# CENTRE FOR SPACE PHYSICS

## ANNUAL REPORT

(2005-2006)

**TABLE OF CONTENTS**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report of the Governing Body</td>
<td>5</td>
</tr>
<tr>
<td>Governing Body of the Centre</td>
<td>7</td>
</tr>
<tr>
<td>Research Advisory Council Members</td>
<td>7</td>
</tr>
<tr>
<td>Faculty Members</td>
<td>7</td>
</tr>
<tr>
<td>Honorary Faculty Members</td>
<td>8</td>
</tr>
<tr>
<td>Research Scholars</td>
<td>8</td>
</tr>
<tr>
<td>Engineers</td>
<td>8</td>
</tr>
<tr>
<td>Research Facilities of the Centre, Head Office</td>
<td>9</td>
</tr>
<tr>
<td>Research Work Published or Accepted for Publication</td>
<td>10</td>
</tr>
<tr>
<td>Books/Books reviewed</td>
<td>13</td>
</tr>
<tr>
<td>Members of the Scientific Society</td>
<td>13</td>
</tr>
<tr>
<td>Ph.D. degree expected</td>
<td>13</td>
</tr>
<tr>
<td>Registered for Ph. D. Degree</td>
<td>13</td>
</tr>
<tr>
<td>Awards Honours and Distinction</td>
<td>14</td>
</tr>
<tr>
<td>Participation in National/International Conferences &amp; Symposia</td>
<td>14</td>
</tr>
<tr>
<td>Important visitors to the Centre</td>
<td>15</td>
</tr>
<tr>
<td>CSP Activities in the Year of Physics</td>
<td>16</td>
</tr>
<tr>
<td>Brief Profiles of the Scientists of the Centre</td>
<td>17</td>
</tr>
<tr>
<td>Collaborative Research and Project Work</td>
<td>20</td>
</tr>
<tr>
<td>Other Ongoing Projects of the Scientists of the Centre</td>
<td>22</td>
</tr>
<tr>
<td>Media Coverage of Centre’s Events</td>
<td>22</td>
</tr>
<tr>
<td>Summary of the Research Activities</td>
<td>23</td>
</tr>
<tr>
<td>Popularization of Space Science</td>
<td>38</td>
</tr>
<tr>
<td>Activities of the Coochbehar Branch</td>
<td>38</td>
</tr>
<tr>
<td>Activities of the Malda Branch</td>
<td>39</td>
</tr>
<tr>
<td>Activities of the Observatory Branch</td>
<td>40</td>
</tr>
<tr>
<td>Space Science Symposia in Dinajpur(D) and Darjeeling</td>
<td>41</td>
</tr>
<tr>
<td>Auditor’s Report to the Members</td>
<td>42</td>
</tr>
</tbody>
</table>
Cover: Various activities of CSP in 2005-2006 have been put together. L to R (top): M. Saha and R. Khan with assistant R. Das in the observatory. A. Nandi discussing in the seminar room. VLF antenna on the roof-top. L to R (middle): VLF data acquisition, medals for the quiz competition, students in the computer room. L to R (bottom): C. Salter chatting with the vice president of CSP, students at the written eligibility test for the district level quiz competition, time keeper in the quiz competition, P. Nandi and others in the electronics lab for the testing and evaluation of payloads.
Report of the Governing Body

This is the seventh Annual report of the Centre for Space Physics (CSP) and as usual it has seen more growth than previous few years in terms of its scientific activities, research involvements and recognition. The grants received is almost thrice as that of the previous year.

First, with great sadness we wish to record the demise of Prof. M. K. Das Gupta, one of the founding members of the Governing Body. He was a pioneer in radio astronomy and was well known worldwide for his work on radio sources in active galaxies.

In 2005-2006, CSP started to work in full swing in the Russian satellite CORONAS-PHOTON related work. CSP members have been trained in Vikram Sarabhai Space Centre (VSSC), Trivandrum and Tata Institute of Fundamental Research (TIFR) on electronics components of the RT-2 payloads. CSP even had to hire an office and guest house in Trivandrum for this workload. Some of the CSP members (ASTROSAT junior research fellow and post-doctoral fellow) continued to work on the shielding characteristics of the payload on ASTROSAT satellite and contributed to identify suitable shielding parameters for the LAXPC and CZT detectors components.

Apart from receiving a few new projects, specifically on the Astrobiology programme and the study of the characteristics of a few black holes, CSP has received funding for the lease-line internet facilities and has acquired a domain named csp.res.in. Data from several space missions are expected to be kept in the CSP data bank which will be accessed through this lease-line in future.

Several research scholars are working on a full time basis on astrobiology/astrochemistry, star formation, and black hole astrophysics related projects, solar physics, earthquakes, radio astronomy etc. Our students carried out observations with Giant Meter Radio Telescope (GMRT) in Pune. Some of the students are receiving their stipends from the Council of Scientific and Industrial Research (CSIR) and others are receiving from Indian Space Research Organization (ISRO) and Department of Science and Technology (DST). Some software and hardware personnel have been hired. Most importantly ISRO has recruited two individuals Dr. A. Nandi and Dr. V. Yadav for posting in CSP. This is indeed a milestone for CSP.

Several distinguished guests, such as, Prof. C. Salter from Arecibo (US) observatory, Prof. S. Ananthakrishnan and Dr. Y. Gupta from National Centre for Radio Astronomy, Pune visited CSP. Two students Mr. Samir Mandal and Mr. Sabyasachi Pal have submitted their Ph.D Thesis to Jadavpur University. Publications of research work have been made in reputed International Journals and research scholars have actively participated in several National and International conferences. Our student Mr. S. Pal visited Caltech,
Pasadena and also went to Stanford University (SU) to strengthen our collaboration in very low frequency (VLF) radio wave research work with SU. Mr. S. Pal was selected as a Young Scientist by International Union of Radio and Space Science (URSI) and was invited to be with the President of India along with other scientists. Another student Mr. K. Acharyya visited Leiden observatory to carry out experiments on astrobiology for nine months. We are clearly proud of them.

The branches of CSP, namely CSP Observatories (CSPO), the Malda branch and the Coochbehar branch have also progressed considerably. Major effort of the Observatory has been to use Very Low Frequency (VLF) detector, which was made by its members. It was used to detect earthquake related perturbations during Sumatran-Andaman earthquake. With the collaboration with Stanford University, a new VLF antenna has been installed with a receiver capable of monitoring many VLF stations simultaneously. The Malda branch has made a lot of progress in analyzing data from IXAE instrument aboard the Indian Satellite IRS-P3 and NASA satellite data RXTE. The branch members in Coochbehar expressed interest in conducting VLF research. CSPO is installing an indigenously built VLF receiver at the TIFR balloon facility in Hyderabad.

One of the major public outreach events of CSP in 2005-2006, celebrated worldwide as the year of physics, has been to organize the District level, Zone level and finally the State level quiz competition on Astronomy, Astrophysics and Space Science in which several hundred schools in the state of West Bengal have participated. On the final day of the State level Quiz competition, the former ISRO Chairman, Prof. U. R. Rao, presented the awards and gave a very inspiring talk to the youngsters. CSP also conducted the usual District-wise Space Science Symposia (DSSS) in two districts, namely, in Dakshin Dinajpur and Darjeeling. These very successful events were participated by 500-600 school students and teachers in each district. Thus, altogether 13 districts have been covered. Another exciting event is the participation of CSP in the Science-Day activity in the Ballygaunge Science College ground in CSP had a stall with colourful posters, models, computers and a telescope.

CSP took the possession of the land adjacent to the existing part from the West Bengal Government. A boundary wall, the work on which started in the previous year, has now been completed. It is hoped that the construction work would begin soon.

Prof. S.K. Chakrabarti
Honorary Secretary
Centre for Space Physics

Kolkata: August 26, 2006
**Governing Body of the Centre**

Dr. S. P. Sengupta, *President*
Dr. Jogendra N. Chakravorty, *Vice President*
Dr. Sandip K. Chakrabarti, *Secretary*
Dr. Dipak K. Bhaumik, *Treasurer*
Dr. Ananda M. Basu, *Member*
Dr. Sonali Chakrabarti, *Member*
Mr. Gurusaran Das Gupta, *Member*
Dr. Asish Das Gupta, *Member (Nominated by Calcutta University)*
Dr. P.K. Das Poddar, *Member (Nominated by Calcutta University)*

**Members of the Research Advisory Council (RAC)**

Prof. S.N. Ghosh, FNA, Ex Allahabad Univ. & Calcutta Univ. (Chairman)
Prof. S.P. Sengupta, Senior Professor, Indian Assoc. of Cultivation of Science
Prof. J. N. Chakravorty, CSP
Prof. A.R. Rao, Tata Institute of Fundamental Research, Mumbai
Mr. K. K. Chakraborty, Director, Positional Astronomy Centre
Prof. A.M. Basu, Jadavpur University, Kolkata
Prof. S.K. Chakrabarti, S.N. Bose Nat'l Centre for Basic Sciences, Kolkata
Prof. D.C.V. Mallick, Indian Institute of Astrophysics, Bangalore
Prof. S. Ananthakrishnan, Giant Meter Radio Telescope, Pune
Prof. D.J. Saikia, National Center for Radio Astronomy, Pune
Prof. B.G. Ananda Rao, Physical Research Laboratory, Ahmedabad
Prof. P.J. Wiita, Georgia State University, USA

**Faculty Members**

![Dr. A. Nandi](image1.png)  
*Dr. A. Nandi (Scientific Officer D)*

![Dr. V. Yadav](image2.png)  
*Dr. V. Yadav (Scientific Officer D)*
**Honorary Faculty Members**

Dr. D. Bhaumik, CSP  
Dr. S. Chakrabarti, M. M. Chandra College  
Dr. J. N. Chakravorty, CSP  
Dr. S. K. Chakrabarti, SNBNCBS  
Dr. A. K. Chatterjee, Malda College  
Dr. T. K. Das, Narasimha Dutta College  
Dr. P.K. Jana, Inst, of Ed. for Women  
Dr. S. K. Midya, Serampore College  
Dr. A.K. Mukhopadhyay, CSP  
Dr. P. Sarkar, Dhanbad

(Hony. Scientist)

(Hony. Scientist)

(Hony. Prof.)

(Hony. Prof.)

(Hony. Scientist)

(Hony. Assoc. Prof.)

(Hony. Scientist)

(Hony. Assoc. Prof.)

(Hony. Em. Prof.)

(hony. Scientist)

**Research Scholars**

Mr. Kinsuk Acharyya  
Mr. Prasad Basu  
Ms. Sutapa Chatterjee  
Mr. Anirban Choudhury  
Mr. Ankan Das  
Mr. Dipak Debnath  
Mr. Madan M. Majumdar  
Mr. Samir Mandal  
Mr. Apurva Saha  
Mr. Rajat Saha  
Mr. Ritabrata Sarkar  
Mr. Washimul Bari  
Mr. Kumaresh Chakrabarti  
Mr. Utpal Chatterjee  
Mr. Asit Kumar Choudhury  
Mr. Sudipta Das  
Mr. Braja Gopal Dutta  
Mr. Jyoti K. Mandal  
Mr. Sabyasachi Pal  
Mr. Manoj Saha  
Mr. Madan M. Samanta

**Engineers**

Mr. S. Datta (hardware)  
Mr. Indrajit Laha (software)  
Dr. P. Nandi (Electronics, part time)
Research Facilities at the Centre, Head Office

Library: The library has well catalogued journals many of which date back since 1950s. The major Journals are:

1. Astrophysical Journal, Part 1, Part 2 and Supplementary Series
5. Observatories, 6 Journal of Mathematical Physics
7. Reviews of Modern Physics, 8. Physics Today
9 Indian Journal of Physics, 10. Sky & Telescope

The Library also has about two hundred research level textbooks some of which have been donated by International Institutes. It welcomes back volumes and textbooks from potential donours to enrich its collection. Apart from there students have access to the available online journals and archives.

Computers: The Centre has twenty Pentium level computers and several servers. It has a few double-CPU Xeon Server to facilitate parallel processing. These computers are connected through Local Area Network and also through the lease-line internet. Access to online journals and archives is done using the leased line. It also has two color printers, two Laser printers and a scanner for assisting research activities.

Internet: The e-mail address is root@csp.res.in

Website: The Centre’s website is http://csp.res.in

Telephone: The centre has two direct lines 033-2436-6003 and 033-2462-2153 which are connected to all the rooms through EPABX. Ext. 28 is the Fax line.

Seminar room: The seminar room at CSP is well equipped with LCD projector, OH Projector, microphone, amplifiers, white board, wireless internet.

Guesthouse: There are facilities to provide lodging for residential scientists and visitors to stay overnight who come from far distance. It has a television, modern kitchen/dining facility with a refrigerator and gas stoves.

Future Site of CSP: The future site of CSP, a land admeasuring about 25 kottahs on the E.M. bypass has been received and a boundary wall with an iron gate has been erected. It is hoped that the building construction would commence soon.
Research Work Published or Accepted for Publication in 2005-2006

Journals


9. S. K. Chakrabarti, 2005, Numerical simulations reveal the origin of QPOs in black hole candidates, ChlIAA, 5, 27


Books

1. S. K. Chakrabarti, 2006, *Compact Stars (Block 3, Unit 11), The Milky Way (Block 3, Unit 12), Active Galaxies (Block 4, Unit 14)*, IGNOU, New Delhi

Books Reviewed


Members of Scientific Society

1. A. Das and K. Acharyya became members of the ‘Royal Society of Chemistry’

2. S. K. Chakrabarti and A. Nandi became members of Project Monitoring Board, RT-2 Payload for CORONAS-PHOTON Satellite, ISRO.

Ph.D. Degree Expected

1. Thesis titled “Theoretical Studies of Spectral Properties of Two-Component Advective Flows around Black Holes” submitted to Jadavpur University in 2005 by Mr. Samir Mandal (Supervisor: Prof. Sandip K. Chakrabarti [CSP and S.N. Bose National Centre for Basic Sciences]).

2. Thesis titled “Radio Properties of Compact galactic Objects” submitted to Jadavpur University in 2005 by Mr. Sabyasachi Pal (Supervisor: Prof. Sandip K. Chakrabarti [CSP and S.N. Bose National Centre for Basic Sciences]).

Registered for Ph.D. Degree

1. Kinsuk Acharyya, Calcutta University
2. Prasad Basu, Jadavpur University
3. Dipak Debnath, Calcutta University
4. Ankan Das, Calcutta University
5. Broja Gopal Dutta, Calcutta University
Awards, Honours and Distinctions

S. Pal was selected as the Young Scientist by International Union of Radio and Space Science (URSI) and was invited to the Rastrapati Bhawan to meet the President of India during the URSI general Assembly in October, 2005

S. Pal completed his Thesis work and has been awarded post-doctoral fellowship at NCRA, Pune

R. Sarkar has been awarded ASTROSAT Junior research fellowship

A. Nandi who was the ASTROSAT post-doctoral fellow has been appointed as the Scientific Officer D by ISRO HQ and has been posted at CSP.

A. Bhattacharyya, who was the Fast Track Young Scientist at CSP has been appointed as the Scientific Officer E at the Bhabha Atomic research Centre.

K. Acharyya who received the Mayo Greenberg award to work at the Leiden Observatory has completed his nine months tenure at the observatory and joined back our Centre.

Participation in National/International Conferences and Symposia:

K. Acharyya attended International Astronomical Union (IAU) Symposium 231: Astrochemistry – Recent success and current challenges at Asilomar, USA from August 29 – September 2 2005 and presented a poster titled

K. Acharyya attended a Summer school on Molecular Astrophysics at Les Houches, France from September 26 – 30, 2005.

S. Pal attended a training programme organized by IPAC, Caltech (August, 2005) and also attended URSI general assembly (October, 2005) held in New Delhi.


A. Nandi and S. Das presented lectures on black holes in Haripal Institution, Contai College, and (Gautam-Taklu Collge) as a part of the Einstein Centenary celebration.

S.K. Chakrabarti presented Invited talk on “Galaxies and Extra-Galactic

All the CSP members participated in the Science Day celebration held in Ballygaung Science College in February, 2006.

A. Das, K. Acharyya and S. K. Chakrabarti are participating in the International Conference on Astrochemistry in Brittany, France.

S.K. Chakrabarti and A. Das are participating in the summer school on ‘Space Weather’ to be held in International Centre for Theoretical Physics, Trieste, Italy.


Important Visitors to the Centre

Prof. Chris Salter of Arecibo Observatory along with Dr. Tapasi Dutta (both from Puerto Rico, USA) visited CSP. Prof. Salter presented a lucid talk on the science that could be carried out with Arecibo observatory, the largest single disk radio antenna. Prof. S. Ananthakrishnan and Dr. Y. Gupta of National Centre for Radio Astronomy (Pune) also visited CSP and presented talks. These visits were very fruitful to CSP members.
CSP Activities in the Year of Physics (YOP)

District, Zone and State level Space Science Quiz competition: Centre for Space Physics organized a humongous activity throughout the State of West Bengal. This included the following steps:

i) Taking written examinations in hundreds of schools in the State (with different questions papers in different states) and selecting six top scorers who become eligible for the district-wise quiz competition.

ii) Conducting quiz competition in each district with fifty questions (all different sets in different districts). The top three schools get gold plated brass models of GSLV rocket. All six schools get medals and certificates. Top two schools go to the Zonal competition.

iii) Six schools from three districts constitute a Zonal team to be quizzed again and the top scorer goes to the State Level Quiz competition. All the teams get a medal and a certificate for qualifying in the Zonal team.

iv) Top scorers school team from each zone came to Kolkata for the State level competition. The quiz was conducted at the Laban Hrud Mancha in Salt Lake using totally audio-visual method. The Quiz master was Prof. Sandip K. Chakrabarti. Prof. U.R. Rao, ex-Chairman of Indian Space Research Organization (ISRO) handed over the awards and also delivered a very inspiring talk to the young participants. Jagannath Academy of Murshidabad district bagged the trophy for First position in the State. The trophy was a 1:100 ratio exact replica of gold plated brass model of GSLV rocket. Ms. U. Tirkey from Dept. of Science and Technology also attended the function. The entire event was supported by NCSTC (DST), New Delhi and DST(WB).

Snapshots of district level Quiz test (L to R): Coochbehar and 24 pgs(s)

A second important event in YOP was a series of lectures by the CSP scientists in different districts. For example, Prof. S.K. Chakrabarti delivered a talk in R.K.M. Vidyamandir, Belur, Dr. A. Nandi and Dr. S. Mandal presented talks in Haripal institution in Hoogly, Dr. A. Nandi and Mr. P. Basu presented talks in Ghatal College, and Dr. Nandi presented a talk in Assansol B.C. College.

16
Brief Profiles of the Scientists of the Centre

1. **Mr. Kinsuk Acharyya:** He is a senior research fellow of CSP. He is working on the origin of organic molecules during star formation. He is in the ISRO project “Synthesis of Bio-molecules during star formation”. He was invited for nine months to Leiden University to work on Astrobiology. He is submitting his thesis.

2. **Mr. Wasim ul Bari:** He is a school teacher in Malda and is an honorary junior research fellow at CSP, Malda branch. He works on VLF studies of ionosphere.

3. **Mr. Prasad Basu:** He is a senior research fellow of CSP and a CSIR NET scholar. His field of interest is gravitational waves generated by perturbed black holes.

4. **Dr. A. Bhattacharya:** He is a fast track young scientist at CSP supported by Department of science & Technology. He is working on the physics of dusty plasmas, simulation of hydrodynamic flows and planetary rings. He is also analyzing Voyager data. He left CSP to join Bhabha Atomic Research Centre as a Scientific Officer E.

5. **Dr. D. Bhaumik:** He is an Ex-Reader at the Ramakrishna mission residential college, Narendrapur and an honorary scientist of the Centre. His interest lies in the airglow, reaction properties of molecules in the upper atmosphere and also VLF research.

6. **Mr. K. Chakrabarti:** He is a teacher at Durgapur Government College and is a honorary graduate student of CSP. He is working on similarities of accretion flows around black holes and fluid dynamics in a pipe.

7. **Dr. Sonali Chakrabarti:** She is a senior grade lecturer at the Maharaja Manindra Chandra College and an honorary scientist of the CSP. Her research interest lies in the formation of bio-molecules in space, VLF research and resolving power of millimeter and microwave grating instruments.

8. **Dr. Sandip K. Chakrabarti:** He is a professor of the S.N. Bose National Centre for Basic Sciences and an honorary professor of CSP. His research interests range from physics of accretion around black holes, cosmic radio jets, numerical simulations, observational data analysis, etc. He also works on planetary rings, collapse of interstellar clouds and bio-molecule formation.

9. **Mr. K. K. Chakrabarti:** He is the director of Positional Astronomical Society of India. He is doing research on Cyclonic activities with Prof. A.K. Mukhopadhyay.
10. **Dr. J.N. Chakrabarti:** He is a honorary professor of CSP. He had been the Head, Physics Department of Ramakrishna Mission Residential College, Narendrapur for over 30 years. His current field of interest is millimeter and microwaves, airglow, etc.

11. **Dr. A.K. Chatterjee:** He is the Head, Physics Department, Malda College and an honorary scientist of CSP. He is currently doing data analysis of IXAE instrument aboard ISRO launched satellite IRS-P3.

12. **Mrs S. Chatterjee:** She is an honorary junior research fellow (JRF) of CSP and is teaching at Malda Girl's College. She is working on the resolution and polarization of the millimeter and microwave gratings.

13. **Mr. A. Choudhury:** He is a junior research fellow (JRF) of the DST project “Geo-spot Model of Earthquake” and is working under the supervision of Prof. T.K. Das.

14. **Mr. U. Chatterjee:** He is a honorary junior research fellow of CSP and is teaching at Malda railway high school. He is working on data analysis of IXAE instrument aboard ISRO launched satellite IRS-P3.

15. **Mr. Asit Choudhury:** He is a teacher at the L.M.S.M. Institution, Malda and is an honorary senior research fellow of the CSP. He is working on data analysis of IXAE instrument aboard ISRO launched satellite IRS-P3.

16. **Mr. Sudipta Das:** He is a teacher in Murshidabad and is currently an honorary junior research fellow (JRF) of the CSP. He is joining the team of data analysis of black hole candidates.

17. **Prof. T.K. Das:** He is a Reader at Narasimha Dutta College and an honorary associate professor of CSP. His work is on solar physics, especially on sunspots and classification of radio bursts. He also works on geo-spot model of earthquakes.

18. **Mr. D. Debnath:** He is a CSIR scholar working at CSP. He is working on CZT detector of ASTROSAT satellite and analyzing data on GRO J1655-40, a black hole candidate.

19. **B.G. Dutta:** He is a teacher of Medinipur College and is an honorary junior research fellow (JRF) of CSP. His field of interest is astrophysical jets, data analysis of radiation from black holes, etc.

20. **Dr. P.K. Jana:** He is teacher of Institute of Education (P.G.) for Woman, Chandernagor and an honorary scientist of CSP. He works on trends of Ozone depletion over India.
21. **Mr. R. Khan:** He is a teacher of Bidhan Nagar Govt. High School and is in charge of CSP observatories. He is working on interfacing equipments with computers, VLF experiments, etc.

22. **Mr. I. Laha:** He is a software engineer. He is working as a software developer on Indo-Russian project RT-2. His job is to make robust, user-friendly, web-based software for analyzing the data coming from the satellite. He is presently working on it. One version of this web-based software is already uploaded in our server.

23. **Mr. M.M. Majumdar:** He is in DPI of West Bengal Higher education Department and is an honorary junior research fellow (JRF) of CSP. He is working on similarities of accretion flows around black holes and fluid dynamics in a pipe.

24. **Prof. S.K. Midya:** He is a Reader at Serampore College and an honorary Associate Professor of CSP. He works on Airglow experiments and Ozone depletion problem.

25. **Mr. Jyoti Kanta Mandal:** He is a teacher in Murshidabad and is currently an honorary junior research fellow (JRF) of CSP. He is joining the team of data analysis of black hole candidates.

26. **Mr. Samir Mandal:** He was a senior research fellow of CSP and is working on spectrum of radiation coming from accretion flows. He also studies polarization of radiation from accretion disks. He is in an ISRO project. He submitted his thesis to Jadavpur University and is currently a Post-Doctoral fellow at CSP.

27. **Prof. A.K. Mukhopadhyay:** He is an Emeritus Professor of CSP and is an expert on Cyclones. In the past, he was the Regional director of Meteorological Society of India.

28. **Dr. Anuj Nandi:** Dr. Nandi is an ASTROSAT Post-Doctoral Fellow at CSP and is working on the shielding properties of the CZT detector and LAXPC payloads aboard ASTROSAT. He has received an appointment as a Scientific Officer D from ISRO HQ to work at CSP.

29. **Mr. S. Pal:** He is a senior research fellow of CSP and is working on the black hole candidate SS433 and on stellar evolution in general. He was a CSIR NET scholar. He has observed galactic compact sources using GMRT for several hundred hours and also used European VLBI network and Effelsberg radio telescopes. He recently submitted his Thesis and has joined National Center for Radio Astronomy, Pune as a Post-doctoral fellow.
30. **Mr. A Saha**: He is a junior research fellow (JRF) of the DST project “Geo-spot Model of Earthquake” and is working under the supervision of Prof. T.K. Das.

31. **Mr. P. Sarkar**: He is an honorary scientist of CSP and a teacher in Mython School. He works on millimeter wave detection and transmission.

32. **Mr. R. Sarkar**: He is a ASTROSAT junior research fellow of CSP and is mainly working on the shielding properties of the CZT detector and LAXPC payloads aboard ASTROSAT.

33. **Mr. M.M. Samanta**: He is a teacher of B.M. Institution, Tarkeswar and is a honorary junior research fellow (JRF) of CSP. His field of interest is physics of accretion around black holes.

34. **Dr. V. Yadav**: His is an ISRO scientist of CSP (SO-D). His field of interest is experimental plasma physics.

**Collaborative research & project work**


Proto-stars are formed out of collapsing diffused clouds. We produce a hydrodynamic code which follows the collapse of these clouds and produce proto-stars. The gas also contains dust grains (made up of olivine and amorphous carbon) on which simple atoms combine to produce molecules through hopping or tunneling processes. We carry out Monte-Carlo simulations to compute the molecule formation. We study the time dependent evolution of the chemical species in the gas and the grain phase and compare with the observed abundances of organic molecules in star forming regions.


Inner edge of the accretion disk has a large ellipticity due to very fast rotation close to the black hole. These deformed regions produce radiations in which polarization is significant. Our first goal is to obtain the spectrum of the high energy gamma-rays from the inner part of this disk. We showed that the
accretion shocks can accelerate electrons to a non-thermal distribution which in turn can produce a power-law soft X-ray spectrum. These soft X-rays are then inverse Comptoned to a very high energy. We show that the energies of the order of a few MeV could be achieved by repeated Compton scattering. The spectrum was then compared with that from the well known black hole candidates Cyg X-1.


The next solar maximum is expected to produce strong X-ray activities which could affect the ionospheric phenomena on earth. Keeping this in view a payload is being designed and constructed to image the X-ray active regions on the solar disk. Imaging is done with CZT detectors. Photometry is also included. User-friendly softwares are being developed to ensure that the data, when comes from the satellite, are easily analyzed and interpreted. Testing and evaluation of the technology model is complete and it is being sent to Russia for integration with the rest of the payloads. The flight model will be sent in near future.

ASTROSAT Satellite: The first Indian multi-wavelength instrument, S.K. Chakrabarti (Science team), A. Nandi, S. Mandal and R. Sarkar (Centre for Space Physics), P.C. Agrawal (TIFR, Principal Investigator) and B. Paul (TIFR) Funded by Indian Space Research Organization (April 2005 – March 2008)

The first Indian multi-wavelength satellite will have X-ray imaging devices and spectro-meters. It will also have UV and Gamma ray instruments. The part of the work that has been assigned to us is to generate shielding parameters (thickness, exact metals required) to cover the spectrometer and the imaging devices. These are obtained by using GEANT4 code (basically a Monte Carlo method) used in CERN to study interaction matter with high energy particles. Proper shielding would ensure that the backgrounds generated by interactions with cosmic rays and radiation belt particles are reduced. We find appropriate estimates of these backgrounds.

Spectral studies of a few black hole candidates: S.K. Chakrabarti and A. Nandi, Funded by Indian Space Research Organization (March 2006 – February 2009)

Some of the black holes such as GRS 1915+105 and GRO J1655-40 are very exciting since they change their spectral properties from time to time. This project envisages the modeling of the spectral evolution using the well known two component advective disk model.

Grain chemistry is very important in evolution of the species. We study the evolution of species containing H, O, N, C on the grains and study how they are desorbed into the gas phase and interact with other molecules or atoms to produce more complex elements.

Creation of a Data Bank in Space Astronomy, Funded by Indian Space Research Organization

ISRO has funded for a Data Bank which includes a JVC made MC600 model jukebox and its controlling servers. Purchase of a few terabyte storage solution is being envisaged. This will enable us to keep all the Space science related data as well as VLF data procured by CSP on a daily basis.

Geospot model of Earthquakes, Prof. T.K. Das, Mr. A. Chaudhuri and Mr. A. Saha; Funded by Dept. of Science and Technology.

It will be the goal of this project to show that strong magnetic fields in the earth may play a major role in triggering earthquakes.

Other Ongoing Projects of the Scientists of the Centre:

2. Development of Space Physics Awareness among Common People of West Bengal.
4. Radio properties of the compact objects near the galactic center.
5. Viscous transonic flows around black holes
6. Gravitational waves of a binary black hole system in presence of an accretion disk.

Media Coverage:

Several articles were published in the newspapers on CSP activities. Special coverage was made on the quiz competition in space science. Prof. U. R. Rao’s message delivered on the occasion of the State level quiz competition was also covered.
Astrobiology/Astrochemistry

Astrobiology is becoming the major research topic of this century as we wish to know how lives have formed in this universe. The questions it envisages are (a) How ‘life’ began on earth? (b) Is their any life outside solar system? (c) What are the physical requirements for the formation of complex life-forms. However, before these are answered we wish to know whether complex biomolecules are formed in space. Our work mostly concentrates on the formation of biomolecules during the collapse of interstellar clouds.

Knowledge of the recombination time on a grain surface has been a major obstacle in deciding the production rate of molecular hydrogen and other molecules such as methanol in the interstellar medium. We perform a Monte Carlo simulation to calculate the recombination time for hydrogen properly. We compare our results with the rate equation method, incorporating the exact recombination time in the rate equation and we found an excellent agreement between these two.

K. Acharyya, S. Chakrabarti, S.K. Chakrabarti, A. Das
Comparison of the simulation results (dark circles) with those obtained from analytical considerations (dashed curves) when suitable modification of the average recombination rate is made. An olivine grain of $10^4$ sites at a temperature of 10 K has been chosen in this comparison. Dotted curves are drawn using analytical results for $\alpha_0$ extrapolated to very low accretion rates.

We also developed a time dependent spherically symmetric hydrodynamic code to study the formation of the proto-stars from the collapse of the molecular clouds and studied how the chemical abundance of the cloud is evolved during this process. We used grain chemistry to find the production rate of hydrogen molecule and chemical reaction code to find abundances of complex molecules.

A typical example of our result showing the time variation of the spatially averaged mass fractions of simple amino acids such as alanine and glycine inside a molecular cloud. The question of whether glycine has actually been observed is unresolved as of today.
Black hole Astrophysics

Several topics are being studied by the black hole astrophysics group of the Centre, a few of which are discussed here.


Spectral properties of a Two-component advective flow

Two component advective flows have Keplerian accretion disks on the equatorial plane surrounded by sub-Keplerian transonic flows which may or may not have accretion shocks. We study the spectral properties of these flows when the shocks are present. The shock-acceleration produces non-thermal electrons in the post-shock region which in turn produces power-law synchrotron radiation. The soft photons generated by the bremsstrahlung and synchrotron processes in the sub-Keplerian flow, as well as the multi-colour black body emission from the Keplerian disk are Comptonized by the
thermal and non-thermal electrons. Each of these processes leaves its mark on the spectrum. By varying Keplerian and sub-Keplerian rates we are able to reproduce the observed soft and hard states as far as X-ray region is concerned and low gamma-ray intensity and high gamma-ray intensity states as far as the soft gamma-ray region is concerned. We also find two pivotal points where the spectra intersect. Our fit of the observed data from Cyg X-1 indicates that our solution is capable of explaining X-ray and gamma-ray spectra from accreting black holes.

A schematic diagram of the two-component advective flow around a black hole showing major hydrodynamic and radiation transfer processes.

Fit of the observed spectra of Cyg X-1 in soft and hard states using the shocked accretion flow solution presented in this work. Open circles with error-bars represent the data points correspond to soft state and solid circles with error-bars represent the data points correspond to hard state. The solid curve and dotted curves represents fit in the hard state and soft states respectively.
Black hole Astrophysics through RXTE data analysis

The timing and spectral analysis of RXTE data of the black hole candidate GRO J1655-40 have been conducted using FTOOLS.

The well-known galactic micro-quasar GRO J1655-40 was dormant since 1997 and has suddenly come in life in March 2005. It showed very prominent quasi-periodic oscillations (QPOs) in its recent outburst. This behaviour was analyzed and was found that the frequency of the QPOs evolved rapidly as the matter dived into the black hole. Particularly interesting is that the QPO interested in a way as if the oscillating shock which causes it actually propagate towards the horizon of the black hole as a constant speed.

![Observed QPO frequency variation](image)

*Observed QPO frequency variation (circles) with time fits perfectly well with the oscillatory propagating shock solution (solid curve). The QPO disappeared in the next day as the shock wave went inside the black hole horizon. Such a behaviour would be absent for a neutron star accretion.*

![Numerical simulations](image)

*Numerical simulation of matter infalling on to a black hole indicates oscillation of the shock which causes QPOs. We see not only a single shock at the location expected from theoretical work, we also see a secondary, weaker shock closer to the black hole. Both oscillates with a high frequency and the outer one oscillate at a low frequency.*
Effects of massive disks on the metric around a black hole

Black holes are often surrounded by a massive disk. This disk can distort the metric of space-time. The static axi-symmetric space-time of the hole-ring systems is considered and the Einstein equation is solved to obtain the metric of the resulting space-time. We show that the black-hole horizon is distinctly deformed. We also computed the luminosity of the gravitational wave, generated due to the vertical oscillation of the disk and estimated the damping of disk vibration due to the gravity wave emission by it.

Another problem of interest is to study the effect of an accretion disk on the gravitational wave emission of from a binary system. This requires one to find the solution topologies of viscous advective flows around a Kerr black hole and use it to find the effect. Of particular interest in our group is to study the case when a stellar mass black hole orbits a super massive Kerr black hole with an accretion disk.

Some work is being carried out to find the similarities between a black hole accretion system and the converging and diverging flows inside a de-Laval nozzle which are also transonic. Exciting new results are obtained in presence of a shock wave inside the flow tube. This work is being sent for publication.

Another set of works includes the study of magneto-hydrodynamic flow around compact objects. It is seen that at least eighteen different types of topologies of solutions exist in this case. Shocks are also studies.

One of the problems in handling a true general relativistic (GR) flow is that the study of the radiative transfer properties becomes next to impossible. In this case we proposed to prescribe a new Pseudo-Newtonian potential which can handle the external geometry around a Kerr geometry as well. This is being tested for fluid dynamics by comparing various flow properties in GR and in the field of our potential.
Radio Astronomy of Compact Objects

Our team is interested in studying time variabilities of compact objects such as SS433, Cyg X-1, Cyg X-3 using the Giant Meter-wave Radio Telescope (GMRT) located near Pune.

Some of the students in Radio astronomy programme: Dr. Sabyasachi Pal, Mr. Rajat Suvra Saha and Mr. Manoj Saha.

Very Low Frequency (VLF) Observatory and its activities

CSP is capable of making receivers for VLF observations. It has started collaborations with Stanford University STAR laboratory which has sent a VLF receiver capable of deciphering signals from a large number of call stations. These two antennas are now monitoring several stations. The data is being used to study solar flares, electron precipitation and earthquakes.

VLF laboratory group members (L to R): R. Khan, M. Saha, S. Sasmal (standing); S. Chakrabarti, J.N. Chakravorty, D. Bhawmik (sitting).
Some results from VLF laboratory: Amplitude of VLF signals from VTX station at 18.2KHz for seven days (top/left), broadband result showing signals from several stations in the morning and in the evening (top/right), solar flares causing ionospheric disturbances (bottom)

CSPs Involvement with Satellite Payload Related Activities

**Background simulation of the LAXPC and CZT detectors of the Multiwavelength Satellite ASTROSAT**

The simulation team (L to R): Dr. S. Mandal, Mr. R. Sarkar and Mr. D. Debnath

ASTROSAT is a multiwavelength, first Astronomy related satellite. CSP is participating in its activities along with several National institutes such as
TIFR (PI), IIA, RRI, IUCAA etc. CSP has carried out the background simulations of Large Area X-ray Proportional Counter (LAXPC) and CZT detectors using the GEANT4 code, which is a toolkit for the simulation of the passage of particles through matter. It provides a complete set of tools for all areas of detector simulation: geometry, tracking, detector response, run, event and track management, visualization and user interface. For the simulation purpose, first the detector has been constructed with real detector specifications and materials.

*Modeling the LAXPC detector for simulation of its shielding properties.*

The LAXPC is a proportional counter consisting Xenon (90% Xe and 10% CH₄) as the detecting gas. It has a large effective area of about 6000 cm² and its operating energy range is 3 – 100 keV.
CZT imager is a semiconductor detector comprising CZT (Cd, Zn, Te) as the detecting material. The detector has an effective surface area of 1024 cm$^2$. It is intended to be operated in the energy range 10 – 100 keV.

Test & Evaluation of RT-2/S payload

Labteam (L to R): A. Nandi, P. Nandi, A. Dhar, I. Laha and V. Yadav

Schematic diagram of the RT-2/S spectrometer(left) and its testing and evaluation at CSP (right)

RT-2 is a part of Indo-Russian collaborative satellite project, named Coronas-Photon Mission (expected to be launched in 2007). TIFR (PI), ISRO and CSP (Co-PI) are participating in this project. It is basically a solar experiment. RT-2 system is comprised of 3 detector modules namely RT-2/S, RT-2/G (both Phoswich detectors), RT-2/CZT (CZT detector) and one processing electronics box RT-2/E. The detector module houses the low energy gamma ray / hard X-ray detector system and front end electronics. The RT-2/S and RT-2/G consist of NaI (TI) / CsI (Na) scintillator Phoswich assembly viewed by a photo-multiplier tube (PMT).
The electronics system in the detector module consists of i) front end electronics for the Phoswich scintillator, ii) electronics for pulse shape and pulse height, iii) FPGA based data packaging system, iv) high voltage DC-DC converters and distribution box and v) low voltage DC-DC converter.

We tested two main electronics cards of RT-2/S payload (card-1 & card-2) separately with the help of programs written in LabVIEW software. After successful card level testing we connected two main cards with other cards (power & HV cards) and PMT to make it as RT-2/S payload & tested its behavior with the help of programs written in LabVIEW software. We sent various commands to RT-2/S & received data from RT-2/S. We further analyzed that received data with the help of two softwares named LabVIEW & IDL.

RT-2/S data are of mainly two modes:
1) Normal Mode
2) Event Mode

For Normal Mode data acquisition & analysis LabVIEW main program (VI) is:

For Event Mode data acquisition & analysis LabVIEW main program (VI) is:

For RT-2/S card-1 testing we used ADC, G1 Amplifier & G2 Amplifier responses with the help of programs written in LabVIEW. For RT-2/S card-2 testing we used Voltage Controlled Oscillator (VCO) +5V, High Voltage (HV) output and Lower Level Discriminator (LLD) responses with the help of programs written in LabVIEW. Also, G1-NaI (Tl), G1-CsI (Na) & G2 spectra
channels were calibrated with 5 known X-ray sources (Am$^{241}$, Ba$^{133}$, Cs$^{137}$, Cd$^{109}$, Eu$^{152}$). The Thermal testing & Vibration testing of the RT-2/S payload is also performed in Space Application Center, Ahmedabad. After the vibration test we got the natural frequency of the RT-2/S payload, which is 279 Hz, approximately matches with the acquired data from RT-2/S detector system were saved in files & further analyzed in IDL.

**Event Mode Spectral analysis of G1 NaI (Tl) with source Am$^{241}$ (60 keV) in IDL**

Figure above represents the results of analyzed data using IDL. The G1-Nal data was taken for 100 sec duration with HV value = 675 Volts.

- 1st Block shows the G1-Na Spectrum with Am$^{241}$ (59.5 keV) source.
- 2nd Block shows the G1-Na Spectrum without source i.e. background Spectrum.
- 3rd Block shows the G1-Na source Spectrum after subtracting background (Real Spectrum).
- 4th Block shows the Gaussian fitted real spectrum of G1-Na.

After successful testing of RT-2/S detector system separately, we attach this payload with our electronics box RT-2/E. For this complete setup testing, we are now sending commands to the detector system through RT-2/E processing electronics box system & receiving data from RT-2/E. Here also RT-2/S detector system working well with all our scientific requirements.
RT-2/CZT imaging with zone Plates

CSP is toying with the zone plates to replace Coded Aperture Masks (CAM) to achieve high spatial resolution. Simple zone plates have been locally fabricated for testing.

Zone plates to be used for testing of X-ray imager for the RT-2 CZT detector

CSPOB: Continuous Spectro-Photometry of Blackholes

CSP is proposing to build a new payload (CSPOB) for continuous study of black holes in order to understand how matter is sucked in by these monsters. It will consist of an array of CZT detectors and two all sky monitors looking for new sources. It is anticipated that many new physical processes, including the existence of the boundary layers of black holes, shock-oscillation origin of quasi periodic oscillations of X-rays from black holes would be verified by such long time observations.

CZT detector array in the proposed CSPOB payload (left).
Seismo-electromagneticity Group

The group is mainly interested in the emission of electromagnetic waves during seismic activities. This may be explained on the basis of the presence of geospot near a fault zone. A geospot is a zone of concentrated high magnetic field formed at the core-mantle boundary of the earth and it is responsible for the energy which evolves out of the annihilation of its magnetic field and maintains the essential processes of earth dynamics. We have done a thorough analysis of numerous earthquake data obtained from some major earthquake events like Sumatra earthquake (Dec, 2004), Pakistan earthquake (Oct, 2005), Indonesian earthquake (March - April, 2006) and subsequent aftershocks. We collect earthquake data from our LF band (low frequencies, 30 – 300 KHz) signal receiver operating at 40 KHz and stationed at Agartala, Tripura University campus (23ºN, 91.4ºE) and it delivers around 86400 data per day. Analyzing the obtained earthquake data, we have got four types of histogram pattern, each of which represents the no of earthquake events against earthquake magnitude(M), earthquake focal depth and time difference (Δt, which is 5mints before/after an event) for a particular day of observation. This analysis has helped us to find a relation between the nature of the spectrum and the focal depth and magnitude of a seismic event. We are looking forward to have a better understanding of the role of geospots in seismo-electromagneticity.
Airglow and Ozone Depletion studies

Prof. J.N. Chakravorty, Dr. B. Bhawmik and Prof. S.K. Midya

Dr. S. Midya and his collaborators have made tremendous progress in pinpointing the real cause of Ozone depletion on earth. They showed that nitrous oxide is the real culprit. They take archival data available on the net and analyze the results to show the correlation of ozone content with various physical parameters. Dr. D. Bhawmik, Prof. J. N. Chakravorty and others are interested in airglow studies as well.

ISRO Databank project at CSP

The DATABANK project envisages to store data from a large number of space and ground based instruments at CSP. These could be retrieved online through web from the csp server (galaxy.csp.res.in). The DATABANK (a JVC made jukebox having of 600 slots of CD/DVD) is being enhanced by adding storage solutions of a few terabytes. For this purpose, dedicated lease line at 256kbps has been connected to the CSP server. In future, we plan to store regular data from VLF laboratory in our databank as well.
CSP is actively involved in popularization activities. Every year it conducts district-wise space science symposia (DSSS) in two different districts. These events are mostly funded by ISRO and DST, West Bengal. So far, thirteen districts have been covered (shaded districts). CSP also conducted Quiz competition space science throughout the state and delivered a few popular lectures in schools of various districts. So far, CSP has published eight Mahaviswa-O-Aami (the universe and myself) books in Bengali. Efforts are being made to write a few more. CSP also helping other districts through its branches and to create more resourceful and informed persons in this subject.

Activities of the Centre for Space Physics, Coochbehar Branch

This branch mainly did popularization programme in remote parts of Coochbehar district in particular and the districts of upper North Bengal. They conducted the districtwise quiz contests organized by CSP. The coordinating body consists of

Mr. Sanjay Dhar (President), Mr. Santanu Deb (Jt. Secretary), Mr. Anirban Majumdar (Jt. Secretary), Mr. Samar Saha (Treasurer). Mr. S. Deb, Mr. C. De, Mr. A.K. Dutta, Mr. T. Chakraborty, Mr. A. Chakraborty, Mr. A. Sarkar and Mr. F. Sarkar are the members.
Activities of the Centre for Space Physics, Malda Branch

The Malda branch has been very active in the last year. It has a computer and a VLF antenna and a receiver to continue their research on VLF sources and sudden ionospheric disturbances. Some students are engaged in analysis of Data obtained from IXAE instrument from Indian Satellite IRS-P3. Others are engaged in studies of jets and outflows, lamellar gratings for micro– and millimeter wave gratings etc. This branch has twelve years of back volumes of the Astrophysical Journal, some textbooks and a computer with broadband Internet.

Among the major activities, we wish to report that the Malda branch members had responsibilities to conduct the district level quiz competition and the zone level quiz competition in Malda and Uttar and Dakshin Dinajpur districts. They were also actively involved in organizing the District-wise Space Science Symposia in the Dakshin Dinajpur and Darjeeling districts. Several members of this branch attended the symposia and presented talks and demonstrated space science related posters.

A publication in international journal was made on the research work carried out on class transitions of the black hole candidate GRS1915+105 in which Malda branch members participated. The activities of GRS1915+105 is being scrupulously monitored on a daily basis and the variability class transitions are being understood using the existing black hole accretion models.

Corresponding Address:
Dr. A.K. Chatterjee/Mr. A. K. Choudhury/Mr. S. Das
Centre for Space Physics, Malda Branch, Atul Market, Malda, 732101

Co-ordinating Body of the Malda Branch of the Centre

Dr. Achintya K. Chatterjee, President
Mr. Kankar Bandopadhyay Branch-Vice President
Mr. Asit K. Choudhury, Branch-Secretary
Mr. Subhankar Das, Branch-Treasurer
Mr. Zahirul Islam, Member
Mr. Gobinda Chandra Mandal, Member
Mr. Nilmadhab Nandi, Member
Mrs. Sutapa Chatterjee, Member
Mr. Utpal Chatterjee, Member
Activities of the Centre for Space Physics Observatories, the observational wing of the Centre

CSP Observatory (CSPO) has been very active in this year. The 10-inch fully Automatic Meade telescope is operating in the Observatory situation on the rooftop. The roof of the observatory is movable. A spectrometer is also present.

CSPO is concentrating on the Very Low Frequency observations to study ionospheric disturbances due to terrestrial and extra-terrestrial causes. In collaboration with Stanford University’s STAR laboratory, the centre has set up a VLF antenna which is capable of monitoring stations all around the world simultaneously, both the amplitude and phase of the VLF signals. The broadband data is automatically updated and the images are available online.

Mountains in the crater edges created mysterious floating arches on the Moon in Mr. R. Khan’s camera

Contact person: Mr. Rana Khan, Observatory in Charge and Mr. Manoj Saha, VLF engineer.
Space Science Symposia at Dakshin Dinajpur and Darjeeling Districts

A Space Science Symposium was organized at the Lalit Mohon Adarsha Uchha Vidyalaya (20th February, 2006) of Dakshin Dinajpur District and another one was organized at the Siliguri Girls High School (21st February, 2006) in Darjeeling District. About nine hundred space physics enthusiasts from these districts which included many college teachers, parents and school children, attended this programme. Each participant was distributed a copy of the Centre's magazine ‘Mahaviswa-O-Aami’ (Universe and Myself) free of cost. At the lunch break a poster session was arranged in the school compound and they were demonstrated by volunteers. The scientific speakers were:

Prof. S.K. Chakrabarti (SNBNCBS & CSP) Mysterious Universe  
Mr. Rana Khan (B.D. Govt. High School) Night Sky  
Mr. Samir Mandal (CSP) Mysterious Black Holes  
Mr. Asit Choudhuri (CSP, Malda) Story of Comets and Meteorites  
Dr. A. Chatterjee (CSP, Malda) X-rays Universe

The persons in charge of poster demonstration were Dr. Sonali Chakrabarti (MMC College and CSP), Mr. Ritabrata Sarkar (CSP) and Mr. Soumen Mandal (SNBNCBS), Ankan Das (CSP), Mr. Prasad Basu (CSP) and several other volunteers. At the end, each and every participant was given a certificate. The Vice president of CSP, Prof. J.N. Chakravorty and the Member of the Governing Body Mr. G. Das Gupta were also present in the programme.
1. We have audited the attached Balance Sheet of Centre for Space Physics, Chalantika 43, Garia Station Road, Kolkata 700 084 as at March 31, 2006 and also the Income and Expenditure Account for the year ended on that date annexed thereto. These financial statements are the responsibilities of the Company’s management. Our responsibility is to express an opinion on these financial statements based on our audit.

2. We conducted our audit in accordance with auditing standards generally accepted in India. Those Standards require that we plan and perform the audit to obtain a reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting, the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by the management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion and report that:

- a) We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our Audit.
- b) In our opinion, proper books of account as required by the law have been kept by the Centre for Space Physics so far as appears from our examinations of these books.
- c) The Balance Sheet and Income and Expenditure Account dealt in this report are in agreement with the books of account.
- d) In our opinion, the Balance Sheet and Income and Expenditure Accounts comply with the Accounting Standards referred to in Sec. 211 (3c) of the Company’s Act 1956, to the extent applicable.
- e) On the basis of our information and explanations given to us and representations received from the committee of management, we report that no committee member is disqualified from being appointed as committee member of the Centre under clause (g) or sub-section (i) of Section 274 of the Companies Act 1956.
- f) In our opinion and to the best of our information and according to the explanation given to us, the said accounts read with the notes thereon give a free and fair view in conformity with the accounting principles generally accepted in India.
- i. In the case of Balance Sheet of the state of affairs of the Centre as of March 31 2006 and
- ii. In the case of Income and Expenditure Account of the surplus of the Centre for the
ANNEXURE TO THE AUDITOR’S REPORT

Referred to in Paragraph 1 of our Report of even date

1. The Centre has not taken any loan from Companies, Firms or Other parties listed in the register maintained under Section 301 of the Companies Act, 1956. There are no Companies under the same management.
2. The Centre has not given any loans/advance to parties/companies during the year.
3. The Centre has not accepted any deposit from public during the year.
4. The Provident Fund Act is not applicable to the Centre.
5. Other clauses of manufacturing other companies (auditor’s report) order issues by Company Law Board in terms of Section 227 (4A) of the Companies Act 1956 are not applicable in this case.

P.K. Chakravorty & Associates
Chartered Accountants
F/52, Bapujinagar, P.O. Regent Estate,
Kolkata 700 092, Phone: 033 2412 5244
### CENTRE FOR SPACE PHYSICS
Chalantika 43, Garia Station Road
Kolkata - 700 084

**BALANCE SHEET AS ON 31ST MARCH'2006**

<table>
<thead>
<tr>
<th>SOURCE OF FUNDS</th>
<th>Schedule</th>
<th>As on 31.03.2006</th>
<th>As on 31.03.2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Funds</td>
<td>1</td>
<td>1330507.00</td>
<td>441316.00</td>
</tr>
<tr>
<td>Loan Funds</td>
<td>2</td>
<td>120798.00</td>
<td>125798.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>1451305.00</strong></td>
<td><strong>567114.00</strong></td>
</tr>
</tbody>
</table>

#### APPLICATION OF FUNDS

<table>
<thead>
<tr>
<th>Fixed Assets</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Block</td>
<td>661096.00</td>
</tr>
<tr>
<td>Less : Depreciation</td>
<td>141005.00</td>
</tr>
<tr>
<td><strong>Net Block</strong></td>
<td>520091.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security Deposit</td>
</tr>
<tr>
<td>Cash &amp; Bank Balances</td>
</tr>
<tr>
<td><strong>Less :Current Liabilities</strong></td>
</tr>
<tr>
<td>Less :Funds for next Fiscal yr.</td>
</tr>
<tr>
<td>Less : Unspent during the year</td>
</tr>
<tr>
<td><strong>Net Current Assets</strong></td>
</tr>
<tr>
<td>Miscellaneous Expenditure to the extent not written off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>As on 31.03.2006</th>
<th>As on 31.03.2005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1451305.00</strong></td>
<td><strong>567114.00</strong></td>
</tr>
</tbody>
</table>
Schedules referred to above form an integral part of the Balance Sheet
As per our Annexed Report of even date

<table>
<thead>
<tr>
<th>Schedule</th>
<th>As on 31.03.2006</th>
<th>As on 31.03.2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>3690142.00</td>
<td>1551837.00</td>
</tr>
<tr>
<td>Administrative and other expenses</td>
<td>3039165.00</td>
<td>1362666.00</td>
</tr>
<tr>
<td>Preliminary expenses written off</td>
<td>1229.00</td>
<td>1229.00</td>
</tr>
<tr>
<td>Depreciation</td>
<td>43829.00</td>
<td>6842.00</td>
</tr>
<tr>
<td>Excess of income over expenditure</td>
<td>605919.00</td>
<td>181100.00</td>
</tr>
<tr>
<td>Surplus (Deficit) brought forward from the earlier year</td>
<td>0.00</td>
<td>427316.00</td>
</tr>
<tr>
<td>Balance transferred to the Balance Sheet</td>
<td>1033235.00</td>
<td>427316.00</td>
</tr>
</tbody>
</table>

Notes on Account

Significant Accounting Policies

CENTRE FOR SPACE PHYSICS
Chalantika 43, Garia Station Road
Kolkata - 700 084
INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH’2006

P.K.Chakraborty & Associates
Chartered Accountants

(P.K.Chakraborty)
Proprietor
Place :- Kolkata
Date :- 21st August, 2006

sd./- S.K. Chakrabarti
Honorary Secretary, Centre for Space Physics

sd./- D. Bhawmik
Honorary Treasurer, Centre for Space Physics

sd./- S.P. Sengupta
Honorary President, Centre for Space Physics

Proprietor

Place :- Kolkata
Date :- 21st August, 2006

sd./- S.K. Chakrabarti
Honorary Secretary, Centre for Space Physics

sd./- D. Bhawmik
Honorary Treasurer, Centre for Space Physics

sd./- S.P. Sengupta
Honorary President, Centre for Space Physics

Place :- Kolkata
Date :- 21st August, 2006

sd./- S.K. Chakrabarti
Honorary Secretary, Centre for Space Physics

sd./- D. Bhawmik
Honorary Treasurer, Centre for Space Physics

sd./- S.P. Sengupta
Honorary President, Centre for Space Physics
Schedules referred to above form an integral part of the Balance Sheet
As per our Annexed Report of even date

P.K.Chakraborty & Associates
Chartered Accountants
sd./- S.K. Chakrabarti
Honorary Secretary, Centre for Space Physics

(P.K.Chakraborty)
Proprietor
Place :- Kolkata
Date :- 21st August, 2006

sd./- D. Bhawmik
Honorary Treasurer, Centre for Space Physics

sd./- S.P. Sengupta
Honorary President, Centre for Space Physics

CENTRE FOR SPACE PHYSICS
Chalantika 43, Garia Station Road
Kolkata - 700 084

<table>
<thead>
<tr>
<th>Schedule - 1</th>
<th>As on 31.03.2006</th>
<th>As on 31.03.2005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Fund</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life Membership Fees</td>
<td>16000.00</td>
<td>14000.00</td>
</tr>
<tr>
<td>Balance transferred from Income &amp; Expenditure Account(*)</td>
<td>1314507.00</td>
<td>427316.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1330507.00</td>
<td>441316.00</td>
</tr>
</tbody>
</table>

| Schedule-2 |
| Loan Funds |
| Loan from Directors | 120798.00 | 125798.00 |
| **TOTAL** | 120798.00 | 125798.00 |

| Schedule-4 |
| **Cash & Bank Balances** |
| Cash in hand | 5442.00 | 5594.00 |
| Fixed Deposit at UBI, Purbachal, Kol | 1203266.00 | 0.00 |
| United Bank of India, Purbachal, Kol | 2247652.00 | 1444064.00 |
| Malda Dist. Central Co-op Bank Ltd | 20418.00 | 15418.00 |
| **Total** | 3476778.00 | 1465076.00 |

| Schedule-5 |
| **Current Liabilities** |
| Audit Fees | 6285.00 | 1500.00 |
| Loan from Project | 273927.00 | 0.00 |
| Accounting Charges | 5000.00 | 0.00 |
| **Total** | 285212.00 | 1500.00 |

<p>| Schedule-6 |
| <strong>Miscellaneous Expenditure (To the Extent not written off)</strong> |
| Preliminary &amp; Pre-operative Expenses | 4923.00 | 6152.00 |
| Less : Written off during the year | 1229.00 | 1229.00 |</p>
<table>
<thead>
<tr>
<th>Schedule-7</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grant - in - Aid</td>
<td>2908555.00</td>
<td>1050450.00</td>
</tr>
<tr>
<td>Unspent grants from Previous year</td>
<td>70000.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Overhead recovery from Project</td>
<td>291565.00</td>
<td>222460.00</td>
</tr>
<tr>
<td>Equipment recovery from Project</td>
<td>95755.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Guest House Charge</td>
<td>186144.00</td>
<td>105750.00</td>
</tr>
<tr>
<td>Book Sale</td>
<td>52530.00</td>
<td>37105.00</td>
</tr>
<tr>
<td>CSP Activities Fees</td>
<td>21930.00</td>
<td>47040.00</td>
</tr>
<tr>
<td>Interest</td>
<td>20913.00</td>
<td>11481.00</td>
</tr>
<tr>
<td>Donation</td>
<td>42500.00</td>
<td>67395.00</td>
</tr>
<tr>
<td>Misc. Income</td>
<td>250.00</td>
<td>10156.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3690142.00</td>
<td>1551837.00</td>
</tr>
</tbody>
</table>

(*) Capital Expenditure includes Rs.2,81,272.00 which was incurred in 2004 – 2005 but erroneously entered in CSP Development Expenses (Administrative head)

**CENTRE FOR SPACE PHYSICS**
Chalantika 43, Garia Station Road
Kolkata - 700 084

<table>
<thead>
<tr>
<th>Schedule - 8</th>
<th>As on 31.03.2006</th>
<th>As on 31.03.2005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Administrative &amp; Other Expenses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fund draw for Project Expenses</td>
<td>2641955.00</td>
<td>638000.00</td>
</tr>
<tr>
<td>Symposium Expenses</td>
<td>208648.00</td>
<td>307774.00</td>
</tr>
<tr>
<td>Office Expenses</td>
<td>33856.00</td>
<td>31041.00</td>
</tr>
<tr>
<td>Postage</td>
<td>1939.00</td>
<td>1707.00</td>
</tr>
<tr>
<td>Traveling &amp; Conveyance</td>
<td>7166.00</td>
<td>1460.00</td>
</tr>
<tr>
<td>Telephone, Fax and Internet</td>
<td>5920.00</td>
<td>6843.00</td>
</tr>
<tr>
<td>Stationery, Consumables &amp; Printing</td>
<td>7457.00</td>
<td>1872.00</td>
</tr>
<tr>
<td>Filing Fees</td>
<td>400.00</td>
<td>300.00</td>
</tr>
<tr>
<td>Bank Charges</td>
<td>3987.00</td>
<td>2191.00</td>
</tr>
<tr>
<td>Books &amp; Periodicals</td>
<td>700.0</td>
<td>5831.00</td>
</tr>
<tr>
<td>Rent &amp; Electricity</td>
<td>74442.00</td>
<td>34674.00</td>
</tr>
<tr>
<td>CSP Development</td>
<td>48000.00</td>
<td>318941.00</td>
</tr>
<tr>
<td>Accounting Charges</td>
<td>2450.00</td>
<td>1621.00</td>
</tr>
<tr>
<td>Loan to project</td>
<td>0.00</td>
<td>5473.00</td>
</tr>
<tr>
<td>Miscellaneous Expenses</td>
<td>0.00</td>
<td>3438.00</td>
</tr>
<tr>
<td>Audit Fees (For Statutory Audit)</td>
<td>2245.00</td>
<td>1500.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3039156.00</td>
<td>1362666.00</td>
</tr>
</tbody>
</table>

**Schedule-9**

**Grants received during the year for the next fiscal year**

- ASTROSAT Satellite (JRF) | 0.00 | 124800.00 |
- ASTROSAT Satellite work (PDF) | 0.00 | 171600.00 |
- Indo-Russian Satellite project (RT-2) | 2000000.00 | 0.00 |
- ISRO DATABANK project | 0.00 | 482000.00 |
<p>| <strong>Total</strong> | 2000000.00 | 778400.00 |</p>
<table>
<thead>
<tr>
<th>Schedule-10</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Committed Advances from projects</td>
<td>0.00</td>
<td>91756.00</td>
</tr>
<tr>
<td>RT-2</td>
<td>13717.00</td>
<td>0.00</td>
</tr>
<tr>
<td>CSIR(I)</td>
<td>6932.00</td>
<td>0.00</td>
</tr>
<tr>
<td>CSIR(II)</td>
<td>1415.00</td>
<td>0.00</td>
</tr>
<tr>
<td>ASTROSAT Satellite project (JRF)</td>
<td>6812.00</td>
<td>0.00</td>
</tr>
<tr>
<td>ASTROSAT Satellite project (PDF)</td>
<td>500.00</td>
<td>0.00</td>
</tr>
<tr>
<td>ISRO DATABANK Project</td>
<td>235770.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Committed Grants for Quiz competition</td>
<td>0.00</td>
<td>70000.00</td>
</tr>
<tr>
<td><strong>Total unspent (committed) amount</strong></td>
<td>265146.00</td>
<td>161756.00</td>
</tr>
</tbody>
</table>

**CENTRE FOR SPACE PHYSICS**
Chalantika 43, Garia Station Road
Kolkata - 700 084

**Receipts and Payments of CSP main funds**

<table>
<thead>
<tr>
<th>Receipts</th>
<th>Amount (Rs.)</th>
<th>Payments</th>
<th>Amount (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Op. Bank balance</td>
<td>1444064.00</td>
<td>Books &amp; Periodicals</td>
<td>700.00</td>
</tr>
<tr>
<td>Op. Bank balance(Mid)</td>
<td>15418.00</td>
<td>Filing fees</td>
<td>400.00</td>
</tr>
<tr>
<td>Op Cash balance</td>
<td>5594.00</td>
<td>Stationary &amp; Consum.</td>
<td>7457.00</td>
</tr>
<tr>
<td>Sale of Books</td>
<td>52530.00</td>
<td>Telephone, Fax. Int’net</td>
<td>5920.00</td>
</tr>
<tr>
<td>Bank Interest</td>
<td>17647.00</td>
<td>Bank Charges</td>
<td>1513.00</td>
</tr>
<tr>
<td>Life Membership fees</td>
<td>2000.00</td>
<td>Rent &amp; Electricity</td>
<td>74442.00</td>
</tr>
<tr>
<td>Activity Fees</td>
<td>18430.00</td>
<td>Traveling &amp; C’veyance</td>
<td>7466.00</td>
</tr>
<tr>
<td>Guest house rent</td>
<td>124944.00</td>
<td>Office Expense</td>
<td>33856.00</td>
</tr>
<tr>
<td>Donation</td>
<td>42500.00</td>
<td>Postage</td>
<td>1939.00</td>
</tr>
<tr>
<td>Registration fees</td>
<td>3500.00</td>
<td>CSP Development</td>
<td>48000.00</td>
</tr>
<tr>
<td>Misc Income</td>
<td>250.00</td>
<td>Symposium Expense</td>
<td>208648.00</td>
</tr>
<tr>
<td>Loan from Directors</td>
<td>89000.00</td>
<td>Fixed Deposit</td>
<td>1200000.00</td>
</tr>
<tr>
<td>Grant-in-Aid received</td>
<td>4904560.00</td>
<td>Boundary Wall</td>
<td>95830.00</td>
</tr>
<tr>
<td>Overhead from project</td>
<td>337919.00</td>
<td>Telescope Component</td>
<td>6821.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equipment</td>
<td>4519.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Software</td>
<td>40952.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CSP own project</td>
<td>1797.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loan refund to Director</td>
<td>94000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Security deposit</td>
<td>1100.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audit fees project a/c</td>
<td>4010.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liability for Audit fees</td>
<td>1500.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RT-2 Project</td>
<td>681366.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trnsfr. to project fund</td>
<td>1388379.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Astrosat PDF (salary)</td>
<td>171100.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Astrosat JRF (Salary)</td>
<td>117988.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISRO Databank Proj.</td>
<td>246030.00</td>
</tr>
</tbody>
</table>

48
## CENTRE FOR SPACE PHYSICS
Chalantika 43, Garia Station Road
Kolkata - 700 084

Receipts and Payments of CSP Project funds

<table>
<thead>
<tr>
<th>Receipt</th>
<th>Amount (Rs.)</th>
<th>Payments</th>
<th>Amount (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Op. Bank Balance</td>
<td>247595.45</td>
<td>Bank Charges</td>
<td>267.00</td>
</tr>
<tr>
<td>Transferred from CSP</td>
<td>1343139.00</td>
<td>Salary</td>
<td>519600.00</td>
</tr>
<tr>
<td>Interest</td>
<td>2750.00</td>
<td>Consumables</td>
<td>42799.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contingency</td>
<td>56906.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Travel</td>
<td>26881.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computer</td>
<td>35215.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overhead and others</td>
<td>158319.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closing cash balance</td>
<td>1652.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closing bank balance</td>
<td>751844.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1593484.45</strong></td>
<td><strong>Total</strong></td>
<td><strong>1593484.45</strong></td>
</tr>
</tbody>
</table>

## NOTES TO ACCOUNTS

1. This is a Company limited by Guarantee and Liabilities of each member will be as per the provisions specified by the Memorandum of Association.
2. Loan from Directors represent preliminary expenses incurred at the time of incorporation as well as pre-operative expenses incurred time to time.
3. Accounts have been regrouped and re-arranged wherever necessary.

## SIGNIFICANT ACCOUNTING POLICIES

### BASIS OF ACCOUNTING
a) The Company prepares its account on accrual basis, except otherwise stated in accordance with normally accepted accounting policies.
b) Donations and Annual membership fees received from patrons are treated as revenue receipts and life-membership fees as capital receipts.
c) Preliminary expenses and deferred Revenue Expenditure are charged in 10 years and 3 years respectively.

FIXED ASSETS

Fixed Assets are stated at cost including installation expenses if any.

DEPRECIATION

Depreciation on fixed assets has been provided on straight-line method at the rates specified in Schedule XIV of the Companies Act, 1956.