Omveer Singh

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Acadamic Details

2023 – Sept 2025 **Postdoctoral Fellow,**
Goethe-Universität Frankfurt, Germany.

2015 – 2022 **Ph.D.** in Experimental High Energy Physics.
Aligarh Muslim University, India

- **Senior Research Fellow [2017 - 2020]** Supported by DST-SERB (grant SERB/2016/001604) through the research project titled "Study and optimization of absorber, geometry for tracking chambers of MuCh of CBM and its physics performance at FAIR energies".

2014 – 2015 **M.Phil.** in Experimental High Energy Physics.
Aligarh Muslim University, India

2011 – 2013 **M.Sc.** in Physics.
Aligarh Muslim University, India

2008 – 2011 **B.Sc. (Hons.)** in Physics.
Aligarh Muslim University, India

Technical Skills

Programming & Scripting	FORTRAN, C, C++, Python, R, and SQL
Build Systems & DevOps	CMake, Git, Docker (basic), and CI/CD pipelines
Computing Environments	Linux/Ubuntu and High-Performance Computing (HPC) systems
Data Analysis & Simulation	ROOT framework; simulation tools: GEANT3, GEANT4 and VecGeom
Machine Learning	Machine learning techniques and workflows in Python

Research Experience

2023–Sept 2025 **Postdoctoral Researcher, CBM-TRD Group, Goethe-Universität Frankfurt**
Supervisor: Prof. Chrishtoph Blume, Goethe-Universität Frankfurt, Germany

- Designed and implemented a QA framework for CBM and mCBM simulations, integrating automated checks into CI pipelines.
- Develop a CAD-to-GDML-to-ROOT pipeline, enabling the import of detailed CAD models into ROOT simulations using tessellated GDML geometry.
- An alternative simplified ROOT geometry was created based on primitive solids that greatly reduced simulation runtime while accurately preserving material budgets.
- Comparative studies between detailed and simplified models to determine the optimal TRD configuration, effectively balancing physics performance and computational efficiency.

2015–2022 **PhD, Experimental High-Energy Physics, Aligarh Muslim University**
Thesis: "Study of Low Mass Vector Mesons using MuCh detector in CBM at FAIR."
Supervisor: Prof. Nazeer Ahmad, AMU Aligarh, India

- Detailed study of LMVM production at FAIR energies using detailed MuCh detector geometry in CBMROOT.
- Optimized absorber configurations and GEM tracking chambers to improve di-muon reconstruction using Muon Chamber detector in CBM experiment at FAIR.
- Non-statistical fluctuations in particle production during relativistic heavy-ion collisions using the Scaled Factorial Moment (SFM) method to investigate intermittency in pseudorapidity and azimuthal phase spaces.

2014–2015 **MPhil, High-Energy Physics, Aligarh Muslim University**
Dissertation: "Some Aspects of Heavy-Ion Collision at High Energies."
Supervisor: Prof. Shafiq Ahmad, AMU Aligarh, India

- Studied ^{28}Si–Emulsion interactions at 14.6 AGeV
- Analyzed multiplicity distributions, pseudorapidity and angular spectra, and tested KNO scaling
- Investigated compound multiplicity in forward and backward hemispheres
- Explored correlations and scaling behavior in secondary particle production

Research Experience (continued)

2022 **GET-INvolved Internship, FAIR (GSI), Germany (6 months)**
Title: "Implement new build system for CbmRoot"
Superviser: Dr. Florian Uhlig, GSI, Germany.

- Built and compiled CbmRoot and its dependencies using CMake.
- Gained experience in building and integrating software components into a complete and usable system.
- Applied modern CMake practices, using targets and properties to manage dependencies more effectively.
- Improved the modularity of the CbmRoot build system.
- Documented the use of modern CMake features within the CBM software. framework.

Conferences and Schools

Apr 19–May 09, 2016 **Xth SERC School in Experimental High Energy Physics**
Delhi University, Delhi, India.

Feb 02–06, 2015 **7th International Conference on Physics and Astrophysics of Quark–Gluon Plasma**
Variable Energy Cyclotron Centre, Kolkata, India.

Feb 15–19, 2016 **6th Asian Triangle Heavy Ion Conference**
IIC, New Delhi, India.

Feb 13–15,2017 **CNT Workshop on Quarkonia Production and Suppression in High-Energy Heavy-Ion Collisions**
Department of Physics, University of Calcutta, India.

Nov 02–06, 2016 **International Workshop on Frontiers in Electroweak Interactions of Leptons and Hadrons**
Department of Physics, Aligarh Muslim University, Aligarh, India.

Invited Talks

2025 **Introduction to ROOT (Data Analysis Framework)**
Workshop on Mastering Physics with Software & AI
DPBS College Anupshahr, India

Oral Presentations

Feb 15–17, 2018 mini-MUCH simulation
CBM-India Meeting, Kolkata, India

Oct 1–5, 2018 Realistic MUCH geometry simulation
32nd CBM Collaboration Meeting, GSI, Darmstadt

Apr 1–5, 2019 Study of 1st MUCH absorber
33rd CBM Collaboration Meeting, GSI, Darmstadt

Sep 29 - Oct 3, 2019 An Optimization of the MuCh 1st Absorber Configuration
Simulation of muon system for SIS100 CBM and mini-CBM experiments
34th CBM Collaboration Meeting, Bose Institute, Kolkata, India

Oral Presentations (continued)

Mar 23–27, 2020 — First absorber optimization
35th CBM Collaboration Meeting, eZuce / Vibe

Mar 1–5, 2021 — Eta, Omega and Phi reconstruction @ SIS100 ($\mu^+ + \mu^-$ - channel)
Status of Muon Chamber (MuCh) simulations & Future plans
37th CBM Collaboration Meeting, virtual meeting

Oct 10–14, 2022 — Transition to a modern CMake build system for cbmroot
40th CBM Collaboration Meeting, CZIITT PW

Mar 4–8, 2024 — TRD: Mainframe simulation status
43rd CBM Collaboration Meeting, GSI

Sep 15–20, 2024 — A QA framework for a uniform view on CBM measurements and MC. Application to mCBM22/24 data taking campaigns
44th CBM Collaboration Meeting, Czech Technical University in Prague

Feb 16–21, 2025 — TRD mainframe simulations
45th CBM Collaboration Meeting, GSI

Certifications

2025
- **Supervised Machine Learning: Regression and Classification**, DeepLearning.AI (Coursera)
- **R Programming A-Z: R For Data Science With Real Exercises!**, Udemy
- **Python A-Z: Python For Data Science With Real Exercises!**, Udemy
- **Databases and SQL for Data Science with Python**, IBM (Coursera)

Research Publications

Journal Articles

1. Neuhaus, Simon, Shiroya, Mehulkumar, Singh, Omveer, & Dahm, Patrick. (2025). Experiences from the cbm collaboration: Cad to root conversion for detector geometries. *EPJ Web Conf.*, *337*, 01268. doi:10.1051/epjconf/202533701268
2. Sharma, A., **Singh, O.**, & Das, S. (2025). Proton intermittency analysis in au + au collisions: Exploring critical behavior in the fair energy range. *Journal of Subatomic Particles and Cosmology*, *4*, 100122. doi:https://doi.org/10.1016/j.jspc.2025.100122
3. Shiroya, Mehulkumar, Singh, Omveer, Uhlig, Florian, Friese, Volker, Clerkin, Eoin, Blume, Christoph, & Toia, Alberica. (2025). Simulation comparison for the msts geometry based on root primitive solids and tessellated solids. *EPJ Web Conf.*, *337*, 01213. doi:10.1051/epjconf/202533701213
4. Singh, O., Sharma, A., & Ahmad, N. (2023). Intermittency analysis in relativistic hydrodynamic simulations of heavy-ion collision at fair energies. *European Physical Journal A*, *59*(4), 92. doi:10.1140/epja/s10050-023-00994-w
5. Ahmad, N., Ahmad, T., & Singh, O. (2022). A multifractal study of charged secondaries produced in relativistic nucleus–nucleus collisions. *European Physical Journal Plus*, *137*, 653. doi:10.1140/epjp/s13360-022-02787-4
6. Kumar, A., Agarwal, A., Chatterjee, S., Chattopadhyay, S., Dubey, A., Ghosh, C., … Zabołotny, W. (2021). Commissioning and testing of pre-series triple GEM prototypes for cbm-much in the mcbm experiment at the SIS18 facility of GSI. *Journal of Instrumentation*, *16*(09), P09002. doi:10.1088/1748-0221/16/09/P09002

7. Ahmad, N., Ahmad, T., **Singh**, **O.**, & Ahmad, S. (2018). A Study of Multifractal Analysis in ^{16}O-AgBr Collisions at 60A and 200A GeV. *J. Mod. Phys.*, *9*(5), 1029–1036. doi:10.4236/jmp.2018.95064. arXiv: 2008.10453 [hep-ex]

8. Rasool, M. H., Ahmad, M. A., Ahmad, S., Bhat, M., & Singh, O. V. (2016). Multiplicity characteristics of forward–backward emitted particles in heavy-ion interactions at sps energies. *Springer Proceedings in Physics*, *174*, 61–66.

9. Rasool, M. H., Ahmad, M. A., Singh, O. V., & Ahmad, S. (2015). Multiplicities of forward-backward relativistic charged particles produced in ^{32}s-emulsion interactions at 200 agev/c. *Chinese Journal of Physics*, *53*(5), 100302-1-100302–12. doi:10.6122/CJP.20150629

10. Rasool, M., Ahmad, M., Singh, O., & Ahmad, S. (2015). Some important features of relativistic charged particles produced in ^{32}s–emulsion interactions at 200Agev/c. *Journal of Modern Physics*, *6*, 1498–1509. doi:10.4236/jmp.2015.611154

Conference Proceedings

1. Sharma, A. K., Shiroya, M. K., Singh, O., Ghosh, C., Dubey, A. K., & Chattopadhyay, S. (2025). Simulation of muon chamber detector for mini–cbm experiment at sis18 fair. In *68th dae–brns symposium on nuclear physics* (pp. 979–980). Held December 7–11, 2024 (proceedings published 2025). Retrieved from https://inspirehep.net/literature/2874046

2. Sharma, A., **Singh**, **O.**, & Ahmad, N. (2024b). Comparitive Study of Multiplicity Fluctuations in ^{28}Si-AgBr Collisions at 14.5A GeV/c. (Vol. 304, pp. 707–709). doi:10.1007/978-981-97-0289-3_169

3. Hushnud, H., Singh, O., Tripathy, S. K., Mishra, A. N., & Dey, K. (2023, September). Effect of event classifiers on jet quenching–like signatures in high-multiplicity $p + p$ collisions at $\sqrt{s} = 13$ tev. Submitted September 18, 2023; 5 pages. arXiv: 2309.09533 [hep-ph]. Retrieved from https://arxiv.org/abs/2309.09533

4. Sharma, A. K., Singh, O., & Ahmad, N. (2023). Reconstruction of ω mesons with cbm detector at fair. In *66th dae–brns symposium on nuclear physics* (pp. 1032–1033). Retrieved from https://inspirehep.net/literature/2632407

5. Ahmad, N., Khan, M. M., **Singh**, **O.**, & Ahmad, T. (2018). On scaling properties of multiplicity fluctuations in 60A and 200A gev/c ^{16}o–agbr collisions. In *Dae symposium on nuclear physics* (Vol. 63, pp. 1008–1009).

6. **Singh**, **O.**, Bhaduri, P. P., Chattopadhyay, S., & Ahmad, N. (2018). Realistic Muon Chamber (MuCh) geometry simulation for the CBM experiment at FAIR. (Vol. 63, pp. 1002–1003).

7. Ahmad, N., Singh, O., & Ahmad, S. (2017). On multifractality in 60A and 200A gev/c ^{16}o–agbr collisions. In *Dae symposium on nuclear physics* (Vol. 62, pp. 860–861).

8. Ahmad, N., & **Singh**, **O.** (2016). Multifractality in pp collisions at lhc energies. In *Dae symposium on nuclear physics* (Vol. 61, pp. 834–835).

9. Rasool, M. H., Ahmad, M. A., Bhat, M., Veer Singh, O., & Ahmad, S. (2016). Multiplicity Characteristics of Forward-Backward Emitted Particles in Heavy-Ion Interactions at SPS Energies. In B. Bhuyan (Ed.), (Vol. 174, pp. 61–66). doi:10.1007/978-3-319-25619-1_10

10. Rasool, M. H., Ahmad, M. A., Ahmad, S., Bhat, M., & Singh, O. V. (2015, February). Intermittency and multiplicity moments of relativistic charged particles produced in ^{32}s–emulsion interactions at 200A gev/c. In *7th international conference on physics and astrophysics of quark–gluon plasma (icpaqgp–2015)*, Kolkata, India.

11. Ahmad, M. A., Rasool, M. H., Bhat, M. A., Singh, O. V., Ahmad, S., & Bakry, M. Y. (2015). Method for the characterization of central collisions in nuclear emulsion experiment. In *60th dae–brns symposium on*

nuclear physics (pp. 768–769). Prasanthi Nilayam, India, December 7–11, 2015. Retrieved from https://inspirehep.net/literature/1425295

12. Rasool, M. H., Ahmad, M. A., **Singh**, **O.**, & Ahmad, S. (2015). Multifractal analysis of relativistic charged particle distribution in ^{32}s–agbr interactions at 200A gev. In *Dae symposium on nuclear physics* (Vol. 60, pp. 734–735). Available in DAE Symp. Nucl. Phys. Proc. vol. 60. Retrieved from https://www.sympnp.org/proceedings/60/E15.pdf

13. **Singh**, **O.**, Rasool, M. H., Ahmad, M. A., & Ahmad, S. (2015). Characteristics of compound multiplicity in ^{28}Si-Em interactions at 14.6A GeV. In B. K. Nayak, D. Dutta, & S. M. Sharma (Eds.), (Vol. 60, pp. 736–737).

Reviewed Progress Reports

1. Blume, C., Kahler, P., Meyer-Ahrens, A., Singh, O., & Wahmes, L. (2024). *Towards an optimized trd geometry* (CBM Progress Report No. 2023). CBM Collaboration. doi:10.15120/GSI-2024-00765

2. Singh, O., Shiroya, M., Uhlig, F., Friese, V., Emschermann, D., Clerkin, E., … Vasylev, O. (2024). *Modelling of simulation geometries using tessellated shapes with the vectorized geometry (vecgeom) package* (CBM Progress Report No. 2023). CBM Collaboration. doi:10.15120/GSI-2024-00765

3. Aman, M. A., Chattopadhyay, S., Bhaduri, P. P., & Singh, O. (2023). *Optimization of the muon chamber (much) for the cbm experiment at fair* (CBM Progress Report No. 2022). CBM Collaboration. doi:10.15120/GSI-2023-00384

4. Singh, O., & Uhlig, F. (2023). *Transition to a modern cmake-based build system for cbmroot* (CBM Progress Report No. 2022). CBM Collaboration. doi:10.15120/GSI-2023-00384

5. Singh, O., Chatterjee, S., Bhaduri, P. P., & Chattopadhyay, S. (2021). *Implementation and performance simulation of realistic design of the gem chambers for the first two stations of much* (CBM Progress Report No. 2020). GSI Helmholtzzentrum für Schwerionenforschung. doi:10.15120/GSI-2021-00421

6. Chatterjee, S., Singh, O., Bhaduri, P. P., Chattopadhyay, S., & Nikulin, V. (2020). *Effect of gaps on the fifth absorber of muon chamber (much) for the cbm experiment at fair* (CBM Progress Report No. 2019). GSI Helmholtzzentrum für Schwerionenforschung. doi:10.15120/GSI-2020-00904

7. Chatterjee, S., Singh, O., Bhaduri, P. P., Chattopadhyay, S., Senger, A., & Nikulin, V. (2020). *Effect of absorbers surface tolerance on the muon chamber (much) performance for the cbm experiment at fair* (CBM Progress Report No. 2019). GSI Helmholtzzentrum für Schwerionenforschung. doi:10.15120/GSI-2020-00904

8. Chatterjee, S., Singh, O., Senger, A., Bhaduri, P. P., & Chattopadhyay, S. (2020). *Reconstruction of j/ψ mesons at sis100 energies with realistic much set up* (CBM Progress Report No. 2019). GSI Helmholtzzentrum für Schwerionenforschung. doi:10.15120/GSI-2020-009041

9. Nandy, E., **Singh**, **O.**, Singhal, V., Ahammed, Z., Bhaduri, P. P., & Chattopadhyay, S. (2020). *Optimization of rpc detector segmentation and charge threshold in 3rd and 4th much station* (CBM Progress Report No. 2019). CBM Collaboration. doi:10.15120/GSI-2020-00904

10. Singh, O., Bhaduri, P. P., Nandy, E., Chatterjee, S., Chattopadhyay, S., Senger, A., … Ahmad, N. (2020). *Evolution of first absorber in muon chamber* (CBM Progress Report No. 2019). CBM Collaboration. doi:10.15120/GSI-2020-00904

11. Singh, O., Chatterjee, S., Bhaduri, P. P., Chattopadhyay, S., Senger, A., & Galatyuk, T. (2020). *Reconstruction of ω mesons at sis100 with realistic much set up* (CBM Progress Report No. 2019). GSI Helmholtzzentrum für Schwerionenforschung. doi:10.15120/GSI-2020-00904

12. Nandy, E., Singh, O., Singhal, V., Ahammed, Z., Bhaduri, P. P., & Chattopadhyay, S. (2019). *Implementation of rpc geometry and digitization in the 3rd and 4th much station* (CBM Progress Report No. 2018). CBM Collaboration. doi:10.15120/GSI-2019-01018

13. Singh, O., Bhaduri, P., Nandy, E., Chattopadhyay, S., & Ahmad, N. (2019). *Realistic muon chamber (much) geometry simulation for the cbm experiment at fair* (CBM Progress Report No. 2018). CBM Collaboration. doi:10.15120/GSI-2019-01018

14. Chattopadhyay, S., Dubey, A. K., Ahammed, Z., Saini, J., Bhaduri, P., Nandy, E., … Division, F. (2018). *Muon chamber developments for cbm* (GSI-FAIR Scientific Report No. 2017). GSI Helmholtzzentrum. RESEARCH-NQM-CBM-11. doi:10.15120/GR-2018-1

15. Nandy, E., Ahmed, Z., Singh, O., & Chattopadhyay, S. (2018). *Implementation of rpc geometry for the 3rd and 4th station of cbm-much* (CBM Progress Report No. 2017). CBM Collaboration. doi:10.15120/GSI-2018-00485

16. Singh, O., Bhaduri, P., Emschermann, D., Singhal, V., Chattopadhyay, S., & Ahmad, N. (2018). *Description of the cbm-much geometry in cbmroot* (CBM Progress Report No. 2017). CBM Collaboration. doi:10.15120/GSI-2018-00485

17. Singh, O., Bhaduri, P., Nandy, E., Chattopadhyay, S., & Ahmad, N. (2018). *First results of mmuch simulation for the mcbm full system setup at sis18* (CBM Progress Report No. 2017). CBM Collaboration. doi:10.15120/GSI-2018-00485

Notes (Indico, intern)

1. Chatterjee, S., Bhaduri, P. P., **Singh**, **O.**, Nikulin, V., & Chattopadhyay, S. (2020, September). Non-monolithic design of the 5th much absorber parameters and tolerances. CBM Technical Note CBM-TN-20006, September 30, 2020.

2. **Singh**, **O.**, Nandy, E., Bhaduri, P. P., Emschermann, D., Singhal, V., & Chattopadhyay, S. (2019, July). Implementation of muon chamber (much) geometries in the cbmroot software. CBM Collaboration Note CBM-CN-19002, July 13, 2019.