

# INDIAN CENTRE FOR SPACE PHYSICS

## ANNUAL REPORT

(2009-2010)

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**Front Cover:** The corona of the eclipsed sun makes a strange shape at the totality as the rapidly moving Dignity-IX camera takes the picture of the dark sky and shadowed earth from a height of about 25 kilometers. For more pictures of July 22, 2009, see, back cover.

## **Report of the Governing Body**

This is the Eleventh Annual report of our Centre. As the annual report would testify, there is a steady growth of the standard of scientific activities in terms of quality and quantity and the Centre is reaching a new height of a truly National and International level.

In the last few years, ICSP, along with Tata Institute of Fundamental Research, had been instrumental in the development of the Indian payloads RT2/S, RT2/G, RT2/CZT and RT2/E for the Russian satellite CORONAS-PHOTON. The overall project was funded by ISRO. We reported last year that on the 30<sup>th</sup> of January, 2009 the payloads were in the orbit on board Russian satellite CORONAS-PHOTON. Subsequently, due to power supply problem by the solar cells all the instruments were shut down indefinitely in December 2009. However, the instruments sent very valuable data on Gamma Ray Bursts and Solar flares. ISRO is currently funding our scientists to analyze these valuable data.

ICSP is also directing its resources for developing instruments such as X-ray detectors using Si-PIN photo-diodes and CdTe detector chips for future space use. It has successfully integrated pre-amplifiers and post-amplifiers with Si-PIN and compared with indigenously made amplifiers. It has also successfully completed low-cost GPS units to track balloon borne payloads, ejection system of payloads from the parachutes etc. These are of immense use to study the behaviour in zero-gravity or micro-gravity condition. Exciting balloon experiments (Dignity VII-IX missions) were carried out during the Total Solar eclipse which took place on 22<sup>th</sup> of July, 2009. The picture of the shadow of the moon passing by was taken. Samples of photos are in this report.

Our former student Dr. Samir Mandal has become an Asst. Professor at the IIST Trivandrum and another student Dr. Sabyasachi Pal joined a Radio Astronomy group in Australia. Mr. Ritabrata Sarkar joined INFN group in Italy after submitting his thesis. One NET scholar and a project student joined the institute and one DST project was granted. One new faculty (Dr. Ankan Das) joined the Astrobiology group. We welcome all of them.

As far as the manpower development is concerned, in the last year, one of our scientists received Ph. D. degree; one student submitted his thesis and a number of research scholars registered themselves for the Ph. D. degree. Several students are expected to submit their thesis in the coming academic year.

Several scientists went abroad for attending conferences. Similarly, scientists from Australia/Germany made visits to our Centre. ICSP has been playing a major role in helping scientists from the nearby colleges. Last year, five students from colleges affiliated to Calcutta University carried out their M.Sc. projects at ICSP. A student from Nepal is working at our Centre as an ICTP (Italy) Junior Research Fellow.

In the field of Very Low Frequency (VLF) studies, extraordinary team work was shown when an India- wide VLF campaign was carried out by us in Summer, 2009 to study the quality of signals from some VLF stations at thirteen stations all over India. The receivers and data acquisition stations were built and manned by our scientists and also some students from the S.N. Bose National Centre for Basic Sciences. Good quality data obtained from this campaign enabled us to have an over all understanding of the ionospheric behaviour over an area of about four million square kilometers of the Indian sub-continent. We had extensive data collection during the Solar eclipse of July 22, 2009. It was particularly an active year for the VLF group of the Centre. Four scientists attended the Sharjah conference and presented talks. Similarly eight scientists attended the International conference (VELFRATO-10) held at SBNBCBS.

The work on new building site is in progress. Another piece of land for a remote Ionospheric and earthquake station is being acquired at Sitapur, about one hundred kilometer away from Kolkata. The coming year should see tangible activities in this direction.

The branches of ICSP at Malda and Coochbehar have progressed considerably. Major activity of the ICSP Observatory has been to use Very Low Frequency (VLF) receiver/antenna systems, which were made by its members. The Malda branch scientists have written papers on VLF astronomy and attended several International conferences.

This year ICSP celebrated its tenth anniversary. The foundation day celebration was held on the 10<sup>th</sup> of December, 2009. In this issue we have printed in the centre of the report some colour photographs of some old events which were organized by ICSP since inception in 1999. We presented photographs of many of the seventeen districtwise space science symposia, the popularization events such as telescope making workshop (where 21 number 5" telescopes were made by district-based teams), districtwise and statewide quiz competition etc.

I thank Dr. V. Yadav and Mr. Rajkumar Maity for helping me with initial compilation of the data for 2009-2010.

Prof. S.K. Chakrabarti, Honorary General Secretary  
Indian Centre for Space Physics

Kolkata: September 29, 2010

## **Governing Body (GB) of the Centre**

Dr. B.B. Bhattacharyya, *President*  
Dr. Jogendra N. Chakravorty, *Vice President*  
Dr. Sandip K. Chakrabarti, *Secretary*  
Dr. Dipak Bhaumik, *Treasurer*  
Dr. Sonali Chakrabarti, *Member*  
Dr. S. C. Chakravarty, *Member*  
Dr. A. R. Rao, *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. J. N. Chakravorty, Indian Centre for Space Physics  
Prof. A.R. Rao, Tata Institute of Fundamental Research, Mumbai  
Mr. K. K. Chakraborty, Ex-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 & ICSP  
Prof. D.C.V. Mallick, Indian Institute of Astrophysics, Bangalore  
Prof. S. Ananthakrishnan, Ex-Senior Prof., GMRT, 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. Ankan Das	Lecturer
Dr. D. Debnath	Scientist -B
Mr. D. Bhawmik	Hardware Engineer
Dr. A. Nandi	Scientific Officer D (from ISRO/HQ)
Dr. Vipin K. Yadav	Scientific Officer D (from ISRO/HQ)

## **Honorary Faculty Members**

Dr. D. Bhaumick, ICSP	(Hony. Scientist)
Dr. S. Chakrabarti, M. M. Chandra College	(Hony. Reader)
Dr. S. K. Chakrabarti, SNBNCBS	(Hony. Professor)
Dr. J. N. Chakravorty, ICSP	(Hony. Professor)
Dr. A. K. Chatterjee, Malda College	(Hony. Scientist)
Dr. T. K. Das, Narasimha Dutta College	(Hony. Assoc. Professor)
Dr. P. K. Jana, Panipukur BEd College	(Hony. Scientist)
Dr. M. M. Majumdar, DPI	(Hony. Scientist)
Dr. S. K. Midya, Serampore College	(Hony. Assoc. Professor)
Dr. S. Mondal, RKMR College	(Hony. Scientist)
Dr. R. Chattopadhyay (Haripal Instituion)	(Hony. Scientist)
Dr. G. Tarafdar (Barasat Govt. College)	(Hony. Scientist)

## **Research Scholars**

Mr. Wasim ul Bari	Mr. Santanu Mondal (CSIR)	Mr. Kumaresh Chakrabarti
Mr. Asit K. Choudhury	Mr. Liton Majumdar (DST)	Mr. Dipak Debnath (CSIR)
Mr. Tilak Kotoch (ISRO)	Mr. Sushanta K. Mondal (CSIR)	Mr. Partha S. Pal (ISRO)
Mr. Sourav Palit (CSIR)	Mr. Ritabrata Sarkar (RT-2)	Mr. Sudipta Sasmal (ISRO)
Mr. Surya Maji	Mr. Suman Ray (ISRO)	Mr. M.M. Samanta

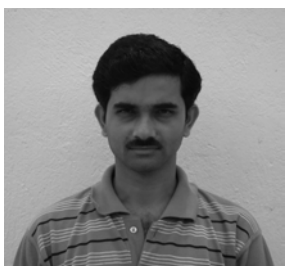
## **ICTP Junior Research Fellow**

Mr. Chandra Bahadur Singh

## **UGC Teacher Fellow (FIP)**

Mr. Brojagopal Dutta (UGC)

## **Administrative Section**



Mr. Rajkumar Maity

(Accountant/  
Office Assistant)



Mr. Hriday Roy

(Laboratory  
Assistant)



Mr. Ram Chandra Das

(Office Helper)



Mr. Uttam Sardar

(Office Helper)

## **Security**

Mr. Barun Chakraborty

## **Research Facilities at the Centre**

**Library:** The library has well cataloged journals in Astronomy, Astrophysics and Space sciences and an excellent collection of text books.

**Computers:** The Centre has modern high-speed computers and several servers which are connected through LAN/Wi-Fi and through the lease-line internet.

**Seminar room:** The seminar room at ICSP is well equipped with modern amenities and wireless internet.

**Guest house:** This facility is to provide lodging for residential scientists and visitors to stay overnight.

**Future Sites of ICSP:** The future sites of ICSP and the remote VLF station are being developed. At Sitapur a new site has been selected for ionosphere and earthquake research centre.

## **Brief Profiles of the Scientists of the Centre**

**Mr. Wasim ul Bari:** He is a teacher in Malda and is an honorary Junior Research Fellow at ICSP, Malda branch. He works on VLF studies of ionosphere and also data analysis of NASA/ISRO satellites.

**Prof. Bimalendu B. Bhattacharyya:** He is the President of the governing body of ICSP. He was an ex-Director of Indian School of Mines, Dhanbad. He is an INAE Distinguished Professor associated with S.N. Bose National Centre for Basic Sciences. His field of specialization is the study of deep crustal structure on earth from magneto-telluric data.

**Dr. Dipak Bhaumick:** He is an Ex-Reader at the Ramakrishna Mission Residential College, Narendrapur and an honorary scientist and Treasurer of the Governing Body of the Centre. His interest lies in the airglow, reaction properties of molecules in the upper atmosphere and also VLF research.

**Mr. Debashis Bhowmik:** He is a hardware engineer at ICSP and is involved in activities related to RT-2, VLF and balloon experiments.

**Mr. K. Chakrabarti:** He is a selection grade Assistant Professor in Hooghly Mahsin College and is an honorary Senior Research fellow of ICSP. He is working on similarities of accretion flows around black holes and fluid dynamics in a converging-diverging duct.

**Mr. K. K. Chakrabarti:** He was the director of Positional Astronomical Society of India. His field of interest is the cause of Cyclonic activities.

**Prof. Sandip K. Chakrabarti:** He is a Senior Professor of the S.N. Bose National Centre for Basic Sciences and an honorary Professor, In-Charge of Academic activities and the General Secretary of ICSP. 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. Instrumentation and experimental activities at ICSP are directed by him as well.

**Dr. Sonali Chakrabarti:** She is a senior grade Lecturer at the Maharaja Manindra Chandra College and an honorary Reader of the ICSP. Her research interest lies in the formation of bio-molecules in space, VLF research and computing the possibility to produce high resolution millimeter and microwave grating instruments.

**Prof. J. N. Chakravorty:** He is an honorary Professor of ICSP. He had been the Head, Physics Department of Ramakrishna Mission Residential College, Narendrapur. His current field of interest is millimeter and microwaves, airglow, etc.

**Dr. Achintya K. Chatterjee:** He is the Head, Physics Department, Malda College and an honorary scientist of ICSP. He is currently doing data analysis RXTE satellite and observing SID by VLF antenna. He is also the President of Malda Branch of Indian Centre for Space Physics.

**Dr. R. Chattopadhyay:** He is a Teacher in Haripal G.D. Institution. His research work includes Airglow and Ozone depletion.

**Mr. Asit Kumar Choudhury:** He is a Teacher at the L.M.S.M. Institution, Malda and is an honorary senior research fellow of the ICSP. He is working on data analysis of RXTE satellite and also observing SID using VLF. He is also the Secretary of the Malda branch of Indian Centre for Space Physics.

**Dr. Ankan Das:** He had been visiting the Raymond and Beverly Sackler laboratory for astrophysics at Leiden University, Netherlands as a Greenberg Fellow. Presently, he is a Lecturer at ICSP.

**Dr. T. K. Das:** He was a Reader at Narasimha Dutta College and an honorary Associate Professor of ICSP. His work is on the solar physics, especially on sunspots and classification of radio bursts. He also works on the geo-spot model of earthquakes, relationships between earthquakes and VLF etc.

**Mr. Dipak Debnath:** He was a CSIR Senior scholar working at ICSP. He is working on analyzing data of GRO J1655-40, a black hole candidate. He is also working on Zone plates and is involved in the testing and evaluation of the RT-2 payloads.

**Dr. Broja G. Dutta:** He is a teacher of Y. S. Palpara College, Purba Medinipur and is a "Teacher Fellow" at ICSP under "Faculty Improvement Programme" of UGC. He is working on the data analysis of X-ray emission from accretion disks around black holes.

**Dr. P. K. Jana:** He is teaching at the Panipukur B. Ed. College and is an honorary scientist of ICSP. He works on trends of Ozone depletion over India.

**Mr. R. Khan:** He is a teacher of Bidhan Nagar Govt. High School and is involved in activities of the ICSP observatories. He is working on interfacing equipments with computers, VLF experiments, etc.

**Mr. Tilak C. Kotoch:** He is a Senior Research Fellow (SRF) appointed under RT-2 project (ISRO funded) for software development and data analysis, in order to study Solar Activity.

**Mr. Surya Maji:** He is a school teacher and an honorary Junior Research Fellow at ICSP. He works on the effect of eclipse on VLF signals.

**Dr. M. M. Majumdar:** He is an honorary scientist of ICSP. He is working on similarities of accretion flows around black holes and fluid dynamics in a converging-diverging duct.



**Dr. Anuj Nandi:** He is a Scientific Officer D of ISRO HQ posted at ICSP. His present activity is data analysis of black hole candidates. He is involved in testing and evaluation of RT-2 payloads on the ground and in orbit.

**Mr. Partha Sarathi Pal:** He is a senior research fellow in an ISRO RESPOND project. He is working at ICSP on spectral and timing properties of Black hole Astrophysics.

**Mr. Liton Majumdar:** He is a DST project research scholar at ICSP and has started working on theoretical studies in Astrochemistry/Astrobiology.

**Dr. Samir Mandal:** He is a Fast Track Young Scientist of DST working at ICSP and has become a Post-Doc fellow at Ben Gurion University, Israel. He works on the Spectral studies of accretion flows.

**Dr. S. K. Midya:** He is a Reader of the Dept. of Atmospheric Science of the Calcutta University and an honorary Associate Professor of ICSP. He works on Airglow experiments and Ozone depletion problem.

**Mr. Santanu Mondal:** He is a research scholar at ICSP and has started working on Black-hole Astrophysics.

**Mr. Sushanta K. Mondal:** He is a CSIR Junior Research Fellow and working at ICSP on radio and VLF studies of very high energy gamma ray activities in space.

**Mr. Sourav Palit:** He is a CSIR Senior Research Fellowscholar working at ICSP. He is working on theoretical and experimental study X-ray imaging with Fresnel Zone plates.

**Mr. Suman Ray:** He is working as a junior research fellow in an ISRO project. He is in VLF group and is working on the earthquake related perturbation of VLF signals.

**Mr. M. M. Samanta:** He is a teacher of B.M. Institution, Tarakeswar and is an honorary Senior Research Fellow (SRF) of ICSP. His field of interest is time dependent accretion around black holes.

**Dr. R. Sarkar:** He is a senior research fellow of ICSP (Astrosat and RT-2 projects) and has worked on the shielding properties of the CZT detector and LAXPC payloads on board ASTROSAT. He also worked on the RT-2 payload properties, position sensitive proportional counters, Space Science from Lunar Missions etc. He is presently in ICSP at a TRIP fellow.

**Mr. Sudipta Sasmal:** He is a Senior Research fellow working at ICSP under ISRO RESPOND project. He is working on earthquake predictions using VLF data.

**Mr. Chandra B. Singh:** He is an ICTP Junior Research Fellow. He is working on outflows from accretion disks around Black holes.

**Dr. G. Tarafdar:** He is an honorary scientist of the Center. He is permanently with Barasat Govt. College.

**Dr. Vipin K. Yadav:** He is a Scientific Officer D of ISRO HQ posted at ICSP. He is doing experiments with quasi-parallel beams in the X-ray Laboratory of ICSP.

## **Research Work Published or Accepted for Publication**

### **Papers in Journals and Proceedings**

**S.K. Chakrabarti, S. Palit, D. Debnath, A. Nandi and V. Yadav**, *Fresnel Zone Plate Telescopes for X-ray Imaging I: Experiments with a quasi-parallel beam*, Exp. Astronomy, 24, 109, (2009).

**S.K. Chakrabarti, B.G. Dutta and P.S. Pal**, *Accretion flow behaviour during the evolution of the Quasi Periodic Oscillation Frequency of XTE J1550-564 in 1998 outburst*, MNRAS, 394, 1463, (2009).

**S.K. Chakrabarti**, *Generalized Accretion Flow Configuration: Rationale and Observational Evidences*, (Eds.) S.K. Chakrabarti, G.S. Bisnovatyi-Kogan and A.I. Zhuk, p. 244, 2009 (AIP:NY).

**S.K. Chakrabarti, S. Palit, A. Nandi, V. K. Yadav, D. Debnath**, *Fresnel Zone Plate Telescopes as high resolution imaging devices*, in Proceedings of International conference on Space Science and Technology, Thessaloniki, Greece, Eds. G. Lampropoulos and M. Petrou, 2009 (CD Version).

**S.K. Chakrabarti**, *Black Hole Astrophysics* in 'The Sun, Stars, The Universe and General Relativity', R. Ruffini and G. Vereschagin (Eds.) 41, (2010).

**S.K. Chakrabarti and S. Chakrabarti**, *Evolution of Pre-biotic molecules during star formation* in 'The Sun, Stars, The Universe and General Relativity', R. Ruffini and G. Vereschagin (Eds.), 51, (2010).

**S.K. Chakrabarti, S. Sasmal and S. Chakrabarti**, *Ionospheric Anomaly due to Seismic Activities - II: Possible Evidence from D-Layer preperation and disappearance times*, Nat. Hazards Earth Syst. Sci., (in press).

**A. K. Chatterjee, W. Bari and A. K. Choudhury**, *Anomalous behavior of D-layer formation time of the ionosphere due to earthquake*, Indian Journal of radio and Space Physics, **38**, June 2009, 138-142.

**A. Das, K. Acharyya and S. K Chakrabarti**, *Effects of Initial Condition and Cloud Density on the Composition of the Grain Mantle*, MNRAS, 2010 (in press).

**A. Das, K. Isokoski, Z. Awad, E. F. Van Dishoeck and H. Linnartz**, *A systematic laboratory study of interstellar water ice containing O<sub>2</sub>, N<sub>2</sub>, CO and CO<sub>2</sub>*, 2009, 42<sup>nd</sup> IUPAC congress (In press)

**S. Das, S.K. Chakrabarti and S. Mondal**, *Studies of dissipative standing shock waves around black holes*, MNRAS, 401, 2053, (2010).

**D. Debnath, A. Nandi, A. R. Rao, J. P. Malkar, M. K. Hingar, T. B. Kotoch, S. Sreekumar, V. P. Madhav and S. K. Chakrabarti**, *Instruments of RT-2 Experiment onboard CORONAS-PHOTON and their test and evaluation I: RT-2/S and RT-2/G Payloads*, Exp. Astronomy, (in press), (2010).

**S.C. Ganda, S.K. Midya** *Short term stratospheric ozone trend over Dumdum and it's relation with flare index of Northern Hemisphere*, *Mausam*, **61**,1, 117-120, (2010)

**H. Ghosh, S.K. Chakrabarti and P. Laurent**, *Monte-Carlo Simulations of Thermal Comptonization Process in a Two Component Accretion Flow Around a Black Hole*, IJMPD, 18, 1693, (2009).

**H. Ghosh, S. Garain, S.K. Chakrabarti and P. Laurent**, *Monte-Carlo Simulations in a Two component Flow in presence of Outflow*, IJMPD, 19, 607, (2010).

**K. Giri, S. K. Chakrabarti, M. M. Samanta, D. Ryu**, *Hydrodynamic Simulations of Oscillating Shock Waves in a Sub-Keplerian Accretion Flow Around Black Holes*, MNRAS, 403, 516, (2009).

**P. K. Jana, I. Saha, D. Sarkar, P. Das, S. K. Midya** Long term O<sub>3</sub> trend and its effect on night airglow intensity of Li 6708Å° at Ahmedabad (23N, 27.50E) and Hally Bay (76S,27W), British Antarctic Service Station *Ind. J.Phys.* **84(1)** 41-53, (2010).

**P. K. Jana, D. K. Saha, S. K. Midya** Effect of cloud on Atmospheric ozone formation over Kolkata, *Ind.J.Phys* **84(4)** 367-375, (2010).

**T.B. Kotoch, Anuj Nandi, D. Debnath, J. P. Malkar, A. R. Rao, M. K. Hingar, V. P. Madhav, S. Sreekumar and S. K. Chakrabarti**, *Instruments of RT-2 Experiment onboard CORONAS-PHOTON and their test and evaluation II: RT-2/CZT Payload*, Exp. Astronomy, (in press).

**T.B. Kotoch, S. K. Chakrabarti, A. Nandi, D. Debnath**, *Gamma-Ray Bursts from RT-2 payloads and VLF signals* in proceedings of *Very Low Frequency Radio Waves: Theory & Observations (VELFRATO-10)* from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata, India (AIP).

**A. Nandi, A.R. Rao, S.K. Chakrabarti, J.P. Malkar, S. Sreekumar, D. Debnath, M.K. Hingar, T. Kotoch, Y. Kotov, A. Arkhangelskiy**, *Indian Payloads (RT-2 Experiment) Onboard CORONAS-PHOTON Mission*, in Proceedings of International conference on Space Science and Technology, Thessaloniki, Greece, Eds. G. Lampropoulos and M. Petrou, 2009 (CD-Version).

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**A. Nandi, S. K. Chakrabarti, D. Debnath, T. B. Kotoch, A. R. Rao, S. K. Mondal, S. Maji and S. Sasmal**, *Simultaneous observation of Solar Events by Indian Payload (RT-2) and by ICSP-VLF receiver*, in proceedings of *Very Low Frequency Radio Waves: Theory & Observations (VELFRATO-10)* from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata, India (AIP).

**A.R. Rao, J. P. Malkar, M. K. Hingar, V. K. Agrawal, S. K. Chakrabarti, A. Nandi, D. Debnath, T. B. Kotoch, R. Sarkar, T. R. Chidambaram, P. Vinod, S. Sreekumar, Y. D. Kotov, A. S. Buslov, V. N. Yurov, V. G. Tyshkevich, A. I. Arkhangelskij, R. A. Zyatkov, S. Naik**, *Detection of GRB090618 by RT-2 Experiment onboard the Coronas-Photon Satellite*, ApJ (2010) (in press).

**A.R. Rao, J. P. Malkar, M. K. Hingar, V. K. Agrawal, S. K. Chakrabarti, A. Nandi, D. Debnath, T. B. Kotoch, T. R. Chidambaram, P. Vinod, S. Sreekumar, Y. D. Kotov, A. S.**

**Buslov, V. N. Yurov, V. G. Tyshkevich, A. I. Arkhangelskij, R. A. Zyatkov, S.S. Begum, P.K. Manoharan**, *RT-2 detection of Quasi-Periodic Pulsations in the 2009 July 5 Solar Hard X-ray Flare*, ApJ, 714, 1142R (2010).

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**R. Sarkar, S. Mandal, D. Debnath, T. B. Kotoch, A. Nandi, A. R. Rao, S. K. Chakrabarti**, *Instruments of RT-2 Experiment onboard CORONAS-PHOTON and their test and evaluation IV: Background Simulations using GEANT-4 Toolkit*, Exp. Astronomy (in press).

**S. Mandal and S.K. Chakrabarti**, *On the Evolution of Accretion Rates in Compact Outburst Sources*, Astrophysical Journal Letters, 710, 147, (2010).

**S.K. Midya, H. Sarkar, S.S. Dey, A. Maitra, M. Ghosh**, Sharp Depletion of attenuation of 22.235GHz associated with Nor'wester over Kolkata-May be one possible method of forecasting Nor'wester *Ind.J.Phys*, **84(4)** 377-381, (2010)

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**S. Palit, S. K. Chakrabarti, D. Debnath, A. R. Rao, A. Nandi, Vipin K. Yadav, V. Girish**, *Fresnel Zone Plate Telescopes for X-ray Imaging II: Numerical simulations with parallel and diverging beams*, Exp. Astronomy, 27, 77, (2009).

**S. Sreekumar, P. Vinod, E. Samuel, J. P. Malkar, A. R. Rao, M. K. Hingar, V. P. Madhav, D. Debnath, T. B. Kotoch, A. Nandi, S. S. Begum and S. K. Chakrabarti**, *Instruments of RT-2 Experiment onboard CORONAS-PHOTON and their test and evaluation V: Onboard software, Data Structure, Telemetry and Telecommand*, Exp. Astronomy (in press).

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**Vipin K. Yadav, S.K. Chakrabarti, A. Nandi, S. Palit**, *X-ray experiments for Space applications in intermediate energy range* in Proceedings of International conference on Space Science and Technology, Thessaloniki, Greece, Eds. G. Lampropoulos and M. Petrou, 2009 (CD Version).

## **Books**

**S. K. Chakrabarti, A. I. Zhuk and G. S. Bisnovatyi-Kogan** (Editors): *Astrophysics and Cosmology After Gamow*, American Institute of Physics (New York).

## **Members of Scientific Societies/Committees**

**Sandip K. Chakrabarti** was an International Advisory Committee member of 1st Galileo-Xu Guanqi conference (Shanghai); George Gamow meeting (Odessa) and Origin of Life conference (Roorkee). Chaired APT4 session on 'Astrophysical Black Holes: From Quasars to Nano-Quasars' of the 12th Marcel Grossman Conference (UNESCO-HQ, Paris, July 2009). Editorial board member of Indian Journal of Physics and Open Astronomy Journal (Bentham). In Charge, Academic Affairs of Indian Centre for Space Physics. Head of the

Department, Astrophysics and Cosmology. Convener, Very Low frequency Radio Waves: Theory and Observations (VELFRATO-10).

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

**Ankan Das** was the Chairman of a session in the International Workshop on Chemical evolution and origin of Life, 5-7<sup>th</sup> March 2010, IIT Roorkee, India. He was an extended Visitor and Linkage Programme, October 2009 to December 2009, S N Bose National Centre for Basic Sciences, India. He was also in Theoretical Physics Seminar Circuit, 1<sup>st</sup> January 2010 to 31<sup>st</sup> January 2010, S N Bose National Centre for Basic Sciences.

**Vipin K. Yadav** became Life member (LM/0855) of Indian Physical Society (IPS), Kolkata in 2009.

### **Ph.D. Degree Received**

**Ankan Das** received PhD degree on his thesis titled “*Hydrodynamic simulation of the formation of protostars during molecular cloud collapse and the chemical evolution in these processes*” from Calcutta University in December 2009.

### **Ph.D. Thesis Submitted**

Thesis titled “*X-ray Studies of Compact Objects: Data Analysis, Development of Instruments and their characterization*” by Mr. Ritabrata Sarkar submitted to Jadavpur University in January 2010.

### **Course of Lectures offered by ICSP members**

**Sandip K. Chakrabarti, Ankan Das, Anuj Nandi, Vipin K. Yadav and J.N. Chakravorty** gave a series of about 40 lectures to the Physics post-graduate students of R. K. Mission Residential College on High Energy Astrophysics and Cosmology in 2009 as part of the Astronomy and Astrophysics Course. This is regularly being offered. In future, number of courses would be increased for MSc and Post-MSc students.

**Ankan Das, Sushanta Modal and Debashis Bhaumik** supervised several MSc students to complete their obligatory project courses.

### **Participation in National/International Conferences & Symposia**

**Achintya K Chatterjee** gave an oral presentation on “Anomalous behavior of D layer formation time of the ionosphere due to earthquake” Invited talks on “VLF Research at SBNBCBS and ICSP” at the 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves: Theory and Observations (VELFRATO-10) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

**Asit K Choudhury** presented a paper “Calibration of the VLF signal of VTX 18.2 kHz station by a receiver in Malda” during the Sharjah-Stanford AWESOME VLF workshop, 22 - 24 February, 2010, at College of Science, University of Sharjah, UAE. He also attended the 1<sup>st</sup> International Conference on Very Low Frequency Waves: Theory and Observations (VELFRATO-10) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

**Ankan Das** presented a poster at 42<sup>nd</sup> IUPAC Congress, August 2–7, 2009, Glasgow, UK. He presented a poster at NAC 2009: 64<sup>th</sup> Dutch Astronomy Conference, May 13 - 15 May, 2009 at Kerkrade, Zuid-Limburg, Netherlands and gave an oral presentation at 65<sup>th</sup> Astro-Surfsci Discussion meeting on April 4, 2009, Leiden University, Netherlands. He gave an invited talk at International Workshop on Chemical Evolution and Origin of Life from March 5 - 7 2010, IIT Roorkee, India.

**Anuj Nandi** gave an oral presentation titled “Simultaneous observation of Solar Events by Indian Payload (RT-2) and ICSP-VLF receiver” during the 1<sup>st</sup> International Conference on Very Low Frequency Waves: Theory and Observations (VELFRATO–10) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

**Nilmadhab Nandy** presented a paper titled “Detection of Solar flares by monitoring the VLF signal at ICSP Malda Branch” at 1<sup>st</sup> International Conference on Very Low Frequency Waves: Theory and Observations (VELFRATO–10) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

**Sushanta Mondal** gave an oral presentation titled “Results of Detections of a Soft Gamma ray Repeater and two Gamma Ray Bursts” at Sharjah Stanford AWESOME VLF conference held in Sharjah, UAE on Feb, 2010 and during the 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves (VELFRATO-2010) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

**Partha Sarathi Pal** gave an oral presentation titled “Dynamical Nature of GRS 1915+105: Application of two component flow” at 12<sup>th</sup> Marcel Grossmann Meeting, 2009 at Paris, France in July 2009. He also attended the 11<sup>th</sup> COSPAR Capacity Building Workshop on Data Analysis of Fermi Gamma Ray Space Telescope at Raman Research Institute, Bangalore, in February, 2010 and the 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves (VELFRATO-2010) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata. He gave a popular talk titled “Mahabiswer Mukhomukhi” at Golden Jubilee Celebration of Boso Priyanath Higher Secondary School on January 29, 2010.

**Sandip K Chakrabarti** gave following presentations: Invited talk on 'Seeing is believing -- Do we see black holes?' at the 12th Marcel Grossman Conference held at UNESCO HQ July 12-18, 2009; Invited talk on 'Evolution of QPOs in Transient Black Holes' at the 12th Marcel Grossman Conference held at UNESCO HQ July 12-18, 2009; Plenary Talk on 'Shock waves in Accretion flows into black holes', at the 'Astronomy and beyond: Astrophysics, Cosmology, Radioastronomy, High Energy Physics and Astrobiology' conference in Odessa, Ukraine, 17-23rd Aug. 2009; Oral presentations on 'Fresnel Zone Plate Telescopes as high resolution imaging devices', 'Indian Payloads (RT-2 Experiment) Onboard CORONAS-FOTON Mission' and 'X-ray experiments for Space applications in intermediate energy range' at the International Conference on Space Technology, Thessaloniki, 24-26th August, 2009; Oral presentation on 'X-Ray and Gamma-Ray Astronomy from the Moon' at the International Conference on 'Low Cost Planetary Missions' at Goa, 31 August 31 – September 4, 2009; Invited talk on "Unification of Accretion and Outflows Around Black Holes" at the 1st Galileo - Xu Guanqi meeting at Shanghai in Oct. 2009; Invited talk on "Evolution of Telescope based Observations" Commemorative 150th Birth Centenary of J.C. Bose and 400th year of Galileo's observation (IYA prog.), BESU, West Bengal, November 2010; Invited talk on "Importance of Galileo and Darwin today" at IYA programme (400yrs. of Galileo Telescope and 200 years of Darwin's birth), Baruipur and Dhonekhali.; Gave a series of five lectures at Nice Observatory, France in Jan. 2010; Gave an invited talk on "Chemical Evolution during Star

formation and effects of X-rays and Gamma Rays" at IIT/Roorkee at the Conference on 'Origin of Life' in March, 2010. Gave an invited talk on "VLF Research at SBNBCBS and ICSP" at the 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves: Theory and Observations (VELFRATO-10) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata; Gave an oral presentation titled "Summer and Winter VLF Campaigns in Indian sub-continent" at the 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves: Theory and Observations (VELFRATO-10) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

**T.C. Kotoch** gave an oral presentation titled "Studies on VLF atmospherics during severe meteorological activity over North-East India" at the 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves: Theory and Observations (VELFRATO-10) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

**S.K. Maji** gave an oral presentation titled "Effects of Annular Solar Eclipse on VLF Data" at the 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves: Theory and Observations (VELFRATO-10) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

**Suman Ray** gave an oral presentation titled "Study of the anomalous behaviors of the ionosphere during earthquake for VTX-Malda baseline" during 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves (VELFRATO-2010) at S.N. Bose National Centre for Basic Sciences, Kolkata in March, 2010.

**Sudipta Sasmal** gave an oral presentation on (a) Ionospheric anomaly during Seismic Activities during the workshop on VLF studies & results on September 12, 2009 at Indian Centre for Space Physics, Kolkata; (b) Ionospheric anomaly during Seismic Activities during the Sharjah-Stanford AWESOME VLF workshop, 22 - 24 February, 2010, at College of Science, University of Sharjah, UAE; (c) 'Life & Science in Antarctica' at the Space Science Symposium on November 18, 2009 at Malda College, Malda, West-Bengal, India; (d) "From ICSP to Antarctica: for the sake of Science" on December 9, 2009, A Decade of Achievements of ICSP, Yuba Kendra Auditorium, Moulali, Kolkata, India; (e) Scientific Research in Maitri Station, Antarctica", on December 13, 2009, Scientific Meeting, H.A. Block, Salt-Lake, Kolkata, India; (f) 'Indian Scientific Expeditions to Antarctica' at the Space Science Symposium on January 29, 2010, Golden Jubilee celebration, Boso Priyanath High School, Boso, Hoogly, West- Bengal, India; He talked on "Correlations between the ionospheric anomaly and earthquakes using VLF" at the 1<sup>st</sup> International Conference on Very Low Frequency Radio Waves (VELFRATO-2010) from March 13-18, 2010 at S.N. Bose National Centre for Basic Sciences, Kolkata.

### **Visits abroad from the Centre**

**Dipak Debnath** visited the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy from September 1, 2009 to February 28, 2010 as a visiting scientist

**Sandip K. Chakrabarti** visited Nice Observatory (Jan. 2010), France; to attend MG12 meeting in France, 1<sup>st</sup> Galileo Xu-Guanqui conference in Shanghai (Oct. 2009).

**Ritabrata Sarkar** visited ICTP, and INFN, Trieste, Italy from July 2008 to July 2009 and from January 2010.

**P. S. Pal** attended MG12 meeting in France (July 2009).

## **Visitors to the Centre**

P. Schnoor visited ICSP on March 20-21, 2010.

K. Lynn visited ICSP on March 21, 2010.

## **Collaborative research & project work**

RT-2 experiment aboard Russian satellite CORONAS-PHOTON and Associate Data Analysis, S.K. Chakrabarti [Co-PI] (SNBNCBS and ICSP), A. Nandi (ICSP/ISRO), D. Debnath (ICSP), V. K. Yadav (ICSP/ISRO) R. Sarkar (ICSP) and A. Rao [PI] (TIFR) Funded by Indian Space Research Organization (June 2005 – March 2012).

Abstract: Solar activity is expected to become maximum in a matter a couple of years. This will affect the ionospheric structure on earth. Keeping this in view several payloads have been designed and constructed to obtain photon counts and spectrum at energies up to 100 keV and to image the X-ray active regions on the solar disk. Imaging is done with CZT detectors and CMOS/CCD. After testing of the payloads with the satellite itself, the payloads are now in the near polar orbit of the earth at an approximate height of 550km above the ground. The data is received directly from the Russian ground stations and are being analyzed. RT-2 JRF/RA positions have been filled to analyze the data.

Spectral studies of a few black hole candidates: A. Nandi (ICSP/ISRO) and S.K. Chakrabarti (SNBNCBS and ICSP), P.S. Pal (ICSP): Funded by Indian Space Research Organization (April 2006 – March 2010).

Abstract: Some of the black holes such as GRS 1915+105 and GRO J1655-40 are very exciting since they change their spectral properties very rapidly. These are analyzed and several exciting properties of the QPOs as well as the ratio of the Power-law photons to black body photons have been obtained. In particular, we now have convincing evidence that these black hole accretion flows have two components.

Time dependent evolution of gas/grain chemistry, and S. Chakrabarti (MMC and ICSP), S.K. Chakrabarti (SNBNCBS and ICSP), L. Majumdar (ICSP) Funded by Department of Science and Technology (March 2010 – March 2013).

Abstract: We carry out time dependent simulations of the collapsing molecular clouds and at the same time carry out the Monte-Carlo simulations on grains and simulations of chemical evolutions. We compare with observational results.

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

Abstract: ISRO funded for a Data Bank which includes a JVC made MC600 model jukebox and its controlling servers. Purchase of a few terabyte storage solution has been made. The VLF and RT-2 data are regularly kept in these data banks. Presently, some funding is provided to continue the project.

Study of Correlation between ionospheric activities with earthquakes by monitoring Very Low Frequency (VLF) signals: Funded by RESPOND (ISRO):

Abstract: We study the shifting of the sunset and sunrise terminators and try to correlate with earthquake related activities. We also find correlations between the seismic activities



and the time to produce and destroy the D-Layer in the ionosphere. Similar the relation with night-time fluctuations was found.

### **Media Coverage:**

Live telecast of an interview of Prof. S. K. Chakrabarti on different aspects of Astrophysics was arranged by ICSP and Malda Cable Network on Nov. 17, 2009. Mr. Asit K Choudhury conducted the interview. Extensive live telecasts of the balloon experiments took place during the total solar eclipse on 22<sup>nd</sup> July, 2010. Several newspapers covered the results.

## **Summary of Research Activities of the Scientists at the Centre**

### **Astrobiology/Astrochemistry**

Astrobiology is a newly emerging field of research. The broader questions it seeks to answer are (a) How did 'life' begin on earth? (b) Is there 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 bio-molecules can be formed in space even before the formation of planets. Our work mostly concentrates on the formation of bio-molecules during the collapse of interstellar clouds.

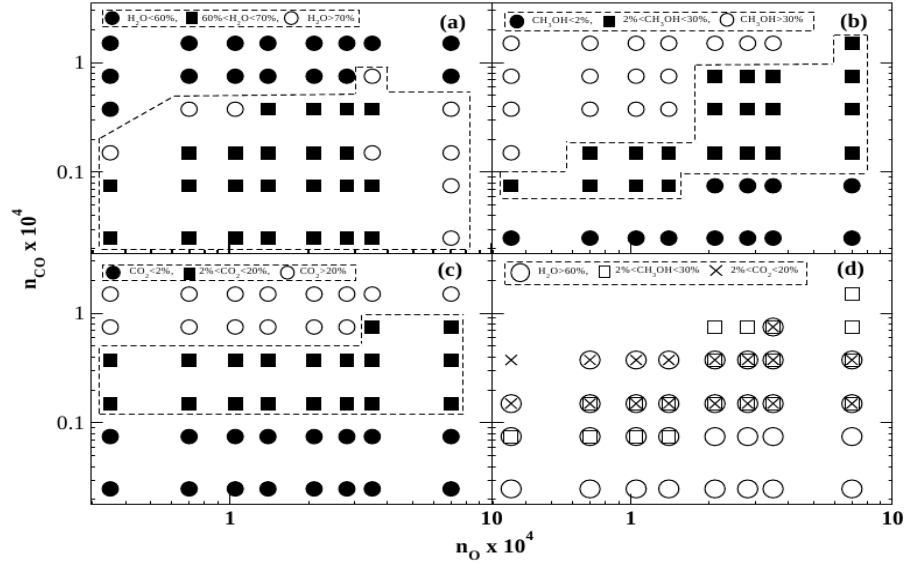


***S.K. Chakrabarti, S. Chakrabarti, A. Das and L. Majumdar***

In the Interstellar medium molecules can be trapped in the ice. The strengths and profiles of the band changes for different mixture contents because the ice bands are very much sensitive to the intermolecular interactions. Previous laboratory studies suggest that the changes in the profiles can be used as a good probe to study the composition of the ice. Thus, a detail and accurate analysis of the band strengths and profiles of the IR features are necessary. In the present context, a detailed systematic IR study were performed to find out the effect of different impurities (CO, CO<sub>2</sub>, O<sub>2</sub>, and N<sub>2</sub>) on H<sub>2</sub>O ice. Infrared emission feature around 3.3, 6.2, 7.7, 8.6, 11.3, 12.7  $\mu\text{m}$  from various astronomical sources were observed. These features are called the unidentified infrared bands (UIR) as these are not from any specific molecule. These features coincide with the vibrational modes of aromatic materials and attributed to be due to the Polycyclic Aromatic Hydrocarbons (PAH). If this is true then up to 10-15% of the available interstellar carbon might be locked in the form of PAH. Till date, no specific PAHs have yet been identified outside the solar system. We have studied different photochemical behavior after irradiating the Pyrene and Anthracene sample with the water ice.

Evolution of grain mantles in various interstellar environment is studied. We concentrate mainly on water, methanol, carbon di-oxide, which constitute nearly 90% of the grain mantle. We investigate how the production rates of these molecules depend on the relative gas phase abundances of oxygen and carbon monoxide and constrain the relevant

parameter space which reproduces these molecules closed to the observed abundances. Allowing to accrete, only H, O and CO on the grains and using the Monte-Carlo method, we follow the chemical processes for a few million years. We allow formation of multi-layers on the grains and incorporate the freeze-out effects of accreting O and CO. We find that the formation of these molecules depends on the initial conditions as well as the average cloud density. Using available reaction pathways it appears to be difficult to match the exact observed abundances of all the three molecules simultaneously. Only in a narrow region of parameter space, all these three molecules are produced within the observed limit. In addition to this, we found that the incorporation of the freeze-outs of O and CO leads to almost steady state on the grain surface. In addition, we consider a case where the gas number density changes with time due to gradual collapse of the molecular cloud and present the evolution of composition of different species as a function of radius of the collapsing cloud.



Parameter space in which formation of water, methanol and CO<sub>2</sub> are studied. The regions in which these molecules are produced within the observed limits (favourable zones) are marked on the parameter space. (d) Favourable zone is the common zone when (a-c) are superimposed.

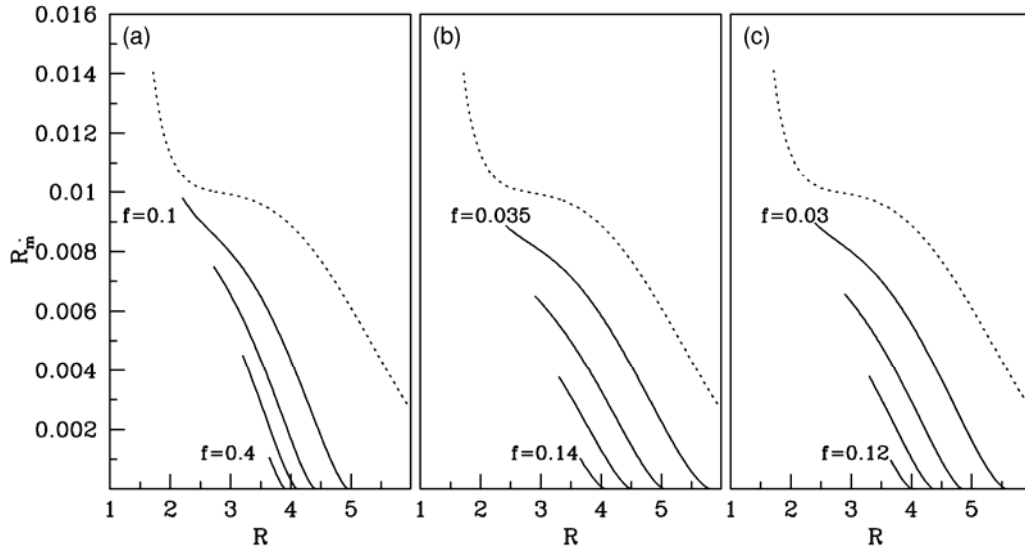
## Black hole Astrophysics



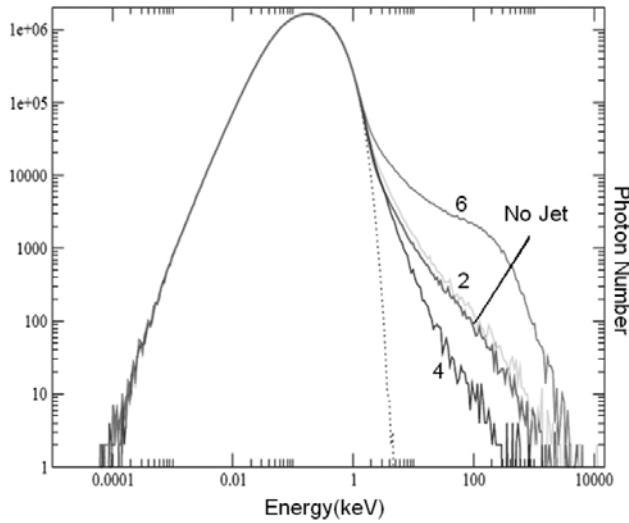
***S. K. Chakrabarti, A. Nandi, D. Debnath, C.B. Singh and S. Mandal***

Black Hole astrophysics is done in varieties of branches. One of the most important aspects of quasars to nano-quasars is the formation of jets and outflows from the accretion disks. It is found that the centrifugal barrier dominated boundary layer, or the CENBOL, actually produces the outflow. We wrote the Rankine-Hugoniot condition in presence of

mass and energy loss from the CENBOL and using that computed the outflow rate self-consistently as a function of flow parameters (Chandra B. Singh and S. K. Chakrabarti).



**Variation of the ratio of the outflow rate and inflow rate as a function of the shock strength  $R$  and the degree of dissipation  $f$  for three models of the dissipation.**

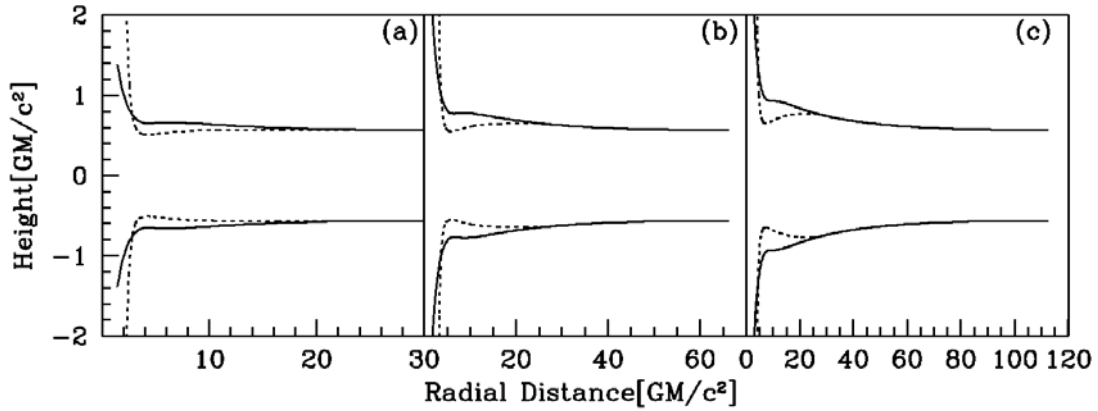


When the outflows are produced, they can also affect the spectrum. We compute the spectrum of the radiation using Monte-Carlo method in presence of outflows. We also couple hydrodynamics of the flow with radiative transfer to study the quasi-periodic oscillations (S.K. Chakrabarti, H. Ghosh, K. Giri, S. Garain)

**(Left) Variation of spectrum from disk and jet with the strength of the shock marked on each curve.**



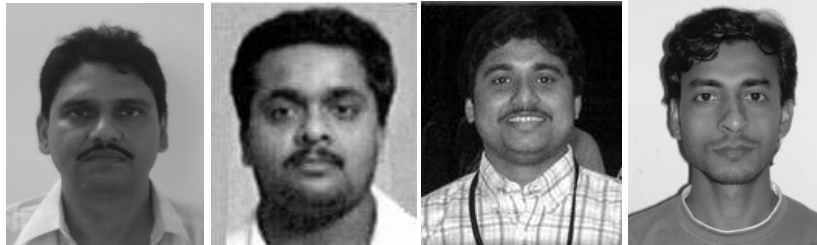
**Visiting scientists: K. Chakrabarti, M. M. Majumdar, M. M. Samanta**



**Variation of the duct shapes which are equivalent of a Kerr black hole accretion. Solid curves are for pre-shock branch and the dotted curves are for post-shock branch [(a)  $a = -0.5$ ; (b)  $a = 0$ ; (c)  $a = 0.5$ ].**

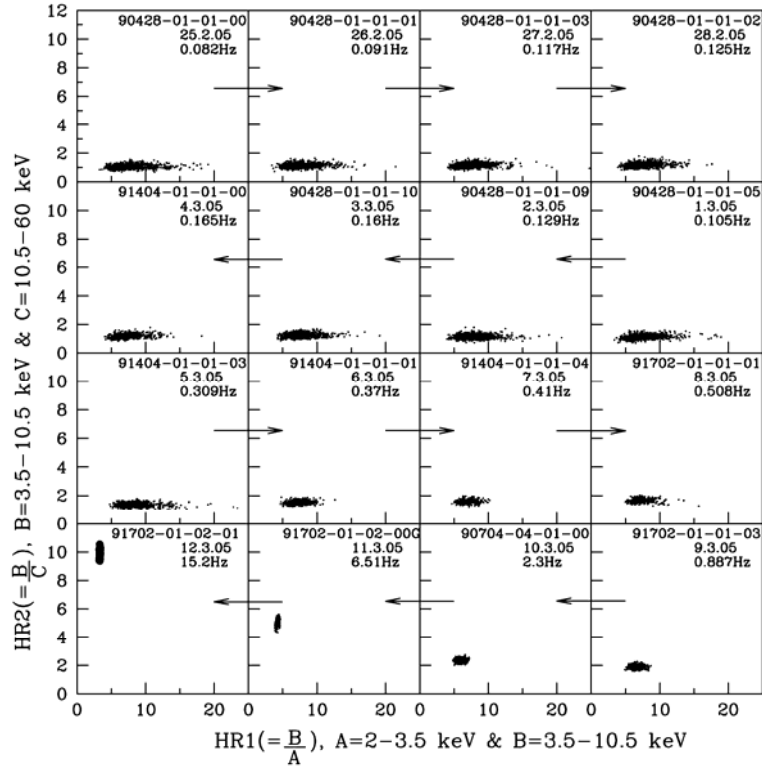
Since black hole accretion is transonic and the de-Laval nozzle flow is also transonic, we find that we can obtain the equivalent nozzle shape of a black hole accretion flow for the same inflow parameter. We successfully showed this in Schwarzschild geometry in our earlier work. Subsequently, this has been completed for a Kerr black hole. We find most interesting behaviour of the duct as the black hole evolves from a Schwarzschild to an almost extreme Kerr black hole (K. K. Chakrabarti, M.M. Majumdar and S.K. Chakrabarti).

## **X-ray Astronomy**

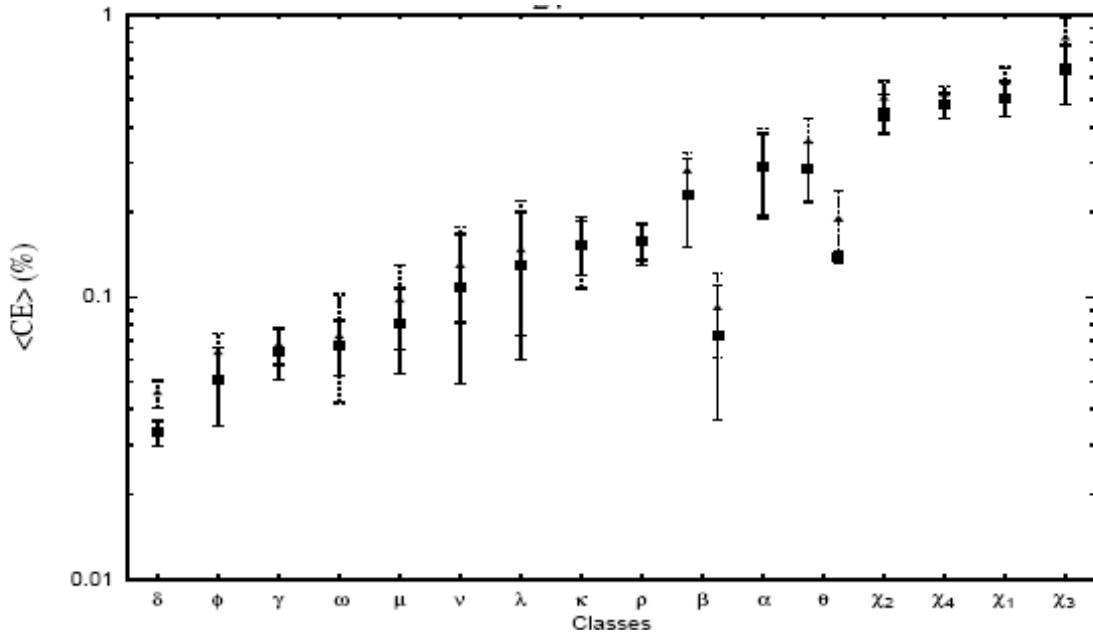


**Research Fellows: A. Chaudhury, B. G. Dutta, P.S. Pal and R. Sarkar**

The timing and spectral analysis of the RXTE data for the object GRS 1915+105 using FTOOLS is done. GRS 1915+105 is the object with changing temporal and spectral properties. So model independent timing analysis has been provided. For a detailed understanding, the data are analyzed dynamically for both temporal and spectral studies. This dynamic approach of analysis enables us to understand the real phenomena happening in the vicinity of the event horizon of the compact object. The calculation of the Keplerian and sub-Keplerian photons dynamically helps us to understand the geometrical variation of CENBOL with time. The ratio of power-law and blackbody photons is named as Comptonization Efficiency (C.E.). Depending upon the variation of C.E. with classes a sequence of evolution of classes can be predicted. We prove below the sequence of the variability classes based on the Comptonizing efficiency. This sequence supports the observed class transitions reported earlier in the journals by our group members.



**Hardness ratio evolution during the outburst of a transient source clearly showing the spectrum becoming softer.**



**Variation of the mean Comptonizing efficiency in all the variability classes of GRS 1915+105. This clearly shows that the average CENBOL size in each class is different. Observed class transitions follow this sequence.**

## X-ray Experiments

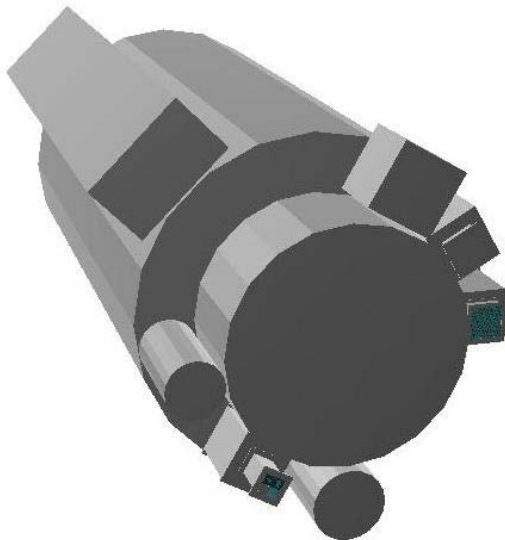


**Top- S.K. Chakrabarti, A. Nandi, V. K. Yadav and D. Bhawmick**

**Bottom - D. Debnath, T. Kotoch, R. Sarkar and S. Palit**

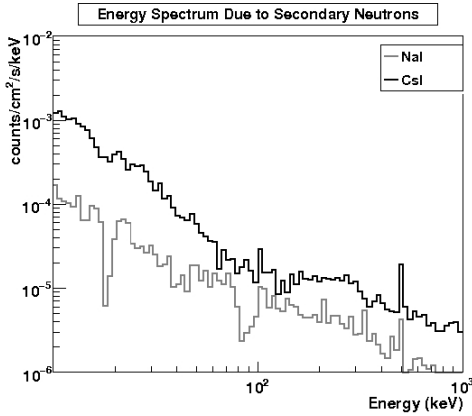
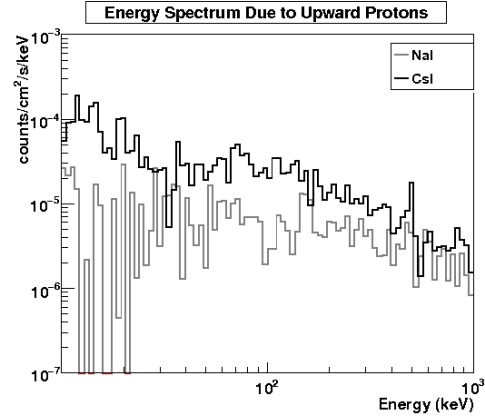
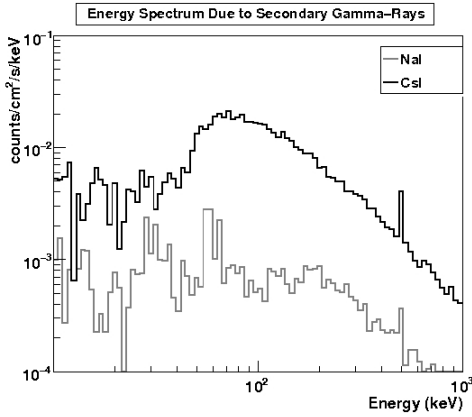
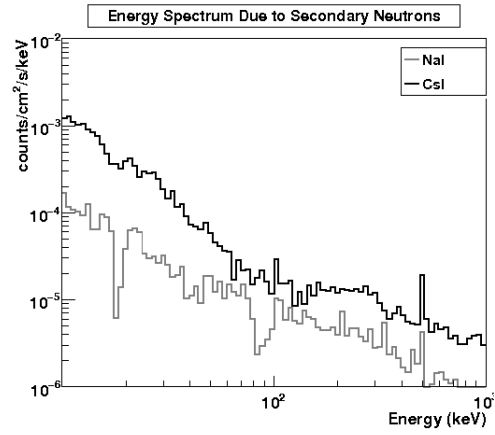
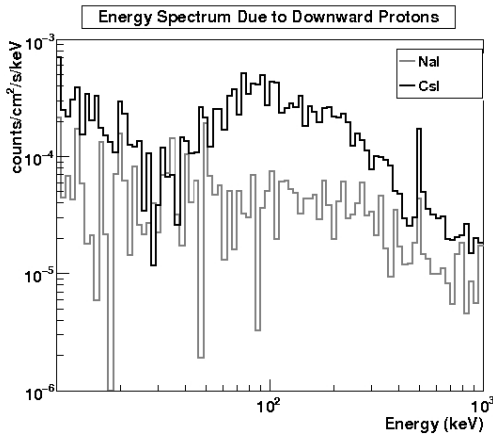


**R.C. Das, H. Roy and U. Sardar**



Due to the low signal to background ratio of the satellite-borne detectors it is essential to properly understand the background behavior in the detector. We studied the effects of major background in the detector considering its position vis a vis the whole satellite. Simulation of RT-2/S, RT-2/G and RT-2/CZT detectors on-board Coronas Photon satellite were carried out. We simulated the detectors in the background environment due to the Cosmic diffused Gamma-Rays, Cosmic Protons and albedo effect due to the Earth atmosphere. We are using the Geant4 Toolkit through the Virtual Monte Carlo simulation interface for this simulation (R. Sarkar).

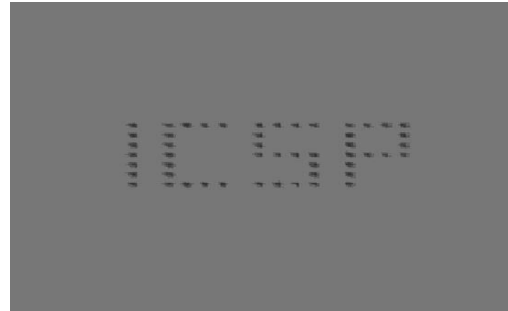
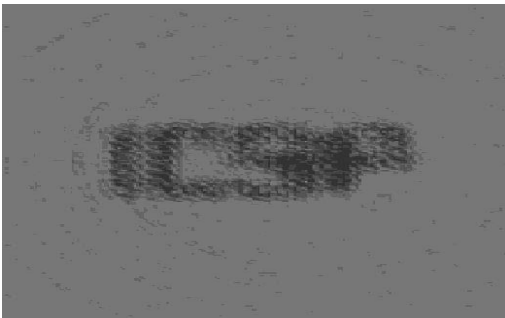
**The solid works rendering of the Coronas Photon Satellite containing three RT-2 detectors along with other Experiments on the satellite (Figure produced by R. Sarkar using the simulation toolkit).**



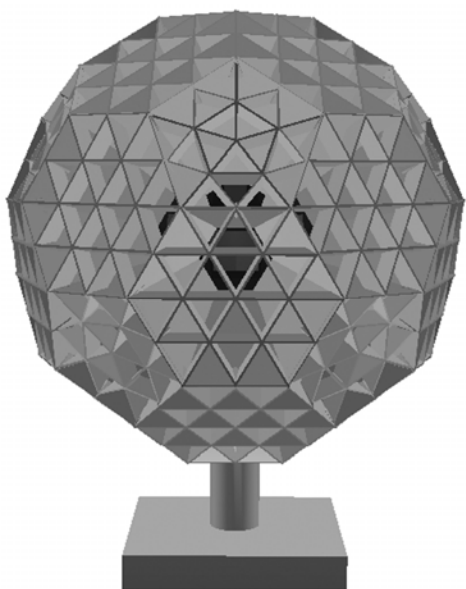
### ***Results of GEANT4 simulations of the RT-2/S payloads in presence of the whole satellite and other payloads.***

Simulations are done extensively on X ray imaging devices, namely Coded Aperture Mask and Fresnel Zone Plate coders. The properties of FZP coders, such as FOV, angular resolution etc. are examined. Modifications are done to improve quality of reconstructed figures by reducing blurring in finite distance case. This makes possible the use of FZP coders in Medical and other finite distance imaging.

Simulations are done with both CZT and CMOS detector modules. Simulations for reconstruction of multiple sources are done. The picture in the left is hazy due to the effect of large PSF in finite distance case.



**(Left) Reconstruction of a distributed source at finite distance from the Fresnel Zone Plate coder. (Right) The front zone plate of the coder is modified to reduce the effect of PSF.**



We carried out a rigorous simulation for the proposed SPHINX (Spectro-Photometry IN X-rays) detector. This detector has a wide field-of-view to survey the whole visible sky from the Moon surface to detect the GRBs, SGRs or Solar events. We find the effects of various shaped collimators on those detectors. We also have simulated the efficiency of the detector to detect the molecular lines from the Moon regolith due to the reflection of the X-rays (Sarkar and Chakrabarti 2010).

#### ***Sphinx detector for a future Lunar mission.***

RT-2 Experiment as a part of Indo-Russian collaborative project of CORONAS-PHOTON Mission was launched into polar LEO (Low Earth Orbit) (~550 km) on 30th January 2009 from Plesetsk Cosmodrome, Russia. Initially, the first few months, the in-flight performance of RT-2 instruments and data verification from the instruments were carried out. The instrument has detected so far four Gamma-Ray Bursts (GRBs) and several solar flares. The analysis of the first solar flare is published whereas the analysis of the other solar flares and GRBs is under process (See, cover figures.) (A.R. Rao [TIFR], S.K. Chakrabarti [SNBNCBS and ICSP], D. Debnath, R. Sarkar)

### **Radio and VLF Astronomy**

We have been conducting VLF related experiments since 2002. Major motivation is to correlate the VLF signals with terrestrial and extra-terrestrial high energy radiations, such as solar flares, GRBs, Soft Gamma Ray repeaters etc. We are also interested in finding possible co-relations between the seismic activities and the ionospheric anomaly.



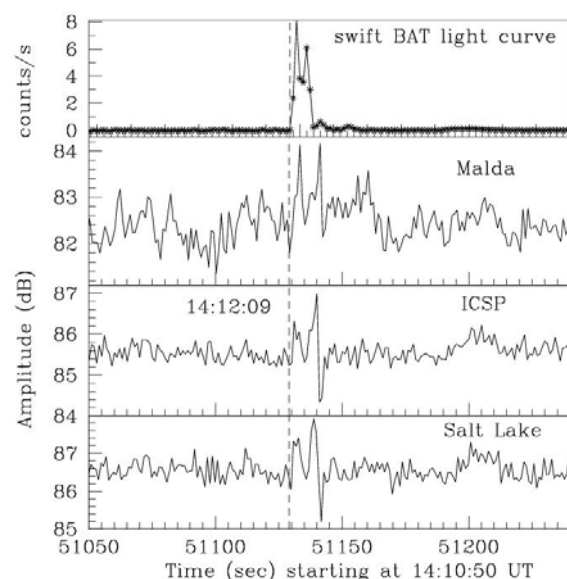
**Top (L to R): S.K. Chakrabarti, S. Chakrabarti, S. Sasmal, S. Mondal**  
**Bottom (L to R): D. Bhowmick, S. Ray, S. Maji**

This group has a diverse interest, from normal monitoring of VLF stations all around the world with SOFTPAL, STANFORD/AWESOME and gyrator type receivers, to find the



relationship between seismic events and ionospheric anomalies, to effects of high energy phenomena such as GRBs, SGRs, solar flares etc.

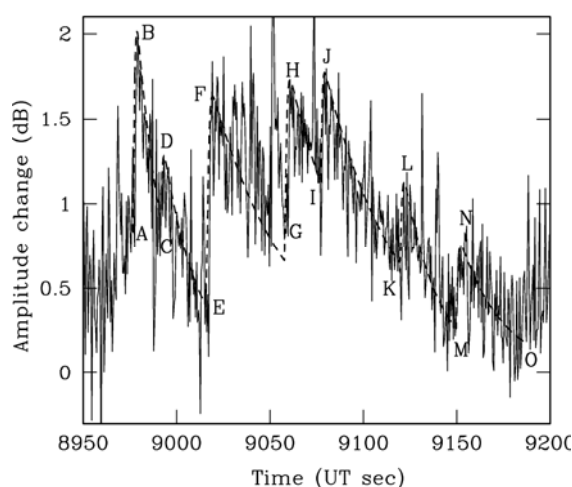
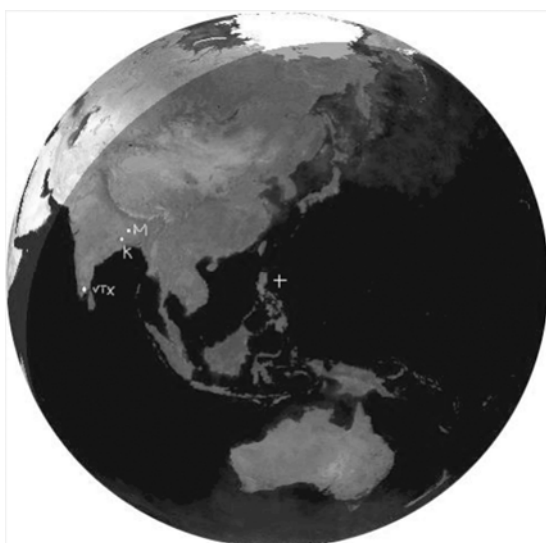
### **Detection of two Gamma Ray Bursts (GRBs)**



Two Gamma Ray Bursts has been detected in ICSP made Very Low Frequency (VLF) receiver while monitoring VTX signal (18.2 kHz). GRB090424 has been detected from three receivers at Salt Lake, ICSP (Garia) & Malda. Salt Lake receiving station is 200 miles away from Malda and 15 miles away from ICSP. The data of SWIFT/BAT satellite is superposed and we see a double peaked structure in the original Gamma ray signal as well (S.K. Chakrabarti, S. Mondal, A. Choudhury, S. Sasmal)

### **VLF detection of GRB090424 from Malda, Salt Lake and ICSP receiving stations.**

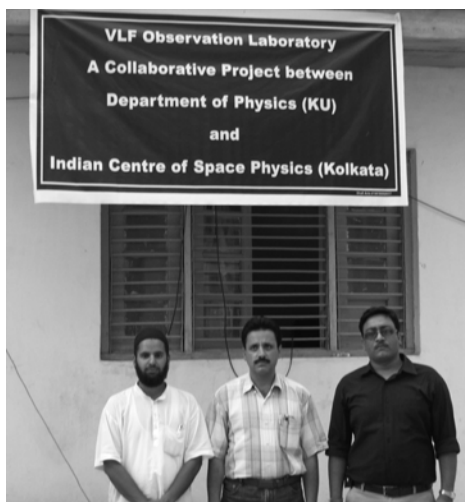
The sub-flare point for the source was (16.83 N, 124.38 E). We found good correlation between the data from different receivers up to about 100 seconds only.



***(Left) Earth's illuminated hemisphere by the GRB090424. The sub-flare point is shown by a cross. M: Malda station, K: Kolkata (ICSP & Salt Lake) station. VTX transmitter is also shown. (Right) Amplitude of the VLF signal perturbed by the repeated bursts of a Soft Gamma Ray Repeater. They are fitted with FRED shapes.***

On April 27, 2009, GRB090427 was detected from two of our receivers at Salt Lake and Pune (~1000 miles away from the former). The sub-flare point (13.5 S, 28.86 E) for the source was in the west of India and hence the effect due to the GRB090427 on VLF data is stronger at Pune than at Salt Lake signal. These findings have been reported in GRB Circular Network (GCN-9316, 9317). [S. Mondal, S.K. Chakrabarti, N. Patra].

We studied the behaviour of the VLF signal from a station as it was perturbed by a soft-gamma-ray repeater (SGR) on 22<sup>nd</sup> January, 2009. We found that 73 times our signal was perturbed which have a well known fast rise and exponential decay (FRED) shapes. This data is analyzed to check the correlation with injected energy (S. Mondal, S.K.Chakrabarti, S. Sasmal).



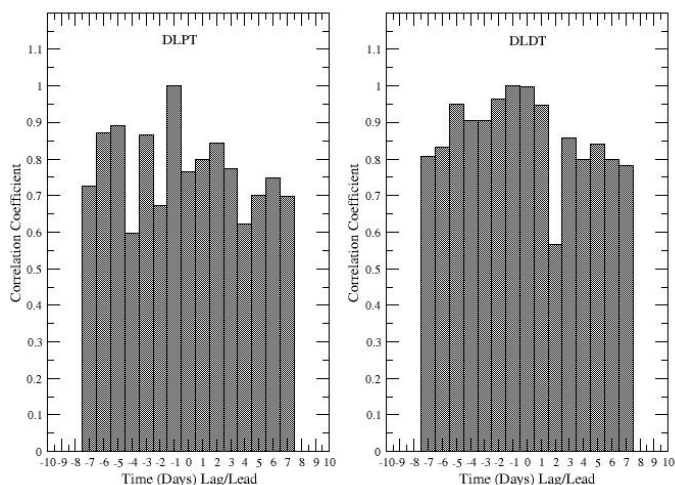
### Seismic Correlation with Ionospheric Anomaly

There have been reports of clear correlations between seismic events and ionospheric and ionospheric anomalies. We have carried out a similar analysis of finding correlations among the terminator times, D-layer preparation time, D-layer disappearance time, night-time fluctuations etc. and found very positive results.

#### ***S. Sasmal with the collaborators on VLF work at Kashmir University.***

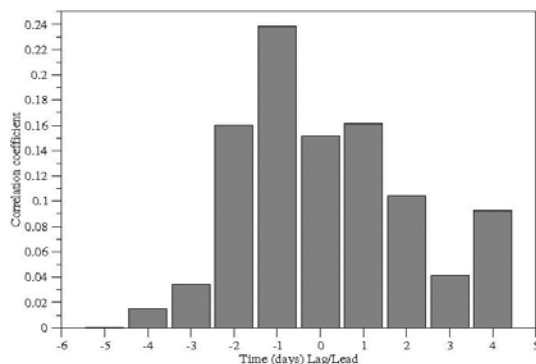
We have collected all the earthquake data around the Indian subcontinent during the period November 2006 to February 2008 and using a statistical analysis we

have observed that the value of the DLPT and DLDT become anomalously high one day before the earthquakes within a radius of 3000 kilometers of the first reflection point of the VLF signal on its way to the receiver. However, this correlation is not very tight (left).



**(Left) The cross correlation between the DLPT and DLDT with the effective magnitude of earthquake indicating the peak is one day before the earthquake.**

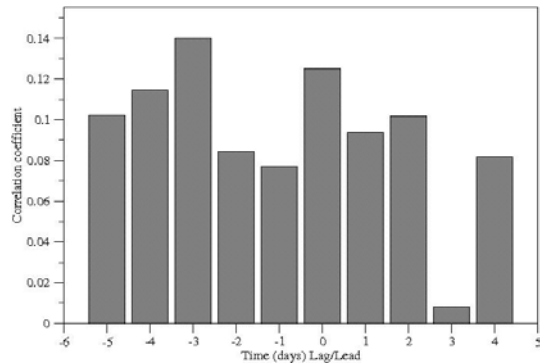
Apart from the statistical analysis we have also done some case by case study to observe the correlations between earthquakes and DLPT/DLDT. We choose some bigger earthquakes with magnitude ( $M > 5$ ) and we have observed that the DLPT becomes anomalously high two days before the earthquakes while DLDT becomes anomalously high on one day before (below).



We have incorporated the depth of the epicenter of the earthquakes and we have checked similar cross correlations and observed that the correlation is better for the shallower earthquakes than the deeper earthquakes.

We also observed that the nighttime fluctuation of the VLF data is also correlated with the magnitude of the earthquake and we found the fluctuation is maximum on three days before the earthquake (S. Sasmal and S.K. Chakrabarti).

Data received at ICSP Malda branch are also analyzed. We have plotted the 'Standardized Calibration Curve' (SCC) of the sunrise and sunset terminators using the four years data. We found that the 'VLF day length' becomes anomalous just few days prior to the earthquake. The correlation coefficient shows that a weak peak appears three days prior to the earthquake (left). We also found the anomalous behaviour of the 'DLPT' (D-layer preparation time) and 'DLDT' (D-layer disappearance time) few days before the earthquake. (S. Ray, S. Mondal, S.K. Chakrabarti)

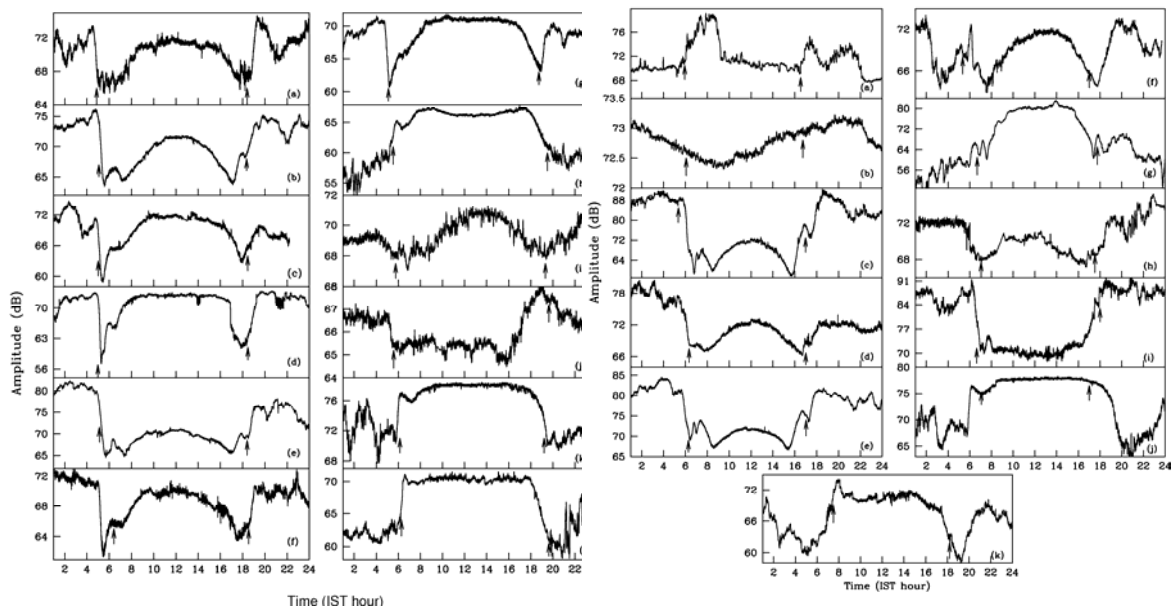


### VLF Observation in Antarctica

ICSP participated in the 27<sup>th</sup> Indian Scientific expedition to Antarctica and obtained excellent data at Maitri station from different transmitters. Our analysis is being completed and the results will be published shortly (S. Sasmal and S.K. Chakrabarti).

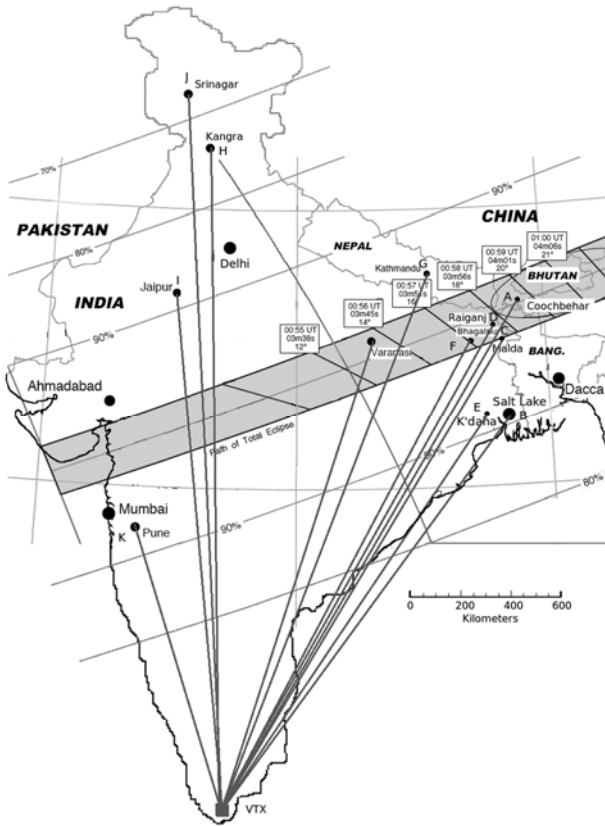
### Multi-station VLF campaigns of ICSP

ICSP organized simultaneous multi-station campaigns all over Indian sub-continent to find the nature of the VLF signals. The goal was to understand whether the mode theory of propagation can explain even in short paths which are less than 3000km. Examples of natures of the signals in Summer and Winter are shown. As is obvious, the signals vary from location to location and in particular, due to East-West propagation effects. Based on the nature of the signals we divide Indian subcontinent in four zones.

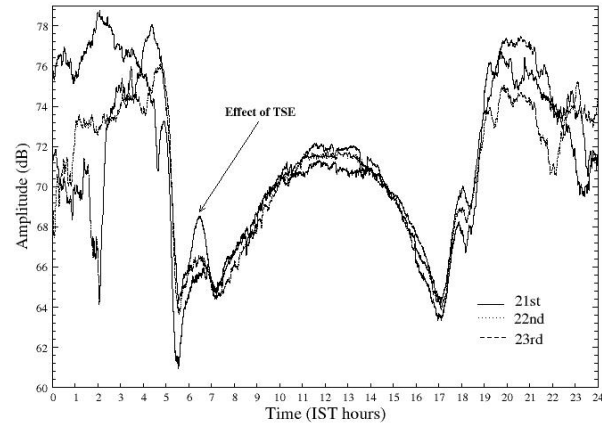


**Sample results of the Signal of 18.2KHz signal from VTX station from stations all over India in summer (left) and winter (right).**

## Campaign during total solar eclipse on July 22, 2009

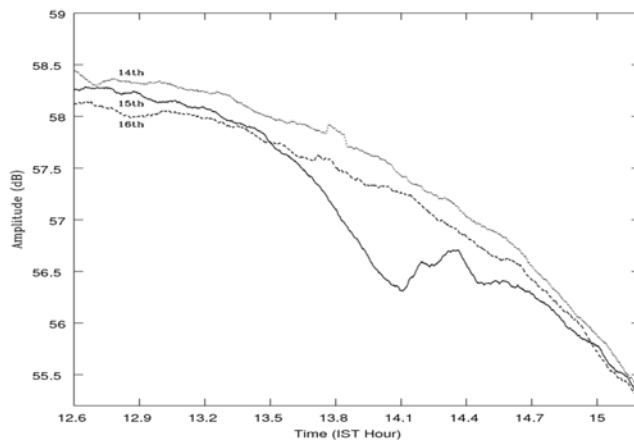


*The effect of TSE on 22<sup>nd</sup> of July, 2009 is clearly seen and the signal is amplified in this ICSP signal when compared to the signals of the previous or the next day (below). The stations (black dots connecting the transmitter) at which VLF data was collected before, during and after Total solar eclipse of 22/7/09 (left).*



ICSP organized a multi-station VLF campaign during the Total Solar Eclipse (TSE) on and around 22<sup>nd</sup> July 2009. We installed the ICSP made VLF antenna/receive system in 13 different places (Two in Kolkata) of India and the data has been successfully recorded.. We have got very good signature of the effect of the eclipse the places like Kolkata, Pune, Malda, Raiganj, etc. On of our receiver was also running in Kathmandu, Nepal during the Campaign and it received good signal. The data analysis is going on. In some places the signal is amplified (as in the Figure) while in other places the signal has been reduced. (ICSP and SNBNCBS VLF team members).

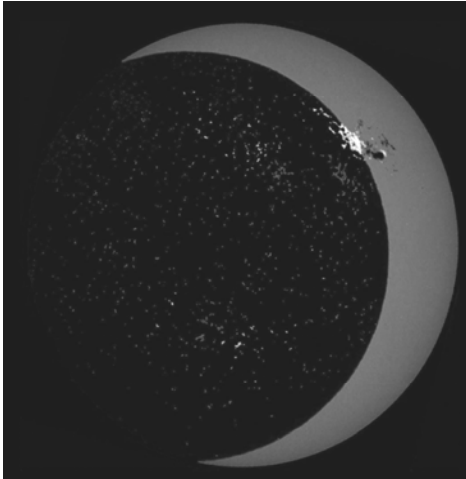
## VLF data during the annual solar eclipse of 15<sup>th</sup> January, 2010



Partial solar eclipse (75%) was observed on January 15, 2010 from Kolkata area. Clear depression in the VLF signal amplitude was observed during the period of partial eclipse. There was also a solar flare (spot no. 1240) on that day reaching maximum to C1.3 (as observed by GOES satellite)

*(Left) Comparison of VLF data on 15<sup>th</sup> January, 2010 (solid) with the one day prior and after the annual eclipse day during the eclipse period.*

at that same time when moon covered the sun. The occultation of the solar



flare by the moon is unique and we are analysing the data (S. Maji, S.K. Chakrabarti, S. Mondal)

*Superposition of the NASA magnetogram data with the optical image (courtesy of Mr. Biswajit Bose, a life member of ICSP) of the sun at the time of maximum occultation. This directly shows the blocking of active region.*

### **Balloon borne experiments**



ICSP has been sending balloon borne equipments to near space environment (20-25 miles) last few years for testing various scientific possibilities. In this year we had three missions (Dignity VII – Dignity IX) sent on the solar eclipse day (22/7/09). Major observations were capturing the shadow of moon passing over the earth, the photos of stratospheric clouds. Various tests relating retrieval of the missions were made. In particular all the three payloads were recovered successfully. Photos from the payload are on the cover pages.

*Dignity VII mission with a parachute and payload (left)*

*A panoramic view of the earth below from Dignity-VII camera just before totality of eclipse (below).*



## **Airglow and Ozone Depletion studies**



***J.N. Chakravorty, D. Bhaumik, S.K. Midya, R. Chattopadhyay and P.K. Jana***

Airglow and Ozone depletion activities are conducted mostly by the visiting and honorary scientists of ICSP. This year setting up of new equipments are planned for balloon borne studies. The activity includes the study of the effects of solar parameters on the airglow emission lines. Other work includes the study of variation of Ozone over India and Antarctica. It is recently shown that sharp depletion of absolute humidity may be one possible method of predicting Nor'wester.

## **ICSP teaching programme & Service to University/Colleges**

ICSP has been contributing to human resource development by nurturing college and school teachers to continue research works. Indeed, many of its visiting research fellows and honorary scientists are from University/college/school sectors. Several papers in international Journals were published by these scientists and many are working towards their Ph.D. degree. ICSP is recognized by Calcutta University, a premiere University of the country. One college teacher is studying at ICSP under Faculty Improvement Programme (FIP).

ICSP is developing its teaching programme for the MSc and Post-MSc students. Last several years its course on Astrophysics and Cosmology is taken by R.K.M.R. College (Autonomous) students. Its scientists also gave series of lectures as a part of course at nearby Institutes.

Each year ICSP receives several M.Sc. students who wish to complete their mandatory project course. In 2009-2010, seven such Physics postgraduate students whose projects include studies of Ionosphere, Interstellar space, Stars, Gamma ray bursts (GRBs), Solar flares, etc. These various projects are as follows:

1. Bondi Accretion on a Newtonian Star – Pinaki Kayal and Suvadip Pan with Prof. Sandip K. Chakrabarti.
2. Ionospheric Absorption of Radiation due to Gamma Ray Bursts – Subrata Dhara and Sumanto Mondal with Mr. Sushanta Mondal.
3. Ionospheric Absorption of Radiation from a Solar Flare – Debashis Saha and Sandip Chakraborty with Mr. Sushanta Mondal.
4. Recombination Efficiency of Molecular Hydrogen on Interstellar Grains – Kishalay De with Dr. Ankan Das.

## **Major Conferences and Workshops at ICSP**

A workshop on Very Low Frequency Radio Waves was organized at ICSP during Sept 11<sup>th</sup> and Sept 12<sup>th</sup>, 2009. There were altogether eight lectures on various aspects of propagation.

ICSP scientists participated in a very significant way several major International conferences: (a) The 12<sup>th</sup> Marcel Grossman conference on general relativity and cosmology took place in Paris (July, 2009) Mr. P.S. Pal and S.K. Chakrabarti attended the conference. (b) Stanford/AWESOME conference on VLF took place in Sharjah (Feb. 2010). S. Sasmal, S. Choudhury, S. Mondal, S.K. Chakrabarti attended the conference. (c) Very Low Frequency Radio Waves: Theory & Observations (VELFRATO-10) took place at SNBNCBS (March, 2010). S. Mondal, T. Kotoch, A. Nandi, S. Sasmal, S. Maji, S. Ray, D. Bhawmick and S.K. Chakrabarti participated and presented talks at this conference. (d) Origin of Life conference took place at IIT/Roorkee (March, 2010). A. Das, S.K. Chakrabarti, S. Chakrabarti attended the conference.



*(Top left clockwise): S. Sasmal, S. Maji, S. Mondal and D. Bhowmick at VELFRATO-10.*

## **ICSP Foundation Day Celebration**

ICSP celebrated its 10<sup>th</sup> anniversary on December 9, 2009 at Yuba Kendra Auditorium, Moulali, Kolkata from 4–7 PM. A programme titled “A Decade of Achievements” was organized on this occasion. The vice president of State Council of Higher Education presided over the meeting. After the welcome address by Dr. Dipak Bhaumik, Treasurer





ICSP, Dr. J.N. Chakravorty, Vice-President ICSP, narrated "A brief history of ICSP". Mr. Asit Choudhury, Secretary, ICSP Malda branch talked about "ICSP's contribution to Popularization of Space Science". Prof, Sandip K. Chakrabarti, In charge Academic Affairs and Secretary, ICSP described "Some Highlights of Scientific Research at ICSP". Mr. Tilak Kotoch, Senior Research fellow conducted the whole programme.



A series of Scientific Talks of popular level were also organized on this occasion. Mr. Sudipta Sasmal, an active member of ICSP VLF group, started the series with "From ICSP to Antarctica: For the sake of Science!" Dr. Anuj Nandi, Scientist/Engineer – SD deputed from Space Science Division, ISRO Headquarters, continued the series with "Space Exploration by Satellites – An ICSP perspective". Prof. Sandip K. Chakrabarti further extended the series with "Science in near space environment – An ICSP initiative". Prof. J.N. Chakravorty presented



mementos to all ICSP staff members and life members present in the occasion. Dr. Vipin K. Yadav, Scientist/Engineer – SD deputed from Space Science Division, ISRO Headquarters, gave the vote of thanks in the end to wind up the programme.

*(From T to B): C.B. Singh, A. K. Choudhury and V. Yadav taking mementos from the Vice president Prof. J.N. Chakravorty. T. Kotoch, a Senior Research Fellow is the announcer.*

### All Work and No Play!



*(Left) ICSP staff and students at the Firoz Minar, Gour (Malda) when they attended the space science symposia organized by Malda Branch of ICSP at Malda College Auditorium and watched the Leonid Meteor shower the night before. (Right) ICSP scientists and students in a relaxing mood at the Sundarban tiger reserve just after VELFRATO-10 conference.*



### **Activities of the Indian Centre for Space Physics, Coochbehar Branch**

The Coochbehar branch, mainly carry out popularization programme in remote parts of Coochbehar district in particular and the districts of upper North Bengal. 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. They arranged the VLF observations from Coochbehar during the total solar eclipse campaign around 22<sup>nd</sup> of July, 2009.

### **Activities of the Indian Centre for Space Physics, Malda Branch**

The Malda Branch of Indian Centre for Space Physics organized various types of scientific activities along with research work since its inception. It has a VLF antenna and a receiver to continue their research on VLF sources and sudden atmospheric disturbances as well as lightning and earthquake. Some students are engaged in analysis of data obtained from IXAE instrument from Indian satellite IRS-P3 and RXTE. Several scientific papers on class transitions and earthquake have been published in this year. A. K. Choudhury attended the VLF workshop at ICSP, Sharjah meeting and VELFRATO-10 meetings on VLF. A. Chatterjee, N.M. Nandy attended VELFRATO-10 meeting and presented talks. The Malda branch organized a one day symposium at Malda College Auditorium where several lectures (Near Space experience of ICSP by S.K. Chakrabarti; Antarctica trip experience by S. Sasmal) were presented.

Some of the members participated in the VLF campaigns, and all the workshops, annual general body meetings etc.

### **Corresponding Address for Malda branch:**

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

### **Co-ordinating Body of the Malda Branch of the Centre**

Dr. Achintya K. Chatterjee, <i>President</i>	Mr. Kankar Bandopadhyay, <i>Vice President</i>
Mr. Asit K. Choudhury, <i>Secretary</i>	Mr. Subhankar Das, <i>Treasurer</i>
Mr. Zahirul Islam, <i>Member</i>	Mr. Gobinda Chandra Mandal, <i>Member</i>
Mr. Nilmadhab Nandi, <i>Member</i>	Mrs. Sutapa Chatterjee, <i>Member</i>
Mr. Utpal Chatterjee, <i>Member</i>	

**AUDITOR'S REPORT TO THE MEMBERS**

1. We have audited the attached Balance Sheet of Indian Centre for Space Physics, 43, Chalandika, Garia Station Road, Kolkata 700 084 as at March 31, 2010 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 from 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 law have been kept by the Indian 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 accounts.
  - 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 at March 31 2009 and
    - ii. In the case of Income and Expenditure Account of the surplus of the Centre for the year ended on that date.

P.K. Chakravorty & Associates  
Chartered Accountant

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

P.K. Chakravorty, Proprietor  
M.No. 5170I  
Place: Kolkata  
Date: 29<sup>th</sup> Sept'2010  
F/52, Bapuji Nagar, PO: Regent Estate  
Kolkata 700 092

Sd/- D. Bhaumik  
Honorary Treasurer, Indian Centre for Space Physics

Sd/- B.B.Bhattacharyya  
Honorary President, Indian Centre for Space Physics

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 Accountant

(P.K. Chakravorty)  
Proprietor  
M.No. 5170I  
F/52, Bapuji Nagar, PO: Regent Estate  
Kolkata 700 092

Place: Kolkata  
Date: 29<sup>th</sup> Sept'2010

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

Sd/- D. Bhaumik  
Honorary Treasurer, Indian Centre for Space Physics

Sd/- B.B.Bhattacharyya  
Honorary President, Indian Centre for Space Physics

**INDIAN CENTRE FOR SPACE PHYSICS**  
**43 Chalandika, Garia Station Road**  
**Kolkata-700084**

**BALANCE SHEET AS AT 31.03.2010**

SOURCE OF FUNDS	Schedule	As on 31.03.2010	As on 31.03.2009
		Amount (Rs.)	Amount (Rs.)
Capital Funds	1	4019759.00	3945140.00
Loan Funds	2	73946.00	67046.00
<b>TOTAL</b>		<b>4093705.00</b>	<b>4012186.00</b>
<b>APPLICATION OF FUNDS</b>			
Fixed Assets			
Gross Block	3	2027210.00	1267131.00
Less: Depreciation		511735.00	329219.00
<b>Net Block</b>		<b>1515475.00</b>	<b>937912.00</b>
<b>Current Assets, Loans &amp; Advances:</b>			
Security Deposit		5100.00	5100.00
Cash & Bank Balances	4	3675424.00	3624951.00
Dues from funding agencies	4A	190657.00	1097376.00
<b>Total</b>		<b>3871181.00</b>	<b>4727427.00</b>
Less: Current Liabilities	5	1010500.00	364327.00
Less: Unspent during the year	9	282451.00	1288826.00
<b>Net Current Assets</b>		<b>2578230.00</b>	<b>3074274.00</b>
Miscellaneous Expenditure to the extent not written off	6	0.00	0.00
		<b>4093705.00</b>	<b>4012186.00</b>
Schedules referred to above from an integral part of the Balance Sheet As per our Annexed Report of even date			
P.K. Chakravorty & Associates Chartered Accountant	Sd./- S.K.Chakrabarti Honorary Secretary, Indian Centre for Space Physics		
	Sd./- D.Bhaumik Honorary Treasurer, Indian Centre for Space Physics		
(P.K.Chakravorty) Proprietor Place: Kolkata Date: 29th Sept. 2010	Sd./- B.B.Bhattacharyya Honorary President, Indian Centre for Space Physics		

**INDIAN CENTRE FOR SPACE PHYSICS**  
**43 Chalanika, Garia Station Road**  
**Kolkata-700084**

**INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2010**

	Schedule	As on 31.03.2010 Amount(Rs.)	As on 31.03.09 Amount(Rs.)
<b>INCOME</b>			
Income	7	3996502.00	3940323.00
		<b>3996502.00</b>	<b>3940323.00</b>
<b>EXPENDITURE</b>			
Administrative & Other Expenses	8	3739367.00	3203598.00
Preliminary Expenses written off		0	1236.00
Depreciation		182516.00	71645.00
		<b>3921883.00</b>	<b>3276479.00</b>
Excess of Income Over Expenditure		<b>74619.00</b>	<b>663844.00</b>
Surplus(Deficit) brought forward from the earlier year		3928640.00	<b>3264796.00</b>
Balance transferred to the Balance Sheet		<b>4003259.00</b>	<b>3928640.00</b>
Notes on Account	10		
Significant Accounting Policies	11		
Schedules referred to above from an integral part of the Balance Sheet As per our Annexed Report of even date			
P.K. Chakravorty & Associates Chartered Accountant	Sd./- S.K.Chakrabarti Honorary Secretary, Indian Centre for Space Physics		
	Sd./- D.Bhaumik Honorary Treasurer, Indian Centre for Space Physics		
(P.K.Chakraborty) Proprietor Place: Kolkata Date: 29th Sept. 2010			
	Sd./- B.B.Bhattacharyya Honorary President, Indian Centre for Space Physics		

<b>INDIAN CENTRE FOR SPACE PHYSICS</b> <b>43 Chalantika, Garia Station Road</b> <b><u>Kolkata- 700084</u></b>		
	<b>As on 31.03.2010</b> <b>Amount (Rs.)</b>	<b>As on 31.03.2009</b> <b>Amount (Rs.)</b>
<b><u>Schedule -1</u></b>		
<b>Capital Fund</b>		
Life Membership Fees	16500.00	16500.00
Balance Transferred from		
Income & Expenditure Account	4003259	3928640.00
<b>TOTAL</b>	<b>4019759.00</b>	<b>3945140.00</b>
<b><u>Schedule -2</u></b>		
<b>Loan Fund</b>		
Loan from Directors	73946.00	67046.00
<b>TOTAL</b>	<b>73946.00</b>	<b>67046.00</b>
<b><u>Schedule-4</u></b>		
<b>Cash &amp; Bank Balances</b>		
Cash in hand	121.20	154.20
Fixed Deposit at Axis Bank, Salt Lake	3666254.00	3341878.00
UBI, Purbachal#2056	0.00	223089.49
UBI, Purbachal#2471	0.00	6322.79
Axis Bank Ltd, Salt Lake	660.00	47361.00
Malda Dist. Central Co-op Bank Ltd.	8389.00	6146.00
<b>TOTAL</b>	<b>3675424.00</b>	<b>3624951.00</b>
<b><u>Schedule-4A</u></b>		
<b>Loans &amp; Advances</b>		
ICTP Fellow	43136.7	0.00
DST Projects	0.00	36869.00
Advance to Employees	69950.00	1690.00
CSIR Fellows	77570.00	117792.00
ISRO Projects	0.00	941025.00
<b>TOTAL</b>	<b>190657.00</b>	<b>1097376.00</b>
<b><u>Schedule-5</u></b>		
<b>Current Liabilities</b>		
Audit Fees	7000.00	7750.00
Liability for Development		
For Projects	1003500.00	356577.00
Equipment from project		
<b>TOTAL</b>	<b>1010500.00</b>	<b>364327.00</b>
<b><u>Schedule-6</u></b>		
<b>Miscellaneous Expenditure</b>		
( To the Extent not written off )		
Preliminary & Pre-operative Expenses	0.00	1236.00
Less: Written off during the year	0.00	1236.00
<b>TOTAL</b>	<b>0.00</b>	<b>0.00</b>
<b><u>Schedule-7</u></b>		

<b>Income</b>		
Grant-In-Aid	3466994.00	3240334.00
Overhead recovery from project	112600.00	267700.00
Equipment recovery from project	0.00	0.00
Guest House Rent	37800.00	61900.00
Registration Fees	0.00	13000.00
Interest & other Income	280668.72	317509.00
Donation	0.00	19636.00
Misc. Income	98439.00	20244.00
<b>TOTAL</b>	<b>3996502.00</b>	<b>3940323.00</b>
<b><u>Schedule-8</u></b>		
<b>Administrative &amp; Other Expenses</b>		
Fund draw for Project Expenses	1848020.00	2372562.00
Salaries	349120.00	139180.00
Office Expenses	314375.00	211746.00
Postage	19391.00	2651.00
Travelling & Conveyance	81594.00	205888.00
Telephone, Fax & Internet	109123.00	84020.00
Stationary, Consumables & Printing	10558.00	14640.00
Filing Fees	2080.00	200.00
Bank Charges	1114.00	756.00
Rent & Electricity	111531.00	104731.00
ICSP Development	48000.00	48000.00
Accounting charges	0.00	9000.00
Provision for expenses	837188.00	0.00
Miscellaneous Expenses	3273.00	4474.00
Audit Fees (For Statutory Audit)	4000.00	5750.00
<b>TOTAL</b>	<b>3739367.00</b>	<b>3203598.00</b>
<b><u>Schedule-9</u></b>		
<b>Unspent During the Year</b>		
DST Projects	0.00	298207.00
ISRO Projects	282451.00	850219.00
CSIR Projects	0.00	0.00
ICTP Fellowship	0.00	140400.00
<b>Total unspent (committed) during the year</b>	<b>282451.00</b>	<b>1288826.00</b>

#### Schedule – 10 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.

## Schedule – 11 **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-member-ship fees as capital receipts.
- c) Preliminary expenses and deferred Revenue Expenditure are chargeable 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.

P.K. Chakravorty & Associates  
Chartered Accountant

(P.K. Chakravorty)  
Proprietor  
M.No. 5170I  
F/52, Bapuji Nagar, PO: Regent Estate  
Kolkata 700 092

Place: Kolkata  
Date: 29<sup>th</sup> Sept'2010

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

Sd./- D.Bhaumik  
Honorary Treasurer, Indian Centre for Space Physics

Sd./- B.B.Bhattacharyya  
Honorary President, Indian Centre for Space Physics