Curriculam Vitae

Dr. Avinanda Chaudhuri

Ph. D.

- **Present Position :**
  Assistant Professor, Department of Physics,
  Brahmananda Keshab Chandra College,
  Kolkata – 700108, West Bengal , India
  (From 01. 04. 2017 – to continuing in a permanent post)

- **Former Position (as Ph.D. Research Student):**
  High Energy Physics Group,
  Harish-Chandra Research Institute (HRI)
  Chhatnag Road, Jhunsi, Allahabad, U.P. , India – 211019.
  (From 02. 08. 2010 - 15. 09. 2016)

- **E-mail :** avinandac@gmail.com

- **Mobile No :** (+91) 7897252362

- **Date of Birth :** 11 . 07 . 1983

- **Permanent Address :** C/O. : Prof. Sarbeswar Chaudhuri
  Chaudhuri Lane, Ramkrishna Pally,
  Kalna Road, Badamtala, Burdwan – 713101,
  West Bengal, India.

- **Ph.D. Research Field : Subject : Physics - High Energy Particle Physics**
  Ph. D. Degree Awarded in 2016.

- **Title of Thesis : " Seesaw and Seesaw Like Scenarios : Some Phenomenological Implications "**

- **Thesis Supervisor :** Professor Biswarup Mukhopadhyay,
  Harish_Chandra Research Institute, Allahabad – 211019 (U.P.)
  E-mail : biswarup@hri.res.in
  (Presently Professor of Physics, IISER, Kolkata).

- **Visit Abroad: Visited CERN ,** Geneva , Switzerland in 2013 under the programme of **Summer Students' Fellowship.**

- **Awards / Recognitions :**

- Received **"Infosys Scholarship"** in 2016.
- Selected for **National Post Doctoral Fellowship (NPDF), SERB,** Govt. of India , in 2017.
- Selected for **Dr. D.S. Kothari Post Doctoral Fellowship** , UGC, Govt. of India in 2017

- **Pre Ph.D. Project Work :**
  Carried out a research project on **" Black Hole Thermodynamics and Hawking Radiation "** under the supervision of **Professor Ashoke Sen,** HRI, Allahabad.

- **Research Interests:**

  (i) Beyond Standard Model Higgs Sector and their implications in CP – Violation .
  (ii) Neutrino Physics / Dark Matter Phenomenology.
  (iii) Exact Solutions in General Theory of Relativity.
  (iv) Cosmology
  (v) Astrophysics : Black Hole – Accretion Disk System.

Academic Qualifications:

- Qualified **CSIR- UGC (NET)** Research Fellowship (organized jointly by the Council of Scientific and Industrial Research and The University Grants Commission, Govt. of India).
- Qualified **JEST** (Joint Entrance Screening Test) Fellowship (Ph.D. entrance examination organized by all premier research institutes in India),
  Grade obtained - 98.8 percentile
- Qualified **GATE** (Graduate Aptitude Test) Examination (organized by All Indian Institute of Technologies (IITs)),
  Grade obtained - 96.5 percentile.

- Master of Science (M. Sc.) in Physics , 2006
  Grade obtained – First Class, Jadavpur University, India
  Marks obtained - 71.5 %
- Bachelor of Science (B. Sc.) with Physics Major / Honors , 2004
- Grade obtained – First Class with Distinction, Jadavpur University, India
  Marks obtained - 69.5 %
- Higher Secondary Examination , 2001, West Bengal Council of Higher Secondary Education
  Marks obtained - 84 %
- Secondary (Madhyamik) Examination, 1999 , West Bengal Board of Secondary Education
  Marks obtained - 86.5 % .

- **Teaching Experience :** More than four (4) Years of U G (with Honors / Major in Physics) regular Teaching experience in a College (permanent post) in West Bengal

Publications : In Journals and Conferences :

1. A Type – II seesaw scenario with two Higgs triplets and doubly charged scalar decays - by **Avinanda Chaudhuri** , Walter Grimus and Biswarup Mukhopadhyaya
   - **Journal of High Energy Physics, JHEP 02 (2014) 060 .**

2. Dark matter candidate in an extended type III seesaw scenario,
   by - **Avinanda Chaudhuri ,** Najimuddin Khan, Biswarup Mukhopadhyaya and Subhendu Rakshit,
   Physical Review D 91, 055024 (2015)

3. CP – violating phase in a two Higgs triplet scenario : Some phenomenological implications - by **Avinanda Chaudhuri** and Biswarup Mukhopadhyaya
   Physical Review D 93, 093003 (2016)

4. First studies towards a measurement of the Higgs width at TELP ,
   by **Avinanda Chaudhuri , CDS, CERN (2013).**

5. On the generation of magnetostatic solutions from gravitational two-soliton solutions of a stationary mass -
   by **Avinanda Chaudhuri** and S Chaudhuri
   Eur. Phys. Journal C. (2017) 77: 747

6. Static magnetovac solutions of Einstein- Maxwell equations from stationary gravitational fields -
   by **Avinanda Chaudhuri** and S Chaudhuri
   Eur. Phys. Journal Plus (2017) 132: 472

7. On some Aspects of Accretion Disk–Black Hole System – by **Avinanda Chaudhuri** and S. Chaudhuri, - Paper presented in the "International Conference on Radiation Physics and Its Applications" held at the Department of Physics, The University of Burdwan during January 16 -17, 2010.

8. Two-zero texture of neutrino mass matrices and the type II Seesaw scenario -
   by **Avinanda Chaudhuri** - Paper presented in the National Conference on "Frontiers of Physics" held at the Department of Physics, The University of Burdwan, West Bengal, India during March 30 – 31, 2017.

9. "Texture Zero of Neutrino Mass Matrices and the Seesaw Scenario" by **Avinanda Chaudhuri** – Paper presented in the UGC sponsored State Level Seminar on "Recent Trends in Physics : Research and Education" , held at Barrackpore Rastraguru Surendranath College (W.B.), on 8 December, 2017.

Communicated Papers :

10. Static magnetic dipole solutions of Einstein – Maxwell equations from the soliton solutions of a Kerr object - by **Avinanda Chaudhuri,** S. Nandi and S. Chaudhuri,
(Communicated for publication in **Canadian Journal of Physics.)**

11. Anisotropic Bianchi type – I Universe under the Brane World Scenario –
    by **Avinanda Chaudhuri** (Communicated for publication in **JETP)**

Research Activities and Future research Plan:

I have carried out my research work during my Ph.D. Degree on **"Beyond Standard Model" (BSM) of Particle Physics and on some properties of Dark Matter (DM).** These works have been published in reputed international journals in Physics.

The Standard Model of Particle Physics (SM) is very much successful in describing most of the observed phenomenon in Particle Physics. However, the SM can not explain some theories and observed facts and there is a strong motivation for Physics beyond SM, to address some yet unexplained observations, which include small masses and mixing pattern of neutrinos, the existence of Dark Matter (DM) and Dark Energy (DE), the matter – antimatter asymmetry in the universe etc. Also in the Large Hadron Collider (LHC) era, we hope to test the theory beyond SM which describes physics in the TeV scale.

To explain the observed evidences for neutrino masses a number of mechanisms were developed beyond SM. In our work we focused on "Seesaw" framework – which is considered as the most elegant way of explaining the smallness of neutrino mass. Out of the four possible seesaw scenarios, my works are based on Type II and Type III seesaw frame work. In my study, **I explored the phenomenology of doubly charged scalar particle decays in Type II seesaw framework and described the usefulness and uniqueness of these decays at the LHC.**

To search for the existence of a suitable Dark Matter candidate, **I have proposed a model inspired by Type III seesaw framework.**

Uniqueness of our Work:

To have information about neutrino mass generation mechanism and the absolute values of their masses, we used the concept of neutrino mass matrix. In absence of any clear guidelines from the empirical data, various 'textures' for neutrino mass matrix are often investigated. My work is focused on the "two-zero texture" of mass matrix as it has wide acceptability in explaining the observed data. **It is our achievement to show that by introducing two scalar particle fields beyond SM, it is possible to obtain a two-zero texture of neutrino mass matrices in accordance with the observed data.**

Secondly, we have also shown that because of the presence of two scalar fields in the model rather than one, a very dominant decay channel via W (+ , -) bosons opens up and this decay width overshadows other decay modes over a wide range of parameter space

of a charged scalar field, as discussed in previous works by other researchers. We have carried our study which points out this difference at LHC.

There is strong empirical evidence for the existence of Dark Matter in the universe. A simple attractive candidate for DM would be a new elementary particle that is electrically neutral and stable on cosmological scales. We proposed an extension of normal Type III seesaw scenario to explain these features of a DM particle. By employing Z_2 symmetry in our model, we obtained Z_2 odd neutral fermion state that emerged as the DM candidate. We have shown by varying one parameter at a time and keeping others fixed, it is possible to obtain a wide region of DM mass ranging from 200 GeV to TeV scale which satisfies correct relic density range and the constraints imposed on Weakly Interacting Massive Particle **(WIMP)** nucleon cross section by XENON 100 and LUX experimental data.

Besides my research in particle physics, presently I am doing some research work in General Theory of Relativity, Cosmology and Astrophysics and I intend to carry on some research in these fields.

General Relativity: Exact Solutions of Einstein and Einstein-Maxwell Equations in General Relativity are of much importance in the analysis of the properties of astrophysical objects. However, since Einstein's field equations are highly non-linear in nature, different transformation techniques have been developed by assuming some kind of symmetry. **We have constructed some new solutions of Einstein and Einstein-Maxwell equations using some solution generating techniques.** The properties of the generated solutions are also investigated. These works have been published in international research journals.

Cosmology: I have started some investigations on Brane Cosmology to study the evolution of the universe with time. In brane cosmology, it is assumed that the standard 4-Dimensional world (called the "brane") is embedded in a 5-Dimensional space-time (called the "bulk"). The brane is thus a hypersurface of the bulk. **In our work anisotropy of the universe, volume scale factor, expansion scalar, shear, deceleration parameter and their variations with respect to time for a Bianchi type-I universe are being studied / investigated.** The results of my investigations are being communicated in a research journal for publication.

Astrophysics: Accretion disk – Black hole system: Recently I am engaged with some research work in the study of the behavior of Accretion Disks around Black Holes. Black holes owing to their intense gravitational field attract matter from their surroundings and these attracted matter form an accretion disk around the black hole. The study on accretion disk with a black hole as a central object is thus in conformity with physical reality. We evaluated the energy density and pressure of the disk and disk – black hole combination. It is shown that the presence of the black hole tends to stabilize the disk. A

region is detected in the system where the disk particles can assume superluminal velocity. These regions are to be excluded for physical analysis. Solutions of a particular Disk-Black hole combination are evaluated and works for more general type of solutions are in progress.

Invited Talks Delivered:

(1) Delivered an Invited Talk on " Phenomenological Implications of Seesaw Scenarios" at Indian Association for the Cultivation of Sciences, Kolkata in June 2016.

(2) Delivered an Invited Talk on "Texture zero of neutrino masses and Type II seesaw mechanism" at the Nu Horizon, International Conference held at Harish-Chandra Research Institute , Allahabad , India in March 2016.

Talks and Presentations:

(i) Dark matter model in a type-III seesaw scenario at Harish-Chandra Research Institute , Allahabad , India in 2014.
(ii) Neutrino mass ordering and mixing structure at Harish-Chandra Research Institute , Allahabad , India in 2013.
(iii) First studies towards a measurement of the Higgs width at TELP, CMS Group Meeting CERN, Geneva, Switzerland in 2013.
(iv) Little Higgs Theories and the current LHC Data at Harish-Chandra Research Institute , Allahabad , India in 2013.
(v) Forward- Backward Asymmetry at colliders at Harish-Chandra Research Institute , Allahabad , India in 2012.
(vi) Theory of Kerr Black Hole at Harish-Chandra Research Institute , Allahabad , India in 2012.
(vii) Monte Carlo Simulations of Ising Models, The Metropolis Algorithm at Harish-Chandra Research Institute , Allahabad , India in 2012.
(viii) CP Violation in Particle Physics at Harish-Chandra Research Institute , Allahabad , India in 2011.
(ix) Hawking Radiation at Harish-Chandra Research Institute , Allahabad , India in 2011.
(x) Black Hole Entropy at Harish-Chandra Research Institute , Allahabad , India in 2011.

(xi) Geometrical Phases in Physics at Harish-Chandra Research Institute , Allahabad , India in 2010.

Computational Skills :

- Extensive knowledge in FeynRules, CalcHEP / CompHEP, MadGraph, Mathematica, Matlab, microOmega, MadAnalysis packages.
- Microsoft Office, LaTex, JaxoDraw.
- Programming ability in Fortran, C++ , Python, PHP, Java

Schools and Conferences Attended :

(i) Participated in the International Conference on "Frontiers in High Energy Physics", held at Indian Institute of Mathematical Sciences, Chennai, India in Dec. 10 – 14, 2012.

(ii) Participated in the International Conference on "Nu Horizons on Neutrino Physics" held at Harish-Chandra research Institute, Allahabad , India during 1 – 3 Feb., 2012.

(iii) Participated in the Workshop on " High Energy Physics Phenomenology" held at Harish-Chandra research Institute, Allahabad , India during Nov. 2 – 5 , 2012.

(iv) Participated in the International Conference on "HIGGSTOP" held at Goa, India during 25 – 27 Feb., 2013.

(v) Participated in the Instructional Workshop in Particle Physics "Sangam @HRI" – an Advanced School cum Workshop on current topics in Particle Physics , held at Harish-Chandra research Institute, Allahabad , India during Mar. 25 – 30 , 2013.

(vi) Summer Fellowship at CERN, Geneva, Switzerland during the period ! July – 25 Aug., 2013.

(vii) Invited to attend an Workshop on High Energy Physics and Phenomenology WHEPP 13, held at Puri, Odisha, India during December 12 – 21, 2013.

(viii) Participated in the Instructional Workshop in Particle Physics "Sangam @HRI" – an Advanced School cum Workshop on current topics in Particle Physics , held at Harish-Chandra research Institute, Allahabad , India during Mar. 24 – 29 , 2014.

(ix) Invited to attend a Conference on " Electroweak Symmetry Breaking (EWSB) and Status of Flavor Physics" held at Indian Institute of Technology Guwahati, Assam during February 20 – 22, 2014.

(x) Attended a National Workshop on " LHC and Dark Matter (LHCDM)" held at Indian Association for the Cultivation of Sciences, Kolkata during February 16 – 20, 2015.

(xi) Attended the National Conference on " The Universe Yours to Discover" held at MUC Women's College , Burdwan , West Bengal, India.

(xii) Attended and presented a paper in the National Conference on " Frontiers of Physics" held at the University of Burdwan , Burdwan, India during March 30 – 31 , 2017.

(xiii) Participated and presented a paper in the UGC sponsored State Level Seminar on "Recent Trends in Physics : Research and Education" held at Barrackpore Rastraguru Surendranath College, (W.B.) on 8 December, 2017.

Teaching Assistance :

- Acted as a Teaching Assistant for a course on General Theory of Relativity at the Graduate School at Harish-Chandra Research Institute, Allahabad, India during the period from August to December, 2012.
- Acted as a Teaching Assistant for a course on Quantum Mechanics at the Graduate School at Harish-Chandra Research Institute, Allahabad, India during the period from August to December, 2014.
- **Acted as a Teaching Assistant for School level students for Backward Classes in the locality** on several occasions over a period of 3 years **held at the HRI Campus, Allahabad** during 2013 – 2016.

Pre-Ph.D. Graduate Course :

- Successfully completed two year Graduate Course Work in Physics Stream at Harish-Chandra research Institute, Allahabad , India.