

# EASWAR ANAND NARAYANAN

Postdoctoral Fellow | Southern Methodist University

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## EDUCATION

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### University of New Mexico

Jan 2020 - May 2024

Doctor of Philosophy, Physics

Thesis: *A Precise Measurement of the Lifetime of  $B_d^0$ -mesons, Measurement of CP-violation Parameters of  $B_s^0$ -mesons, the ATLAS Experiment at the LHC, and Development of Silicon Detectors for Future Particle Physics Experiments*

Advisor: Prof. Sally Seidel

### Indian Institute of Technology Madras

Aug 2016 - July 2018

Master of Science, Physics

Thesis: *Sensitivity of Belle II experiment to the CP-violating parameter gamma*

Advisor: Prof. James Libby

### St. Stephen's College, University of Delhi

Aug 2013 - May 2016

Bachelor of Science with Honors, Physics

## TECHNICAL SKILLS

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**Programming Languages:** C/C++, Python

**Software:** ROOT, Geant4, FLUKA, Pythia, LaTeX, Mathematica, MATLAB, Origin, LABView, Microsoft Office

**Frameworks:** Athena, a software framework used by the ATLAS experiment at the LHC for data acquisition and analysis

**Instrumentation:** Proficient in characterizing semiconductor detectors and associated readout electronics with probe station and metrology instrumentation

**Data Analysis:** Expertise in conducting sophisticated statistical analyses on extensive datasets, akin to those acquired via the detectors at the Large Hadron Collider (LHC)

## AWARDS & ACHIEVEMENTS

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**Doctoral Conference Presentation Award** sponsored by University of New Mexico 2023

**Alexander Graham Bell Scholarship** sponsored by Alexander Graham Bell Association 2022  
for the Deaf and Hard of Hearing

**Chateaubriand Fellowship** sponsored by the Embassy of France in the United States 2022-2023

**Travel Award** sponsored by Department of Particles and Fields, American Physical Society 2022

**William G. Larsen, Ph.D., Memorial Award** for Best Teaching Assistant sponsored by 2021  
University of New Mexico

**Sigma Xi Outstanding Graduate Researcher Award** 2021

**Junior Research Fellowship in Physics** sponsored by University Grant Commission and 2018  
University Lectureship in Physics for scoring in top 6 percentile in the National Eligibility Test

**Merit-Cum-Means scholarship** sponsored by Indian Institute of Technology Madras for 2017-2018  
top 25% students

**Institute Freeship Scholarship** sponsored by Indian Institute of Technology Madras for 2016-2017  
top 10% students

## WORK EXPERIENCE

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<b>Postdoctoral Fellow</b> Southern Methodist University	<i>June 2024 - Current</i>
<b>Graduate Research Assistant</b> University of New Mexico	<i>Jan 2020 - May 2024</i>
<b>Graduate Teaching Assistant</b> University of New Mexico	<i>Jan 2020 - Dec 2023</i>
<b>Chateaubriand STEM Fellow</b> Laboratoire De Physique Des 2 Infinities Irène Joliot-Curie (IJCLab), University of Paris-Saclay	<i>Oct 2022 - July 2023</i>

## RESEARCH EXPERIENCE

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<b>Measurement of <math>CP</math>-violation parameters in strange <math>B</math>-mesons using ATLAS dataset</b>	<i>Jan 2023 - present</i>
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- Developed trigger and event selection criteria from dominant triggers in Run 2 data
- Applying time efficiency corrections to reduce  $B$ -meson proper decay time bias from trigger and selection cuts
- Performing simultaneous likelihood fit for 9 physics parameters in the  $B^0 \rightarrow J/\psi\phi$  decays and  $B_s^0 - \bar{B}_s^0$  mixing
- Expecting a statistical precision improvement by 1.32 compared to the previous ATLAS result

<b>Radiation Damage Modeling in the Silicon Sensors</b>	<i>June 2020 - present</i>
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- Studied the evolution of leakage current and depletion voltage for ATLAS Pixel detector with Hamburg Model and temperature and fluence data from 2015 to 2023
- Evaluated the radiation tolerance of ATLAS Pixel detector in Run 3 (2022-2025)
- Estimated radiation damage of a possible thermal runaway case in ATLAS Pixel detector in Run 3
- Analyzed power consumption of ATLAS Pixel detector in Run 3
- Assessed different staging scenarios for ATLAS Inner Tracker (ITk) for High Luminosity Large Hadron Collider (HL-LHC) phase
- Improved Hamburg Model by fitting its parameters to the high fluence data ( $1.25 \times 10^{15}$  1 MeV  $N_{eq}/cm^2$ ) collected with the ATLAS Pixel detector

<b>Irradiation campaigns at LANSCE and FNAL</b>	<i>June 2021 - present</i>
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- Computed necessary radiation doses and hardness factors using Non-Ionising Energy Loss (NIEL) scaling hypothesis for subjecting more than 200 silicon sensors to proton beams in two distinct tests
- Created documentation and mentored fellow group members at University of New Mexico

<b>ATLAS Inner Tracker (ITk) Pixel Phase-II upgrade</b>	<i>Oct 2022 - July 2023</i>
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- Assembled and tested over 30 ITk pixel modules at IJCLab
- Improved module metrology and visual inspection using automation techniques
- Ran data acquisition for module testing with technical proficiency
- Automated QC stages and upload process in ITk production database and documented extensively
- Performed metrology measurements and visual inspection for over 100 components

<b>ATLAS Inner Detector - Run 3 Data-taking</b>	<i>Oct 2022 - April 2023</i>
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- Carried out shift-tasks in the ATLAS control room focusing on the ATLAS Inner Detector, during both shutdown and data-collection phases

## Measurement of the lifetime of the neutral $B$ -mesons using ATLAS dataset

*Aug 2020 - Dec 2023*

- Developed trigger and event selection criteria from dominant triggers in ATLAS Run 2 data
- Applied time efficiency corrections to reduce lifetime bias from trigger and selection cuts
- Performed simultaneous mass and proper decay time likelihood fits to extract lifetime of  $B$ -mesons
- Estimated the systematic error from time efficiency correction on lifetime measurement, which accounts for about 53% of the total systematic error
- Developed methods to filter out events with multiple and fake candidates
- Final measurements improve statistical precision by 2.5 times compared to world average

## ATLAS High Level Triggers (HLT) and AthenaMT

*May 2020 - May 2021*

- Developed HLT algorithms for B-Physics in ATLAS software framework, AthenaMT
- Optimized trigger algorithms for multithreaded CPUs and low memory usage
- Configured B-Physics triggers with transverse momentum threshold as low as 4 GeV
- B-Physics triggers were validated with over 70% efficiency using Monte Carlo samples

## Measurement of CKM angle $\gamma$ using charged $B$ -mesons with Belle detector

*May 2017 - May 2018*

- Measured the CKM angle  $\gamma$  from various tree-level  $B$ -meson to  $D$ -meson decays and combined them statistically for ultimate precision
- Extrapolated the result to a much larger data set (50 times) expected at Belle II and found new decay modes sensitive to  $\gamma$
- Analyzed the systematic error on the combined result at Belle

## CONFERENCES & INVITED TALKS

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### Radiation Damage Effects in ATLAS Pixel Detector Monte Carlo Simulations: Status and Perspectives

Technology and Instrumentation in Particle Physics (TIPP) 2023, Cape Town, South Africa

*Sept 2023*

### Measurement of the $CP$ -violating phase $\phi_s$ in $B_s^0 \rightarrow J/\psi\phi$ decays in ATLAS/LHC at 13 TeV

LHCC Meeting, Geneva, Switzerland

*Nov 2022*

### Mixing and CP Violation at the LHC

Vietnam Flavour Physics Conference, Quy Nhon, Vietnam

*Aug 2022*

### Measurement of the $CP$ -violating phase $\phi_s$ in $B_s^0 \rightarrow J/\psi\phi$ decays in ATLAS/LHC at 13 TeV

APS April Meeting, New York City, USA

*April 2022*

### Measurement of the $CP$ -violating phase $\phi_s$ in $B_s^0 \rightarrow J/\psi\phi$ decays in ATLAS/LHC at 13 TeV

Meeting of the Division of Particles and Fields of the American Physical Society

*July 2021*

### New Techniques for Finding New Physics at the LHC

University of New Mexico Seminar

*April 2021*

### Measurement of the $CP$ -violating phase $\phi_s$ in $B_s^0 \rightarrow J/\psi\phi$ decays in ATLAS/LHC at 13 TeV

APS Four Corners Section Annual Meeting

*Oct 2020*

## PUBLICATIONS

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**ATLAS Depletion Voltage Measurement and Modelling using Hamburg Model.** E.A. Narayanan, et al. - draft now under preparation *2024*

**Precision measurement of B meson lifetime in  $B_d^0 \rightarrow J/\psi K^{*0}$  decay.** ATLAS Collaboration, ATL-COM-PHYS-2022-1168 (2023)- draft now under internal collaboration review *2024*

**Measurement of the Planar IBL Sensor Depletion Voltage as a function of Particle Fluence with Run 2 and 3 Collision Data.** M. Battaglia, et al, ATL-INDET-INT-2023-009 (2023)- internal but in the process of becoming public 2024

**Simulations of Silicon Radiation Detectors for High Energy Physics.** B. Nachman, et al, APDL-2022-002 (2022) 2022

## WORKSHOPS ATTENDED

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**ATLAS Inner Tracker (ITk) Pixel Quad Tooling Hands-on Workshop** Oct 2022  
CERN, Switzerland

**Workshop on  $CP$ -violation in strange  $B$ -mesons and lifetime measurements for charged and neutral  $B$ -mesons in ATLAS Run 2/3 data** Dec 2020  
Virtual

**US-ATLAS Computing Bootcamp** Aug 2020  
Virtual

## TEACHING

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**University of New Mexico** Jan 2020 - Dec 2023  
Taught recitation classes, tutored and graded homework assignments for various undergraduate courses - Classical Mechanics (PHYS 303/304), Quantum Mechanics (PHYS 491/492), Nuclear and Particle Physics (PHYS 450) and Geophysics (PHYS 327)

## OUTREACH

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**Poster Judge**, Undergraduate Research Opportunity Conference (UROC), University of New Mexico 2024

**Poster Judge**, Undergraduate Research Opportunity Conference (UROC), University of New Mexico 2022

**General Secretary** to the Enabling Unit, at St. Stephen's College, Delhi, an university initiative for supporting disabled students 2016

**Organizing Committee**, Inter-college Fest for Disabled Students, St. Stephen's College, Delhi 2015

**Facilitator**, Science Facilitation Centre, Mar Ivanios College, University of Kerala 2015