian Academy of Sciences, 2009.
5. **Elected Fellow**, Indian Geophysical Union, Hyderabad, 2008.

#### International

6. **Elected Corresponding Member**, International Academy of Astronautics, 2014.
7. **Elected Liaison Officer**, European Geophysical Union, Planetary Division, 2009.
8. **Elected Member**, International Astronomical Union, 2009.

#### **Recognitions:**

1. **Invited Chapter** in *“Encyclopedia of the Solar System”* (2007, and 2014).
2. **Invited Review** on *“Auroral Emission of the Giant Planets”*, published in 2000 in **Reviews of Geophysics** (the highest impact factor journal in geosciences, atmosphere, planetary and space sciences).
3. **Invited Review** on *“X-rays from Solar System Objects”*, published in 2007, in *Planetary and Space Science*.
4. **Contributor** to **Athena+ Mission** support document – **Europe’s** Next Generation X-ray Observatory, which is selected by **ESA Science Program** as Large project.

## Major Positions Held:

### International

1. **President**, Planetary Science Section *Asia Oceania Geosciences Society*, 2006–2010.
2. **Editor-in-Chief**, *Advances in Geosciences* (World Scientific), 2006 – 2013.
3. **Member, Board of Advisory Editors**, *Planetary and Space Science*, 2007–2009.
4. **Chair**, Publication Committee of *Asia Oceania Geosciences Society*, 2006 – 2008.
5. **Member, Editorial Board**, *Space Science Reviews* (Springer), 2010– .
6. **Vice-Chair, COSPAR Commission B**, 2012 – .
7. **Associate Editor**, *Advances in Space Research* (Elsevier), 2014– .
8. **Member, AOGS Award Committee**, 2014–2016.
9. **Member, Editorial Board**, *Molecular Astrophysics* (Elsevier), 2015– .
10. **Member, International Academy of Astronautics Commission 1** (Space Physical Sciences), 2015–2017.
11. **Member, IUGG Union Commission on Planetary Sciences** (UCPS), 2015– .
12. **Member, AOGS Publication Committee**, 2017– .

### National

13. **Member, Executive Council of Indian Geophysical Union**, 2011 – 2014.
14. **Member, INSA-ICSU Committee** for COSPAR, SCOSTEP and URSI, 2012 – .
15. **Member Editorial Board**, *Bulletin of Astronomical Society of India*, 2012 –2015 .
16. **Member, S S Bhatnagar Award Committee** for Earth Sciences, 2013.
17. **Member, NISER-Earth & Planetary Sciences National Steering Committee**, 2016.
18. **Member, SwarnaJayanti Award Committee** Earth & Atmospheric Sciences, 2015
19. **Member, B M Birla Science Prize Committee**, for 2016.
20. **Member, INSA Section Committee** for Earth and Planetary Sciences, 2017-2019.
21. **Member, Governing Council, Indian Institute of Geomagnetism**, Mumbai, 2017 –
22. **Member, Governing Council, National Centre for Earth Science Studies (NCESS)**, Trivandrum, 2017–2020.
23. **Member, ISRO Council**, 2017–.
24. **Member, Research Council, CSIR-National Institute of Oceanography (NIO)**, Goa, 2017– .
25. **Member, Research Council, CSIR-National Geophysical Research Laboratory (NGRI)**, Hyderabad, 2017– .

## Press Releases:

*Press Releases by NASA and European Space Agency (ESA) on Discoveries and Landmark Research Findings, which formed the Breaking News at several science websites.*

1. **NASA Press Release**, Feb. 27, 2002, “*Jupiter Hot Spot Makes Trouble For Theory*”, on the Nature paper coauthored by Anil Bhardwaj “A Pulsating Auroral X-Ray Hot Spot on Jupiter”. It also made “ASTRONOMY PICTURE OF THE DAY” on March 1, 2002.
2. **ESA Press Release**, March 7, 2005, “*Jupiter: A Cloudy Mirror for the Sun*” on Geophysical Research Letters paper by Bhardwaj et al. “Solar Control on Jupiter’s Equatorial X-ray Emissions”.
3. **NASA Press Release**, May 25, 2005, “*NASA’s Chandra Finds Saturn Reflects X-rays from Sun*” on Astrophysical Journal Letters paper by Bhardwaj et al. “Chandra Observation of an X-ray Flare at Saturn”.

4. **NASA Press Release**, March 2, 2005, "*Chandra Probes High-Voltage Auroras on Jupiter*", on Journal of Geophysical Research paper coauthored by A. Bhardwaj "Simultaneous Chandra X-ray, HST UV, and Ulysses Radio Observations of Jupiter's Aurora".
5. **CXC-NASA Photo Press Release**, June 27, 2005, "*Saturn's Rings Sparkle with X-rays*" on Astrophysical Journal Letters paper by Bhardwaj et al. "Discovery of Oxygen K $\alpha$  X-ray Emission from Rings of Saturn".
6. **NASA Press Release**, Dec. 28, 2005, "*Chandra Looks Back at the Earth*" on Journal of Atmospheric and Solar-Terrestrial Physics paper by Bhardwaj et al. "First Terrestrial Soft X-ray Auroral Observation".
7. **CXC-NASA Photo Press Release**, March 1, 2007, "*Jupiter: Chandra Examines Jupiter During New Horizons Approach*", on Chandra X-ray observations of Jupiter during New Horizon flyby made on Feb. 10, 12, 24, 2007.
8. **ESA Press Release**, October 16, 2009, "*Hydrogen offers a New Way to study the Moon*" on Planetary and Space Science paper coauthored by A. Bhardwaj "Extremely High Reflection of Solar Wind Protons as Neutral Hydrogen Atoms from Regolith in Space".
9. **ISRO Story of the Week**: May 2, 2016, The paper "*On the evening time exosphere of Mars: Result from MENCA aboard Mars Orbiter Mission*" by Bhardwaj et al. published in **Geophysical Research Letters** (2016) made the Story of week at ISRO website titled "**MENCA observed the evening exosphere of Mars**". <http://isro.gov.in/menca-observed-evening-exosphere-of-mars>
10. **CXC-NASA Photo Press Release**: Sept. 14, 2016, "*X-ray Detection Sheds New Light on Pluto*", on Icarus paper coauthored by Anil Bhardwaj "The puzzling detection of x-rays from Pluto by Chandra". <http://chandra.harvard.edu/photo/2016/pluto/>
11. **ISRO Story of the Week**: March 27, 2017, The paper "*Observation of Suprathermal Argon in the exosphere of Mars*" by Bhardwaj et al. published in **Geophysical Research Letters** (2017) made the Story of week at ISRO website titled "**Observation of Suprathermal Argon in the exosphere of Mars**". <http://isro.gov.in/observation-of-suprathermal-argon-mars-exosphere>
12. **ISRO Story of the Week**: 27 June 2017, The paper "*New suprathermal proton population around Moon: Observation by SARA on Chandrayaan-1*" by Dhanya, Bhardwaj, et al. published in **Geophysical Research Letters** (2017) made the Story of week at ISRO website titled "**Discovery of new suprathermal proton population around the Moon by SARA onboard Chandrayaan-1**". <http://www.isro.gov.in/discovery-of-new-suprathermal-proton-population-around-moon-sara-onboard-chandrayaan-1>

## Cover Page of Journals & Highlights of Articles:

1. **Cover Page of Reviews of Geophysics**: Figure 1 of Bhardwaj and Gladstone (2000) article made the Cover Page of August 2000 issue of the American journal "Reviews of Geophysics".
2. **Cover Page of Astronomy and Astrophysics**: Figure 5 from Branduardi-Raymont, Bhardwaj, et al. (2007) paper made the Cover Page of the European journal *Astronomy and Astrophysics*, vol. 463, No.2 (2007).
3. **Cover Page of Geophysical Research Letters**: The paper "First Observation of a Mini-Magnetosphere above a Lunar Magnetic Anomaly using Energetic Neutral Atoms" on

- discovery of Mini-Magnetosphere on the Moon using the **SARA** experiment aboard **Chandrayaan-1** mission made the cover page of the March 16, 2010 issue of the *Geophysical Research Letters*.
4. **American Geophysical Union (AGU) Journal Highlights:** *Geophysical Research Letters* (2005) paper by *Bhardwaj et al.* "Solar Control on Jupiter's Equatorial X-ray Emissions: 26-29 November 2003 XMM-Newton Observation", was selected by AGU as the Journal Highlights.
  5. **Most Popular Journal Article at AGU:** As per the *American Geophysical Union* (AGU) website on 30 March 2010, the *JGR* (2009) paper by *Bhardwaj and Jain* "Monte Carlo Model of Electron Degradation in a CO<sub>2</sub> Atmosphere" has been the Most Popular Article (Top 5 Weekly Downloads = 364) across all journals of AGU.
  6. **One of the top-50 most cited papers:** As per the communication from Elsevier – the paper "**X-rays from Solar System Objects**", by **Bhardwaj et al.**, is one of the top-50 most cited papers published in the *Planetary Space Science* (Elsevier Publication) during January 2006 – February 2011.
  7. ***Astronomische Nachrichten* Editor's Choice**, the paper "Solar system X-rays from charge exchange processes", coauthored by **A. Bhardwaj**, selected as Editor's Choice of journal *Astronomische Nachrichten* (Astronomical Notes) in 2012.
  8. ***Nature India* Research Highlight:** The paper "**Proton entry into the near-lunar plasma wake for magnetic field aligned flow**", by Dhanya, Bhardwaj, et al. published in *Geophysical Research Letters* (2013) made *Research Highlight of Nature India* with title "**Tracing Sun's Protons Near Moon**", Published online on 23 July 2013; doi:10.1038/nindia.2013.99.
  9. ***ISRO Story of the Week***, June 19, 2017, "Mars Orbiter Mission Completes 1000 Days in Orbit", Scientific Results from MENCA aboard MOM are summarised in this Press Release. <http://www.isro.gov.in/mars-orbiter-mission-completes-1000-days-orbit>

### Best Paper Awards:

1. "Source mechanism of protons in near-lunar wake: SARA/Chandrayaan-1 observations", M.B. Dhanya, Anil Bhardwaj, et al., 19<sup>th</sup> *National Space Science Symposium (NSSS-2016)*, SPL, VSSC, Trivandrum, Feb. 9–12, 2016.
2. "First Observation of Protons in the Near-Lunar Plasma Wake for magnetic field aligned flow from SWIM/SARA on Chandrayaan-1", M.B. Dhanya, Anil Bhardwaj, et al., 18<sup>th</sup> *National Space Science Symposium (NSSS-2014)*, Dibrugarh University, Dibrugarh, Assam, Jan. 29 – Feb.1, 2014.
3. "Study of N<sub>2</sub> Vegard-Kaplan band emission in the dayglow of Mars, Venus and Titan", Sonal K. Jain and Anil Bhardwaj, 17<sup>th</sup> *National Space Science Symposium (NSSS-2012)*, Sri Venkateswara University, Tirupati, February 2012.
4. "First Results from SARA Experiment on the Chandrayaan-1 Mission", Anil Bhardwaj, et al., 16<sup>th</sup> *National Space Science Symposium (NSSS-2010)*, Saurashtra University, Rajkot, February 2010.
5. "First GMRT Observation of Jupiter's Synchrotron Radio Emission", Anil Bhardwaj, *Golden Jubilee Symposium on Radio Science (INCURSI-2007)*, National Physical Laboratory, New Delhi, February 2007.
6. "Non-Stationary Plasma Processes on Comets and its Implications", Anil Bhardwaj, *PLASMA-95 Symposium*, Banaras Hindu University, October 1995.

## Recent Colloquium / Invited Lecture at Institutes:

1. "Multi-spectral Aurora on Jupiter", *National Center for Radio Astronomy*, Pune, Dec. 2001.
2. "Auroral Radiation of Jupiter", *Swedish Institute of Space Physics*, Kiruna, Sweden, May 30, 2002.
3. "Space Program of India", *Swedish Institute of Space Physics*, Kiruna, Sweden, May 31, 2002.
4. "Multi-wavelength Observations of Jupiter", *Raman Research Institute*, Bangalore, May 2002.
5. "The Indian Space Program", *Institut d'Astrophysique et de Géophysique*, Université de Liège, Liège, Belgium, June 10, 2002.
6. "X-Rays from Solar System Bodies", *Rutherford Appleton Laboratory*, Chilton, Oxford, UK, October 7, 2002.
7. "Solar System X-rays", *University of Virginia*, Charlottesville, VA, USA, October 10, 2002.
8. "Indian Space Program", *Southwest Research Institute*, San Antonio, TX, USA, October 23, 2002.
9. "Remote Sensing of Solar System Bodies in Soft X-Rays", NSSTC Space Science Colloquium, *NASA Marshall Space Flight Center*, Huntsville, AL, USA, September 24, 2004.
10. "X-rays from the Jupiter and Saturn Systems", *Jet Propulsion Laboratory*, Pasadena, CA, USA, December 9, 2004.
11. "Low Energy Neutral Atom (LENA) Imaging of the Moon Environment", *California Institute of Technology*, Pasadena, CA, USA, December 10, 2004.
12. "X-Rays from the Solar System Bodies", *Joint CSP-IAR Colloquium*, Boston University, Boston, MA, USA, February 15, 2005.
13. "Chandrayaan-1 Mission and the SARA Experiment", *Mullard Space Science Laboratory*, University College London, UK, August 5, 2005.
14. "X-rays from Saturnian System", *Mullard Space Science Laboratory*, University College London, UK, August 5, 2005.
15. "SARA aboard the Chandryaan-1 Mission", *PLANEX program Invited talk*, PRL, Ahmedabad, Nov. 17, 2008.
16. "X-ray Emission from the Solar System Bodies", *PRL Colloquium*, Ahmedabad, Nov. 19, 2008.
17. "Indian Space Program and Space Research", *Physikalisches Institut*, University of Bern, Bern, Switzerland, June 26, 2009.
18. "X-rays from the Solar System", *Laboratory for Electro-Optics Systems (LEOS)*, Bangalore, July 31, 2009.
19. "X-ray Emission from the Solar System Bodies", *Colloquium at Raman Research Institute*, Bangalore, Nov. 11, 2009.
20. "Solar System and the Chandrayaan-1 Mission", *Sardar Patel University*, Vallabh Vidyanagar, Gujarat, Jan. 6, 2011.
21. "Indian Mars Orbiter Mission", Dept. of Physics, *Andhra University*, Visakhapatnam, March 26, 2014.
22. "MOM and SARA: Mars and Moon, Colloquium at *Tata Institute of Fundamental Research*, Mumbai, 7 Jan., 2015.
23. "Planetary Sciences: New Science and My Work", *Mini-Symposium on Earth and Planetary Sciences*, NISER, Bhubaneswar, May 5, 2016.
24. "India to Mars: The Mars Orbiter Mission (MOM)", *Science Week Lecture*, University of Mauritius, Mauritius, Sept. 28, 2016.
25. "MOM and SARA: Mars and Moon, Institute Lecture at *Indian Institute of Technology*, Kanpur, 7 Nov., 2016.
26. "Solar System and Planetary Exploration", Lecture at The Bangalore Science Forum, in National Science College, Basavanagudi, Bangalore, 18 Jan. 2017.
27. "Indian Mars Mission", *Indian Institute of Toxicology Research*, Lucknow, October 17, 2017.

## Membership in Professional Bodies:

1. Member, American Geophysical Union.

2. *Member*, American Association for Advancement of Sciences.
3. *Life Member*, Astronomical Society of India.
4. *Life Member*, Kerala Academy of Sciences.
5. *Life Member*, Indian Society of Atomic and Molecular Physics.
6. *Life Member*, Plasma Science Society of India.
7. *Life Member*, Indian Physics Association.
8. *Life Member*, Indian Science Congress Association.
9. *Life Member*, Astronautical Society of India.

## **Current Professional Responsibilities:**

### **International**

- 1) Member, **ISRO-NASA Mars Working Group** (INMWG), 2014–
- 2) Member, **International Academy of Astronautics**, Study Group 1.13, 2014–
- 3) Member, **India-US Earth Science Working Group**, 2015–
- 4) **Proposal Evaluator**, NASA Planetary Science Program.
- 5) **Reviewer**, FRS-FNRS, Belgium, proposal evaluation.
- 6) *Referee*, Journals – Nature, Science, ApJ, A&A, JGR, Icarus, Planetary Space Sci., GRL.

### **Member of**

- 1) **ISRO Study Team** for *Solar System Exploration Program*.
- 2) Advisory Committee for Space Research (**ADCOS**) of ISRO.
- 3) **Management Board**, *TIFR Balloon Facility*, Hyderabad.
- 4) **Member, Board of Management**, *Indian Institute of Space Science and Technology (IIST)*, Trivandrum.
- 5) Member, **Governing Council**, North East-Space Application Centre, Shillong.
- 6) **Member**, Program Management Committee, *National Information System for Climate & Environment Studies (NICES)*.
- 7) **ISRO Strategy Group** (ISG).
- 8) Kerala State Young Scientist Award selection committee.
- 9) *Proposal Evaluator*, GMRT Observation Time Allocation committee.
- 10) *Proposal Evaluator*, DST, ISRO (RESPOND, PLANEX), and CSIR scientific proposals.
- 11) *Proposal Evaluator*, Indo-US Science and Technology Forum.
- 12) *Referee*, Indian J. Radio Space Physics, Current Science, JESS.

## **Conferences Organised in India:**

1. **Co-Convener**, *22nd Meeting of Astronomical Society of India*, Feb. 13-15, Trivandrum, 2003.
2. **Convener**, *PLANEX Workshop* on "Planetary Atmospheres, Ionospheres, and Magnetospheres", Feb. 17-22, SPL, VSSC, Trivandrum, 2003.
3. **Co-Convener**, Parallel Session 3, *XIV National Space Science Symposium-2006*, Andhra University, Visakhapatnam, 9-12 Feb. 2006.
4. **Member-Convener**, Venue and Events Committee, *97th Indian Science Congress*, Trivandrum, January 3-7, 2010.



5. **Co-Convener**, Parallel Session 4 “The Solar System bodies including Planetary system”, *XVI National Space Science Symposium-2010*, Saurashtra University, Rajkot, 24-27 February 2010.
6. **For the first time** brought the **AOGS International Meeting** to India by bidding for it, and hosting successfully the meeting – the *7th AOGS Annual Meeting* – in Hyderabad, during July 5-9, 2010.
7. **Convener**, 19<sup>th</sup> National Space Science Symposium (NSSS-2016), SPL, VSSC, Trivandrum, Feb 9-12, 2016.

## Details of Research and Professional Accomplishments:

### Experiments on Indian Planetary Missions:

- 1) **Principal Investigator**, Sub-keV Atom Reflecting Analyzer (**SARA**) experiment, an Indo-Swedish collaboration, on the **First Indian Lunar Mission Chandrayaan-1**.
- 2) **Principal Investigator**, Mars Exospheric Neutral Composition Analyzer (**MENCA**) experiment on the **First Indian Mars Orbiter Mission**.
- 3) **Principal Investigator**, Chandra’s Atmospheric Composition Explorer (**CHACE-2**) experiment on the **Chandrayaan-2 Orbiter** mission.

#### Supervising the development of :

(i) **ASPEX** and **PAPA** on **Aditya-L1** mission; (ii) **CHASTE** and **RAMBHA** on **Chandrayaan-2 Lander** mission; (iii) **XSM** on **Orbiter** and **APXS** on **Rover of the Chandrayaan-2 mission**.

### Planetary Multi-wavelength Astronomy using Telescopes:

#### 1. Radio Observation of Jupiter with Giant Metrewave Radio Telescope (GMRT)

- 1) **Principal Investigator** on **first** radio observation of Jupiter using GMRT, Feb–March 2003.
- 2) **Co-Principal Investigator** on the GMRT observation of Jupiter, May–June 2007.
- 3) **Co-Investigator** on the GMRT observation of Jupiter, May–June 2008.

#### 2. X-ray Observations with Chandra and XMM-Newton Space Observatories

- 1) **Co-Investigator** on Chandra HRC-I **Jupiter** observation during **Cassini** flyby, Dec. 2000.
- 2) **Co-Investigator** on Chandra HRC-I observation program for **Jupiter** – 2001.
- 3) **Co-Investigator** on Chandra ACIS **Jupiter** observation program – Feb. 2003.
- 4) **Co-Investigator** on Chandra ACIS **Saturn** observation – Jan. 2004.
- 5) **Co-Investigator** on Chandra **Earth** aurora observations – Dec. 2003–April 2004.
- 6) **Co-Investigator** on XMM-Newton **Saturn** observation program – April & Oct. 2005.
- 7) **Co-Investigator** on joint Chandra–XMM-Newton observation of **Jupiter** during **New Horizon** flyby of Jupiter – Feb.-March 2007.
- 8) **Co-Investigator** on XMM-Newton **Mars** Observation – Nov. 2009.
- 9) **Co-Investigator** on XMM-Newton **Mars DDT** Observation – Aug. 2016.
- 10) **Co-Investigator** on XMM-Newton observation of **Pluto** in April-May 2017.

#### 3. Ultraviolet Observation of Jupiter with Hubble Space Telescope (HST)

- 1) **Co-Investigator** on HST-STIS **Jupiter** observation program – Feb. 2003.

#### **4. Joint Infrared-Radio Observation of Jupiter with NASA-IRTF and GMRT**

- 1) **Co-Investigator** on near-simultaneous GMRT radio and NASA Infrared Telescope Facility (IRTF) infrared observations of **Jupiter** during Nov. 2011.

#### **5. Multi-Instrument Observation of Jupiter in radio, infrared, and ultraviolet**

- 1) **Co-Investigator** on Multi-wavelength (radio, UV, IR) and multi-instrument (GMRT, NASA-IRTF-CHSELL, HST, IPRT, SPRINT-A, Nict 34m) observation of Jupiter, Jan. 2014.
- 2) **Co-Investigator** on “Evaluation of dawn-dusk electric field on the Jovian radiation belt based on GMRT, Juno, and Hisaki”, 10 observations each of about 2 hrs during May-June, 2016 during **Juno** approach to Jupiter.
- 3) **Co-Investigator** on “Ground based support for Juno mission: Investigation of physical processes in Jovian radiation belt by GMRT and Juno”, 2 observations each of about 6 hrs around 16-17 Dec, 2017 when **Juno** is near radiation belts of Jupiter.

#### **6. Radio Observation of Venus with Giant Metrewave Radio Telescope (GMRT)**

- 1) **Co-Investigator** on radio observation of Venus, 5, 25 Jan. 2014.
- 2) **Co-Investigator** on the four radio observation of Venus, July–Sept. 2015.

### **Research Supervision:**

#### **Ph.D.'s – 7**

- 1) **Marykutty Michael, 2001.** Ph.D. thesis topic “*Model for electron degradation and production of emission in the atmosphere of Io*”, MG University, Kottayam.
- 2) **Sonal Kumar Jain, 2013.** Ph.D. thesis topic “*Dayglow Emissions on Mars and Venus*”, CUSAT, Kochi.
- 3) **Susarla Raghuram, 2014.** Ph.D. thesis topic “*Modelling of Ultraviolet and Visible Emissions in Comets*”, CUSAT, Kochi.
- 4) **K. M. Ambali, 2014.** Ph.D. thesis topic “*A study equatorial and low latitude plasma processes using physics based ionospheric models in association with ground based/space borne optical and radio experiments*”, Kerala Univ., Trivandrum.
- 5) **Tirtha Pratim Das, 2017.** Ph.D. topic “*Study of Noble Gases in Lunar Exosphere using the CHACE-MIP Observation of Chandrayaan-1*”, CUSAT, Kochi.
- 6) **M. B. Dhanya, 2017.** Ph.D. thesis topic “*Study of Lunar-Solar Wind Interaction with the SARA Experiment aboard the Chandrayaan-1 Mission*”, Kerala Univ., Trivandrum.
- 7) **P. R. Shreedevi, 2018,** Ph.D. thesis topic “*A study on the impact of space weather events on the ionosphere over the Antarctic station Bharati and the Indian subcontinent*”, CUSAT, Kochi.
- 8) **Vrinda Mukundan, 2018 (submitted),** Ph.D. thesis “*Modelling the Dayside Ionosphere of Titan: Application of Electron Degradation Model for Methane*”, CUSAT, Kochi.

**Ph. D.'s currently supervising: 1**

**M. Tech. Thesis Supervision: 2**

**M. Phil. Thesis Supervision: 1**

**M. Sc. Thesis Supervision: 15 (1 from MIT, USA)**

**DST-INSPIRE Fellowship Project Supervision: 2**

**Indian Academies of Sciences – Summer Fellows Project Supervision: 24**  
**DST INSPIRE Faculty: 1**  
**ISRO Research Associate: 3**

### **Recognized Research guide:**

1. Mahatma Gandhi University, Kottayam.
2. University of Kerala, Trivandrum.
3. Cochin University of Science and Technology (CUSAT), Kochi.
4. Andhra University, Vishakhapatnam.

### **Publications: (for details see separate list)**

- 1) Refereed Journal Publications: 133 [First/Second authored : 83]
- 2) Chapter in Books: 6
- 3) Refereed Proceedings: 4
- 4) Books edited (Editor-in-Chief): 6
- 5) Guest Editor - Special issue of Journals: 3
- 6) arXiv Publications: 2
- 7) Popular/General Articles: 6

### **Conferences, Lectures and Invited Talks:**

- 1) Invited Talks at Conferences: >60 (30 abroad)
- 2) Conference Presentations: >300 (about >130 abroad)
- 3) Session Chair at Conferences Abroad: >25
- 4) Sessions Organized/Co-organised at International Conferences Abroad: >45
- 5) Member of Scientific Organising Committee – International Conferences : >10
- 6) Conferences/Workshops/Sessions Organized in India: 8

### **Teaching Lectures:**

Delivered series of invited lectures (>150) in the area of Space and Planetary Sciences at several workshops/courses/training programs, including :

- 1) United Nations Post Graduate Course in Space Physics and Atmospheric Sciences.
- 2) Planetary Sciences and Exploration (PLANEX) Workshops.
- 3) Winter School on Modeling of Planetary Atmospheres.
- 4) DST-SERC Schools.
- 5) ISRO Induction Training Programs.
- 6) B. Sc. and M. Sc. students of several colleges and universities.
- 7) CSIR Program for Youth Leadership in Science.
- 8) Swadeshi Science Movement.
- 9) International Science Olympiad.
- 10) National Science Day Celebrations.
- 11) UGC Refresher course in Physics for College Teachers.
- 12) ISRO Structured Training Program.

## Public Outreach:

With the aim to enthuse students, in recent years, delivered more than 80 public outreach lectures and popular lectures in the area of the Solar System, Space, Planetary, Lunar and Martian Sciences and Exploration to students of schools and colleges in and around Trivandrum, as well as in other places/cities in the States of Kerala, Tamilnadu, West Bengal, Orissa, Rajasthan, Andhra Pradesh, Karnataka, Gujarat, Maharashtra, Goa, Himachal Pradesh, Punjab, Delhi, and Uttar Pradesh, and Union Territory of Chandigarh and Pondicherry.

Also participated in many Interactive Sessions with school and college students on the occasion of *World Space Week* Celebrations in VSSC and *INSPIRE* programs. Interacted with more than 5000 students during the last 10 years.

## Talk at All India Radio:

1. Moon eliciting man's curiosity since time immemorial, **Talk at All India Radio, Trivandrum**, 9.30 pm, 22 July 2016, in context of First Human Landing on Moon.

## Invited talks In Hindi:

1. **Invited Talk** on "Chandrayaan-1 Mission", at the *Inter-centre Technical Hindi Seminar*, LPSC, Trivandrum, Sept 22, 2010.
2. **Inaugural Key-Note address**, on "Mars Mission", IISU, Trivandrum, 7 Nov., 2012.
3. **Inaugural Key-Note address**, on "Indian Planetary Missions", ISTRAC, Bangalore, 8 Sept., 2014.
4. **Chief Guest**, Hindi Fortnight Program Valedictory Function, National Centre for Earth Science Studies (NCESS), Sept. 28, 2015.
5. **Chief Guest and Key Note address** on "Indian Planetary Missions", Hindi Talk, Feb. 18, 2016, IISU, Trivandrum.
6. **Chairman, Editorial Committee**, Centre Hindi Seminar, VSSC, July 19-20, 2016.
7. **Chief Guest**, and Key Note Lecture on "Planetary Missions of India" World Hindi Day Program, Master Control Facility (MCF), Hassan, Jan. 10, 2017.

## Recent Distinguished/ Key-note / Inaugural Lectures delivered at:

1. *Joint Seminar of Kerala Academy of Science, Society for Polymer Science India, and High Energy Material Society of India*, Trivandrum, Oct. 29, 2007.
2. *19<sup>th</sup> Annual General Meeting of Materials Research Society of India (MRSI)*, SCTIMST, Trivandrum, Feb. 14, 2008.
3. *DAE-BNRS Symposium on Atomic, Molecular and Optical Physics*, Inter-University Accelerator Centre, Delhi, Feb. 10, 2009.
4. *National Conference of Shanti Swarup Bhatnagar Award Winners*, Devi Ahilya University, Indore, July 17, 2009.
5. *National Academy of Sciences, India*, Regional Science City, Lucknow, Oct. 30, 2009.
6. *National Conference on Recent Trends in Materials and Devices - 2010*, Amity School of Engineering and Technology, Amity University, Noida, May 22, 2010.
7. *National Technology Day Lecture*, Centre for Earth Sciences System, Trivandrum, June 8, 2010.

8. *16<sup>th</sup> National Seminar on Physics and Technology of Sensors*, Lucknow University, Lucknow, Feb. 11, 2011.
9. *Lectures in Atomic and Molecular Physics*, IIST, Trivandrum, April 2, 2012.
10. *Bhautik-2012*, Government Arts College, Trivandrum, Dec. 13, 2012.
11. *34<sup>th</sup> Institute of Indian Geographers' (IIG) Meet*, Centre for Earth Sciences System, Trivandrum, Dec. 14, 2012.
12. *The National Academy of Sciences Annual Meeting*, Goa, Dec. 5, 2013.
13. *17<sup>th</sup> National Space Science Symposium*, Dibrugarh University, Assam, Jan. 29, 2014.
14. *Kerala Academy of Sciences and Kerala State Council for Science Technology and Environment*, Thiruvananthapuram, Feb. 28, 2014.
15. *Chief Guest Lecture at Valedictory Function of Physics Association 2013-2014*, Andhra University, Visakhapatnam, March 26, 2014.
16. *Amelthea 2014 Conclave Lecture*, Indian Institute of Technology, Gandhinagar, Oct. 12, 2014.
17. *National Institute of Interdisciplinary Science and Technology Foundation Day Lecture*, Oct. 15, 2014.
18. *Convocation Week Lecture*, Lucknow University, Jan.17, 2015.
19. *National Technology Day Oration*, May 11, 2015, Kozhikode, organized by KSCSTE and CWRDM.
20. *Infosys Award Function*, Homi Bhabha Centre for Science Education, TIFR, Mumbai, Dec. 22, 2015.
21. *Science Day Lecture*, Satish Dhawan Space Centre, SHAR, Sriharikota, March 1, 2016.
22. *Science Week Lecture*, University of Mauritius, Mauritius, Sept. 28, 2016.
23. *INSA Vainu Bappu Memorial Medal Lecture*, INSA Annual Meeting, NISER, Bhubaneswar, Dec. 29, 2016.
24. *Represented India*, and deliver talk on Indian Space Program, in the *Opening Ceremony of CIENCIA 2017 - National Science Summit of Portugal*, Lisbon, July 3-5, 2017.
25. Invited talk at 3rd Indian Society of Systems for Science and Engineering (ISSE) National Conference – 2017, National Conference on Complex Engineering Systems of National Importance: Current Trends & Future Perspective, Indian School of Business, Mohali, October 12, 2017.
26. *Foundation Day Lecture*, CSIR-Central Scientific Instruments Organisation (CSIO), Chandigarh, 30 October, 2017.
27. *Key Note Inaugural address*, PLASMA-2017, Plasma Science Society of India (PSSI), 32nd National Symposium on Plasma Science & Technology, Institute for Plasma Research, Gandhinagar, Gujarat, 7 November 2017.

### **Invited Talks at Conferences/Symposium/Workshops (during last ~15 years):**

1. "X-ray Studies of the Jovian System", *National Space Science Symposium*, Bhopal, February 25-28, 2002.
2. "Soft X-Ray Emissions from Planets and Moons", *ESLAB 36 Symposium on "Earth-Like Planets and Moons"*, ESTEC, Noordwijk, Amsterdam, Netherlands, June 3-8, 2002.
3. "Auroral Observations of the Giant Planets", *34th COSPAR Scientific Assembly*, Houston, Texas, USA, Oct 12-19, 2002.
4. "New results on X-ray emissions from the Jovian system", *22nd Meeting of Astronomical Society of India*, Trivandrum, February 13, 2003.

5. "Planetary Sciences in India – Recent Developments", *IAA Asia-Pacific Regional conference on "Advances in Planetary Exploration"*, Bangalore, India, June 26-29, 2005.
6. "X-Ray Emission from the Saturnian System", *Magnetospheres of the Outer Planets 2005 Meeting*, University of Leicester, Leicester, UK, 7-12 August, 2005.
7. LENA Imaging on the Moon with SARA instrument aboard Chandrayaan-1, *National Space Science Symposium*, Andhra University, Visakhapatnam, India, February 9-12, 2006.
8. "Planetary X-rays: Relationship with Solar X-rays and Solar Wind", *International Living With Star Workshop on "The Solar Influence on the Heliosphere and Earth's Environment: Recent Progress and Prospects"*, Goa, India, February 19-24, 2006.
9. "Indian Lunar Mission Chandrayaan-1", *Third AOGS Annual Meeting*, Singapore, July 10-14, 2006.
10. "Chandrayaan-1: First Indian Lunar Mission", *Fourth AOGS Annual Meeting*, Bangkok, Thailand, July 30-August 4, 2007
11. "Solar wind flows and interaction with planets, comets and other solar system bodies", *International Heliophysical Year School for the Asia-Pacific Region*, Kodaikanal Observatory (IIA), Kodaikanal, Dec. 10-22, 2007.
12. "Recent Advances in Planetary X-ray Astronomy and Science", *National Space Science Symposium (NSSS-2008)*, Radio Astronomy Center-TIFR, Ooty, India, February 26-29, 2008.
13. "India's First Lunar Mission Chandrayaan-1", *Fifth AOGS Annual Meeting*, Busan, Korea, June 16-20, 2008.
14. "Monitoring Solar Wind in the Near-Earth Environment with SWIM of the SARA Experiment aboard the Indian lunar Mission Chandrayaan-1, *Magnetic coupling between the Interior and the Atmosphere of the Sun, "Centenary Commemoration of the discovery of the Evershed Effect"*, Indian Institute of Astrophysics, Bangalore, Dec. 2-5, 2008.
15. "X-Ray Emission from the Solar System Bodies: Connection with Solar X-Rays and Solar Wind", *International Solar Wind 12 Conference*, Saint Malo, France, June 21-26, 2009.
16. "Exploration of Planetary Atmospheric Processes", *DST National Discussion Meeting on Atmospheric Sciences*, CAOS, IISc, Bangalore, 22-24 Oct, 2009.
17. "New findings on Moon from the SARA experiment on board Chandrayaan-1 Mission, *Platinum Jubilee Meeting 2 of the Indian Academy of Sciences*, Bangalore, Nov. 13, 2009.
18. "New Findings on the Moon from the SARA Experiment aboard Chandrayaan-1 Mission", *International Conference on Astronomy IICFA 2009*, Field Marshal K.M. Cariappa College, Madikeri, Karnataka, Dec. 28-30, 2009.
19. "Planetary Exploration: Future Perspective", *16<sup>th</sup> National Space Science Symposium (NSSS-2010)*, Saurashtra University, Rajkot, Feb. 24-27, 2010.
20. "Solar System X-ray Emission", *DST-SERC School on "Space Weather"*, Indian Institute of Geomagnetism, Mumbai, April 23, 2010.
21. "Indian Lunar Mission Chandrayaan-1", *DST-SERC School on "Space Weather"*, Indian Institute of Geomagnetism, Mumbai, April 23, 2010.
22. "The Solar System and Planetary Exploration", *Fourth Summer Workshop on Foundations of Space Science and Technology*, Ramakrishna Mission Vivekananda University and Kalpana Chawla Centre for Space and Nano Sciences, Kolkata, May 17, 2010.
23. "Solar System X-ray Emissions", *International Workshop on Planetary Atmospheres*, PRL, Ahmedabad, July 12-13, 2010.
24. "Chandrayaan-1: India's First Mission to the Moon, *38th COSPAR Scientific Assembly*, Bremen, Germany, 18-25 July, 2010.
25. "Electron Impact Processes in Cometary Coma: Implications for Cometary Missions", *38th COSPAR Scientific Assembly*, Bremen, Germany, 18-25 July, 2010.
26. "Chandrayaan-1: Indian First Mission to the Moon, *International Symposium of the Science and Utilization of the Moon (SUM2010)*, Research Institute for Science and Engineering, Waseda University, Tokyo, Japan, 7-9 September, 2010.

27. "Solar System and the Chandrayann-1 Mission", National Seminar on "Advances in Science, Emerging Technologies and Societal Development (ASETS-2011)", Bodhananda Research Foundation for Management & Leadership Studies, KSCSTE, Trivandrum, Jan. 15, 2011.
28. "Mars Atmosphere: Present Understanding, *Brainstorming Session on Mars Science and Exploration*, Physical Research Laboratory, Ahmedabad, March 24-25, 2011.
29. "An overview on the Results from the SARA Experiment aboard the Chandrayaan-1 mission", *Eighth AOGS Annual Meeting*, Taipei, Taiwan, August 8-12, 2011.
30. "Study of the Lunar Exosphere with the CHACE-2 Experiment aboard the Chandrayaan-2", *Conference on Planetary Sciences and Exploration*, PRL, Ahmedabad, Dec. 12-14, 2011.
31. "A New View of the Moon: Discoveries from the SARA and CHACE/MIP Experiments aboard the Chandrayaan-1", *National Conference on Space Transportation Systems: Opportunities and Challenges*, VSSC, Trivandrum, Dec. 16-18, 2011.
32. "A New View of the Solar Wind – Moon Interaction: Results from the SARA Experiment aboard Chandrayaan-1, *17<sup>th</sup> National Space Science Symposium (NSSS-2012)*, Sri Venkateswara University, Tirupati, A.P., Feb 14-17, 2012.
33. "New View of the Moon: Discoveries from the SARA and CHACE/MIP Experiments aboard the Chandrayaan-1", Workshop on "*Recent Trends in Space Physics, Atmospheric Physics & Astrophysics*", Banaras Hindu University, Varanasi, March 14, 2012.
34. "Model for the Cameron band emission of CO molecule in comets, *39th COSPAR Scientific Assembly*, Mysore, India, 14-22 July, 2012.
35. "Interaction of the solar wind with the Moon: New results from the SARA/Chandrayaan-1", *International Symposium on Atmospheres of Terrestrial Planets: Observations & Modeling*, PRL, Ahmedabad, July 23-24, 2012.
36. "New Results from SARA/Chandrayaan-1", *Workshop on Space Science Education and Technology*, India Institute of Space Science and Technology (IIST), Trivandrum, July 26, 2012.
37. "Electron Impact Processes in Cometary Coma: Chemistry and Emissions", Talk at the Team Meeting on the International Space Science Institute (ISSI) Project "Modelling cometary environments", ISSI, Bern, Switzerland, Nov. 19-23, 2012.
38. "Evolution of Planetary Atmospheric Research in India", *Workshop on 'Infrared spectroscopy of planetary atmospheres*, Space Science Instrumentation Facility (SSIF), ISRO Satellite Centre, ISITE campus, Bangalore, May 8-10, 2013.
39. "Current and future activities in planetary exploration in the Indian Space Research Organization", *Low Cost Planetary Mission (LCPM-10)*, Caltech, Pasadena, CA, USA, June 18-21, 2013.
40. "MENCA: Instrument and Science", *Workshop on Mars Orbiter Mission*, PRL, Ahmedabad, July 26-27, 2013.
41. "Mars Orbiter Mission (MOM) & Scientific Studies", Pre-Symposium Tutorial on Planetary Exploration, ISRS-ISG National Symposium on Remote Sensing and GIS for Environment, Dec. 2-3, 2013, Vishakhapatnam.
42. "Planetary Exploration and the case for Understanding Mars", Symposium on "Space for Human Welfare, The National Academy of Sciences Annual Meeting, Goa, Dec. 5-6, 2013.
43. "Interaction of Solar Wind with the Moon: A New View from the SARA/Chandrayaan-1", *17<sup>th</sup> National Space Science Symposium (NSSS-2014)*, Dibrugarh University, Dibrugarh, Assam, Jan. 29-Feb 1, 2014.
44. "Venus: Airglow and X-ray emissions", *Venus Workshop*, SSIF/ISITE, ISAC, June 2-6, 2014.
45. "Indian Mars Orbiter Mission", Alfvén conference, Skype talk, *6th Alfvén Conference*, University College London (UCL), London, UK, 8 July, 2014.
46. "Indian Mars Orbiter Mission", *40th COSPAR Scientific Assembly*, Moscow, Russia, 8 August, 2014.
47. Indian Mars Orbiter Mission, *Comet Siding Spring Workshop*, Aug. 11, 2014.
48. Indian Mars Orbiter Mission, *JPL comet C/2013 A1 Siding Spring workshop*, Sept. 19, 2014.
49. Atmosphere of Mars, *PLANEX workshop*, PRL, Ahmedabad, 6 Jan., 2015.
50. "Indian Mars Orbiter Mission", *National Seminar on Space Sciences and Space Missions*, NSS Hindu College, Changanacherry, March 11-13, 2015.

51. "Influence of Space Weather on Planetary Environments", International meeting on *Science of Space Weather*, Goa, 24-29 Jan. 2016.
52. "Planetary Atmospheres: Our Current Understanding", *19th National Space Science Symposium (NSSS-2016)*, VSSC, Trivandrum, Feb. 10 (Feb.9-12), 2016.
53. "Exploration of Venus", *PLANEX Workshop*, PRL, Ahmedabad, March 7, 2016.
54. "Solar-Planetary-Moon Connection", *IIA-ISAC National Symposium on Exoplanets*, Kodaikanal Observatory, Kodaikanal, 7-8 Oct. 2016.
55. India to Mars: The Indian Mars Orbiter Mission (MOM), *TWAS Young Scientists Conference on "Frontiers in Earth, Climate and Ocean Sciences"*, IISc, Bangalore, Dec. 6, 2016.
56. "A New View on Solar Wind - Moon Interaction from SARA/Chandrayaan-1", *Frontiers in Theoretical and Applied Physics (FTAPS-2017)*, American University of Sharjah (AUS), Sharjah, UAE, 22 Feb., 2017.
57. "Space Sciences and Planetary Exploration", *3rd Indian Society of Systems for Science and Engineering National Conference – 2017*, October 12, 2017, Indian School of Business, Mohali.
58. "Science of the Outer Planets and their Moons," *Brainstorming session on Vision & Exploration for Planetary Sciences in Decades 2020-2060*, PRL, Ahmedabad, 8 Nov., 2017.

## Video Link on Talks to NDTV:

Talking to NDTV about SARA experiment aboard first Indian Lunar mission Chandrayaan-1

<http://www.ndtv.com/video/player/ndtv-specials/anil-bharadwaj-speaks-of-sara-an-instrument-on-chandrayaan/41961>

Talking to NDTV about MENCA experiment aboard first Indian Mars Orbiter Mission (MOM)

<http://www.ndtv.com/video/player/news/exciting-that-mangalyaan-may-fly-through-a-tail-of-comet/294282>

## Infosys Prize (2016) related video links:

<http://www.infosys-science-foundation.com/prize/laureates/2016/anil-bhardwaj.asp>

**Anil Bhardwaj – Infosys Prize 2016 Laureate, Physical Sciences**

<https://www.youtube.com/watch?v=nKMyWT2S-10>

<https://www.youtube.com/watch?v=NkidsyOWOEo>

<https://www.youtube.com/watch?v=aT4tPd0y6H0>

[Dr. Bhardwaj receives the INFOSYS Prize in Physical Sciences \(2016\)](#)

<http://www.infosys-science-foundation.com/prize/laureates/2016/anil-bhardwaj.pdf>

## Interesting News Clippings links:

- **Life may exist outside Earth but we may not recognize it - An Interview with Mint**  
<http://www.livemint.com/Politics/A9NAbvUPa2WASZcdrpTJI/Life-may-exist-outside-Earth-but-we-may-not-recognize-it-sa.html>
- **VSSC-SPL director Anil Bharadwaj wins Infosys Prize 2016 : Interview with Times of India**



<http://timesofindia.indiatimes.com/city/thiruvananthapuram/VSSC-SPL-director-Anil-Bharadwaj-wins-Infosys-Prize-2016/articleshow/55516595.cms>

- **He aims for stars, moon, mars and more : Interview with Indian Express**  
<http://www.newindianexpress.com/cities/thiruvananthapuram/2016/dec/22/he-aims-for-stars-moon-mars-and-more-1552086--1.html>
- **ISRO is CHACEing big space dreams : Interview with Indian Express**  
<http://www.newindianexpress.com/states/kerala/2016/dec/27/isro-is-chaceing-big-space-dreams-1553374.html>
- **INFOSYS Prize in Physical Sciences (2016) to Dr. Anil Bhardwaj: An Article by Prof. R. Sridhran in Current Science**