हरीश-चन्द्र अनुसंधान संस्थान

Harish-Chandra Research Institute

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वार्षिक प्रतिवेदन

Annual Report
(2012-13)

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About the Institute

Early Years

The Harish-Chandra Research Institute is one of the premier research institutes in the country. It is an autonomous institute fully funded by the Department of Atomic Energy, Government of India. Till October 10, 2000 the Institute was known as Mehta Research Institute of Mathematics and Mathematical Physics (MRI) after which it was renamed as Harish-Chandra Research Institute (HRI) after the internationally acclaimed mathematician, late Prof Harish-Chandra.

The Institute started with efforts of Dr. B. N. Prasad, a mathematician at the University of Allahabad, with initial support from the B. S. Mehta Trust, Kolkata. Dr. Prasad was succeeded in January 1966 by Dr. S. R. Sinha, also of Allahabad University. He was followed by Prof. P. L. Bhatnagar as the first formal Director. After an interim period in January 1983, Prof. S. S. Shrikhande joined as the next Director of the Institute. During his tenure the dialogue with the Department of Atomic Energy (DAE) entered into decisive stage and a review committee was constituted by the DAE to examine the Institute's future. In 1985 N. D. Tiwari, the then Chief Minister of Uttar Pradesh, agreed to provide sufficient land for the Institute and the DAE promised financial support for meeting both the recurring and non-recurring expenditure. In January 1990, about 66 acres of land was acquired in Jhunsi, Allahabad and the Institute came up at this site.

Prof. Shrikhande was followed by Prof. H. S. Mani who took over as the Director in January 1992. With his joining and the shift to the new campus at Jhunsi in 1996, the Institute's activities picked up pace. This phase of rapid growth still continues.

New Phase

After a distinguished tenure of about nine years Prof. Mani retired in August 2001 and the charge was taken over by Prof. R. S. Kulkarni. After Prof. Kulkarni's tenure, Prof. Amitava Raychaudhuri was the Director from July 19, 2005 to May 15, 2011. Prof. Jayanta Kumar Bhattacharjee, the current Director, took over in April 29, 2012. The Institute continues to be devoted to fundamental research in diverse areas of mathematics and theoretical physics. Research is carried out by faculty members, visiting members, post-doctoral fellows and Ph. D. students.

Since 1992 the Institute has attracted worldwide attention, as is evident from the recognition received by many of its members. Several members of the Institute have been recognised for their scientific contribution. Prof. B. Mukhopadhyaya, Prof. Pinaki Majumdar, Prof. Rajesh Gopakumar and Prof. Ashoke Sen have been awarded the S.S. Bhatnagar prize for work done at HRI. Prof. Gopakumar has also received the Swarnajayanti Fellowship of the Department of Science & Technology and the ICTP Prize for 2006. The outstanding contribution of Prof. Ashoke Sen has been recognised by a Fellowship of the Royal Society, the award of Padmashri and Padmabhushan and the award of one of the first Fundamental Physics Prize (2012) from the Yuri Milner Foundation. He was the only recipient of the prize from all of Asia.

Research in Mathematics

The mathematics group at HRI carries out research in several areas. In algebra, work is done on algebraic groups and related structures, the theory of groups and group rings, representation theory, and infinite-dimensional Lie algebras. Work in analysis is in the field of harmonic analysis of Lie groups.

Activity in geometry includes discontinuous groups and Riemann surfaces, algebraic topology, variational problems on manifolds, Chow groups of rational surfaces, and moduli of vector bundles. The number theory group works on algebraic, analytic and combinatorial number theory, automorphic forms and cryptography.

Research in Physics

Research in Physics at HRI is carried out in the fields on astrophysics, condensed matter physics, quantum information and computing, high energy phenomenology and string theory. In astrophysics, work is done on the cosmic microwave background, large scale structure formation and galaxy evolution. Main areas of activity in condensed matter physics are strongly correlated electron systems, mesoscopic systems, quantum Hall effect and superconductivity. In string theory, perturbative and non-perturbative aspects of string theory and quantum field theory are being actively investigated. Research in neutrino physics, strong interactions, lattice gauge theory, supersymmetry and various aspects of physics beyond the standard

model is done in high-energy phenomenology. The Institute is a member of the India-based Neutrino Observatory (INO) collaboration.

The Institute has a residential campus in Jhunsi, Allahabad with a library, state of the art computational facility and fast Internet link to the outside world. There is an active graduate program and a large traffic of visiting scientists and students.

Director's Report

Even by the rather high standards of HRI, 2012-2013 was an exceptional year. Prof Ashoke Sen was among the first nine recipients of the newly instituted "Fundamental Physics Prize" in July 2012. This prize funded by the Russian entrepreneur Yuri Milner honours theorists who have made absolutely outstanding contributions. It recognizes the fact that the Nobel prize which is considered the biggest recognition, is often not a viable option for the theorist. This is because unless there is experimental corroboration, a theorist's contribution is generally sidelined and often there is a long gap between a prediction and its experimental realization. In the case of Bose Einstein condensation this gap was about 75 years, for the Higgs boson about 50! So it is necessary to have a different yardstick for the theorist and thus the first installment of this award recognized theorists who are literally household names and Prof Sen was among this set of theorists. In the beginning of 2013, Prof Arun Pati of the newly constituted quantum information group of HRI was elected fellow of the Indian Academy of Sciences, Bangalore and as the republic day came along , the Government of India bestowed the Padma Bhushan award to Prof Ashoke Sen, completing a dream year for HRI so far as recognitions go.

Academic activities remained as vibrant as ever with important publications in physics and mathematics. The increasing number of students and post doctoral fellows from across the country and across the world is an adequate testimony to the regard in which HRI is held in the academic community. The number of short term visitors also keeps on increasing every year and is an excellent indicator of the standing of HRI. With the admissions in the post BSc and post MSc programmes this year, the number of students has crept up quite close to the three figure mark. The Triveni lecture for the year was given in December 2012 by Prof Klaus Von Klitzing of the Max Planck Institute for Solid State Research in Stuttgart, Germany. Prof Klitzing, who discovered the quantum Hall effect spoke on "News from Quantum Hall Physics". The Giridharilal lecture for the year was also held in Dec 2012 and was delivered by Prof Fernando Quevedo who is currently the director of ICTP,Trieste. He spoke on "The large Hadron Collider, our Universe and String Theory". The winter months , this year, were dominated by the 8 week-long maha kumbh celebrations just outside the institute boundary and hence prevented the holding of large scale conferences /schools which are the norm for this time of the year. A short instructional school in high energy physics was held in March 2013. The INSA S.N. Bose lecture was arranged

in HRI and the lecturer was Prof S M Roy, formerly of TIFR. In summer the SPIM (Summer program in mathematics) program was conducted as usual. This program for college students which exposes them to learning mathematics by thought and reason is extremely popular and draws students from neighbouring countries as well. The visiting student program (VSP) for physics students (undergraduates primarily) has been so popular that it has been introduced at other times of the year, apart from the usual summer months. A week long science program in Hindi has also been conducted, as usual, to help local students get a real feel for scientific logic.

As in other years, HRI conducted Science Talent Tests in mathematics and physics for school students in the Allahabad area. Students of 10^{th} and 12^{th} grade from various schools in Allahabad appeared for this test. The toppers were awarded prizes in a special function organized in HRI, which this year was held on February 20, 2013. The chief guest for the occasion was Prof. Rupamanjari Ghosh of JNU, presently the vice chancellor of SMU, who gave a popular lecture on light and lasers.

On the construction front the year started with a bang but ended with a whimper. Thanks to a huge amount of effort put in by the engineering section, the engineering building and the extension of the community centre could be inaugurated by the DAE secretary and AEC chairman Prof. Ratan Sinha in August 2012. The married students quarters were as nearly ready as possible by the end of 2012. The work on the six storey student hostel was progressing at a rapid rate and was headed for providing at least a partial occupation to the students who entered in 2013. The contract for constructing an extension to the guest house and a state of the art conference centre was given to DCSEM. When things were really looking up on this front, all construction had to be halted by an order passed by the Allahabad High Court in a public interest litigation of 2006 about the pollution of Ganga. This order prohibits any construction within 500 metres of the bank of the river. The stalemate in construction persists as this report is written.

In the quest to improve the scientific infrastructure, HRI has recently installed a 50-node parallel cluster with high speed interconnect. The benchmarks indicate that it is currently the 22^{nd} fastest supercomputer in India. It will be used for solving problems in materials theory, quantum information and high energy physics.

This year has also been marked by the visit of several high profile visitors on the administration front. In August 2012, the DAE secretary visited HRI to felicitate Prof. Sen on his receiving the "Fundamental Physics Prize". In January 2013, the parliamentary standing committee for science and technology, environment and forests, visited HRI and interacted with the faculty members in a friendly and open environment. In February 2013, the Member, Finance of DAE visited HRI and had a long discussion with the faculty members.

There have been some changes on the personnel front. Dr. Tirthankar Roy Choudhury has resigned to stay on in NCRA, Pune. Prof. Ravindran has been given lien to join IMSc., Chennai. Dr. Santosh Rai and Dr. Anshuman Maharana have joined the physics faculty while Dr. Hemangi Shah is expected to join the maths faculty soon. Mr. K.S. Shukla of the library has retired in the course of the year.

Important Achievements of the Institute

Yuri Milner Prize

Prof. Ashoke Sen was awarded the first Yuri Milner Fundamental Physics Prize in 2012. It should be understood that often theorists fail to win the Nobel Prize inspite of path breaking contributions because it is necessary for the theory to be corroborated by experiments before the prize is awarded. It has taken 50 years to get a tentative signature of the Higgs boson after it was predicted! The Yuri Milner prize was instituted to honour outstanding theorists whose work has changed the course of investigations in different areas of theoretical physics even if they have not been experimentally realized till now.

It should also be mentioned that in 2013, the Government of India recognized the contributions of Prof. Sen through the "Padmabhushan" award.

Prof. A.K. Pati has been elected a Fellow of Indian Academy of Sciences, Bangalore.

High Energy Physics

In July 2012, it was announced that the Large Hadron Collider (LHC) has seen signature of the Higgs boson. So is it the beginning or the end? In the first publication from India after the announcement, HRI scientists, in an internationally acclaimed work, carried out a multichannel global analysis of all data from ATLAS, CMS and the Tevatron experiment to see how much scope exists for deviation from the standard model scenario. The conclusion is that there are enough avenues to explore, an example being the couplings of the observed scalar with up and down fermions. It is also worth mentioning that one of the most important works pertaining to LHC physics which discusses higher order corrections in the total cross section for Higgs Boson production in hadron collisions has also come from HRI.

HRI scientists have taken a leading role in the collaboration between Indian institutions and the Fermilab, USA. This is reflected particularly strongly in the HRI participation in the long baseline neutrino experiments (LBNE) where scientific contributions of HRI faculty have played a pivotal role.

String Theory and Related Areas

A large number of internationally recognized works on formal aspects of quantum gravity and quantum field theory and the interplay of formal developments with the real life world of cosmology, particle physics and condensed matter physics has come out of HRI in the past year . A particular development on the formal front makes very specific predictions about the leading correction term to the area law of black hole entropy. This correction has to be reproduced by any admissible theory of quantum gravity and thus acts as a filter for limiting the class of viable theories. As other examples of formal developments that have originated in HRI are techniques to simplify calculation of scattering amplitudes in gauge theories, higher derivative corrections to string theory and a fresh look at gauge gravity duality through the stochastic quantization procedure.

A formal development with a practical import that has been initiated and carried forward in HRI is a duality between a class of two dimensional quantum field theories and generalized gravitational theories. What is unique here is that this duality involves non super symmetric realistic theories and thus opens the door to bringing condensed matter physics within the ambit of such duality. An application to strange metals in one dimension sets the stage for future developments. Application of formal string theory to practical issues in cosmology and hydrodynamics constitute an equally vital part of HRI contributions.

Condensed Matter Physics

One of the more striking pieces of condensed matter research in the recent past has involved HRI theorists. This is the discovery of magnetic superatoms. Cluster of atoms that mimic the properties of single atoms in assemblies are termed superatoms. Nonmagnetic superatoms have been known for a while and they are useful for designing materials whose electronic properties can be tuned. Discovery of these magnetic superatoms has paved the way for designing materials whose electrical as well as magnetic properties can be tuned.

Quantum Information

One of the most fundamental properties of quantum entanglement is the concept of monogamy. In its extreme form it asserts that if two qubits A and B are maximally quantally correlated they cannot be correlated with a third qubit at all. In less than ideal situations it means that if two parties share a large amount of some quantity then they cannot share a significant amount of it with others. This is a requirement in quantum cryptography and HRI scientists have recently established an important result which asserts that if A has a quantum advantage in sending a classical information to B, then she can have no quantum advantage in sending the same to C.

Quantum information devices almost always operate on quantum many body system substrates. In understanding the flow of classical and quantum information in quantum many body systems scientists of HRI have been playing a pioneering role. The recent work on quantum information aspects of non equilibrium many body systems and resonating valence bond systems is an important contribution.

The HRI-IISc collaboration in theory and experiments related to quantum information has been particularly fruitful. The most striking result has to do with the no hiding theorem which asserts that the information missing from one system must be residing somewhere else in the universe. The missing information cannot be hidden in the correlation between the system and its environment. The very first experimental verification of this theorem involved HRI theorists and IISc experimentalists.

Astrophysics

The recent focus of the astrophysics program in HRI has been the study of analogue gravity in the area of accretion flows around massive objects like black holes.

Mathematics

The mathematics group in HRI has contributed significantly in research as well as through one of the more vibrant outreach programmes in the country. A number of schools, workshops etc. have rejuvenated mathematics learning at college and university levels. This has led to the generation of a pool of manpower trained in current topics in mathematics who are not only trained

to start a research career but are also able to contribute significantly in different areas of science and engineering.

Most of the mathematics research is, by the subject's very nature, highly specialized and hence on the research front we report here only those areas which can have a broad appeal. Restricting ourselves thus, we mention that research in HRI has led to significant advances in cryptography (algorithm preventing "unknown key share attacks", factoring of integers and in the analysis of visibility of lattice points (relevant for deciding on seating in auditoriums etc).

Future Programme of the Institute

Presently the institute has a sanctioned strength of 40 academics divided among physicists and mathematicians. The number distribution is a bit skew with physics having 23 faculty members and maths13. The physics program has 7 string theorists, 6 high energy phenomenologists, 3 quantum information specialists, 5 condensed matter (electronic properties) theorists and 1 astrophysicist, leaving wide open spaces in areas that are strongly populated in comparable institutes of the world. The maths department has its primary strength in number theory (8) with the other disciplines sparsely populated at best and any "applicable mathematics" not at all.

The institute runs a Ph.D program with outstanding initial course work and an integrated Ph.D program where some masters level courses are taught in the first 2 years. The training programs run by us are much sought after but because of our size related limitations discussed above, we can hardly fulfill our obligation to society. This is where we want a new widening emphasis to be. In the next decade we want HRI to become not just the leading research institute in certain areas but the leading centre for theoretical and mathematical sciences in a holistic sense- an institution where young students come to learn from and work with practitioners who are the best in advancing the knowledge bank and also in imparting knowledge. As the only centre with unlimited potential in the Hindi heartland of our country, this vision is intimately connected with the upliftment of the nation.

Our scope widening in the first ten years (2015-2025) will be two fold:

A) Start a 2 YEAR MSC program in physics and mathematics running in parallel with our integrated program. The students selected after their BSc stage will have the option of joining the integrated PhD program or the 2 year program where he/she can leave after 2 years with a Masters degree to pursue a PhD elsewhere or to join a more practical branch of science and technology where their comprehensive masters training will be immensely beneficial. Consequently the 2 year masters program will require in addition to a core, a fair number of electives in diverse disciplines.

B) Start a HRI – UNIVERSITY INITIATIVE whereby our excellent teaching program at the PhD level, at par with any institution

anywhere (Harvard, Princeton, Cambridge..) is thrown open to university Ph.D students across the country. The university departments are hard pressed to provide courses designed specifically for PhD students. Given enough faculty and infrastructure HRI can make the first year of its PhD program available to university PhD registrants under a MOU to be signed between HRI and the university concerned (university includes IITs and IISERs).

Governing Council

1. Prof. M. S. Raghunathan Chairman	School of Mathematics Tata Institute of Fundamental Research Homi Bhabha Road, **Mumbai – 400 005**
2. Prof. R. Balasubramanian	Director Institute of Mathematical Sciences CIT Campus, Taramani, **Chennai – 600 113**
3. Mr. V. R. Sadasivam	Joint Secretary (F) DAE, Govt. of India, Ch. Shivaji Maharaj Marg **Mumbai – 400 001**
4. Mr. Pradeep R. Baviskar	Joint Secretary (R& D) DAE, Govt. of India, Anushakti Bhavan, Ch. Shivaji Maharaj Marg, **Mumbai – 400 001**
5. Dr. J. N. De	BH-135, Sector II Salt Lake, **Kolkata – 700 091**
6. Prof. Narendra Kumar	Raman Research Institute C.V. Raman Avenue, Sadashivnagar, **Bangalore – 560 080**
7. Prof. H. S. Mani	2, Fourth Cross Street, Durga Colony, Sembakkam **Chennai - 600 073**
8. Dr. J.D. Mitra	Director, Higher Education, U.P. Near G.P.O., Civil Lines, **Allahabad – 211 001**

9. Mr. S. L. Mehta	4, Clive Row **Kolkata – 700 001**
10. Mr. Avnish Mehta	4, Penn Road **Kolkata – 700 027**
11. Mr. Rajnish Mehta	4, Penn Road, **Kolkata – 700 027**
12. Prof. J.K. Bhattacharjee Director	Harish-Chandra Research Institute Chhatnag Road, Jhunsi, **Allahabad – 211 019**

Summary of Research Activities in Mathematics

Analysis and Geometry

Work was done in the geometric quantization of integral Kahler manifolds. It was shown that a high enough tensor power of the quantum bundle is topologically equivalent to a certain Quillen determinant line bundle.

Work was done in obtaining a one parameter family of solutions from minimal surfaces.

Work was done in obtaining non-trivial identities from some of Ramanujan's identities and the theory of minimal surfaces and solutions.

Work was done in the prequantization of pathspaces of prequantized symplectic manifolds.

Work on real algebraic vector bundles over real curves and over real abelian varieties was done. Projects on semi-algebraic and O-minimal geometry also were started.

The Annual Foundational School III was organised in July, 2012, and an Advanced Instructional School on Aspects of Galois Theory in December, 2012. Both these schools were funded by the National Centre for Mathematics. Members of the mathematics faculty gave several lectures in these schools, and a few students from the mathematics group were tutors in them. One student in algebraic geometry successfully defended his thesis during the year.

Group Theory and Lie Algebra

Classified finite groups of prime power order which admit maximum number of conjugacy class preserving automorphisms. Probability distribution of commutator word maps of certain finite nilpotent groups of class at most 3 was also studied.

In a joint work, irreducible modules have been classified with finite dimensional weight spaces for the derivations of the rational quantum torus.

These modules have been given in terms of the modules for the finite dimensional irreducible gld-module.

Number Theory

An intrinsic and explicit parametrisation of the set of tamely ramified extensions of a local field with finite residue field was given.

Work is going on monochromatic configurations under finite colorings of the Euclidean plane. Some new zero-sum results have been obtained.

Convolution sums of the divisor functions have been evaluated and as an application the number of representations of positive integers by certain quadratic forms have been obtained.

A generalization of the correspondence between Jacobi forms of higher degree and elliptic cusp forms is obtained. A conjecture of S. Bocherer on a property of Jacobi forms of weight 2 is proved partially.

A generalization of a result of K. Soundararajan on the power moment of the absolute value of Hecke-multiplicative functions such as Maass forms is carried out.

Work on partial sums of a spectral analogue of the Mobius function is also carried out.

Work is in progress on the study of special functions and the study of set of uniqueness for completely additive functions.

It has been proved that there are infinitely many integers n's for which the nth Fourier coefficients of Klein Modular Invariant function is odd and we proved a quantitative result. If a nonzero integral binary quadratic form with non square discriminant represents an arithmetic progression, then we gave a bound on the length of the progression in terms of the given inputs. We gave a bound on the number of integer solutions of a Diophantine equation in terms of the parameter.

A result of Helfgott and Roton states that a dense subset of primes contains infinitely many three term arithmetic progression. A generalisation of this result is obtained.

Summary of Research Activities in Physics

The Physics group at HRI consists of 22 faculty members, 15 post-doctoral fellows (PDF), and 65 research scholars working toward their Ph. D. The group runs an outreach program that receives a large number of undergraduate and graduate students from all over India to carry out projects on various topics of current interest and hosts a visitors program that attracts a large number of scientists from India and abroad. The members of the group carry out research in five major areas of Physics, *viz.* Astrophysics, Condensed Matter Physics, High Energy Physics, Quantum Information and Computation, and String Theory. In addition to offering Master's level and advanced courses for the students at HRI, the faculty members attend several conferences, both in India and abroad, and also visit other institutes, Universities, and colleges and give lectures on the latest activity in several areas of theoretical physics.

Astrophysics

The astrophysics group at HRI consists of one permanent faculty member, one post-doctoral fellow and one Ph. D. student. It also very generously and frequently supports visits of junior project students to work toward their master's thesis under the supervision of the faculty member and the PDF of the group. In last one year, group members have published 21 research papers in reputed international journals with very high impact factors. Some of these papers were co-authored by the visiting junior project students as well. Members of the group work on reionization of the Universe, formal aspects of general relativity, quantum field theory in curved space time, Hawking radiation, and related issues in relativistic and high energy astrophysics with main focus on astrophysics around black holes, analogue gravity phenomena and related phonon quantization, study of astrophysical fluid dynamics under the influence of strong gravity, and application of dynamical systems approach to investigate the accretion phenomena.

Condensed Matter Physics

In the condensed matter group research was carried out on spin transport in nano systems, Dirac materials and topological phases of matter, strongly correlated electron systems, first-principles electronic structure calculations of material properties, and the phase diagram of Fermi gases. In the first topic, a non-equilibrium density matrix formulation for quantum coherent

spin transport, valid for both single and multi channels, has been developed and spin and charge conservation have been formulated. Its consequences for unitarity of scattering matrix in spin space have been discussed and its relevance for non-Abelian hydrodynamics and transport in mesoscopic Kondo systems is being studied. Work has been carried out on transport through curved surfaces of topological materials and polarized scanning tunneling measurements were suggested to probe the resulting electronic states. The effect of electron-electron interactions in these new phases is being explored. There is ongoing work on correlated quantum systems, in particular, disordered superconductors, frustrated magnets, metal-insulator transitions, ultracold atoms, superconductivity competing with other phases, and coexistence of magnetic phases. These employ locally developed computational tools to probe the spatial structure and thermal fluctuations in these systems.

Spin imbalanced Fermi gas was looked at with a view toward understanding the tricritical points in the phase diagram. The trend of the observed temperature dependence of the width of the metastable region close to the tricritical point in homogeneous superfluids was obtained. This work was further extended to modulated phases (FFLO) and the existence of a Lifshitz tricritical point and the specific heat in its vicinity were obtained, in conformity with recent measurements on organic superconductors. First-principles approach was used to study electronic structure of atomic clusters and two-dimensional electronic systems. Electronic structure of Rh clusters was performed to understand photoelectron spectroscopy experiments on them. Clusters based on Cr, Mn, and Sr were identified as new magnetic superatoms. Properties of structural defects in a hybrid graphene-BN sheet were also studied.

High Energy Physics

The members of the group have been mainly working in two fields: neutrino and collider physics. Neutrinos are tiny, very light particles, which hardly interact with ordinary matter, but which have an important impact in many areas of physics. The main unresolved questions in neutrino physics today are the precise magnitude of the masses of different neutrino species and their mixing pattern. These are among the key inputs when constructing unified theories beyond the Standard Model of particle physics. Members of the neutrino physics group have worked on models to explain some of the properties of neutrinos and studied their signals at various experiments. In

particular, they are actively involved in the development and physics studies of the India-based Neutrino Observatory (INO), which is planned as India's largest basic science project. It will measure the properties of neutrinos by detecting neutrinos generated in the atmosphere and using long-baseline neutrino beams. Other important results include work on the fluxes of ultra high energy neutrinos in the presence of physics beyond the Standard Model.

The collider physics group is working under the umbrella of the Regional Centre for Accelerator-based Particle Physics (RECAPP) at HRI. The group mainly focuses on systematic studies of physics signals at the Large Hadron Collider (LHC), the biggest ever international experiment in the history of fundamental science, which has started its operation in Geneva a few years ago. The LHC, which is expected to shed light on the fundamental issue of the origin of mass of elementary particles, has recently discovered a new particle which behaves in most aspects like the long sought Higgs boson, the last missing piece of the Standard Model, although further detailed studies are needed and such studies are currently being actively pursued at HRI. The LHC is also expected to directly produce amongst other new particles, the so-called dark matter particles, a mysterious invisible component of the Universe that could help to solve the question as to why there is much more matter than antimatter in the universe. The group has intensively worked on all these aspects, mostly in the context of supersymmetric extensions of the Standard Model. Work on the implications of a non-standard Higgs sector, extended gauge symmetries, and extra space-time dimensions has also been carried out and studied in detail. Since hadronic activities play an important role at the LHC, perturbative quantum chromodynamics predictions for new physics signals as well as important Standard Model processes have also been studied in detail.

Quantum Information and Computation

The Quantum Information and Computation (QIC) group works on a variety of topics in quantum information and its interface with many body physics. A fundamental property of quantum entanglement is the concept of monogamy. This is a requirement in quantum cryptography and the QIC group at HRI has recently established an important result, which asserts that if one party has a quantum advantage in sending classical information to a second party, then the former can have no quantum advantage in sending the same to a third party. Another important topic under study has been the

erasure of information, where the QIC group showed that the change in quantum correlation is never larger than the total entropy change of the system and the environment.

Quantum information devices almost always operate on quantum many body system substrates. The QIC group has recently been working on quantum information aspects of non-equilibrium many body systems and resonating valence bond states. Moreover, a collaboration with IISc, Bangalore and IISER, Pune has led to a nuclear magnetic resonance experiment which simulates a quantum Ising model on a triangular lattice placed in a transverse magnetic field and uses the monogamy of quantum correlation functions to distinguish between frustrated and non-frustrated ground states.

String Theory

The string theory group explored various aspects of black hole physics, higher spin theories, string amplitudes, AdS/CFT, flux compactifications, and cosmology. Micro-state counting of black hole degrees of freedom was investigated using quiver quantum mechanics and certain rigorous results were derived on degeneracies of pure Higgs states. The duality between higher spin theories in three dimensional AdS space and two dimensional CFTs was developed further, making steps in the direction of embedding them into string theory. The study of the simplest gauge-string duality involving matrix models and topological strings was also successfully put to test by a comparison of correlators. Models of inflation based on open string tachyon as well as models of quintessence for dark matter were analyzed. A non--BPS 16 derivative interaction in the effective action of type IIB string theory was shown to exist by explicit computation of correlators. A study of supersymmetry breaking in certain flux compactifications was carried out. Preliminary study of cosmological inflation involving multiple fields was also carried out. A relation was established between stochastic quantization and holographic renormalization group in the AdS/CFT correspondence.

Library

The Institute's library is one of the best-equipped libraries in the region. Being the library of a premier Research Institute, it provides the required support to the academic and research activities. It remained open on all working days between 8 a.m. to 2 a.m. including Saturdays. It also remained open during Sundays and Gazzetted holidays between 10 a.m. to 6 p.m. It had added 402 (Four hundred and two) books including gifted books 72 in its fold. It increased the total number of books to 20850 (Twenty thousand eight hundred fifty) which includes 999 (Nine hundred ninety nine) books as gifted books. It has also added 17 bound volumes of the journals during the period from 1st April, 2012 to 31st March, 2013, it has increased bound volumes collection to 35219. The institute's library has a total collection of 56059 (Fifty six thousand and fifty nine) of books and bound volumes. The library had subscribed to 225 journals during this period, it includes 110 as online journals.

The physical stock verification has been recently completed with the help of PDT (Portable Data Terminal) for collection of Bar Codes. Since the whole collection is 'Bar Coded' and equipped with 'Tattle Tapes' for security. It reflected no loss of titles in either books or journals.

The library is facing a lot of space problem. As we know that "**the library is a growing organism**" the need for space is increasing accordingly. We have planned for 2.5 folds increase in our present space. The construction of the same which was in full swing however has been stopped due to an order of Hon'ble Allahabad High Court in regard to PIL No.4003 of 2006. The Hon'ble High court has passed an order that no construction shall be carried out within 500 meters of High Flood Level (HFL) of river Ganges. The Institute has filed an application in the High Court for relief against this order. The recently, we had provided better and latest systems to our users for browsing the library OPAC and related search. We enriched our Building of the Digital Depository of the HRI, which includes the submitted articles, thesis, lectures etc. The library web page has been updated which provides more detailed information about the library such as subscribed databases, archives, library rules, library staff, list of online journals, online link to the Video lectures and other useful links. The emphasis was also given to procure maximum number of journals online. We have been providing on-line access of the periodicals to our users for 96 (Ninety six) titles.

We have provided the Web Enabled library catalogue to its users. The library can be termed as completely automated library system, which includes acquisition, cataloguing, circulation, search modules etc. The online catalogue had increased the opportunities of the use of our library resources by the neighboring organizations such as INSDOC, TIFR etc. through the Document Delivery Services (DDS). Normally we provide the DDS on request through post, at very nominal cost, but requests had also been honored through e-mails. We encouraged the use of its library by providing library consultation facilities to the research scholars from the neighboring institutes. We strengthened its library security with the implementation of Electro-magnetic Tattle Tapes to reduce losses. This has been made completely functional.

Computer Centre

1. Newer versions of different flavors of Linux operating systems were installed on the desktops.

2. New versions of several applications software were loaded on users' systems, computer centre and conference room systems.

3. All the primary servers such as Mail, Webmail, DNS, SSH, DHCP, Proxy, LDAP and Firewall were upgraded with new ones and with newer version of operating systems and other packages.

4. Computing related to conferences were held in the conference computer room.

5. Computer Centre's NIS client machines were upgraded to LDAP clients with newer versions of operating systems and other packages.

6. New black and white laser printers were installed on the network.

Current activities and plans

1. Purchase of about 20 desktops for Ph.D. students is under plan.

2. Upgradation of scientific software with new versions are under plan.

Construction Activity

1. Construction work of Engineering building and Community Centre Annexe has been completed.

2. Construction of Married Block Apartment was completed.

3. Following miscellaneous works were also carried out during the financial year :
   - Renovation of Mess in Hostel-I building.
   - Supply and installation of Automatic fire alarm system in Auditorium.
   - Associated Electrical works related to Community Centre Air-conditioning.
   - Renovation works in Community Centre.
   - Laying Hume pipe (RCC) for storm water drainage near New Hostel building site.
   - Pull down arrangement for three white writing boards in lecture room.
   - Supply, installation, fixing and Commissioning of chimney for Hostel-I Mess.
   - Supply and fixing vertical blind and Sun control film on the windows of Engineering building.

Note: Construction activities from February-2013 was affected due to order of Hon'ble High court in regard to PIL no. 4003 of 2006 related to Ganga pollution. The Hon'ble High court has passed an order that no construction shall be carried out within 500 meters of High Flood Level (HFL) of river Ganges in the year 1978. According to that, HRI fall within this prohibited range. HRI has filed an application in Court for relief against this order as HRI has its own Sewage Treatment Plant (STP) with almost zero discharge and cannot cause pollution to river Ganges. The decision of Court is our case is still awaited.

Note on Persons with Disabilities & SC/ST

This Institute is devoted to theoretical research in the field of Physics and Mathematics, is financially supported by the Department of Atomic Energy, Government of India. Its activities are overseen by the Governing Council and its day-to-day activities are administered by the Director of the Institute. The Institute has a very limited number of sanctioned positions, which are evenly distributed between the Academic & Administrative posts. The Institute does not have any specific scheme catering to persons with disabilities and therefore there is no specific budget allocated in this regard. The recruitment of Academic members is done based on merit whereas recruitment in other sections of the Institute is done through an open advertisement. However, the Institute is sensitive to the subject of recruitment of persons with disabilities and would support such persons as and when the occasion arises.

Also the Institute is aware of its social obligation towards representation of Scheduled Castes and Scheduled Tribes in its services and follows the appropriate norms in recruitment.

Vigilance and Security Report

There is nothing specific to report from vigilance/security point of view for the period upto 31st March, 2013. The Institute follows the instructions received from DAE time to time pertaining vigilance/security matters.

Auditor's Report

1. We have audited the attached Balance Sheet of Harish-Chandra Research Institute, Allahabad as at 31st March, 2013 and also the Income and Expenditure Account for the year ended on that date annexed thereto. These financial statements are the responsibility of the management of the Institute. Our responsibility is to express an opinion on these financial statements.

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 reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining on a test basis, evidence supporting the accounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

3. Subject to our comments as per annexure – "A" read with significant accounting policies and notes on accounts appearing in Schedule-15 annexed hereto, we report that:

    a. We have obtained all the information and explanation, which to the best of our knowledge and belief were necessary for the purpose of our audit.

    b. In our opinion, proper books of accounts as required by law have been kept by the Institute, so far as it appears from our examination of the books.

    c. The Balance Sheet and Income and Expenditure Account dealt with by this report are in agreement with the books of accounts.

    d. In our opinion and to the best of our information and according to the explanations given to us, the said accounts give a true and fair view:

i. In case of Balance Sheet, of the state of affairs of the Institute as at 31st March, 2013.
ii. In case of Income and Expenditure Account, of the excess of expenditure over income of the Institute for the year ended on that date.

For Vibhuti Agrawal & Co.
Chartered Accountants

Sd/-
(Vibhuti Agrawal)
Proprietor
M.No. 073789

Place : Allahabad
Dated: 27.08.2013

Annexure "A" to the Auditor's Report

(Referred to in paragraph 3 of our Report of even date)

1. Library & Publications includes receipt of Current Journals during the current year for ₹ 2,23,71,342/-. The Current Journals received have not been capitalized in books of accounts.

2. Amount recoverable against completed projects shown as claims recoverable and Advance for Journals are outstanding since long. Institute should take necessary steps to recover or write off the following amounts:

A.	NBHM Grant-K. Gangopadhyay	Since 2007	₹ 47,533.00
B.	NBHM Grant-Joseph Samuel	Since 2007	₹ 17,030.00
C.	DST-SFT Manoj Kumar	Since 2007	₹ 33,961.00
D.	NBHM Fellowships	Since 2009	₹ 1,85,867.00
E.	HNB Garhwal University	Since 2010	₹ 40,000.00
F.	Ramanujan Maths Society (DST)	Since 2012	₹ 8,750.00

3. Institute has carried out a physical verification of fixed assets. The quantitative & value reconciliation are being done with fixed assets register, as such it is not possible for us to comment whether financial records are in agreement with physically verified fixed assets.

4. VAT is not being paid on pantry receipts though the Institute is registered with the VAT Department.

5. No interest during the year on security deposit with UPSEB is received.

6. Balance of EMD, Security Deposits, Sundry Creditor, Loan & Advances and Claims Recoverable etc. are subject to confirmation, reconciliation and consequential adjustments thereof.

For Vibhuti Agrawal & Co.
Chartered Accountants
Sd/-
(Vibhuti Agrawal)
Proprietor
M.No. 073789

Place : Allahabad
Dated: 27.08.2013

HARISH-CHANDRA RESEARCH INSTITUTE
ALLAHABAD 211 019

BALANCE SHEET AS AT 31ST MARCH 2013

As on 31st March 2012	*CAPITAL FUND & LIABILITIES*	*Sch.*	*Amount in Rs.*	*As on 31st March 2013*
				Amount - Rs.
7194762.22	CORPUS / CAPITAL FUND	1		16005087.76
57815458.19	PLAN GRANT - Carried over	2		51181984.19
30048.54	NON-PLAN GRANT Carried over	3		0.00
206597712.60	CURRENT LIABILITIES AND PROVISIONS	4		227457331.60
271637981.55	**TOTAL ==>**			**294644403.55**
	ASSETS			
	FIXED ASSETS	5		
575260906.75	GROSS BLOCK		604296617.75	
1586207.00	ADD : Capitalization of assets- Revenue Grant		1008554.00	
36558886.00	ADD : Capitalization of assets- Plan Grant		17297610.00	
-9109382.00	LESS: Deductions/Adjustments		-325472.00	
-471914810.65	LESS: CUMULATIVE DEPRECIATION		-511656283.05	
132381807.10	Net Written Down Value			110621026.70
0.00	Capital Work in Progress	5-A		51450243.00
12702020.80	DEFERRED REVENUE EXPENSES (POWER)	6		11114268.20
4885243.00	INVESTMENTS	7		5147086.00
121668910.65	CURRENT ASSETS, LOANS AND ADVANCES ETC.	8		116311779.65
271637981.55	**TOTAL ==>**			**294644403.55**

For HARISH-CHANDRA RESEARCH INSTITUTE

Sd/-	Sd/-	Sd/-
Raaj Gulati	Ravindra Singh	Jayanta Kumar Bhattacharjee
Accounts Officer	Registrar	Director

As per our separate report of even date attached
For Vibhuti Agrawal & Co.
CHARTERED ACCOUNTANTS

Place : Allahabad
Date : - 27.08.13

Sd/-
Vibhuti Agrawal
Proprietor

HARISH-CHANDRA RESEARCH INSTITUTE
ALLAHABAD 211 019

INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED ON 31ST MARCH 2013

Amount in Rs. Year 2011-12	*INCOME*	*Sch.*	*Amount in Rs.*	Amount in Rs. Year 2012-13
158500000.00	GRANTS / SUBSIDIES	9		176900000.00
352017.00	INCOME ON INVESTMENTS	10		77707.00
5158632.00	INTEREST EARNED	11		1115631.00
4133819.25	OTHER INCOME	12		3957892.00
168144468.25	**TOTAL (A) ==>**			**182051230.00**
	EXPENDITURE			
89578773.80	ESTABLISHMENT EXPENSES	13	100346934.00	
79302462.00	OTHER ADMINISTRATIVE EXPENSES	14	89832520.00	190179454.00
43002440.07	DEPRECIATION - Current Year (Net total at the year end - corresponding to Schedule 5			39999449.40
1587752.60	Deferred Revenue Expenses-33KVA Power Line			1587752.60
47703014.00	PENSION,GRATUITY,EL ENCASHMENT-Current Year			11130441.00
261174442.47	**TOTAL(B) ==>**			**242897097.00**
-93029974.22	BALANCE BEING EXCESS OF EXPENDITURE OVER INCOME (B-A) Transferred to General Fund			-60845867.00
	SIGNIFICANT ACCOUNTING POLICIES & NOTES ON ACCOUNTS	15		

For HARISH-CHANDRA RESEARCH INSTITUTE

Sd/-	Sd/-	Sd/-
Raaj Gulati	Ravindra Singh	Jayanta Kumar Bhattacharjee
Accounts Officer	Registrar	Director

As per our separate report of even date attached
For Vibhuti Agrawal & Co.
CHARTERED ACCOUNTANTS

Sd/-
Vibhuti Agrawal
Proprietor

Place : Allahabad
Date : 27.08.13

HARISH-CHANDRA RESEARCH INSTITUTE
ALLAHABAD 211 019

Amount - Rs. As on 31st March 2012	SCHEDULE - 1 FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2013		Amount - Rs. As on 31st March 2013
	CORPUS / CAPITAL FUND		
59584363.89	Balance as at the beginning of the year		7194762.22
1586207.00	Add: Assets purchased out of Non-Plan Grant	1008554.00	
36558886.00	Add: Assets purchased out of Plan Grant	17297610.00	
	Add: Capital Work in Progress	51450243.00	69756407.00
1758512.00	+/- : Adjustments of previous years		-130263.00
	+/- :Excess of Expenditure over Income trfd. From Income & Expenditure Account		-60845867.00
-93029974.22	Cash Deficit		
	Receipts of the Year	182051230.00	
	Expenses of the Year	190179454.00	
	Excess of Expenses over Receipts	**-8128224.00**	
	Transferred From		
736767.55	Revenue Grant Opening Surplus	30048.54	30048.54
	From General Fund	8098175.46	
	Total	**8128224.00**	
7194762.22	**BALANCE AS AT THE YEAR END**		**16005087.76**

Amount - Rs. As on 31st March 2012	SCHEDULE -2 FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2013		Amount - Rs. As on 31st March 2013
	PLAN GRANT (Non-Recurring)		
292036000.00	OPENING BALANCE (XIth Plan)	268788000.00	
53300000.00	ADD : Received during the year from DAE(XI-Plan)	55400000.00	
	ADD : Received during the year from DAE(XII-Plan)	4900000.00	
	Total Plan Grant Amount Received		329088000.00
-96394446.00	LESS : Revenue Utilisation(XI & XII Plan)	-97359668.50	
-165684207.81	LESS : Capitalization of Assets	-129096104.31	
-25441888.00	LESS : Advances & work-in-progress	-51450243.00	
	Total Plan Grant Amount Utilised		-277906015.81
57815458.19	BALANCE Carried over		
56420738.19	Surplus Grant for Carried Forwarded Projects	51181984.19	
1394720.00	Surplus Grant for Completed Projects-Refundable	0.00	
	(Detail Chart enclosed at enclosure 1)		**51181984.19**

Amount - Rs. As on 31st March 2012	SCHEDULE - 3 FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2013		Amount - Rs. As on 31st March 2013
	NON- PLAN GRANT (Recurring)		
766816.09	OPENING BALANCE		30048.54
158500000.00	ADD : Received during the year from DAE	176900000.00	
9644468.25	ADD : Other Receipts	5554155.00	
0.00	ADD : Transferred from General Fund	8098175.46	
		190552330.46	
-168881235.80	LESS : Utilisation during the year	-190582379.00	
0.00	Balance transferred to General Fund	-30048.54	-30048.54
30048.54	**CLOSING BALANCE**		**0.00**

Annexture to Schedule 2 ***"Executive Summary of XIth Plan Projects"- As on March 31st 2013***

Encl.1

XIth Plan Grants	Received	Total Utilisation	Break-up of Utilisation						Balance Amount
			Revenue	Capitalised				Advance/Work in Progress	
				Capitalisation-upto last year	Capitalisation-Current Year	Gross Capitalisation of closed projects	Capitalised Value (Gross)		
High Performance Scientific Computing	***107045000.00***	***75205908.00***	***9877669.00***	***52676543.00***	***12651696.00***		***65328239.00***		***31839092.00***
Machinery & Equipments		54422408.00	36540.00	42289868.00	12096000.00		54385868.00		
Supplies & Materials		5669151.00	-238412.00	5351867.00	555696.00		5907563.00		
Major Works (Civil,Electrical & AC)		5269922.00	235114.00	5034808.00			5034808.00		
Domestic Travel		175777.00	175777.00						
Salaries		*1190903.00*	1190903.00						
Office Expenses		438797.00	438797.00						
Contingency		8038950.00	8038950.00						
Infrastructure(Housing)	***47500000.00***	***33664669.90***	***3242628.00***					***30422041.90***	***13835330.1***
Advance to DCSEM ofr conf.		*2000000.00*	***2000000.00***						
Construction Hostal Building & PDF (Married Appt.)		30422041.90						30422041.90	
Contingencies-Misc.(Housing)		*1242628.00*	1242628.00						
Infrastructure(Non-Housing)	***66245000.00***	***61723314.10***	***37622461.00***	***9385702.00***			***3072652.00***	***21028201.10***	***4521685.90***
Construction Admin Block		8545811.81						8545811.81	
Construction Community Centre Extn.		3701880.31						3701880.31	
Construction Engg. Section Building		8780508.98						8780508.98	
Civil Works -Infrastructure (Non Housing)		10601143.00	9919693.00	681450.00			681450.00		
Contingencies-Misc.(Non-Housing)		*7205728.00*	4814526.00	2391202.00			2391202.00		
Power Requirement		*20626122.00*	20626122.00	6313050.00					
Salaries		*1277970.00*	1277970.00						
Advance to Architect		*984150.00*	984150.00						
Regional Center- Accelerator Based Particle Physic	**28598000.00**	***29512541.50***	***18194656.50***	***11285485.00***	***32400.00***		***11317885.00***		***-914541.50***
Machinery & Equipments		*6716903.00*	1497.00	6685906.00	29500.00		6715406.00		
Supplies & Materials		*7465911.00*	3037992.00	4425019.00	2900.00		4427919.00		
Major Works (Civil,Electrical & AC)		*174560.00*		174560.00			174560.00		
Salaries		*3919231.00*	3919231.00						
Domestic Travel		*2068594.00*	2068594.00						
Foreign Travel		*1957124.00*	1957124.00						
Office Expenses		*158237.50*	158237.50						
Consultancy		*557655.00*	557655.00						
Contingencies - Collaboration Meetings		*6494326.00*	6494326.00						
Scientific Computing & Networking(XIth Plan)	**74800000.00**	**75501597.31**	**26752697.00**	**45482877.31**	**3266023.00**		**48748900.31**		***-701597.31***
Machinery & Equipment		*34787239.31*		31671867.31	3115372.00		34787239.31		
Major Works (Civil,Electrical & AC)		*2525019.00*	115989.00	2409030.00			2409030.00		
NKN Project		*440681.00*		440681.00			440681.00		
Band Width		22997804.00	22997804.00						
UPS & Batteries		9278000.00		9278000.00			9278000.00		
Books & Softwares		*1046854.00*	4350.00	1042504.00			1042504.00		
Salaries		1187526.00	1187526.00						
Office Expenses		*364075.00*	356050.00	8025.00			8025.00		
Quantum Information Processing & Application		2874399.00	2090978.00	632770.00	150651.00		783421.00		
Special Year in Mathematics(XI-Plan)				***1323902.00***		***-1323902.00***			
Equipping & Furnishing of Conference Centre(XI-Plan)				**1802459.00**		**-1802459.00**			
Library Development Project(XI-Plan)				**31268036.00**		**-31268036.00**			
Scientific Human Resources Training(XI-Plan)				**12459203.50**		**-12459203.50**			
Scientific Information Retrieval Development (XIIth Plan)	**1800000.00**	**597556.00**			597556.00		597556.00		***1202444.00***
Special & Thematic Events in Mathematics (XIIth Plan)	**1000000.00**	**294563.00**	294563.00						***705437.00***
Infrastructure Development (XII Plan)	**2000000.00**								***2000000.00***
Expansion of HRI Campus (XII Plan)	**100000.00**	*13000.00*	13000.00						***87000.00***
Advance Research Facility for Theoretical Physics (XII Plan)		*892701.00*	892701.00						***-892701.00***
RECAPP, Neutrino & HE Astrophysics and Cosmology (XII Plan)		*500165.00*	469293.00		30872.00		30872.00		***-500165.00***
Grand Total	**329088000.00**	**277906015.81**	**97359668.50**	**165684207.81**	**16578547.00**	**-46853600.50**	**129096104.31**	**51450243.00**	**51181984.19**
				*			*		**51181984.19**

Amount - Rs.	SCHEDULE - 4 FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2013		Amount - Rs.
As on 31st March 2012	**CURRENT LIABILITIES AND PROVISIONS**		*As on 31st March 2013*
	A- Current Liabilities		
10656810.90	1. EMD/ Security Deposits Payable		10024654.90
	2. Sundry Creditors		22573472.20
11726724.00	a. Parties - Amount Payable	14753201.00	
959917.80	b. Staff - Amount Payable	1151766.80	
55227.00	c. Staff- Terminal Dues transfers	0.00	
2747194.40	d. Other Recoveries Refundable	6668504.40	
	3. Statutory Liabilities		313900.00
80983.00	a. Income Tax (deducted from staff) Payable	0.00	
0.00	b. VAT Tax (deducted from Parties) Payable	146659.00	
36997.00	b.Income Tax (deducted from parties) Payable	167241.00	
	4. Amounts refundable against completed sponsored projects/schemes		566481.50
38643.00	TPSC Fund	38643.00	
55400.50	Serc Schools	27566.50	
655912.00	NBHM - Projects	500272.00	
	5. Receipts against ongoing sponsored projects/schemes		10672910.00
146504.00	CSIR Grants	146504.00	
0.00	DST Project- Aaarti Girdhar	924.00	
0.00	DST Project (NASI)- Satya Deo	366923.00	
0.00	DST Project- Satya Deo	58528.00	
868108.00	J.C.Bose Fellowship (Ashoke Sen)	651274.00	
178229.00	Swarnjayanti Fellowship (Rajesh Gopakumar)	522808.00	
1013600.00	EU Research Project(Prof. Pinaki Majumdar)	1013600.00	
1724764.00	DAE-SRC Outstanding Research Investigator Award	1813264.00	
327805.00	Ramanujan Fellowships	0.00	
204259.00	India-EU Research Project	167459.00	
2782426.00	Infosys Foundation	2838954.00	
0.00	KVPY Summer programe	40000.00	
0.00	INDIA-UK WORKSHOP-DST	39306.00	
0.00	INSPIRE Faculity Award (R.Prabhu)	1002158.00	
0.00	IFCPAR Research Project(T.P.Pareek)	420300.00	
0.00	INDO-Australia E CST Fellowship(Manoj Kumar)	967097.00	
133000.00	ATM Workshop	0.00	
18930.00	Honorarium from Other Grants	99930.00	
13248.00	Science Education Prog.-INSA	23881.00	
0.00	Library Committ Meeting II	500000.00	
34424682.60	**Total A**		**44151418.60**
	B- PROVISIONS		
126466000.00	1. Pension ,Gratuity, encashment of E.L. B/F	172153000.00	
-2016014.00	Less : Payments during the year		
47703014.00	Add : Additions during the year	11130441.00	183283441.00
20000.00	2. Audit Fee payable		22472.00
172173000.00	**Total B**		**183305913.00**
206597682.60	**Total A + B**		**227457331.60**

Harish-Chandra Research Institute Allahabad

Schedule 5 -forming part of Balance Sheet as at 31st March 2013

Statement of Fixed Assets , Depreciation & Depreciation Fund

Sl.No.	Description	Gross Block									Depreciation Reserve					Net Block of Assets
		Gross Block of Assets		Opening Gross Block of Assets as on 01.04.2012	Additions/Deductions during the year				Total Gross Block of Assets as on 31.03.13	W.D.V.as on 31.03.12	Deprecation Charged on value (Total Gross Block-Total Cumulative Dep.Reserve upto last year)	Depreciation for the year 2012-13	Cumulative Dep.Reserve as on 31.03.2012	Adjustments	Depreciation Reserve up to 31.03.2013	W.D.V.as on 31.03.13
		(Other than XIth Plan) as on 31.03.12	(From XIth Plan Grants) as on 31.03.12		Funded from Non-Plan Grants as on 31.03.2013	Deductions	Gross Block of Assets (Non-Plan Grants)as on31.03.2013	Funded from Plan Grant as on 31.03.2013								
1	2	3	4	(3+4)=5	6	7	(6-7)=8	9	(8+9)=10	12	(10-15)=13	14	15	16	17	18
1	***Land & Building***	***149796326.85***	***440681.00***	***150237007.85***	***0.00***		***150237007.85***	***0.00***	***150237007.85***	***47876812.85***	***47876812.85***	***4787681.19***	***102360195.00***	***0.00***	***107147876.19***	***43089131.67***
1	Land	1.00		1.00			1.00		1.00	*1.00*	1.00	*0.00*	*0.00*	*0.00*	*0.00*	*1.00*
2	Building	149796325.85	440681.00	150237006.85			150237006.85		150237006.85	*47876811.85*	47876811.85	4787681.19	102360195.00		*107147876.19*	43089130.67
2	***Furniture & Fixtures***	***43794404.32***	***547536.00***	***44341940.32***	***320599.00***	***0.00***	***44662539.32***	***344259.00***	***45006798.32***	***18875856.72***	***19540714.72***	***1954071.47***	***25466083.60***	***0.00***	***27420155.07***	***17586643.25***
3	**Other Assets**	**36557392.20**	**663444.00**	**37220836.20**	**133838.00**	**203000.00**	**37151674.20**	**0.00**	**37151674.20**	**14441613.38**	**14372451.37**	**2163481.10**	**22779222.83**	**155982.00**	**24786721.93**	**12364952.27**
4	***Guest House Assets***	**4282410.34**	**411380.00**	**4693790.34**	**83900.00**	**122472.00**	**4655218.34**	**215132.00**	**4870350.34**	**2070100.29**	**2246660.29**	**303150.41**	**2623690.05**	**101995.00**	**2824845.46**	**2045504.88**
5	***Library Assets***	**177492563.92**	**6771246.00**	**184263809.92**	**338412.00**	**0.00**	**184602221.92**	**597556.00**	**185199777.92**	**21755133.32**	**22691101.32**	**5672775.33**	**162508676.60**	**0.00**	**168181451.93**	**17018325.99**
6	***Machinery & Equipments***	**150894689.71**	**27192608.00**	**178087297.71**	**36350.00**	**0.00**	**178123647.71**	**16120914.00**	**194244561.71**	**25116238.46**	**41273502.46**	**24764101.48**	**152971059.25**	**0.00**	**177735160.73**	**16509400.98**
7	***Misc. Equipments***	**4919944.41**	**531991.00**	**5451935.41**	**95455.00**	**0.00**	**5547390.41**	**19749.00**	**5567139.41**	**2246052.05**	**2361256.05**	**354188.41**	**3205883.36**	**0.00**	**3560071.77**	**2007067.64**
	Grand Total====>	**567737731.75**	**36558886.00**	**604296617.75**	**1008554.00**	**325472.00**	**604979699.75**	**17297610.00**	**622277309.75**	**132381807.10**	**150362499.06**	**39999449.40**	**471914810.65**	**257977.00**	**511656283.05**	**110621026.70**

Amount - Rs.	SCHEDULE - 6 FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2013		Amount - Rs.
As on 31st March 2012	**Deferred Revenue Expenses (Power)**		*As on 31st March 2013*
14289773.40	Composite Work for Power Line	12702020.80	
-1587752.60	Less : Deferred Revenue Expenses Written Off	-1587752.60	
12702020.80	**Total**		**11114268.20**

Amount - Rs.	SCHEDULE - 7 FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2013		Amount - Rs.
As on 31st March 2012	**Investments**		*As on 31st March 2013*
2500000.00	Fixed Deposit in Bank Of Baroda	2500000.00	
2155227.00	Fixed Deposit in State Bank Of India	2155227.00	
230016.00	Add: Interest Accrued	491859.00	
4885243.00	**Total**		**5147086.00**

Amount - Rs.	SCHEDULE - 8 FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2013		Amount - Rs.
As on 31st March 2012	**CURRENT ASSETS, LOANS AND ADVANCES ETC.**		*As on 31st March 2013*
	A- Current Assets		
5377.25	*1. Cash Balance in hand*		8116.25
	2. Bank Balances		
	a. Current Accounts		
64904.97	SBI (MB) Current A/C		64904.97
	b. Savings Accounts		71128249.64
47429096.72	Bank Of Baroda - 101 A/C	10589869.72	
7087214.19	Bank Of Baroda - 102 A/C	43918754.19	
8746362.88	Bank Of Baroda - 108 A/C	11843295.88	
2230571.85	Bank Of Baroda - 109 A/C	2457281.85	
2616022.00	Bank Of Baroda - NPS Bank A/c	2319048.00	
5477594.00	c. Short Term Deposits with BoB HRI Branch Ald.	5477594.00	
359814.00	Add: Interest Accrued	1340507.00	6818101.00
1268.12	*3. Postage in hand (Franking Machine)*		2317.12
74018225.98	**Total A**		**78021688.98**

	SCHEDULE -8 FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2013		
Amount - Rs.	**CURRENT ASSETS, LOANS AND ADVANCES ETC.** contd.		**Amount - Rs.**
As on 31st March 2012	**B - LOANS, ADVANCES AND OTHER ASSETS**		***As on 31st March 2013***
	1. Loans to Staff		494028.00
27900.00	Festival Advance	39000.00	
12600.00	Vehicle Advance	48172.00	
169000.00	Medical Advance	123395.00	
149483.00	Traveling Advance -Within India	258461.00	
927200.00	Traveling Advance -Outside India	25000.00	
	2. Advances and other amounts recoverable in cash or in kind or for value to be received :		
	a. On Capital Account		19281127.00
23636129.00	Advance to Suppliers(Journals & Back Vol.)	19281127.00	
	b. Deposits		6215956.67
2574200.00	With UPSEB	2574200.00	
267580.67	With Telephone Deptt.	267580.67	
39900.00	With Gas Agency	39900.00	
4550418.00	Securities in Hand -Fixed Deposits of Parties	3334276.00	
42000.00	Advance Deposit City Hostel Rental	0.00	
	3. Income Accrued :		64042.00
	a. On Loans and Advances		
63642.00	1. Vehicle	64042.00	
	4. Claims Receivable		
	a. Amount Recoverable against completed projects/schemes		1117666.00
14848.00	CARDMATH(DST Meeting)	0.00	
12986.00	DST (C S Dalawat)	0.00	
33961.00	Grant Receivable-DST-SFT (Manoj Kumar)	33961.00	
40000.00	Finanace Officer HNB Garhwal University	40000.00	
47533.00	Grant Receivable - NBHM (Krishnendu G.)	47533.00	
17030.00	Grant Receivable - NBHM (Joseph samuel)	17030.00	
705162.00	INO Conference	784525.00	
185867.00	NBHM Fellowships	185867.00	
8750.00	Ramanujan Math Society(DST Meeting)	8750.00	
	b. Others		10469266.00
6313771.00	Claims Receivables- Parties	10065130.00	
77325.00	Claims Receivables- Staff	404136.00	
	5. Payment against ongoing sponsored projects/schemes		648005.00
50000.00	Registrar IIT Roorkee	50000.00	
25000.00	ISCQI-2008 Bhubneshawar	25000.00	
325843.00	International conference"B Physics at the LHC"	593.00	
0.00	Mritunjay Kumar Verma(CSIR Fellowship)	146578.00	
0.00	Grant Receivable from DST(Suvrat Raju)	235223.00	
0.00	Jest Examination	154611.00	
30000.00	IIT Guwahati	30000.00	
212012.00	NISER- Bubaneswar	0.00	
161544.00	Grant-Receivable from DST(Aarti Girdhar)	0.00	
6923000.00	Grant Receivable from DAE	0.00	
47650684.67	**Total B**		**38290090.67**
121668910.65	**TOTAL A + B**		**116311779.65**
			115862264.65
			449515.00

HARISH-CHANDRA RESEARCH INSTITUTE
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SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED ON 31ST MARCH 2013

Amount in Rs. Year 2011-12	SCHEDULE 9 - GRANTS / SUBSIDIES (Grants & Subsidies Received)		Amount in Rs. Year 2012-13
158500000.00	1. Central Government - DAE	176900000.00	
0.00	2. State Government	0.00	176900000.00
158500000.00	**Total**		**176900000.00**

Amount in Rs. Year 2011-12	SCHEDULE 10 - INCOME ON INVESTMENTS		Amount in Rs. Year 2012-13
100800.00	1. INTEREST received on deposits with UPPCL		
	2. OTHERS (Specify)		
251217.00	(Misc. Receipts -Recovery of LD clause/LSPS)	77707.00	77707.00
352017.00	**Total**		**77707.00**

Amount in Rs. Year 2011-12	SCHEDULE 11- INTEREST EARNED		Amount in Rs. Year 2012-13
	1. On Deposits		
5156440.00	with Scheduled Banks		1113431.00
2192.00	2. On Loans to Employees		2200.00
5158632.00	**Total**		**1115631.00**

Amount in Rs. Year 2011-12	SCHEDULE 12 - OTHER INCOME	Amount in Rs. Year 2012-13
2064250.00	1. License Fee & Electricity from Rented Buildings	2212407.00
735357.00	2. Guest House Receipts	1137328.00
356294.00	3. Pantry Receipts	485970.00
44700.00	4. Sale of Tenders	16700.00
11485.00	5. Recovery of Telephone Charges	10019.00
58950.00	6. Recovery of Cable TV Charges	50850.00
222004.00	7. Recovery of Transport Charges	81637.00
0.00	9. Sale of Scraps	1280.00
515734.00	10. Profit on Sale of Assets	-44085.00
125045.25	11. Misc.Income	5786.00
4133819.25	**Total**	**3957892.00**

Amount in Rs. Year 2011-12	SCHEDULE 13 - ESTABLISHMENT EXPENSES	Amount in Rs. Year 2012-13
51952990.00	(A) PAY AND ALLOWANCES	58860201.00
2248995.00	(B) HONORARIUM	3049480.00
13405985.00	(C) FELLOWSHIP	22632381.00
1209745.00	(D) CONTRIBUTION TO PROVIDENT FUND (CPF & NPS)	1609107.00
2090667.00	(E) PENSION	2346295.00
1909816.80	(F) RETIREMENT BENEFITS	1860147.00
1057290.00	(G) LEAVE TRAVEL CONCESSION	662429.00
3706265.00	(H) MEDICAL AID	3600760.00
5206948.00	(I) PRIS	5726134.00
82788701.80	**Total**	**100346934.00**

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SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED ON 31ST MARCH 2013

Amount in Rs. Year 2011-12	SCHEDULE 14 - OTHER ADMINISTRATIVE EXPENSES ETC.		Amount in Rs. Year 2012-13
157200.00	a) Overtime Allowance		152900.00
	b) Travel Expenses - Academic & Admin. Staff		
1488632.00	Within India	1513329.00	
758466.00	Outside India	905146.00	2418475.00
	c) Office Expences		7575581.00
434865.00	Furniture & Fixtures - From Non-Plan Grant	252079.00	
3042283.00	Computers and Computer Service & Maintenance	3151753.00	
619878.00	Stationery & Printing	191093.00	
65885.00	Postage	73909.00	
1378864.00	Telephone, Telex ,Telegrams Etc.	834484.00	
674095.00	Pantry	913769.50	
60845.00	City Guest House	355396.00	
1739476.00	Campus Guest House & Hostels	1803097.50	
18972130.00	d) Library & Publications		22371342.00
630431.00	e) Supplies & Materials		546952.00
	Minor Works		
	Maintenance of Office/Building		29082294.00
2104724.00	Civil Maintenance	3849592.00	
1804761.00	Lawn Maintenance	1434469.00	
8263777.00	Watch & Ward Services	9767412.00	
13206669.00	House Keeping Services	14030821.00	
	f) Electricity & Power		17600282.00
12347299.00	Electricity	15283205.00	
1240510.00	Generator Expenses	2317077.00	
	g) Maintenance and Euipment		3510027.00
1034378.00	Electrical Installations	1050703.00	
1469719.00	Misc.Equipment / Installations	733645.00	
1560272.00	Air Conditioners	1593068.00	
6343.00	Fire Extinguishers	4593.00	
16940.00	Gas Bank	26320.00	
52345.00	Aqua Guards	28690.00	
136711.00	Photocopiers	73008.00	
847047.00	h) Conference /Symposia		675525.00
	Vehicle Running & Maintenance		
87064.00	Staff Cars	81207.00	
204398.00	Hired Autos	238968.00	
3626923.00	Hired Transport Services	3670505.00	
523340.00	Hired Vehicles (Vans etc.)	652042.00	4642722.00
25515.00	i) Auditors Remuneration		29972.00
	Others		1226448.00
628807.00	STAFF WELFARE ACTIVITIES	570173.00	
64531.00	Consultancy & Legal Expenses	97866.00	
357876.00	Advertisements	230758.00	
30384.00	Bank Charges	40909.00	
51901.00	Binding Charges	12470.00	
59547.00	HRI Pre-School	29000.00	
0.00	Council Meeting Expenses	41796.00	
19244.00	Liveries	8726.00	
45742.00	News Papers & Periodicals	53697.00	
248652.00	Office Expenses	141053.00	
80088469.00	**Total**		**89832520.00**

HARISH CHNADRA RESERACH INSTITUTE
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SCHEDULE-15 FORMING PART OF BALANCE SHEET AND INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED ON 31st MARCH 2013.

SIGNIFICANT ACCOUNTING POLICIES & NOTES ON ACCOUNTS.

Basis of Accounting

1. The accounts are prepared under historical cost convention on an accrual basis.
2. Accounting policies not specifically referred to otherwise are consistent and inconsonance with generally accepted accounting principles except as stated in Sl. Nos. 9,10 & 12 below.
3. Figures of the previous year and current year have been regrouped wherever necessary to confirm classification.

Fixed Assets

4. Fixed Assets are stated at cost of acquisition inclusive of freight, duties, taxes and incidental expenses related to the acquisition. The Fixed Assets are subject to physical verification.
5. Realization made from Sale of Assets & Scrap is taken as Other Income in the year of receipt.

Depreciation

6. Depreciation on Fixed Assets has been provided on written down value method as per rates specified in the Income Tax Act.1961.

• A	Land	:	Nil
• B	Building	:	10%
• C	Plant Mach. & Equipments	:	15%
• D	Vehicles	:	15%
• E	Furniture & Fixtures	:	10%
• F	Office Equipments	:	15%
• G	Computer/Peripherals :	:	60%
• H	Electrical Installations :	:	10%
• I	Books & Journals	:	25%
• J	Other Fixed Assets	:	15%
• K	Solar Lights & Systems	:	80%

6.1 Depreciation has been charged for the full year on additions made during the year. No Depreciation is charged on assets, which is sold during the year.

Investment

7. Investments are valued at cost plus interest accrued thereon.

Plan Funds

8. Assets purchased from XIth plan funds & XII Plan funds during the year for Rs. 1, 65,78,547. have been capitalized under the appropriate heads of accounts of Fixed Assets.

Funds for Projects/Schemes

9. All grants in respect of projects/Schemes are accounted on realization basis.

   The unspent amount of grants received in respect of the projects/Schemes is shown under Current Liabilities in the Balance Sheet under the head "Receipts against ongoing sponsored projects/schemes" and excess of payments made over the grants received in respect Project /Schemes are shown under Current Assets in the Balance Sheet under the head "Payments against ongoing sponsored Projects/Schemes".

Expenses

10. Consumable, stores and stationery are charged to the Income and Expenditure Account in the year of its purchase.
11. Email, VSAT facility, Internet / Broadband charges, Annual Maintenance charges of fixed assets, Up-date Allowances, PRIS are charged to the Income & Expenditure account in the year of its payment. Rent receipts are taken into Income & Expenditure account on cash basis.
12. Deferred Revenue Expenditure incurred on composite work of Power Line is to be written off $1/10^{th}$ per year over a period of ten years.

Income /Receipts

13. Interest income on UPPCL deposit and bank accounts are recognized on receipt basis.

Retirement Benefits

14. Provision for accrued liability towards Gratuity, Leave Encashment and Pension has been made on actuarial valuation basis.
15. Interest Liability on NPS balances has not been provided for.

Taxation

16. Since there is no taxable income as per the provisions of Income Tax act 1961,provision for Income Tax has not been made.

As per our separate report of even date attached.

Vibhuti Agrawal & Co. for Harish Chandra Research Institute
Chartered Accountants

Sd/-	Sd/-	Sd/-	Sd/-
Proprietor	Raaj Gulati Accounts Officer	Ravindra Singh Registrar	Prof.Jayanta Kumar Bhattacharjee Director

Place: Allahabad
Date: 27.08.13

Action Taken on Auditors Report – FY 2012-13

S.No.	Notes on Accounts	Compliance
1.	Library & Publications includes receipt of Current Journals during the current year for ₹2,23,71,342/-. The Current Journals received have not been capitalized in books of accounts.	The Institute was advised by the Joint Secretary (Fin.) in the Governing Council meeting dt.22.07.2011 that Journals of the Library should not be capitalized and the Institute should inform the Auditors in this regard accordingly. The Institute has taken a policy decision to treat the current journals and magazine as a revenue item and is accounted for accordingly in the books of account.
2.	Amount recoverable against completed projects shown as claims recoverable and Advance for Journals are outstanding since long. Institute should take necessary steps to recover or write off the following amounts: A. NBHM Grant- K. Gangopadhyay Since 2007 ₹47,533.00 B. NBHM Grant- Joseph Samuel Since 2007 ₹17,030.00 C. DST-SFT Manoj Kumar Since 2007 ₹33,961.00 D. NBHM Fellowships Since 2009 ₹1,85,867.00 E. HNB Garhwal University Since 2010 ₹40,000.00 F. Ramanujan Maths Society (DST) Since 2012 ₹8,750.00	The Institute has written to NBHM for its realisation and is also following it up with DST and Garhwal University for recovery of these amounts. We hope that there will be positive outcome to our efforts.
3.	Institute has carried out a physical verification of fixed assets. The quantitative & value reconciliation are being done with fixed assets register, as such it is not possible for us to comment whether financial records are in agreement with physically verified fixed assets.	The Institute carries out physical verification of its assets on regular basis and after the end of the financial year an asset register is prepared giving quantitative and numerical value of assets.
4.	VAT is not being paid on pantry receipts though the Institute is registered with the VAT Department.	The total pantry sales is less than Rs.5/- lacs hence, no VAT is to be deposited. Further, we plan to surrender our VAT Registration and may apply for Tax Deduction Number after taking advice from our Tax Consultant.
5.	No interest during the year on security deposit with UPSEB is received.	The Institute will take up this issue with UPSEB officials at the earliest.
6.	Balance of EMD, Security Deposits, Sundry Creditor, Loan & Advances and Claims Recoverable etc. are subject to confirmation, reconciliation and consequential adjustments thereof.	This is a routine process which is being carried out at periodical intervals. No discrepancy/disagreement has been found so far.

Sd/-	Sd/-	Sd/-	Sd/-
(Amit Roy)	(Raaj Gulati)	(Ravindra Singh)	(J.K.Bhattacharjee)
IA&AO	**Accounts Officer**	**Registrar**	**Director**