

# Curriculum Vitæ: Dr. Nishita Desai

31 December 2020

## Personal Details

Name: Nishita Dattatray Desai  
Nationality: Indian  
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## Employment

2018–23 Ramanujan Fellow, Department of Theoretical Physics  
Tata Institute of Fundamental Research, Mumbai, India

2016–18 OCEVU & CNRS Postdoctoral fellow  
Laboratoire Univers et Particules de Montpellier and  
Laboratoire Charles Coulomb, Montpellier, France

2013–16 Postdoctoral Fellow, Institut für Theoretische Physik, Heidelberg, Germany  
Alexander von Humboldt postdoctoral fellowship during 2013–15

2012–13 Postdoctoral Research Associate, University College London, London, UK  
(Resigned in favour of Alexander von Humboldt postdoctoral fellowship)

2010 Marie Curie Actions Early Stage Researcher  
CERN (August–November 2010)

## Education

2013 **Ph. D.** Harish-Chandra Research Institute  
• Thesis: Signals of Supersymmetry and Higgs at the Large Hadron Collider  
• Advisor: Prof. Biswarup Mukhopadhyaya.

2006 **M. Sc.** Indian Institution of Technology Roorkee

2004 **B. Sc.** Fergusson College, University of Pune

## Appointments

2020–22 **Theory Convenor**, LHC Long Lived Particles Working Group  
Working Group composed of theorists and experimentalists from four LHC experiments to determine optimal directions in searches for long-lived particles.  
<https://lpcc.web.cern.ch/lhc-llp-wg>

2020– **Member of steering committee** of the Reinterpretation Forum  
Collaboration of physicists working on testing implications of LHC data on new physics models and ensuring all relevant information is publicly available. Steering committee consists of representatives of public reinterpretation codes, experimentalists and some theorists.  
<https://twiki.cern.ch/twiki/bin/view/LHCPhysics/InterpretingLHCresults>

## Research Interests

Elementary Particle Physics, Physics Beyond Standard Model (BSM), Large Hadron Collider Physics, Dark Matter searches, Particle Phenomenology, Supersymmetry, Monte Carlo tools for collider physics, Computational Physics

## Honours, Grants and Awards

- 2018 **Ramanujan Fellowship**,  
 • Five-year fellowship awarded by the Department of Science and Technology of the Government of India  
 • Grant value INR 10,910,000 (approx USD 150,000)
- 2013 **Alexander von Humboldt Postdoctoral Research Fellowship**  
 • Awarded by the Alexander von Humboldt Foundation, Germany  
 • Grant value 82,800 Euros (approx USD 100,000)
- 2010 **MCNet Short-term Studentship**  
 • Pre-doctoral fellowship awarded by European Research Network MCnet
- 2006 **CSIR Junior Research Fellowship**  
 • Placed in the top 20 percent and shortlisted for Shyama Prasad Mukherjee Fellowship  
 • Declined in favour of fellowship from Harish-Chandra Research Institute
- 2004 Placed in the top 1 percent nationwide in the National Graduate Physics Examination  
 • National examination held by the Indian Association of Physics Teachers

## Public Codes

- **PYTHIA 8**  
 Monte Carlo event generation program for simulating predictions (“collision events”) of high energy physics theories for particle colliders. My main contribution is the implementation of production and decays for supersymmetry, dark matter and various long-lived particle production models.  
<http://home.thep.lu.se/Pythia/>
- **CHECKMATE**  
 Publicly available program for re-interpreting (“recasting”) results from the Large Hadron Collider (LHC) for any new high energy physics theory (e.g., a BSM scenario) with the largest number of LHC analyses currently implemented. Version 2 was the first code to include online event generation. Version 3 (beta is public) is the first code to release validated long-lived particle analyses.  
<http://checkmate.hepforge.org>

## Invited Plenary Talks & Colloquia

<i>Plenary</i> , TOOLS 2020, Lyon and Virtual	Nov 2020
<i>Plenary</i> , Anomalies 2020, Hyderabad and Virtual	June 2020
<i>Plenary</i> , Workshop on Long-lived particles and the third generation, Edinburgh	Nov 2019
<i>Plenary</i> , Frontiers of High Energy Physics 2019, Hyderabad	Sep 2019
<i>Plenary</i> , Planck 2018, Bonn, Germany	May 2018
<i>Plenary</i> , Monte-Carlo for Beyond Standard Model (MC4BSM 2018), Durham, UK	April 2018
<i>DTP Colloquium</i> , Tata Institute of Fundamental Research, Mumbai, India	Dec 2017
<i>Plenary</i> , Monte-Carlo for Beyond Standard Model (MC4BSM 2017), SLAC, USA	May 2017
<i>Plenary</i> , Tutorial on Monte Carlo tools for Colliders, Madrid, Spain	Sep 2015
<i>Plenary</i> , Monte-Carlo for Beyond Standard Model (MC4BSM 2015), Fermilab, USA	May 2015
<i>Plenary</i> , Monte-Carlo for Beyond Standard Model (MC4BSM 2013), DESY, Germany	Apr 2013

**Selected Talks**

* Snowmass Preparatory Joint Sessions on "Open questions and News Ideas" (virtual)	July 2020
* IoP Bhubaneshwar, India	June 2020
Summary talk, Searching for long-lived particles at the LHC, CERN	May 2019
Pythia Workshop, Monash University, Melbourne, Australia	April 2019
* IISER Pune, India	Feb 2019
Dark Side of the Universe 2018, Annecy, France	June 2018
* HEPHY, Vienna, Austria	June 2018
* LHC interpretation forum: 4th workshop, CERN, Geneva, Switzerland	May 2018
*International Centre for Theoretical Sciences, Bengaluru, India	Nov 2017
*National Institute of Science Education and Research, Bhubaneshwar, India	Nov 2017
*LAPTh, Annecy, France	May 2017
*LPSC, Grenoble, France	Apr 2017
*LUPM, Montpellier, France	Sep 2016
*Tata Institute of Fundamental Research, Mumbai, India	Sep 2016
*Indian Institute of Technology-Bombay, Mumbai, India	Sep 2016
*Indian Institute for Science, Bengaluru, India	Sep 2016
* Physikaliches Institut, Heidelberg, Germany	Jun 2016
Pheno 2016, Pittsburgh, USA	May 2016
*Cavendish Laboratory, Cambridge, UK	Dec 2014
SUSY 2014, Manchester, UK	Jul 2014
*IISER-Pune, Pune, India	Apr 2014
*Harish-Chandra Research Institute, Allahabad, India	Apr 2014
*Valencia University, Spain.	Apr 2013
*Imperial College London, UK	Mar 2013
*Lund University, Sweden	Feb 2013
*University College London, UK	Dec 2012
*Karlsruhe Institute of Technology, Germany	Nov 2011
*Bethe Forum, Universität Bonn, Germany	Nov 2011
LHC Discussion Meeting, Shantiniketan, India	Jan 2011
*University of Wisconsin-Madison, USA	Dec 2010
*Northeastern University, Boston, USA	Dec 2010
LHC Tools meeting, IACS, Kolkata	Mar 2010

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\* Invited talks

**Selected Workshop Participation**

Workshop on High Energy Particle Physics (WHEPP 2019), IIT Guwahati	Dec 2019
Physics at TeV Colliders, Les Houches, France.	Jun 2019
Physics at TeV Colliders, Les Houches, France.	Jun 2017
Understanding the First Results from the LHC Run II, Mainz, Germany	July 2016
Johns Hopkins Workshop on Current Problems in Particle Physics	May 2016
Workshop on High Energy Particle Physics (WHEPP 2015), IIT Kanpur	Dec 2015
Physics at TeV Colliders, Les Houches, France.	Jun 2015
Workshop on High Energy Particle Physics (WHEPP 2011), Mahabaleshwar	Dec 2011

## Notable scientific contributions

Author names are alphabetical by convention in High Energy Physics

### 1. Probing dark matter at LHC with displaced leptons

We show that leptons with high impact parameter can be a clean, low-background signature for models that give the right relic density via co-annihilation or co-scattering [Bharucha et al (2018)] and freeze-in [Belanger et al (2019)]. In these cases, the natural signature at the LHC requires producing the charged partners, which then decay but with a long lifetime. We showed in Bharucha et al (2018) that these models often also predict a compressed spectrum and the resulting leptons are too soft to pass current LHC triggers. As a result, a large class of well-motivated scenarios are currently not detectable. In Blekman et al (2020), we propose how to remedy this using a combination of triggers with lower thresholds and neural networks to reduce the associated increase in backgrounds. The recommendations will be included in the LHC LLP WG white-paper on Trigger Recommendations for Run 3 of the LHC.

### 2. Simulating production of supersymmetric particles, dark matter and long-lived particles at the LHC with Pythia 8

Implementing these models includes  $2 \rightarrow 2$  production as well as decay of new particles. A fully generic implementation of supersymmetric particle production and decay available in Pythia 8 [Desai and Skands (2012)] is used by experiments at the LHC to model signal processes. Production of dark matter via scalar, pseudo-scalar, vector and axial-vector mediators was included in [Desai (2018)] along with next-to-minimal dark matter models of dark matter which include scalar + singlet, and fermionic singlet mixing with doublet, triplet or quintuplet. Automatic calculation of decay width allows simulation of cases where produced particles are long-lived.

## Student supervision

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|---------|---|
| 2020    | Adhrit Ravichandran (Internship; Indian Insitiute of Technology Roorkee) <ul style="list-style-type: none"> <li>• Project title: <i>Implementing axion like particles in Pythia8</i></li> <li>• Graduating 2021</li> </ul>                    |
| 2019–20 | Mangesh Sonawane (Internship; IISER, Pune) <ul style="list-style-type: none"> <li>• Project title: <i>Displaced Lepton searches in CheckMATE</i></li> <li>• Now a PhD student in CMS group in Vienna working on displaced leptons.</li> </ul> |
| 2017-18 | Nicolas Lecointrin (Master’s project University of Montpellier) <ul style="list-style-type: none"> <li>• Project title: <i>Discovering New Forces at the LHC</i></li> </ul>   |

## Teaching Experience

### Courses

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|------|---|
| 2020 | <i>Lectures on Monte Carlo for Particle Physics</i> (IIT-Kanpur; virtual; 5 lectures; 20 attendees) |
| 2019 | <i>Introduction to Elementary Particle Physics</i> , (TIFR Graduate School; 13 students)            |

### Tutoring

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|-----------|---|
| 2016      | <i>Standard Model of Particle Physics</i> , Heidelberg University<br>Including designing problem sets which counted for the full grade for the course.  |
| 2014–15   | <i>Statistical Physics</i> , Heidelberg University  |
| 2013      | <i>Mathematical Methods for Physics</i> , University College London   |
| 2008-2009 | Teaching assistant at Harish-Chandra Research Insitiute for beginning PhD students.<br>(Jan–May 2009) <i>Quantum Field Theory II</i><br>(Aug–Dec 2008) <i>Statistical Mechanics</i><br>(Jan–May 2008) <i>Computational Methods in Physics</i> |

## Professional Activities

- Summer Schools & Conferences
- Organiser** *Searching for long-lived particles at the LHC and beyond* recurring workshop
- 8th workshop (Virtual), November 2020
  - 7th workshop (Virtual), April 2020
  - 5th workshop (CERN), April 2019
- Organiser** *Vigyan Vidushi Summer School*, TIFR, June 2020. A summer school for women physics students finishing first year of their Masters programme.
- Organiser** for joint meeting of the LHC LLP Community and the Re-interpretation Forum, CERN, May 2018
- Convenor** for “Precision Calculations and Simulations” session, SUSY 2016, Melbourne, Australia
- Associations
- Visiting scientist (Co-operation Associate), CERN, 2012–15  
Visiting scientist, Cavendish Laboratory, University of Cambridge, 2015–16  
Visiting scientist, DAMTP, University of Cambridge, 2017–18
- Journal Referee
- Physical Review D, European Physics Journal C, Frontiers in Physics
- Other
- Journal Club organiser, TIFR, 2018–20  
Seminar organiser for Laboratoire Charles Coulomb, Montpellier during 2016–18

## Skills

- Programming Languages: Python, C, C++, Fortran 77/90  
Operating Systems: Linux, BSD, Windows, Mac OS X  
Language skills: Fluent English, Marathi, and Hindi; basic German and French

## Publications & Preprints

Author names are alphabetical according to High Energy Physics publishing standards.

1. *Soft displaced leptons at the LHC*  
Freya Blekman, **Nishita Desai**, Anastasiia Filimonova, Abanti Ranadhir Sahasransu, Susanne Westhoff; JHEP 11 (2020) 112
2. *Reinterpretation of LHC Results for New Physics: Status and Recommendations after Run 2*  
(as editor for) LHC Reinterpretation Forum Collaboration; SciPost Phys. 9 (2020) 2, 022
3. *Searching for long-lived particles beyond the Standard Model at the Large Hadron Collider*  
Juliette Alimena, **Nishita Desai et al** (as editor); J.Phys.G 47 (2020) 9, 090501
4. *LHC-friendly minimal freeze-in models*  
G. Bélanger, **Nishita Desai, et al**; JHEP 02 (2019) 186
5. *Extended Gauge Mediation in the NMSSM with Displaced LHC Signals*  
Marcin Badziak, **Nishita Desai**, Cyril Hugonie, Robert Ziegler; Eur.Phys.J.C 79 (2019) 1, 67
6. *Collider signatures for dark matter and long-lived particles with Pythia 8*  
**Nishita Desai**; e-Print: 1807.04240
7. *Next-to-minimal dark matter at the LHC*  
Aoife Bharucha, Felix Brümmer, **Nishita Desai**; JHEP 11 (2018) 195
8. *On the Validity of Dark Matter Effective Theory*  
Martin Bauer, Anja Butter, **Nishita Desai**, Juan Gonzalez-Fraile, Tilman Plehn;  
Phys. Rev. D **95** (2017) no.7, 075036
9. *CheckMATE 2: From the model to the limit*  
Daniel Dercks, **Nishita Desai**, Jong Soo Kim, Krzysztof Rolbiecki, Jamie Tattersall, Torsten Weber;  
Comp. Phys. Comm. 221 (2017) 383-418
10. *Monojet searches for momentum-dependent dark matter interactions*  
Daniele Barducci, Aoife Bharucha, **Nishita Desai**, Michele Frigerio, Benjamin Fuks, Andreas Goudelis, Suchita Kulkarni, Giacomo Polesello, Dipan Sengupta; JHEP **1701**, 078 (2017)
11. *Prompt and displaced searches at the LHC for Next-to-Minimal Gauge Mediated Supersymmetry Breaking*  
B. C. Allanach, Marcin Badziak, Giovanna Cottin, **Nishita Desai**, Cyril Hugonie and Robert Ziegler;  
Eur. Phys. J. C 76 (2016) no.9, 482
12. *Towards a Final Word on Neutralino Dark Matter*  
Joseph Bramante, **Nishita Desai**, Patrick Fox, Adam Martin, Bryan Ostdiek, and Tilman Plehn;  
Phys.Rev. D93 (2016), 063525
13. *An Introduction to PYTHIA 8.2*  
Torbjörn Sjöstrand, Stefan Ask, Jesper R. Christiansen, Richard Corke, **Nishita Desai**, Philip Ilten, Stephen Mrenna, Stefan Prestel, Christine O. Rasmussen, Peter Z. Skands;  
Comp. Phys. Comm. 191 (2015) 159-177
14. *Closing in on the tip of the CMSSM co-annihilation strip*  
**Nishita Desai**, John Ellis, Feng Luo, Jad Marrouche; Phys. Rev. D90, (2014) 055031
15. *Compressed and Split Spectra in Minimal SUSY SO(10)*  
Frank F. Deppisch, **Nishita Desai**, Tomas E. Gonzalo; Front. Phys. 2 (2014) 00027
16. *Is charged lepton flavour violation a high energy phenomenon?*  
Frank F. Deppisch, **Nishita Desai**, Jose W. F. Valle; Phys. Rev. D89 (2014) 051302
17. *An updated analysis of radion-higgs mixing in the light of LHC data*  
**Nishita Desai**, Ushoshi Maitra, Biswarup Mukhopadhyaya, JHEP 2013:93.
18. *Supersymmetry and Generic BSM Models in PYTHIA 8*  
**Nishita Desai** and Peter Skands; Eur. Phys. J. C72 (2012) 2238

19. *Constraints on supersymmetry with light third family from LHC data*  
Nishita Desai, Biswarup Mukhopadhyaya; JHEP 1205 (2012) 057
20. *Constraints on Invisible Higgs Decay in MSSM in the Light of Diphoton Rates from the LHC*  
Nishita Desai, Biswarup Mukhopadhyaya, Saurabh Niyogi; Preprint [arXiv:1202.5190]
21. *CP-violating HWW couplings at the Large Hadron Collider*  
Nishita Desai, Dilip Kumar Ghosh, Biswarup Mukhopadhyaya; Phys. Rev. D 83, 113004 (2011)
22. *R-parity violating resonant stop production at the Large Hadron Collider*  
Nishita Desai, Biswarup Mukhopadhyaya; JHEP 1010 (2010) 060.
23. *Signals of supersymmetry with inaccessible first two families at the Large Hadron Collider.*  
Nishita Desai, Biswarup Mukhopadhyaya; Phys. Rev. D 80, 055019 (2009)

## Proceedings

1. *Beyond MET: Long-Lived Particles at the LHC*  
Nishita Desai; Springer Proc.Phys. 248 (2020) 131-137; Contribution to: FHEP 2019, 131-137
2. *Confronting minimal freeze-in models with the LHC*  
Genevieve Belanger et al; Contribution to: Moriond EW 2019, 247-252, e-Print: 1910.00117
3. *Les Houches 2019: Physics at TeV Colliders New Physics Working Group Report*  
G. Brooijmans et al.; Contribution to: PhysTeV 2019, e-Print: 2002.12220
4. *Les Houches 2017: Physics at TeV Colliders New Physics Working Group Report*  
G. Brooijmans et al.; Conference: C17-07-03.3; e-Print:1803.10379
5. *CheckMATE: Checkmating new physics at the LHC*  
J. Tattersall, D. Dercks, N. Desai, J. S. Kim, F. Poncza, K. Rolbiecki and T. Weber,  
PoS ICHEP **2016**, 120 (2016)
6. *Les Houches 2015: Physics at TeV colliders - new physics working group report*  
G. Brooijmans et al.; Conference: C15-06-01.1 arXiv:1605.02684