

RAM KRISHNA SHARMA

Postdoctoral researcher - CERN/Chinese Academy of Sciences, Beijing

 11th Oct 1988  ram.krishna.sharma@cern.ch  +41 77 815 9387  Geneva, Switzerland
 linkedin.com/in/ram-krishna-sharma  ram1123.github.io



RESEARCH INTERESTS


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

RESEARCH EXPERIENCE

Postdoctoral researcher

CERN, Geneva/IHEP Beijing

 December 2019 - present

 Geneva, Switzerland

- (Ongoing) **High mass scalar search using $ZZ \rightarrow 2l2q(2l2\nu)$ channel within the mass range 400 GeV - 3 TeV based on full Run-2 dataset [1]**
 - **Main analyzer and the contact person**, responsible for result extraction and the documentation of results
 - Expected publication timeline: Summer 2024
- (Ongoing) **Search for a new resonance decaying to two scalars (HH/HY) in $WW\gamma\gamma$ channel in proton-proton collisions at $\sqrt{s}=13\text{TeV}$ [2]**
 - **Spearheading** the analysis and supervising two graduate student
 - Solely responsible for the statistical combination of the different hadronic decays of W bosons
 - Expected publication timeline: Summer 2024
- (Ongoing) **Differential, fiducial cross-section measurement using early Run-3 data with $H \rightarrow ZZ \rightarrow 4l$ channel**
 - One of main analyzer; working on all stages of analysis.
 - Expected publication timeline: Summer 2024
- **Search for non-resonant Higgs boson pair production in the $WW\gamma\gamma$ channel in pp collision at $\sqrt{s} = 13 \text{ TeV}$**
 - **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
 - Result is public as PAS for Higgs2022 conference [5]
- **Differential cross section measurement with $H \rightarrow ZZ \rightarrow 4l$ channel using full Run-2 data**
 - 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
 - Worked on an additional interpretation using the SMEFT & HEL framework
 - Constraining the effective Higgs couplings with bottom and charm quarks and their contributions to the Hgg loop
 - Result were public for Higgs2022, submitted for publication in JHEP [3]
- (Ongoing) **High-Granularity Calorimeter (HGCal) Sensor Studies** for the HL-LHC:
 - **Validation:** Testing and validating non-irradiated HGCal sensors to ensure optimal performance.
 - **Irradiated sensor analysis:** Investigating the effects of radiation ageing on HGCal sensors. Focused on the reduction of charge collection efficiency, increased leakage current, and their potential mitigation strategies.
 - Utilizing HGCal's in-built input DAC for leakage current compensation, aiming to sustain performance within expected fluences of up to $1e16 \text{ neq/cm}^2$.
 - Analysing the performance of the assembled module postirradiation to validate adherence to sensor and electronics specifications.
- **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

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 ~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** [7]
- Created a webpage to display all trigger pre-scales used during run-II, which is easy to navigate and grab information. Here is the link: https://ram1123.github.io/display_TriggerPreScale/

Ph.D. student/researcher

University of Delhi

📅 Oct 2012 – Nov 2019

📍 CERN, Switzerland / Delhi, India

- Evidence for WW/WZ vector boson scattering in the decay channel $lvqq$ 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 [4]
- 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 [10]
 - 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
- Gained the experience with MadGraph_aMCatNLO generator for **polarized WW scattering** sample (by modifying the Madgraph generator, as the polarisation sample generation wasn't available at that time) and the anomalous quartic gauge coupling samples using reweight method
- 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 [6]
 - **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 Ref. [11]** (Corresponding author for this publication)
 - Participated in GEM beam test campaigns at CERN SPS during 2014 and 2016
 - **Responsible for the online data quality monitoring** throughout the beam test campaign
 - **Spearheaded the effort** for offline beam test data analysis targeting the offline alignment of GEM detectors w.r.t the tracking system leading to a 29% improvement in efficiency [9, 14, 13]

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-convenor of "GEM detector response modelling" group

[CMS Collaboration](#)

📅 July 2015 – Nov 2016

📍 CERN, Switzerland

SKILLS

- Languages

English (fluent)

Hindi (native proficiency)

- 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

Teaching

EDUCATION

Ph.D. in High Energy Physics

[University of Delhi](#)

📅 Aug 2012 – Nov 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

[University of Delhi](#)

📅 2009 – 2012

📍 Delhi, India

B.Sc. (Honours) in Physics

[University of Delhi](#)

📅 2006 – 2009

📍 Delhi, India

AWARDS & RECOGNITIONS

- Selected for **Young Scientist Forum** talk at **La Thuile 2019** - Les Rencontres de Physique de la Vallée d'Aoste, La Thuile, Aosta Valley, Italy, 10th-16th March 2019.
- 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*".
- 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.
- Awarded "**2015 Fundamental Physics Special Recognition Award**" from the CMS Fundamental Physics Scholar Committee, CERN, Switzerland in December 2015.
- **Coordinator** of "GEM Detector Response Modelling" group from July 2015- November 2016.
- **Liaison** of "GEM Phase 2 R & D" & Detector Performance Group from September 2015 - November 2016.
- 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.
- 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.
- Selected through National Eligibility Test, a criteria for Assistant Professorship in Physical sciences conducted by the University Grant Commission, Government of India, June 2012.

CONFERENCES/PUBLIC TALKS

- Presented a parallel talk entitled "Searches for BSM scalars - CMS" at "LHCP 2023", 22 - 26 May 2023
- Presented a parallel talk entitled "Higgs pT measurements in ATLAS and CMS" at "QCD@LHC2022: QCD at LHC conference", 28 Nov-2 Dec 2022
- Presented a plenary talk entitled "H Effective Fields Theories" at "HH2022: Higgs Hunting 2022", 12-14 Sep 2022
- **Invited seminar** as a DBT STAR college scheme on "High energy physics and artificial intelligence" at Acharya Narendra Dev college, University of Delhi, 14 October 2022
- Presented a parallel talk entitled "Evidence for vector boson scattering in semileptonic $\ell\nu qq$ final states in proton-proton collisions at $\sqrt{s} = 13$ TeV with CMS" at "CMS China Workshop - 2022", 2 - 3 July 2022
- Presented a parallel talk entitled "Evidence for vector boson scattering in semileptonic $\ell\nu qq$ final states in proton-proton collisions at $\sqrt{s} = 13$ TeV with CMS" at "CLHCP-2021: China LHC Physics Workshop", 25-28 November 2021
- **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
- 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
- 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
- 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
- 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
- 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

PUBLICATIONS

Journal Articles

- [1] CMS Collaboration. "Search for high mass scalar bosons in ZZ semi-leptonic decay mode at CMS (**Internal Note: HIG-23-001**)". In: (2024, **Ongoing**).
- [2] CMS Collaboration. "Search for resonant Higgs boson pair production in the $WW\gamma\gamma$ channel in pp collision at $\sqrt{s} = 13$ TeV (**Internal Note: AN-23-071**)". In: (2024, **Ongoing**).
- [3] Aram Hayrapetyan et al. "Measurements of inclusive and differential cross sections for the Higgs boson production and decay to four-leptons in proton-proton collisions at $\sqrt{s} = 13$ TeV". in: *JHEP* 08 (2023), p. 040. DOI: 10.1007/JHEP08(2023)040. arXiv: 2305.07532 [hep-ex].
- [4] CMS Collaboration. "Evidence for WW/WZ vector boson scattering in the decay channel $\ell\nu qq$ produced in association with two jets in proton-proton collisions at $s=13$ TeV". in: *Phys. Lett. B* 834 (2022), p. 137438. DOI: 10.1016/j.physletb.2022.137438. arXiv: 2112.05259 [hep-ex].
- [5] CMS Collaboration. "Search for nonresonant Higgs boson pair production in the $WW\gamma\gamma$ channel in pp collisions at $\sqrt{s} = 13$ TeV". In: (2022). URL: <https://cds.cern.ch/record/2840773>.
- [6] CMS GEM Collaboration. "Quality control of mass-produced GEM detectors for the CMS GE1/1 muon upgrade". In: *Nucl. Instrum. Meth. A* 1034 (July 2022), p. 166716. DOI: 10.1016/j.nima.2022.166716. arXiv: 2203.12037 [physics.ins-det].
- [7] CMS Collaboration. "Electron and photon reconstruction and identification with the CMS experiment at the CERN LHC". in: *JINST* 16.05 (May 2021), P05014. DOI: 10.1088/1748-0221/16/05/P05014. arXiv: 2012.06888 [hep-ex].
- [8] CMS Collaboration. "Measurements of production cross sections of the Higgs boson in the four-lepton final state in proton-proton collisions at $\sqrt{s} = 13$ TeV". in: *EPJC* 81 (Mar. 2021), p. 488. DOI: 10.1140/epjc/s10052-021-09200-x. arXiv: 2103.04956 [hep-ex].
- [9] CMS GEM Collaboration. "Performance of prototype GE1 / 1 chambers for the CMS muon spectrometer upgrade". In: *Nucl. Instrum. Meth. A* 972 (Aug. 2020), p. 164104. DOI: 10.1016/j.nima.2020.164104. arXiv: 1903.02186 [physics.ins-det].

- [10] CMS Collaboration. "Search for anomalous electroweak production of vector boson pairs in association with two jets in proton-proton collisions at 13 TeV". in: *Phys. Lett. B* 798 (2019), p. 134985. DOI: 10.1016/j.physletb.2019.134985. arXiv: 1905.07445 [hep-ex].
- [11] Shah, Aashaq and Ahmed, Asar and Gola, Mohit and **Ram Krishna Sharma** and Malhotra, Shivali and Kumar, Ashok and Naimuddin, Md and Menon, Pradeep and Srinivasan, K. "Development, characterization and qualification of first GEM foils produced in India (**Corresponding author**)". In: *Nucl. Instrum. Meth. A* 892 (2018), pp. 10–17. DOI: 10.1016/j.nima.2018.02.078. arXiv: 1803.03260 [physics.ins-det].
- [12] CMS Collaboration. "Search for heavy resonances decaying to a pair of Higgs bosons in four b quark final state in proton-proton collisions at $\sqrt{s} = 13$ TeV". in: *CMS Public* (2016). CMS: CADI:B2G-16-008.
-

Conference Proceedings

- [13] Ram Krishna Sharma et al. "Test Beam Study of Gas Electron Multiplier (GEM) Detectors for the Upgrade of CMS Endcap Muon System". In: ed. by Md. Naimuddin. Vol. 203. 2018, pp. 179–183. DOI: 10.1007/978-3-319-73171-1_40.
- [14] Ram Krishna Sharma et al. "Charged particle detection performance of Gas Electron Multiplier (GEM) detectors for the upgrade of CMS endcap muon system at the CERN LHC". in: *2015 IEEE Nuclear Science Symposium and Medical Imaging Conference*. 2016, p. 7581797. DOI: 10.1109/NSSMIC.2015.7581797.

Public Notes

- [15] *Performance of electron reconstruction at High Level Trigger using data collected at the CMS experiment at CERN in 2022*. 2023. URL: <https://cds.cern.ch/record/2855389>.