Dr. Nilanjana Kumar

Assistant Professor (senior) (From 11.02.2022-)
Thanu Padmanabhan Centre for Cosmology and Science Popularization
SGT University, Delhi NCR, India
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Expertise

Experience in Particle Physics and High energy Physics with knowledge in various extensions of Standard Model, expertise in model building and simulations in collider phenomenology, working in the interface of Particle Physics, Cosmology with application of Machine Learning. Experience in teaching B.Sc. and M.Sc. students.

Research Interests

Phenomenological aspects of Beyond Standard Model Physics

Exotic physics in Composite Higgs, Little Higgs Models

Large Hadron Collider and International Linear Collider and Muon Collider

Application of ML in High Energy Physics and Cosmology

Early universe cosmology, Dark Matter, Primordial Black Holes

Past Experience

Ph.D in Physics : Northern Illinois University (NIU) August 2016
Dekalb, IL, USA

Thesis: *"Phenomenological studies of extensions of the Standard Model"*
Advisor:Stephen P. Martin

Postdoc D.S.Kothari Postdoctoral Fellow, 2019-2022
Department of Physics and Astrophysics, University of Delhi, India

Postdoc Theoretical Physics Division 2019
Institute of Mathematical Sciences, Chennai, India

Postdoc Theory Division 2017-2018
Saha Institute of Nuclear Physics, Kolkata, India

Postdoc Theory Division, Institute of Physics(IOP) 2016
Bhubaneswar, India

Publications

Q1 Journal Publication: **14** Reports and Proceedings: **3** Review:**1** arXiv: **1**

Achievements and Awards

Associate of **Indian Academy of Sciences**, Bengaluru, 2023
Recipient of **Core Research Grant (CRG)** as co-PI by SERB DST, 2022
Recipient of **Startup Research Grant(SRG)** as PI by SERB DST, 2022
D.S.Kothari Postdoctoral Fellowship by UGC, (2018-2021)
Outstanding Teaching Assistant award during Ph.D. by Physics department and Northern Illinois University, 2015

All India Rank 142 in National Eligibility Test in Physics in India, 2009

Awarded by Indian Association of Physics Teachers in National Graduate Physics Examination, 2006

Best Talent among undergraduate students in nationwide "Physics Talent Search" by Indian Physics Association, 2005

Awarded 1st prize in district level seminar by Department of Youth Services, INDIA, for recitation on "Biological Revolution -Benefits and Concerns", 2001

Early Education

The Institute of Mathematical Sciences, Chennai, India

Post M.Sc Coursework as JRF, 2010 Physics, 2010, GPA: 8/10

University of Calcutta, Kolkata, India

M.Sc, Physics, August 2009, GPA: 7.2/10(1st class)

- Masters Project: Study of Quantum Computation and Quantum Cryptography

Bethune College, University of Calcutta, Kolkata, India

B.Sc., Physics (Major), May 2007, GPA: 6.1/10(1st class)

Conference Presentations

PHOENIX 2023, IIT Hyderabad, **invited speaker**
"Exotic Particles at Colliders and Future Colliders".
WPAC, 2023, Shiv Nadar University, **invited speaker**
"Alternative Signatures of Exotic Particles at LHC and Future Linear Colliders"
University of Calcutta, **invited speaker**
"Exotic particles at future colloder experiments", 2022
ILC WG3 mini-workshop on BSM at ILC,
"Alternative Searches for Quintuplet fermions at ILC", 2022
PHENO 2020, University of Pittsburgh, USA,
"Collider signatures of multicharged fermions".
APCTP, South Korea, **invited speaker** in APCTP Mini-Workshop 2019- "Recent topics on dark matter, neutrino, and their related phenomenologies": talk titled
"Effects of Higher Dimensional Operators on Higgs couplings"
ANOMALIES 2019, IIT Hyderabad, India,*Effects of Higher Dimensional Operators on Higgs Couplings.*
IIT Chennai, Chennai, India, 2019
"Realization of the Higgs coupling beyond the Standard Model"
IMHEP 2019, IOP Bhubaneswar, India, 2019
"Higgs couplings in Georgi -Machacek Model"
DAE-BRNS Symposium, IIT Madras, Chennai, India, 2018
"Flavor violation at 13 TeV LHC in ($\mu^+\tau^- + b$-jet) events"
IMSC, Chennai, India, 2018
"Confronting LHC data with Composite Higgs Theories"
SUSY 2017, TIFR, Mumbai, India, 2017
"Unique collider signatures of a left-right symmetric model with minimal DM"
SINP, Kolkata, India, 2017
"Confronting LHC data with composite Higgs models"
CAN-DARK, ICTS, Bangalore, India,2017
"Collider signature of a left-right symmetric model"

SINP, Kolkata, India, 2016
"Solving the problems in MSSM Effective Potential due to Goldstone Bosons"
IOP, Bhubaneswar, India, 2016
"A study on the prospects of Vectorlike Leptons at LHC"
Northern Illinois University, IL, USA, 2016
"Phenomenological studies of minimal extensions of Standard Model"
University of Calcutta, India, 2015
"Prospects of Vectorlike Leptons at LHC"
'PHENO 2015', University of Pittsburgh, USA,
"Vectorlike Leptons at LHC"
'PHENO 2014', University of Pittsburgh, USA,
"LHC search for di-Higgs decays of stoponium and other scalar resonances in events with two photons and two bottom jets"

Visits and Other Engagements

Organised yearly international conference **Cosmology@CCSP** at CCSP, SGY University, 2023-.
Part of **Science Popularization** program at CCSP, SGT University.
Delivered a Sci-Pop talk *"LHC:A machine to detect particles and more.."*, 2022
Member of **International Linear Collider Working Group3** and a part of "ILC Report to snowmass collaboration".
Invited speaker at ILC working group workshop, 2022-,
Invited speaker and visitor at APCTP, South Korea, 2019
Project Student at HRI, India under Prof. Amitabha Roychoudhury, 2010
Visiting student at Indian Physics Association for Physics Talent Search, 2005

Workshop and school

2022, Particle Physics:Phenomena, Puzzles, Promises, ICTS, Bengaluru, India
2019, WHEPP XVI, IIT Guwahati, Assam
2018, SANGAM@HRI workshop, Harishchandra Research Institute, India
2018, Indo French conference, IISER Pune, India.
2017, Aspects of Early Universe Cosmology, SINP, Kolkata.
2016, Pedagogical School on Neutrinos and LHC physics at IOP, Bhubaneswar.
2013, Prospects in Theoretical Physics (PiTP) summer program on LHC Physics in Institute for Advanced Study, Princeton,USA
2009, Conference on LHC and New Frontiers of Particle Physics organized by University of Calcutta

Computational Skills

- Computer Programing, ROOT, Extensive numerical simulation in Mathematica
- High Energy Physics Packages: FeynRules, micrOMEGA, Monte Carlo Simulation
- BDT and ML applications in Collider Phenomenology

Teaching Experience

Teaching as Assistant Professor 2022-
Department of Physics, SGT University
B.Sc Thermal Physics and Statistical Mechanics
M.Sc Quantum Mechanics I

Teaching Assistant 2019-2020
University of Delhi

M.Sc Statistical Mechanics, Computer language)

Teaching Assistant 2011-2016
Northern Illinois University, USA
Electricity and Magnetism, Mechanics (Outstanding TA award)

Part Time Physics Instructor 2009
BRSC College, Kolkata, India
Mathematical Physics, Nuclear Physics

Project Students

Ms. Gaadha Lekshmi S
Master in Physics
Department of Physics, SVNIT, Surat, Gujrat
Project for Master's Thesis and Project Associate -I under SRG grant

Mr. Muzammil Akhtar
M.Sc, Jamia Millia Islamia
Project Associate -I under SRG grant

Mr. A M Anirudhan
M.Sc, School of Physics, IISER TVM
Project Associate -I under SRG grant
(Got PhD position at University of Utah, USA in 2023)

Mr. Shreesh Sahai
B. Tech + M. Tech Integrated – Nuclear Science and Technology
Amity Institute of Nuclear Science and Technology, Amity University, Noida
Project for Master's Thesis

Other Information

- Member of NICAAD(2012-2016), Project leader of QuarkNet in 2011
- I like to be involved in academic group activities and cultural programs.
- I do have interest in literature, painting, travel and photography.
- Date of Birth: 8th October, 1986, Nationality: Indian
- Spouse: Dr. Mayukh Raj Gangopadhyay

References

Stephen P. Martin
Distinguished Professor
Department of Physics E-mail: spmartin@niu.edu
Northern Illinois University, Illinois, US

Debajyoti Choudhury
Senior Professor E-mail: debajyoti.choudhury@gmail.com
Department of Physics and Astrophysics
university of Delhi, Delhi

Anirban Kundu
Professor
Department of Physics E-mail: akphy@caluniv.ac.in
University of Calcutta, Kolkata, India

Gautam Bhattacharyya
Senior Professor
Theory Division
Saha Institute of Nuclear Physics, Kolkata
E-mail: gautam.sinp@gmail.com

Publications

Published papers : 14

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1. C. Accettura *et al.*
"Towards a Muon Collider", Eur. Phys. J. C **83**, no.9, 864 (2023)
doi:10.1140/epjc/s10052-023-11889-x

2. J. Das, **N. Kumar**
"Veltman criteria in the beyond standard model effective field theory of a complex scalar triplet",
Phys. Rev. D **108**, no.3, 035048 (2023)
doi:10.1103/PhysRevD.108.035048

3. **N. Kumar**,V.Sahdev,
"Alternative signatures of the quintuplet fermions at LHC and future linear colliders",
Phys. Rev. D **105**, no.11, 115016 (2022)
doi:10.1103/PhysRevD.105.115016

4. **N. Kumar**, T. Nomura and H. Okada,
"N. Kumar, T. Nomura and H. Okada, "A multi-charged particle model with local $U(1)_{\mu-\tau}$ to explain muon $g-2$, flavor physics, and possible collider signature",
Chin. Phys. C **46**, 043106 (2022)
doi:10.1088/1674-1137/ac425a

5. D. Choudhury, K. Deka and **N. Kumar**,
"Looking for a vectorlike B quark at the LHC using jet substructure,"
Phys. Rev. D **104**, no.3, 035004 (2021)
doi:10.1103/PhysRevD.104.035004

6. **N. Kumar** and S. Sadhukhan, **"Emergent 2HDM in LSS Little-Higgs: Musings from Flavor and Electroweak Physics"**,
Phys. Rev. D 103, 055011 (2021)
doi:10.1103/PhysRevD.103.055011

7. **N. Kumar**, T. Nomura and H. Okada, **"Scotogenic neutrino mass with large $SU(2)_L$ multiplet fields"**,
Eur. Phys. J. C **80**, no.8, 801 (2020)
doi:10.1140/epjc/s10052-020-8352-5

8. D. Choudhury, N. Kumar, A. Kundu,
"Search for opposite sign muon-tau pair and a b-jet at LHC in the ontext of flavor anomalies"
Phys. Rev. D **100**, no. 7, 075001 (2019)
doi:10.1103/PhysRevD.100.075001

9. A. Banerjee, G. Bhattacharyya, N. Kumar,
"Impact of Yukawa-like dimension-5 operators on the Georgi-Machacek model"
PHYSICAL REVIEW D 99, 035028 (2019)
doi:10.1103/PhysRevD.99.035028

10. A. Agarwalla, K. Ghosh, N. Kumar and A. Patra,
"Same-sign Multilepton Signatures of an SU$(2)_R$ Quintuplet at the LHC"
10.1007/JHEP01(2019)080
doi:10.1007/JHEP01(2019)080

11. A. Banerjee, G. Bhattacharyya, N. Kumar and T. S. Ray,
"Constraining Composite Higgs Models using LHC data"
10.1007/JHEP03(2018)062
doi:10.1007/JHEP03(2018)062

12. N. Kumar and S. P. Martin,
"Resummation of Goldstone boson contributions to the MSSM effective potential"
Phys. Rev. D **94**, no. 1, 014013 (2016)
doi:10.1103/PhysRevD.94.014013

13. N. Kumar and S. P. Martin,
"Vectorlike leptons at the Large Hadron Collider"
Phys. Rev. D 92, 115018 (2015)
doi:10.1103/PhysRevD.92.115018

14. N. Kumar and S. P. Martin,
"LHC search for di-Higgs decays of stoponium and other scalars in events with two photons and two bottom jets"
Phys. Rev. D **90**, no. 5, 055007 (2014)
doi:10.1103/PhysRevD.90.055007

Reports and Conference Proceedings: 3

(a) J. de Blas *et al.* [Muon Collider],**"The physics case of a 3 TeV muon collider stage"**,
arXiv:2203.07261 [hep-ph], Contribution to "2022 Snowmass Summer Study". (To be Published in EPJC)

(b) I. Adachi *et al.*,**"The International Linear Collider: Report to Snowmass 2021"**,
arXiv:2203.07622 [physics.acc-ph], Contribution to "2022 Snowmass Summer Study".

(c) N. Kumar, **"Flavor violation at LHC in events with two opposite sign leptons and a b-jet "**,
arXiv:2011.12810 [hep-ph]
Springer Proc.Phys. 261 (2021) 239-243, XXIII DAE High Energy Physics Symposium Proceedings

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Papers communicated in journals: 2

(a) A. Basu, A. Chakraborty, **N. Kumar** and S. Sadhukhan
"Viability of Boosted Light Dark Matter in a Two-Component Scenario", [arXiv:2310.09349 [hep-ph]].

(b) M. R. Gangopadhyay, **N. Kumar**, A. Mukherjee and M. K. Sharma,
"Composite pseudo Nambu Goldstone Quintessence", arXiv:2205.15249 [astro-ph.CO].

Review Article : 1

(a) N. Kumar, **"A Brief Review on Jet Substructure in Connection with Collider Phenomenology "**,
arXiv:2211.10651 [hep-ph]