RAM KRISHNA SHARMA

Postdoctoral researcher - CERN/Chinese Academy of Sceiences, Beijing

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EDUCATION

Ph.D. in High Energy Physics

University of Delhi

Aug 2012 – Oct 2019 Delhi India

Thesis title: "Search For Anomalous Gauge Coupling through Vector Boson Scattering and Development of the GEM Detectors at the CMS Experiment"
Supervisor: Prof. Mohamad Naimuddin

M.Sc. in Physics (First division)

University of Delhi

2009 – 2012 Delhi, India

B.Sc. (Honours) in Physics (First division)

University of Delhi

2006 – 2009 Delhi, India

RESEARCH INTERESTS

- Higgs physics
- Vector boson scattering
- Effective field theory
- Machine learning
- Gaseous detectors
- High level trigger development

RESEARCH EXPERIENCE

Postdoctoral researcher

CERN, Geneva/IHEP Beijing

December 2019 – present Geneva, Switzerland

- (Ongoing) **High mass Higgs search using $ZZ \to 2l2q$ channel within the mass range 500 GeV - 3 TeV based on full Run-2 dataset**
  - **Main analyzer and the contact person**, responsible for result extraction and the documentation of results
  - Expected publication timeline: Winter 2023
- (Ongoing) **Search for resonant Higgs boson pair production in the $WW\gamma\gamma$ channel in pp collision at $\sqrt{s} = 13$ TeV within a mass range 250 GeV - 3 TeV**
  - **Spearheading** the analysis and supervising a graduate student using the experience from non-resonant Di-Higgs analysis
  - Solely responsible for the statistical combination of the different hadronic decays of W bosons
  - Expected publication timeline: Winter 2023
- (Ongoing) **Anomalous charged and neutral triple gauge coupling (a(N)TGC) measurement using semi-leptonic decays of di-boson events**
  - **Initialized and Leading the effort**
  - Supervising a Ph.D. student to measure a(N)TGC using SMEFT and EFTatNLO frameworks
  - Worked on the optimization of the analysis strategy to enhance the signal sensitivity
  - Expected publication timeline: Summer 2024
- (Ongoing) **High-Granularity Calorimeter (HGCAL) Studies** for the HL-LHC
  - **Initiated work** on Hexagon silicon sensor module testing
  - **Future Plan:** To perform an in-depth study of cross-talk between adjacent cells, aiming to enhance the sensor's efficiency and reliability
- **Search for non-resonant Higgs boson pair production in the $WW\gamma\gamma$ channel in pp collision at $\sqrt{s} = 13$ TeV**
  - **Main analyzer and the contact person** for the channel with fully hadronic decay of W bosons
  - Responsible for all analysis aspects like data-driven background estimation, **binary and multiclass DNN** for signal extraction and documentation of results in the common PAS

- Published as CMS public analysis note:
  1. CMS-PAS-HIG-21-014

- **Differential cross section measurement with $H \to 4l$ channel**
  - One of the main analyser; working on all stages of analysis.
  - Some of the important tasks undertaken:
    - Introduced a new observable (n-jettiness) for differential cross section measurement; important input for further theoretical developments
    - Working on an additional interpretation for the first time using the MadGraph_aMCatNLO event generator
    - Constraining the effective Higgs couplings with bottom and charm quarks and their contributions to the Hgg loop
  - Publication:
    1. DOI: 10.1007/JHEP08(2023)040
    2. DOI: 10.1140/epjc/s10052-021-09200-x

- Evidence for WW/WZ vector boson scattering in the decay channel $l\nu qq$ produced in association with two jets in proton-proton collisions at $\sqrt{s} = 13$ TeV
  - **One of the main analyzers**; developed the analysis framework from scratch and supervised and coordinated the task for three Ph.D. students
  - **First evidence** from the CMS Collaboration for WV production with 4.4 observed signal significance
  - Publication:
    1. DOI: 10.1016/j.physletb.2022.137438

- **Concentration Pre-Processing Fan-out (CPPF) for L1 upgrade**
  - CPPF is a μTCA based card deployed at the CMS Level-1 hardware trigger for resistive plate chamber detectors
  - **Lead the effort** for the creation of data quality monitoring (DQM) plots for CPPF and add it to the online DQM tool
  - Crucial task for online DQM

EGamma high level trigger group coordination

IHEP Beijing

October 2020 – August 2022 | Geneva, Switzerland

- Worked on the electron and photon high level trigger (HLT) development studies for the ongoing LHC Run-3 and the upcoming HL-LHC upgrade of CMS detector
- Being the CMS L3 EGamma HLT subgroup convener, responsible to oversee and manage group activities involving development and maintenance of electrons/photons HLT paths being used in the CMS Collaboration
- Undertook the task of the optimisation of energy regression for electrons and photons at HLT level leading to $\sim$10% improvement in performance; documenting this task in the form of a detector note
- Streamlined the selection criteria at the HLT level to enhance their performance in Run-3 w.r.t Run-2
- Worked on the optimisation of the identification and isolation criteria for the electrons/photons and derivation of data to simulation scale factors - **widely used by the CMS Collaboration**

- Publication:
  1. DOI: 10.1088/1748-0221/16/05/P05014

Ph.D. student/researcher

University of Delhi

Oct 2012 – Nov 2019 | CERN, Switzerland/Delhi, India

- Search for anomalous electroweak production of vector boson pairs in association with two jets in proton-proton collisions at $\sqrt{s} = 13$ TeV
  - **Sole analyst** for this measurement
  - First ever analysis in the CMS Collaboration targeting VBS production using semi-leptonic final state, leading to the world's best ever limits on aQGC parameters at the time
  - Results were also interpreted for the resonant singly and doubly charged Higgs using the Georgie-Machacek model
- Gas Electron Multiplier (GEM) detectors for the CMS GE1/1 detector upgrade
  - Contributed to assembly, characterization and testing of the GEM detectors for the CMS GE1/1 detector upgrade at CERN and University of Delhi

- **Worked and coordinated** the establishment of first GEM detector laboratory setup at University of Delhi
- **Assembled and characterized a prototype of GEM detector using foils produced in India with findings published in journal NIM-A** (Corresponding author for this publication)
- Participated in GEM beam test campaigns at CERN SPS during 2014 and 2016
  - **Was responsible for the online data quality monitoring** throughout the beam test campaign
- **Spearheaded the effort** for offline bean test data analysis targeting the offline alignment of GEM detectors w.r.t the tracking system leading to a 29% improvement in efficiency

AWARDS & RECOGNITION

2019 Selected for **Young Scientist Forum** talk at **La Thuile 2019** - Les Rencontres de Physique de la Vallée d'Aoste, La Thuile, Aosta Valley, Italy, 10^{th}-16^{th} March 2019.

2018 Instructor at the "**CMS Data Analysis School 2018**" held in Fermilab, 8 January - 13 January 2018 for two short exercises "*Tracking & Vertexing*" and "*PileUp/MET*", and a long exercise on "*Contact Interaction*"

2016 Instructor for "**Collider Physics Simulation, Event Generation**" in SERC School for Experimental High Energy Physics, a national school held once in two year, University of Delhi, 19 April - 09 May 2016

2015 Awarded "**2015 Fundamental Physics Special Recognition Award**" from the CMS Fundamental Physics Scholar Committee, CERN, Switzerland in December 2015

2014 Awarded Senior Research Fellowship from University Grant Commission, Government of India, for pursuing Ph.D. at the Department of Physics and Astrophysics, University of Delhi, August 2014 - August 2017

2012 Awarded Junior Research Fellowship from University Grant Commission, Government of India, for pursuing Ph.D. at the Department of Physics and Astrophysics, University of Delhi, August 2012 - August 2014

2012 Selected through National Eligibility Test, a criteria for Assistant Professorship in Physical sciences conducted by the University Grant Commission, Government of India, June 2012

COORDINATION ROLES

Co-convener of the "EGamma HLT" group
CMS Collaboration

Oct 2020 – Aug 2022 | CERN, Switzerland

CMS Exotica PAG Monte Carlo event generator contact person
CMS Collaboration

2019 - 2021 | CERN, Switzerland

Liaison of "GEM phase2 R&D" and "Detector Performance Group"
CMS Collaboration

Sep 2015 – Nov 2016 | CERN, Switzerland

Co-convener of "GEM detector response modeling" group
CMS Collaboration

July 2015 – Nov 2016 | CERN, Switzerland

SKILLS

- Languages

English (fluent) | Hindi (native proficiency) | French (beginner)

- Programming

C/C++ | HTML | PHP | Python | Shell script | LaTeX | Git | GitLab/GitHub CI/CD

- Libraries

ROOT | RooFit | UpROOT | TensorFlow | Keras | Pandas | Scikit-learn | NumPy | Matplotlib

- Monte Carlo event generators

MadGraph5_aMCatNLO | PYTHIA | VBFNLO

- Softskills

Project management | Team work | Organization | Supervision of graduate and Ph.D. students | Presentation of results

PUBLIC TALKS

2022 **Invited seminar** as a DBT STAR college scheme on "**High energy physics and artificial intelligence**" at Acharya Narendra Dev college, University od Delhi, 14 October 2022

2021 **Invited seminar** as a part of the international series on "**Hybrid webinar series 2.0: Innovative & Emerging Technology in the field of Research**" on "Machine Learning Meets Physics" at Shah & Anchor Kutchhi Engineering College, 4 September 2021

CONFERENCE TALKS

2023 Presented a parallel talk entitled "Searches for BSM scalars - CMS" at "**LHCP 2023**", 22 - 26 May 2023

2022 Presented a parallel talk entitled "Higgs pT measurements in ATLAS and CMS" at "**QCD@LHC2022: QCD at LHC conference**", 28 Nov-2 Dec 2022

2022 Presented a plenary talk entitled "H Effective Fields Theories" at "**HH2022: Higgs Hunting 2022**", 12-14 Sep 2022

2022 Presented a parallel talk entitled "Evidence for vector boson scattering in semileptonic $l\nu qq$ final states in proton-proton collisions at $\sqrt{s}$ = 13 TeV with CMS" at "**CMS China Workshop - 2022**", 2 - 3 July 2022

2021 Presented a parallel talk entitled "Evidence for vector boson scattering in semileptonic $l\nu qq$ final states in proton-proton collisions at $\sqrt{s}$ = 13 TeV with CMS" at "**CLHCP-2021: China LHC Physics Workshop**", 25-28 November 2021

2021 Presented a plenary invited talk on "Standard Model and Electroweak Results from CMS" at "**LISHEP 2021: Workshop on High Energy Physics**", 6-8 July 2021

2019 Presented a plenary talk entitled “Search for Anomalous Electroweak Production of WW/WZ/ZZ Boson Pairs in Association with two Jets in p-p Collision at 13 TeV” in **Young Scientist Forum (YSF)** at, **La Thuile 2019 - Les Rencontres de Physique de la Vallée d’Aoste**, La Thuile, Italy, 10-16 March 2019

2018 Presented a parallel talk entitled “Search for Anomalous Electroweak production of WW/WZ/ZZ Boson Pairs in Association with two jets in p-p Collision at 13 TeV” at **XXIII DAE High Energy Physics Symposium**, IIT Madras, Chennai (India), December 10-14, 2018

2016 Presented a parallel talk entitled “Test Beam Study of Gas Electron Multiplier (GEM) Detectors for the Upgrade of CMS Endcap Muon System” at **XXII DAE High Energy Physics Symposium**, University of Delhi, India, December 12-16, 2016

2015 Presented a poster entitled “Charged particle detection performance of Gas Electron Multiplier (GEM) detectors for the upgrade of CMS endcap muon system at the CERN LHC” at **2015 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC)**, San Diego, California, USA, 31 October - 7 November 2015