Dr. Sasmita Mishra

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Academic Details

Degree	Institute	Year	Division
Ph.D*	Indian Institute of Technology Bombay, Powai, Mumbai, India.	2006 -2011	Degree Awarded
M.Sc. (Physics)	Utkal University, Bhubaneswar, Orissa, India.	2003 - 2005	1st
B.Sc. (Physics)	Utkal University, Bhubaneswar, Orissa, India.	2000 - 2003	1st (Distinction), (7th position)
+2 Science	S.C.S. College, Puri, Orissa, India	1996 - 1998	1st

***Thesis Title:** Accomplishing Parity breaking and Supersymmetry breaking in the context of Cosmology.
Thesis advisor: Prof. Urjit A. Yajnik

Research Experience

- Post-doctoral Fellow, Theory group,
  Physical Research Laboratory, Ahmedabad,
  (September 2011 - November 2013).
- Vising Fellow, Institute of Physics,
  Bbubaneswar, (November 2013 - December 2013).

Scholastic Achievements

- 7th position in Utkal University based on performance in +3Sc (Physics Hons.).
- Selected for National Scholarship (2003-2005).

- Qualified in all India level Graduate Aptitude Test in Engineering, GATE 2006.
- Qualified in all India level National Eligibility Test, NET in Physics in December 2005 and June 2006.
- Selected for Sashtri Indo-Canadian Fellowship for student mobility program (Declined).
- Canadian Commonwealth fellowship from September 2010 to January 2011. Visiting student, McGill University, Montreal, Canada from September 2010 to January 2011.

Teaching

During PhD

- Teaching Assistant, for B. Tech. 1st year Lab, IIT Bombay,
- Teaching Assistant, for M.Sc., Programming in Fortran 90, IIT Bombay,
- Teaching Assistant, Tutorial classes and 1st year Lab for B. Tech., IIT Gandhinagar.

NIT Rourkela

- M.Sc.
  - PH - 407, Quantum Mechanics - I, (Autumn - 2014)
  - PH - 408, Quantum Mechanics -II, (Spring - 2015)
  - First year Lab., (Autumn - 2014, Spring - 2015)

List of Publications

1. **Sasmita Mishra**, A. Sarkar, U. A. Yajnik, “Gauge mediated supersymmetry breaking and the cosmology of Left-Right symmetric model”, Phys. Rev. D 79, 065038, (2009), arXiv:0812.0868.
2. **Sasmita Mishra**, U. A. Yajnik, “Spontaneously broken parity and consistent cosmology with transitory domain walls.”, **Phys. Rev. D 81, 045010,(2010)**, arXiv:0911.1578
3. **Sasmita Mishra**, Wei xue, Robert Branden berger, U. A. Yajnik, ” Supersymmetry breaking and dilaton stabilization in string gas cosmology”, **Journal of Cosmology and Astroparticle Physics 09 (2012) 015**, arXiv:hep-th/1103.1389
4. Debasish Borah, **Sasmita Mishra**, ” Spontaneous R-parity breaking, Left-Right Symmetry and Consistent Cosmology with Transitory Domain Walls ”, **Phys. Rev. D 84, 055008 (2011)**, arXiv:hep-ph/1105.5006,
5. Urjit A. Yajnik, **Sasmita Mishra**, Debasish Borah, ” Left-right symmetry, supersymmetry : cosmological constraint”, **AIP Conf.Proc. 1560 (2013) 284-288**, Conference : CIPANP 2012, St. Petersburg, Florida. May 29 - June 3, arXiv:1401.8063 (hep-th).
6. Srubabati Goswami, Subrata Khan, **Sasmita Mishra**, ” Renormalization group effect in a TeV scale seesaw model.” **Int.J.Mod.Phys. A29 (2014) 1450114**, arXiv:1310.1468 (hep-ph).

Conference, Workshops and Schools Attended

- “SERC Preparatory School in Theoretical High Energy Physics”, Indian Institute of Science, Bangalore, November 2006.
- “Aspects of neutrinos”, International Center, Goa, April 2009
- “Workshop in High Energy Physics Phenomenology(WHEPP)”, Physical Research Laboratory, Ahmedabad, January 2010.
- “4th Asian school in strings, particles and cosmology”, organized by ICTS, TIFR in Mahabaleswar, January 2010.
- “SERC Main School in Theoretical High Energy Physics ”, Punjab University, Chandigarh, April 2010.
- iCAPP (interface of Cosmology And Particle Physics) 21-23 September, Physical Research Laboratory, Ahmedabad.
- Neutrinos - From Majorana to LHC, The Abdus Salam International centre for Theoretical Physics (ICTP), Italy, October 2011.

Referees

1. **Prof. U. A. Yajnik,** (Ph.D. Supervisor)
   Department of Physics,
   Indian Institute of Technology, Bombay - 400076,
   Mumbai, India,
   Ph No: +91 22 2576 7575
   Email: yajnik@phy.iitb.ac.in
2. **Prof Srubabati Goswami** (Post Doctoral supervisor)
   Theoretical Physics Division,
   Physical Research Laboratory, Ahmedabad
   380 009, Gujarat, India
   Ph. No: 079 2631 4471
   Email: sruba@prl.res.in
3. **Prof Robert H Brandenberger,**
   Professor, Canada Research Chair (Tier 1),
   Ernest Rutherford Physics Building,
   McGill University,
   3600 rue University,
   Montral, QC,
   Canada H3A 2T8,
   Email: rhb@physics.mcgill.ca
4. **Prof. S. Uma Sankar,**
   Department of Physics,
   Indian Institute of Technology, Bombay - 400076,
   Mumbai, India,
   Ph No: +91 22 2576 7557
   Email: uma@phy.iitb.ac.in
5. **Prof. A. Mukherjee,**
   Department of Physics,
   Indian Institute of Technology, Bombay - 400076,
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Research Interest

The Standard Model (SM) of particle physics based on the gauge group $SU(3)_c \otimes SU(2)_L \otimes U(1)_Y$ accounts for the basic constituents of matter, in three generations of quarks, three generations of leptons and the gauge bosons. Among the four fundamental interactions of nature; strong, weak, electromagnetic and gravity, the SM explains the former three interactions with great precession. It also unifies the electromagnetic and weak interactions at an energy scale of the order of TeV. This unification is known as electroweak unification. The endeavor to unify strong interaction with the electroweak interaction is called Grand Unification. Gravitational interaction is the weakest of all and it is hard to unify with the other three interactions. String theory has emerged as a strong candidate in unifying all the four basic interactions, with an expectation of being labeled as "Theory of Everything". The unique feature of string theory is that the fundamental constituents of matter are one dimensional vibrating strings with different modes of vibration of the string representing different particles.

The theory of the SM is based on the concept of spontaneous symmetry breaking mechanism by scalar fields called Higgs particles. All the fundamental particles of the SM get their characteristic masses by coupling to the Higgs scalar through Yukawa coupling. The experimental evidence of Higgs scalar and hence the success of the SM is still to be established by the currently running experiment Large hadron collider (LHC). Though successful as a model of particle physics, the SM fails to answer a few open questions. The established nature of massive neutrinos, search for a dark matter candidate, understanding matter-antimatter asymmetry of the Universe and hierarchy problem are some of the issues which are beyond the paradigm of the SM.

Apart from particle physics models, the study of modern cosmology is another interesting area of research. It studies the dynamics of the Universe at large scales. The infusion of ideas from particle physics models to cosmology and vice versa has helped us to understand nature better. Spontaneous symmetry breaking is a key concept in model building. Symmetries which are broken at the present epoch are restored at high temperature in the early Universe. In other words, higher symmetries which would be apparent in the early Universe appears broken and indirect in the cold Universe at present. The focus of my research is on two particular symmetry breaking scenarios: parity and supersymmetry, keeping in mind the cosmological issues.

Supersymmetric extension of the standard model (SM) has emerged as one of the interesting area of research. As the whole mass spectrum in the SM emerges from the coupling of the fundamental particles with the Higgs, its mass should be stabilized against quadratic divergences. Supersymmetry (SUSY) provides a new symmetry in which each fermion comes with a scalar partner and vice versa with same mass and same quantum numbers. These new particles are called the superpartners of the respective SM particles.

In spite of being same in mass and quantum numbers the superpartners have not been seen in collider experiments yet, this clearly indicates that SUSY is a broken symmetry (For example electron and it superpartner selectron have same mass 0.511MeV, but selectron has not been predicted yet at experiments unlikely electron). Studies has been conducted on how to break SUSY spontaneously in MSSM. But the supersymmetric sum rule makes it difficult to get the desired mass spectrum from spontaneous SUSY breaking. So it was proposed that the breaking has to occur in another sector called a hidden sector and the effect of breaking can be communicated to the MSSM or visible sector through some interactions say, gravitational, or gauge interactions.

The experiments based on neutrino masses and mixing have established the fact that this elusive particle has tiny but nonzero mass. There has been search for a theory which can account for the smallness of neutrino masses. The renormalizable Standard Model though successful in explaining most of the experimental results, lacks in incorporating the desired feature. The seesaw mechanisms have been a popular study that can account for smallness of neutrino mass. It requires addition of extra fields to the theory to account for nonzero neutrino mass. However the energy scales at which these extra fields are added are usually high ($10^{12} - 10^{15}$GeV). So the experimental testability of these models is far reaching. It is interesting to study these models as low scale say the energy scale within the reach of Large Hadron Collider (LHC).

The current neutrino oscillation parameters are measures at low energy scale. But the neutrino mass operator emerges at the seesaw scale which is usually high. So the leptonic mixing angles, phases and masses are subject to radiative corrections. They are governed by the effects of renormalization group (RG) evolution between the seesaw scale and the low energy scale. The effect of RG running below the seesaw scale is different from that above the seesaw scale. Below the seesaw scale the RG evolution of the neutrino mass operator is governed by th effective theory which is same for all seesaw models. But above the seesaw scale one has to consider the full theory i.e the interplay of the extra heavy field and the light neutrino field. This region can be model independent.

There are quite a few mechanisms of mediation of SUSY breaking from hidden sector to visible sector. In my research work I have studied about Gauge mediation , Gravity mediation and anomaly mediation of SUSY breaking . By surfing the literature I have some idea about direct gauge mediation and general gauge mediation. While doing some research work in collaboration with Prof Robert Brandenberger at McGill University I got to do some literature survey in gaugino condensation mechanism in superstring theory framework. As a part of my postdoctoral work I have studied renormalization group effect in neutrino sector. It would be interesting to further study their dynamics from cosmological point of view, for example leptogenesis which can explain matter-antimatter asymmetry of the Universe. My interest lies in more study on mediation mechanisms of SUSY breaking, RG effect in different models and their phenomenological signatures.

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