Tommaso Diotalevi

Ph.D. in Physics

tommaso.diotalevi@unibo.it
https://www.unibo.it/sitoweb/tommaso.diotalevi
https://www.tommasodiotalevi.it

Orcid ID: 0000-0003-0780-8785
Scopus ID: 57188685298
InspireHEP ID: 1719038

Education

Nov 2018 – Jun 2022 **Ph.D. in Physics**,
Sector: Nuclear and Subnuclear Physics
"*Application of Deep Learning techniques in the search for BSM Higgs bosons in the $\mu\mu$ final state in CMS*" (link), Supervisor: Prof. D.Bonacorsi; Co-supervisors: Dr. F. Primavera, S. Marcellini and G. Masetti
University of Bologna (Italy)

Oct 2015 – Jul 2018 **Master Degree in Physics**,
Sector: Nuclear and Subnuclear Physics
"*CMS Level-1 Trigger Muon Momentum assignment with Machine Learning*" (link), Supervisor: Prof. D. Bonacorsi; Co-supervisors: Prof. L. Guiducci and Dr. C. Battilana
Final Mark: 110/110 cum laude
University of Bologna (Italy)

Oct 2012 – Oct 2015 **Bachelor Degree in Physics**,
"*Investigation of Petabyte-scale data transfer performances with PhEDEx for the CMS experiment*" (link), Supervisor: Prof. D. Bonacorsi
Final Mark: 110/110 cum laude
University of Bologna (Italy)

Qualifications

July 2025 – June 2037 **National Scientific Qualification ("Abilitazione Scientifica Nazionale (ASN)")**,
Associate Professor
Disciplinary field of 02/A1 - Experimental physics of fundamental interactions
Ministerial Decree n. 1796/2023

Research contracts

Feb 2023 – Today **Junior assistant professor (Ricercatore a tempo determinato - art. 24, comma 3, lettera a) della Legge 30 dicembre 2010, n. 240 (RTDa))**,
Fixed-term researcher at the Department of Physics and Astronomy (DIFA).
Sector: Nuclear and Subnuclear Physics.
Bando Prot. n° 0242544 del 11/10/2022 - Provvedimenti dirigenziali 6352/2022 (All. 10)
University of Bologna (Italy)

Jul 2022 – Jan 2023 **INFN-CNAF technological research fellowship (assegno di ricerca) contract**,
"*Software development for experiments and scientific collaborations of INFN interest*"
Bando INFN n° 24239/2022
Bologna (Italy)

Jul 2021 – Jun 2022 **CERN Doctoral Student (DOCT) fellowship programme**, *1 year duration*,
"*Application of Deep Learning techniques in the reconstruction of high energy muons and in the search for BSM Higgs bosons in the $\mu\mu$ final state in CMS*"
Bando INFN n° 1397
CERN (Switzerland)

Jul 2021 – Sep 2021 **"Marco Polo" Scholarship for students mobility**, *3 months duration*
Note: project was selected, withdrawn due to incompatibility with previous item
University of Bologna (Italy)

Nov 2018 – Jun 2022 **Ph.D. Scholarship (funded by INFN)**,
Ph.D. in Physics XXXIV Ciclo - A.A.2018/19
Bando Prot. 102912 del 31/07/2018, D.R. Rep. n° 1167/2018
University of Bologna (Italy)

Sep 2018 – Oct 2018 **INFN-CNAF Technological Student fellowship**, *2 months duration*,
Technological training activity for university students
"*Log parsing for a Machine Learning application on a predictive maintenance solution at the INFN-CNAF Tier-1 computing center*"
Bando INFN n° 19789/2018 - 2^{nd} in the national selection ranking
Bologna (Italy)

Jul 2016 – Sep 2016 **CERN Summer Student programme contract**,
"*Analyzing CMS transfers using Machine Learning techniques*" (link)
Research contract CERN-SUM-2016
CERN (Switzerland)

Research activities

Junior assistant professor (RTDa) at the University of Bologna (DIFA), carries out his research in the field of High Energy Physics and advanced scientific computing, with a particular focus on the CMS experiment at the CERN's Large Hadron Collider (LHC). Currently, involved in the "*National Center for HPC, Big Data and Quantum Computing*" (ICSC). Additionally, has actively participated (and continues to participate) in various research and technological development projects.

Physics analysis

- **Search for heavy neutrinos in D_s meson decays, in pp collisions at $\sqrt{s}$= 13 TeV**
  (Feb 2023 - Today)
  – Synergy with *Software and Computing* –
  I am contributing to the analysis activity "*Search for heavy neutrinos in D_s meson decays*" of the CMS Collaboration (BPH-23-006) by porting it to a quasi-interactive and distributed computing infrastructure (i.e., Analysis Facility) to assess potential improvements in scalability and computational efficiency. This contribution aligns with the Key Performance Indicators of the flagship activity UC2.2.2 of the National Center ICSC. I also contributed to this analysis through the co-supervision of a Master's thesis in Physics

titled "*A Machine Learning Approach for Heavy Neutral Leptons Search from D_s Meson Decays in the CMS Experiment*" (link, defended the 27/03/24).

- **Search for MSSM Higgs Boson decaying to $\mu^+\mu^-$ in pp collisions at $\sqrt{s}$= 13 TeV**
  (Nov 2018 - Today)
  I joined this group in November 2018. The CMS collaboration on this particular analysis, before my arrival, has published the following paper: CMS-HIG-18-010 (arXiv:1907.03152). My personal contribution is related to the evolution of such analysis, with the inclusion of the entire Run 2 data at a center-of-mass energy of 13TeV. In particular, my involvement is focused on the production of Machine and Deep Learning algorithms for the improvement of the signal/background discrimination, using a novel approach called parametric Neural Network (pNN), comparing the performance with a "classical" cut-based approach. Such new architecture, including by design the Higgs unknown mass hypotheses among with the standard pNN input features, it is able to replace a whole set of single networks, each one trained at a specific mass value, with a single network able to interpolate masses where it is not specifically trained. This approach has also been presented in the ML_INFN CSN5 project. As a MC contact for the HExtended Higgs subgroup, I was also responsible for the production of the analysis' Ultra-Legacy Monte Carlo samples, for the 2016-2018 data taking period. The analysis activity is still ongoing, please refer to my PhD Thesis (June 2022) DOI: 10.48676/unibo/amsdottorato/10356

Software and Computing

- **Quasi interactive analysis of big data with high throughput**
  (Feb 2023 - Today)
  This activity, part of the flagship UC2.2.2 of the National Center ICSC, aims to develop a new infrastructure to optimize and accelerate data analysis in High Energy Physics, both from a technological perspective (developing a Cloud-based facility on ICSC resources) and a scientific one (gathering various data analyses from multiple scientific collaborations, including LHC and Future Colliders). My personal contribution is related to the portability of various analysis activities (detailed in physics analysis and detector performance) to such computing infrastructure. Furthermore, as Principal Investigator (PI) of this flagship initiative, I organized the dissemination workshop "Quasi interactive analysis of big data with high throughput" (8-10/01/2025, DIFA, Bologna), with the involvement of speakers from the CERN and ROOT communities. The topic was addressed with lectures and hands-on sessions, with the final goal of helping users to make their own scientific analyses more efficient and faster.

- **Development of a Tape REST API, for the WLCG storage managers**
  (Jul 2022 - Jan 2023)
  I joined the Software Development group at INFN-CNAF from July 2022. Storage managers (e.g. StoRM, dCache, etc...) operating on the WorldWide LHC Computing GRID (WLCG) handle primarily disk related operations. However, compared to disk, tape storage is much cheaper and capable of storing much more data, but with a huge downside in terms of data recall and IO speed. My personal contribution is related to the development of a REST API for tape storage (named *"WLCG tape REST API"*), offering a common HTTP interface allowing clients to manage disk residency of tape stored files and observe the progress of file transfer on disk. This API (based on RESTful principles) consists of a single endpoint handling different operations: the stage bulk-request of any requested tape-stored files, making them available on disk; the progress tracking of a previously staged bulk-request; the cancellation of previously staged file replicas from disk; the request information about the progress of file's staging. The API has been made accessible via authentication mechanisms like X509 + VOMS (proxy-based) or token based (JWT).

- **Exploring Deep Learning fast inference on an ATCA processor board with Xilinx Virtex-7 FPGA**
  (Feb 2019 – Jun 2022)
  Both the University of Bologna and INFN-Bologna created this group with the idea of building and testing

Machine and Deep Learning models into custom FPGA firmware. This kind of expertise is crucial in the future steps of High Energy Physics, in particular with low-latency hardware solutions like trigger and data acquisition that will cope with the stricter requirements of Run-3 as well as the new phase of operations with the High-Luminosity LHC. My work in this group is mainly focused with the application of the High-Level Synthesis toolkit - *hls4ml* - developed mainly at CERN, to convert simple neural networks into a series of logic operations and testing them on a high end ATC136 board with a Xilinx Virtex-7 FPGA.

- **Collection of system logs and prototypal analytics services with the Elastic (ELK) suite at the INFN-CNAF computing centre**
  (Nov 2018 – Apr 2019)
  The distributed Grid infrastructure for High Energy Physics experiments at the Large Hadron Collider (LHC) in Geneva comprises a set of computing centres, spread all over the world, as part of the Worldwide LHC Computing Grid (WLCG). In Italy, the Tier-1 functionalities are served by the INFN-CNAF data center, which provides also computing and storage resources to more than twenty non-LHC experiments. For this reason, a high amount of logs are collected each day from various sources, which are highly heterogeneous and difficult to harmonize. During my work at the INFN-CNAF, I started working on a centralized system that collects, parses and displays the log information from CNAF data sources, investigating them on a Machine Learning based predictive maintenance system.

- **Monitoring data transfer latency in CMS computing operations**
  (Jan 2015 – Oct 2015)
  I worked in the CMS PhEDEx (Physics Experiment Data Export) group, analyzing several typical CMS transfer workflows, such as distribution of collision event data from CERN or upload of simulated event data from the Tier-2 centres to the archival Tier-1 centres. For each workflow, the typical patterns of transfer latencies that have been identified with the latency monitor, were identified; in particular the areas in PhEDEx where a development effort can reduce the latency, showing the ability to detect stuck transfers which need operator intervention. A set of metrics was created to alert about stuck subscriptions and prompt for manual intervention, with the aim of improving transfer completion times.

Detector performance

- **Performance analysis of the CMS Drift Tubes (DT) on distributed computing resources**
  (Jan 2024 - Today)
  – Synergy with *Software and Computing* –
  I started collaborating with the CMS DT performance group in early 2024, working on the portability of a Tag-and-Probe analysis (CMS-DP-2023-049) to a quasi-interactive and distributed computing infrastructure (i.e., Analysis Facility) to evaluate potential improvements in scalability and computational efficiency. Unlike the traditional approach, which executes the analysis sequentially, the new method (requiring a rewrite of the source code using dedicated libraries) leverages distributed resources, enabling the parallel processing of large datasets. The first results of this work show a significant improvement in execution speed, while keeping the results consistent with the legacy DT segment reconstruction. This allows analysts to re-run the same operations in considerably shorter times, even on extensive datasets (e.g., spanning multiple years of data-taking or following modifications to the analysis configuration). This contribution aligns with the Key Performance Indicators of the flagship activity UC2.2.2 of the National Center ICSC.

Physics Object Group (POG) in the CMS experiment - Muon

- **Run3 High p_T classifier with Machine Learning**
  (Mar 2020 – Jun 2022)
  I started collaborating with the CMS Muon POG L3 subgroups, studying the event-by-event choice of optimal refit techniques for high p_T muons, using Machine Learning techniques. This activity, explored as

part of an R&D effort, was carried out looking for a potential replacement of the current algorithm for the choice of the best refit, TuneP, with the idea of improving the overall muon high p_T assignment.

Detector and trigger R&D

- **Development of a Machine Learning based muon trigger algorithm for the Phase2 upgrade of the CMS detector**
  (Jul 2017 – Jul 2018)
  After the high-luminosity upgrade of the LHC, the muon chambers of the CMS Barrel region must cope with an increase in the number of interactions per bunch crossing. Therefore, new algorithmic techniques for data acquisition and processing will be necessary in preparation for such a high pile-up environment. Using Machine Learning as a technique to tackle this problem, my work was mainly focused on the production of models - with data obtained through Monte Carlo simulations - capable of predicting the transverse momentum of muons crossing the CMS Barrel muon chambers, comparing them with the transverse momentum assigned by the current CMS Level-1 trigger system.

Membership in research groups

Feb 2023 – Today **Member of the National Center "HPC, Big Data and Quantum Computing" (ICSC), founded by PNRR - Missione 4 Componente 2 Investimento 1.4**,
Activity inside the Spoke 2 "Fundamental Research & Space Economy", led by INFN and INAF (with the University of Bologna as affiliate).
Bologna (Italy)

2024 – Today **Member of the "AI_INFN" CSN5 project**
"End-to-end approach to the usage of Artificial Intelligence for INFN research topics"
Bologna operational unit

2021 – Today **Involvement in software&computing for Einstein Telescope (ETIC)**
Validation of the computing resources acquired in the DIFAET storage parts and BETIF processing (CPU, GPU) parts of the newly-born ETIC computing infrastructure in Bologna, including benchmarking of ML/DL applications in such resources, contributing to its commissioning by Summer 2025 as per the workplan.

2020 – 2023 **Member of the "ML_INFN" CSN5 project**
"End-to-end approach to the usage of Machine Learning for INFN research topics"
Bologna operational unit

2016 – Today **Member of the CERN Operational Intelligence team**
CERN-based inter-experiment group on advanced CompOps techniques for current and next generation experiments

2016 – Today **Member of the CMS Collaboration at LHC**

International committees

2020 **Member of Technical committee**
International Workshop on Predictive Maintenance (IWPM) of the 27^{th} FRUCT Conference

Contracts of association

2019 – Today **CERN**

2018 – Today **INFN (National Institution for Nuclear and Subnuclear Physics)**
Bologna, Italy

Responsibilities in research groups

Feb 2023 – Today **Principal Investigator (PI) within the UC2.2.2 flagship "Quasi interactive analysis of big data with high throughput", Work Package 2 "Experimental High Energy Physics", Spoke 2 "Fundamental Research & Space Economy", of the "HPC, Big Data e Quantum Computing" National Center (ICSC)**,
Responsibility given by the project Spoke Leader,
As part of my supervision and coordination activities (involving around 40 people from various experiments), I am responsible for defining key performance indicators (KPIs) and regularly managing the reporting of the required milestones to reviewers.
Founded by PNRR - Missione 4 Componente 2 Investimento 1.4

Feb 2023 – Today **Responsible for computing resources within the ICSC National Center**,
Responsibility as Principal Investigator of the UC2.2.2 flagship (see item above),
Resources assigned by the Resource Allocation Committee (RAC) of ICSC. Among those resources: 128vCORE (2GB RAM/core) of Cloud resources, 672 cores (2GB RAM/core) of HTC resources, $\approx$ 750TB of storage.

Sep 2022 – Today **Responsible as CMS Generator Contact of the analysis group "Beyond Two Generations (B2G)", specialized in new physics models characterized by final states with heavy Standard Model particles (including Di-Higgs and the search for new heavy resonances)**,
Responsibility given by the analysis group conveners,
This responsibility involves overseeing the Monte Carlo simulation requests from all analysts in the group (currently covering nearly 30 analyses), ensuring their creation (both in terms of physics and computing aspects) and monitoring their proper use throughout the publication process of the analysis work.

Jun 2020 – Today **Responsible as CMS Generator Contact of the analysis group "Higgs physics (HIG)"**,
Responsibility given by the analysis group conveners,
This responsibility involves overseeing the Monte Carlo simulation requests from all analysts in the group, ensuring their creation (both in terms of physics and computing aspects) and monitoring their proper use throughout the publication process of the analysis work.

Feb 2023 – Today **Participation to the CMS analysis activity "Search for heavy neutrinos in D_s meson decays"**

Nov 2018 – Today **Participation to the CMS analysis activity "Search for MSSM Higgs Boson decaying to $\mu^+\mu^-$ in pp collisions at 13TeV"**

Editorial activities

Mar 2024 – Sep 2024 **Peer reviewer**, *Journal of Instrumentation (JINST) - ISSN: 1748-0221*
Invited reviewer in the journal (IF(2023): 1.3)

Nov 2018 – Today **Institutional Reviewer**, *CMS Collaboration*
Reviewer of 16 CMS physics analyses papers.

Personal contributions at conferences

Note: For presentations at conferences and congresses on topics related to the CMS experiment, I was selected by the CMS Collaboration's Conference Committee.

Oral contributions

1. **9th International Conference on High Energy Particle and Nuclear Physics in the LHC Era (HEPNP2025)**

6 January - 10 January 2025, Valparaiso (Chile)
Boosting HEP computing: the "Fundamental Research & Space Economy" Italian strategy within the National Center for HPC, Big Data, and Quantum Computing (link) - **Speaker**

2. **ICSC and Spoke 2 - Where are we Now?**
10 December - 12 December 2024, Catania (Italy)
Lightning Talk: Quasi interactive analysis of big data with high throughput - where are we now? (link) - **Coauthor**

3. **27th International Conference on Computing in High Energy & Nuclear Physics (CHEP2024)**
19 October - 25 October 2024, Cracow (Poland).
Leveraging distributed resources through high throughput analysis platforms for enhancing HEP data analyses (link) - **Coauthor**
Proceedings under peer-review

4. **Annual Italian Workshop of the CMS experiment at LHC**
7 October - 9 October 2024, Rome (Italy)
High rate analysis: status, synergies, and perspectives - **Speaker**

5. **ICSC Annual Meeting 2024**
17 September - 20 September 2024, Rome (Italy)
Young Researcher Talk on the ICSC Spoke2 activities (link) - **Speaker**

6. **42nd International Conference on High Energy Physics (ICHEP 2024)**
17 July - 24 July 2024, Prague (Czechia)
Enhancing CMS data analyses using a distributed high throughput platform (link) - **Speaker**
Proceeding published on PoS: PoS(ICHEP2024)1007

7. **Incontri di Fisica delle Alte Energie 2024 (IFAE 2024)**
3 April - 5 April 2024, Firenze (Italy)
Analisi quasi-interattiva per big data con alto throughput per la Fisica delle Alte Energie (link) - **Coauthor**
Proceedings published on Il Nuovo Cimento C (107)

8. **Spoke 2 Annual Meeting**
18 December - 20 December 2023, Bologna (Italy)
Quasi interactive analysis of big data with high throughput - Initial steps and future perspectives (link) - **Speaker**

9. **Workshop sul calcolo nell'INFN, CCR2023**
22 May - 26 May 2023, Loano (Italy)
Esperienza di un'analisi dati CMS nell'INFN "Analysis Facility" framework (link) - **Speaker**

10. **International Workshop on Advanced Computing and Analysis Techniques in Physics Research, ACAT2022**
23 Oct - 28 Oct 2022, Bari (Italy)
Affine Parametric Neural Networks for High-Energy Physics (link) - **Coauthor**

11. **Workshop on data analysis @CMS Italia**
10 March - 11 March 2022, Florence (Italy)
BSM HMuMu analysis - **Coauthor**

12. **25th International Conference on Computing in High-Energy and Nuclear Physics, vCHEP2021**
17 May - 21 May 2021, CERN (Switzerland) [online conference]
Preparing distributed computing operations for the HL-LHC era with Operational Intelligence (link) -

Coauthor
Journal article published on Frontiers in Big Data: Frontiers in Big Data - Volume 4 (2022)

13. **International Symposium on Grids & Clouds 2021, ISGC2021**
    22 March - 26 March 2021, Taipei (Taiwan) [online conference]
    Deep Learning fast inference on FPGA for CMS Muon Level-1 Trigger studies (link) - **Speaker**
    Proceeding published on PoS: PoS(ISGC2021)005

14. **24th International Conference on Computing in High-Energy and Nuclear Physics, CHEP2019**
    4 November - 8 November 2019, Adelaide (Australia)
    Operational Intelligence (link) - **Coauthor**
    Proceeding published on EPJ: EPJ Web of Conferences 245, 03017 (2020)

15. **International Symposium on Grids & Clouds 2019, ISGC2019**
    31 March - 5 April 2019, Taipei (Taiwan)

    - *Collection and harmonization of system logs and prototypal Analytics services with the Elastic (ELK) suite at the INFN-CNAF computing centre* (link) - **Speaker**
      Proceeding published on PoS: PoS(ISGC2019)027
    - *Towards Predictive Maintenance with Machine Learning at the INFN-CNAF computing centre* (link) - **Coauthor**
      Proceeding published on PoS: PoS(ISGC2019)003

16. **International Symposium on Grids & Clouds 2018, ISGC2018**
    16 March - 23 March 2018, Taipei (Taiwan)
    Progress on Machine and Deep Learning applications in CMS Computing (link) - **Coauthor**
    Proceeding published on PoS: PoS(ISGC2018)022

17. **International Symposium on Grids & Clouds 2017, ISGC2017**
    5 March - 10 March 2017, Taipei (Taiwan)
    Progress in Machine Learning Studies for the CMS Computing Infrastructure (link) - **Coauthor**
    Proceeding published on PoS: PoS(ISGC2017)023

Poster contributions

18. **42nd International Conference on High Energy Physics (ICHEP 2024)**
    17 July - 24 July 2024, Prague (Czechia)
    Benchmarking distributed-interactive HEP analysis workflows on the new Italian National Centre analysis infrastructure (link) - **Coauthor**
    Proceeding published on PoS: PoS(ICHEP2024)1043

19. **22nd International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT2024)**
    11 March - 15 March 2024, Stony Brook (USA).
    Quasi interactive analysis of High Energy Physics big data with high throughput (link) - **Corresponding author**
    Proceedings under peer-review

20. **26th International Conference on Computing in High Energy & Nuclear Physics (CHEP2023)**
    8 May - 12 May 2023, Norfolk (USA).
    A RESTful approach to tape management in StoRM (link) - **Coauthor**
    Proceeding published on EPJ: EPJ Web of Conferences 295, 01005 (2024)

21. **6th Annual Conference on Large Hadron Collider Physics (LHCP2018)**
    4 June - 9 June 2018, Bologna (Italy).
    Development of Machine Learning based muon trigger algorithms for the Phase2 upgrade of the CMS (link) - **Corresponding author**
    Proceeding published on PoS: PoS(LHCP2018)092

22. **21st International Conference on Computing in High Energy and Nuclear Physics, CHEP2015**, 13 April - 17 April 2015 (Okinawa, Japan)
    Monitoring data transfer latency in CMS computing operations (link) - **Coauthor**
    Proceeding published on Journal of Physics: 664(3):032033, 2015

Attendance to events

In this section, I list all the attendances to conferences, workshops, masters, schools and tutorials. For my personal contributions, refer to "Personal contribution at conferences" section.

Conferences

6-10 Jan 2025	**9th International Conference on High Energy Particle and Nuclear Physics in the LHC Era (HEPNP2025)** Valparaiso, Chile (remote participation)
19-25 Oct 2024	**27th International Conference on Computing in High-Energy and Nuclear Physics (CHEP2024)** Kraków, Poland (remote participation)
17-24 Jul 2024	**42nd International Conference on High Energy Physics (ICHEP 2024)** Prague, Czechia
4 Apr 2024	**6th AI Forum 2024** Milano, Italy
3-5 Apr 2024	**Incontri di Fisica delle Alte Energie 2024 (IFAE 2024)** Firenze, Italy (remote participation)
8-12 May 2023	**26th International Conference on Computing in High-Energy and Nuclear Physics (CHEP2023)** Norfolk, USA (remote participation)
6-13 Jul 2022	**41st International Conference on High Energy Physics (ICHEP 2022)** Bologna, Italy
17-21 May 2021	**25th International Conference on Computing in High-Energy and Nuclear Physics (vCHEP2021)** CERN, Switzerland (online)
22-26 Mar 2021	**International Symposium on Grids & Clouds 2021, ISGC2021** Taipei, Taiwan (remote participation)
31 Mar-5 Apr 2019	**International Symposium on Grids & Clouds 2019, ISGC2019** Taipei, Taiwan
4-9 Jun 2018	**Sixth Annual Large Hadron Collider Physics conference, LHCP 2018** Bologna, Italy

Workshops

31 Mar - 4 Apr 2025	**6th CMS CAT Hackathon** CERN, Switzerland

8-10 Jan 2025 **Quasi interactive analysis of big data with high throughput, Organizer**
Bologna, Italy

7-9 Oct 2024 **Annual Italian Workshop of the CMS experiment at LHC**
Roma, Italy

17-20 Sep 2024 **ICSC Annual Meeting 2024**
Roma, Italy

17-28 Jun 2024 **4th CMS CAT Hackathon**
CERN, Switzerland

11-15 Mar 2024 **22nd International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT 2024)**
Stony Brook, USA (remote participation)

13-16 Nov 2023 **Fifth ML-INFN Hackathon: Advanced Level**
Pisa, Italy

19-21 Jun 2023 **First course about the porting on GPUs of code and algorithms**
Italy (online)

22-26 May 2023 **Workshop sul calcolo nell'INFN (CCR)**
Loano, Italy

10-11 Mar 2022 **Workshop on data analysis @CMS Italia**
Florence, Italy

13-15 Dec 2021 **Second ML-INFN Hackathon: Starting Level**
Online only

11-13 Oct 2021 **Annual Italian Workshop of the CMS experiment at LHC**
Naples, Italy

5-9 Jul 2021 **PyHEP 2021 (virtual) Workshop**

30 Nov-3 Dic 2020 **Fast Machine Learning for Science Workshop**
Southern Methodist University of Dallas, Texas (online)

19-23 Oct 2020 **4th Inter-experiment Machine Learning (IML) Workshop**
CERN, Switzerland (online)

22-23 Jan 2020 **CERN Openlab Technical Workshop**
CERN, Switzerland

15-18 Apr 2019 **3rd Inter-experiment Machine Learning (IML) Workshop**
CERN, Switzerland (online)

6 Feb 2019 **How to do ultrafast Deep Neural Network inference on FPGAs**
Zurich, Switzerland

Masters

12-13 Nov 2024 **Master of Proposal Writing in Horizon Europe**
Bruxelles, Belgium

Schools

30 Jun - 4 Jul 2025 **Second course on porting code and algorithms to GPUs, Organizer**
Bologna, Italy

2-8 Oct 2022 **Thirteenth INFN International School on: "EFFICIENT SCIENTIFIC COMPUTING" (ESC22)**
Bertinoro, Italy

13-15 Dec 2021 **Second ML-INFN Hackathon: Starting Level**
Online only

7-18 Jun 2021 **ESCAPE Data Science Summer School 2021**
Annecy, France (online)

23-30 Sep 2020 **CMS Virtual Data Analysis School (CMSDAS)**
CERN, Switzerland (online)
Personal contribution: Physics analysis group presentation during plenary session.

20-24 Jul 2020 **Summer School on Physical Sensing and Processing**
Bologna, Italy (online)

27-28 Apr 2020 **Mathematical Methods and Models in Machine Learning**
Bologna, Italy (online)

16-20 Sep 2019 **Third International School on Open Science Cloud, SOSC2019**
Bologna, Italy

2-7 Jun 2019 **INFN School of Statistics 2019**
Paestum, Salerno

11-15 Apr 2016 **2nd BCD International School on High Energy Physics (ISHEP)**
Cargese, France

Tutorials

29 Apr 2022 **CMS Technical/DCS Shift Training**
CERN, Switzerland

7 Apr 2021 **Online CMS DQM Shift Tutorial**
CERN, Switzerland (online)

3-4 Feb 2021 **Quantum Machine Learning Tutorial**
CERN, Switzerland (online)

27-28 Feb 2020 **TensorFlow 2.0 Tutorial**
CERN, Switzerland (online)

Teaching activities

Feb 2025 – Today **Course Leader (Titolare di insegnamento)**, *"Overview of AI approaches in Fundamental Research in High-Energy Physics", 16 hours*,
PhD course in Data Science and Computation; AA 24-25
Department of Computer Science and Engineering, University of Bologna

Jan 2025 – Today **Module Leader (Titolare modulo di insegnamento)**, *"Introduction to Discriminative AI methods", 6 hours*,
International II level master "HPQC - High-Performance & Quantum Computing"; AA 24-25
Course webpage: (*link*)
University of Bologna

Feb 2025 – Today **Module Leader (Titolare modulo di insegnamento)**, *"Software and computing for nuclear and subnuclear physics", 8 hours (≈ 25 students)*,
[cod. 87945] [Modulo 3] - Master (LM) in Physics; AA 24-25
Department of Physics and Astronomy, University of Bologna

Sep 2024 – Today **Module Leader (Titolare modulo di insegnamento)**, *"General Physics T-1", 30 hours (≈ 100 students)*,
[cod. 27996] [Sdoppiamento A-K] [Modulo 2] - Bachelor (L) in Electric Engineering & Automation Engineering; AA 24-25
Department of Electric Engineering & Automation Engineering, University of Bologna

Feb 2024 – Feb 2025 **Module Leader (Titolare modulo di insegnamento)**, *"Fenomeni Ondulatori (Wave-Motion Phenomena)", 12 hours (≈ 80 students)*,
[cod. 15745] [Modulo 2] - Bachelor (L) in Physics; AA 23-24
Department of Physics and Astronomy, University of Bologna

Feb 2023 – Today **Module Leader (Titolare modulo di insegnamento)**, *"Fenomeni Termici (Thermodynamics)", 12 hours (≈ 80 students)*,
[cod. 81783] [Modulo 2] - Bachelor (L) in Physics; AA 22-23, AA 23-24, AA 24-25
Department of Physics and Astronomy, University of Bologna

Theses co-supervisions

27 Mar 2024 **Co-supervisor**, *A Machine Learning approach for Heavy Neutral Leptons search from D_s meson decays in the CMS experiment*,
Master (LM) in Physics
Department of Physics and Astronomy, University of Bologna

26 Mar 2021 **Co-supervisor**, *FPGA implementation of muon momentum assignment with Machine Learning at the CMS Level-1 Trigger*,
Master (LM) in Physics
Department of Physics and Astronomy, University of Bologna

25 Sep 2020 **Co-supervisor**, *Search for Beyond Standard Model neutral Higgs boson in the $\mu\mu$ channel with the CMS detector at LHC with a multivariate approach*,
Master (LM) in Physics
Department of Physics and Astronomy, University of Bologna

18 Oct 2019 **Co-supervisor**, *Search for neutral MSSM Higgs bosons with CMS at LHC: a comparison between a cut-based analysis and a Machine Learning approach*,
Bachelor (L) in Physics
Department of Physics and Astronomy, University of Bologna

Theses Opponent

23 Mar 2024 **Opponent**, *Finding optimal targets in the off-shell Higgs width measurement using deep neural networks in the leptonic WW decay channel*,
Master (LM) in Physics
Department of Physics and Astronomy, University of Bologna

Tutoring contract

Jul 2021 – Jun 2022 **Academic Tutor**, *"General Physics T-1" course, 60 hours*,
Bachelor (L) in Electric Engineering & Automation Engineering
[cod. 27996] Prot. n. 186828 of 29/07/2021
Department of Electrical, Electronic, and Information Engineering, University of Bologna

Mar 2021 – Jun 2021 **Academic Tutor**, *"Applied Machine Learning - Advanced" course, 20 hours*,
Master (LM) in Bioinformatics
[cod. 93282] Prot. n. 5944 of 13/01/2021
Department of Pharmacy and Biotechnology, University of Bologna

Nov 2020 – Jun 2021 **Academic Tutor**, *"General Physics T-1" course, 40 hours*,
Bachelor (L) in Electric Engineering & Automation Engineering
[cod. 27996] Prot. n. 172928 of 27/08/2020
Department of Electrical, Electronic, and Information Engineering, University of Bologna

Mar 2020 – Sep 2020 **Academic Tutor**, *"Applied Machine Learning - Advanced" course, 15 hours*,
Master (LM) in Bioinformatics
[cod. 91934] Prot. n. 10170 of 17/01/2020
Department of Pharmacy and Biotechnology, University of Bologna

Nov 2019 – June 2020 **Academic Tutor**, *"General Physics T-1" course, 30 hours*,
Bachelor (L) in Electric Engineering & Automation Engineering
[cod. 27996] Prot. n. 282321 of 12/11/2019
Department of Electrical, Electronic, and Information Engineering, University of Bologna

Mar 2019 – May 2019 **Academic Tutor**, *"Software and Computing for Nuclear and Subnuclear Physics" course, 16 hours*,
Master (LM) in Physics
[cod. 87945] Prot. n. 25559 of 13/02/2019
Department of Physics and Astronomy, University of Bologna

Technology transfer, professional training, outreach activities

Technology transfer

Nov 2019 – Feb 2020 **Corporate consultant for AlmaCube s.r.l. in the Oper CBI project**,
People involved: $\approx$ *50*, Paid consultancy on Artificial Intelligence applications for industries
Bologna, Italy

Professional training

Ott 2023 – Feb 2024 **Teacher at a training initiative for Emilia-Romagna high-school teachers**,
People involved: ≈ 30,
Title: "Artificial Intelligence: present and future of a pervasive technology",
Organized by the **APS "Fisica e Scuola"** in collaboration with the department of Physics and Astronomy of the University of Bologna.
Bologna (Italia)

Outreach activities

15 July 2025 **INFN STEAM Summer Camp**,
People involved: ≈ 100,
Laboratory of Computing for high-school students. (event agenda)
Bologna (Italy)

8 Jan 2025 – 10 Jan 2025 **Outreach event during workshop "Quasi Interactive analysis of big data with high throughput"**,
People registered: 59,
In the context of the "Quasi Interactive analysis of big data with high throughput" workshop (ICSC National Center), I organized the visit the Bologna technopole: in particular, the Leonardo supercomputer and the INFN-CNAF Tier-1 data center, (event agenda).

13 Feb 2024 **Outreach for the event "Using Leonardo Supercomputer: computing HPC contest"**,
People involved: ≈ 200,
Event organized by Emilia-Romagna region and CINECA
Bologna (Italy)

Jul 2019 **Outreach for the "study/work experience" event for high-school students**,
People involved: ≈ 20,
Project developed by the "*Comitato di Coordinamento III missione (cc3m)*" of the INFN, focused on outreach for general audience and young students.
Bologna (Italy)

Sep 2018 – Today **Outreach for the "European Night of Researchers"**,
Yearly participation and organization of activities in the context of the "European Night of Researchers", specifically, through the "Society reAGIAMO" project, co-founded by the European Union.
The thematic is: "*Artificial Intelligence for High Energy Physics*". (link)
Bologna (Italy)

Honours and awards

- **Award** for the best solution on the Machine Learning Kaggle challenge organized by the INFN School of Statistics 2019 (about 100 applications, my rank: 1^{st}).
- **Award** for the best solution on the Machine Learning Kaggle challenge organized by the Third International School on Open Science Cloud 2019 (about 50 applications, my rank: 2^{nd}).
- **Award** for scientific excellence in Physics (about 30 applications, ten awards assigned, my rank: 1^{st}), by "*Fondazione G.Occhialini*", achieved on 07/06/2013.

Personal skills

Linguistic skills

Italian Mother tongue

English TOEFL iBT

- Understanding (listening): C1
- Understanding (reading): B2
- Speaking (Spoken interaction): B2
- Speaking (Spoken production): B2
- Writing: B2

IT skills

Op. Systems	Microsoft Windows, MacOS, Linux	Languages	C++ (advanced), Python (advanced), Bash (advanced), R (basic), LabVIEW (basic), CUDA (basic)
Data Analysis	ROOT, TMVA, RooFit	Data Simulation	MadGraph5, Pythia8, PowhegV2
Libraries and Tools	Tensorflow, Keras, Pytorch, Jupyter, Scikit-learn, Git, Numpy, Pandas	Protocols	GridFTP, xRootd, WebDAV
Automation Tools	Docker containers (advanced), Puppet deployment on server (basic)	Container Orchestration	Kubernetes (medium), Helm (basic)
Monitoring	Elasticsearch tools (basic), Graphana (basic)	Document editing	Microsoft Office package, LaTeX and Beamer, Overleaf
Distributed computing	HTCondor (medium), Dask (medium)		

Scientific Publications

Latest bibliometric indicators: 7721 total citations, 358 articles, h-index 43 (source Scopus: link).

RELEVANT PUBLICATIONS IN TERMS OF PERSONAL CONTRIBUTION

[1] Tommaso Diotalevi et al. **"Enhancing CMS data analyses using a distributed high throughput platform"**. In: *PoS* ICHEP2024 (2025), p. 1007. DOI: 10.22323/1.476.1007.

[2] Adelina D'onofrio, Tommaso Diotalevi, et al. **"Benchmarking distributed-interactive HEP analysis workflows on the new Italian National Centre analysis infrastructure"**. In: *PoS* ICHEP2024 (2025), p. 1043. DOI: 10.22323/1.476.1043.

[3] Matteo Bartolini, Tommaso Diotalevi, et al. **"Quasi interactive high throughput analysis of high energy physics data"**. In: *Il Nuovo Cimento C* 3 (2025), p. 107. DOI: 10.1393/ncc/i2025-25107-1.

[4] Vianello, Enrico et al. **"A RESTful approach to tape management in StoRM"**. In: *EPJ Web of Conf.* 295 (2024), p. 01005. DOI: 10.1051/epjconf/202429501005. URL: https://doi.org/10.1051/epjconf/202429501005.

[5] Luca Anzalone, Tommaso Diotalevi, and Daniele Bonacorsi**. "Improving parametric neural networks for high-energy physics (and beyond)"**. In: *Machine Learning: Science and Technology* 3.3 (Sept. 2022), p. 035017. DOI: 10.1088/2632-2153/ac917c. URL: https://doi.org/10.1088/2632-2153/ac917c.

[6] Tommaso Diotalevi**. "Application of Deep Learning techniques in the search for BSM Higgs bosons in the $\mu\mu$ final state in CMS"**. PhD thesis. Bologna U., 2022. DOI: 10.48676/unibo/amsdottorato/10356.

[7] Alessandro Di Girolamo et al. **"Preparing Distributed Computing Operations for the HL-LHC Era With Operational Intelligence"**. In: *Frontiers in Big Data* 4 (2022). ISSN: 2624-909X. DOI: 10.3389/fdata.2021.753409. URL: https://www.frontiersin.org/article/10.3389/fdata.2021.753409.

[8] Tommaso Diotalevi et al. [CMS Collaboration]**. "Deep Learning fast inference on FPGA for CMS Muon Level-1 Trigger studies"**. In: *PoS* ISGC2021 (2021), p. 005. DOI: 10.22323/1.378.0005.

[9] Alessandro Di Girolamo et al. **"Operational Intelligence for Distributed Computing Systems for Exascale Science"**. In: *EPJ Web Conf.* 245 (2020). Ed. by C. Doglioni et al., p. 03017. DOI: 10.1051/epjconf/202024503017.

[10] Tommaso Diotalevi et al. **"Collection and harmonization of system logs and prototypal Analytics services with the Elastic (ELK) suite at the INFN-CNAF computing centre"**. In: *PoS* ISGC2019 (2019), p. 027. DOI: 10.22323/1.351.0027.

[11] Luca Giommi et al. **"Towards Predictive Maintenance with Machine Learning at the INFN-CNAF computing centre"**. In: *PoS* ISGC2019 (2019), p. 003. DOI: 10.22323/1.351.0003.

[12] Tommaso Diotalevi et al. **"Development of Machine Learning based muon trigger algorithms for the Phase2 upgrade of the CMS detector"**. In: *PoS* LHCP2018 (2018), p. 092. DOI: 10.22323/1.321.0092.

[13] Daniele Bonacorsi et al. **"Progress on Machine and Deep Learning applications in CMS Computing"**. In: *PoS* ISGC2018 & FCDD (2018), p. 022. DOI: 10.22323/1.327.0022.

[14] Daniele Bonacorsi et al. **"Progress in Machine Learning Studies for the CMS Computing Infrastructure"**. In: *PoS* ISGC2017 (2017), p. 023. DOI: 10.22323/1.293.0023 , FERMILAB-CONF-17-649.

[15] D. Bonacorsi et al. **"Monitoring data transfer latency in CMS computing operations"**. In: *J. Phys. Conf. Ser.* 664.3 (2015), p. 032033. DOI: 10.1088/1742-6596/664/3/032033 , FERMILAB-CONF-15-659-CMS.

LIST OF ALL PUBLICATIONS SUBMITTED TO OR PUBLISHED ON INTERNATIONAL PEER REVIEW JOURNALS

[1] Aram Hayrapetyan et al. [CMS Collaboration]. **"Probing the flavour structure of dimension-6 EFT operators in multilepton final states in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (July 2025). arXiv: 2507.17498 (hep-ex), CMS-TOP-23-009, CERN-EP-2025-143.

[2] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for resonant production of pairs of dijet resonances through broad mediators in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (July 2025). arXiv: 2507.17884 (hep-ex), CMS-EXO-24-038, CERN-EP-2025-156.

[3] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Exploring small-angle emissions in charm quark jets in proton-proton collisions at $\sqrt{s} = 5.02$ TeV"**. In: (July 2025). arXiv: 2507.13469 (nucl-ex), CMS-HIN-24-007, CERN-EP-2025-089.

[4] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Evidence of medium response to hard probes using correlations of Z bosons with hadrons in heavy ion collisions"**. In: (July 2025). arXiv: 2507.09307 (nucl-ex), CMS-HIN-23-006, CERN-EP-2025-046.

[5] Aram Hayrapetyan et al. [CMS Collaboration]. **"A method for correcting the substructure of multiprong jets using the Lund jet plane"**. In: (July 2025). arXiv: 2507.07775 (hep-ex), CMS-JME-23-001, CERN-EP-2025-128.

[6] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for heavy pseudoscalar and scalar bosons decaying to a top quark pair in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (July 2025). arXiv: 2507.05119 (hep-ex), CMS-HIG-22-013, CERN-EP-2025-124.

[7] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for the nonresonant and resonant production of a Higgs boson in association with an additional scalar boson in the $\gamma\gamma\tau\tau$ final state in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (June 2025). arXiv: 2506.23012 (hep-ex), CMS-HIG-22-012, CERN-EP-2025-116.

[8] Aram Hayrapetyan et al. [CMS Collaboration]. **"Operation and performance of the CMS silicon strip tracker with proton-proton collisions at the CERN LHC"**. In: (June 2025). arXiv: 2506.17195 (physics.ins-det), CMS-TRK-20-002, CERN-EP-2025-036.

[9] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for nonresonant new physics signals in high-mass dilepton events produced in association with b-tagged jets in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (June 2025). arXiv: 2506.13565 (hep-ex), CMS-EXO-23-010, CERN-EP-2025-044.

[10] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for top squarks in final states with many light-flavor jets and 0, 1, or 2 charged leptons in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (June 2025). arXiv: 2506.08825 (hep-ex), CMS-SUS-23-001, CERN-EP-2025-017.

[11] Aram Hayrapetyan et al. [CMS Collaboration]. **"Machine learning method for enforcing variable independence in background estimation with LHC data: ABCDisCoTEC"**. In: (June 2025). arXiv: 2506.08826 (hep-ex), CMS-MLG-23-003, CERN-EP-2025-092.

[12] Aram Hayrapetyan et al. [CMS Collaboration]. **"Determination of the spin and parity of all-charm tetraquarks"**. In: (June 2025). arXiv: 2506.07944 (hep-ex), CMS-BPH-24-002, CERN-EP-2025-118.

[13] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for the rare decay $D^0 \to \mu^+\mu^-$ in proton-proton collisions at $\sqrt{s} = 13.6$ TeV"**. In: (June 2025). arXiv: 2506.06152 (hep-ex), CMS-BPH-23-008, CERN-EP-2025-108.

[14] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for dark matter produced in association with a Higgs boson decaying to a τ lepton pair in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (June 2025). arXiv: 2506.04431 (hep-ex), CMS-SUS-23-012, CERN-EP-2025-100.

[15] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for CP violation in events with top quarks and Z bosons at $\sqrt{s}$ = 13 and 13.6 TeV"**. In: (May 2025). arXiv: 2505.21206 (hep-ex), CMS-TOP-24-012, CERN-EP-2025-113.

[16] Aram Hayrapetyan et al. [CMS Collaboration]. **"Measurement of WWZ and ZH production cross sections at $\sqrt{s}$ = 13 and 13.6 TeV"**. In: (May 2025). arXiv: 2505.20483 (hep-ex), CMS-SMP-24-015, CERN-EP-2025-102.

[17] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Measurement of event shapes in minimum-bias events from proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (May 2025). arXiv: 2505.17850 (hep-ex), CMS-SMP-23-008, CERN-EP-2025-041.

[18] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for dark matter produced in association with one or two top quarks in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (May 2025). arXiv: 2505.05300 (hep-ex), CMS-EXO-22-014, CERN-EP-2024-338.

[19] Aram Hayrapetyan et al. [CMS Collaboration]. **"Measurements of inclusive and differential Higgs boson production cross sections at $\sqrt{s}$ = 13.6 TeV in the H $\rightarrow\gamma\gamma$ decay channel"**. In: (Apr. 2025). arXiv: 2504.17755 (hep-ex), CMS-HIG-23-014, CERN-EP-2025-067.

[20] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Combination and interpretation of differential Higgs boson production cross sections in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (Apr. 2025). arXiv: 2504.13081 (hep-ex), CMS-HIG-23-013, CERN-EP-2025-065.

[21] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for charged-lepton flavour violation in top quark interactions with an up-type quark, a muon, and a τ lepton in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (Apr. 2025). arXiv: 2504.08532 (hep-ex), CMS-TOP-22-011, CERN-EP-2025-029.

[22] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for jet quenching with dijets from high-multiplicity pPb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 8.16 TeV"**. In: *JHEP* 07 (2025), p. 118. DOI: 10.1007/JHEP07(2025)118. arXiv: 2504.08507 (nucl-ex), CMS-HIN-23-010, CERN-EP-2025-043.

[23] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Observation of coherent ϕ(1020) meson photoproduction in ultraperipheral PbPb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.36 TeV"**. In: (Apr. 2025). arXiv: 2504.05193 (nucl-ex), CMS-HIN-24-009, CERN-EP-2025-051.

[24] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Combined effective field theory interpretation of Higgs boson, electroweak vector boson, top quark, and multi-jet measurements"**. In: (Apr. 2025). arXiv: 2504.02958 (hep-ex), CMS-SMP-24-003, CERN-EP-2025-035.

[25] Aram Hayrapetyan et al. [CMS Collaboration]. **"Observation of a pseudoscalar excess at the top quark pair production threshold"**. In: (Mar. 2025). arXiv: 2503.22382 (hep-ex), CMS-TOP-24-007, CERN-EP-2025-061.

[26] V. Chekhovsky et al. [CMS Collaboration]. **"Observation of WZγ production and constraints on new physics scenarios in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: *Phys. Rev. D* 112.1 (2025), p. 012009. DOI: 10.1103/cm24-665b. arXiv: 2503.21977 (hep-ex), CMS-SMP-22-018, CERN-EP-2025-020.

[27] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Observation of nuclear modification of energy-energy correlators inside jets in heavy ion collisions"**. In: *Phys. Lett. B* 866 (2025), p. 139556. DOI: 10.1016/j.physletb.2025.139556. arXiv: 2503.19993 (nucl-ex), CMS-HIN-23-004, CERN-EP-2025-014.

[28] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for t-channel scalar and vector leptoquark exchange in the high-mass dimuon and dielectron spectra in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (Mar. 2025). arXiv: 2503.20023 (hep-ex), CMS-EXO-22-013, CERN-EP-2024-275.

[29] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for dark matter production in association with a single top quark in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (Mar. 2025). arXiv: 2503.20033 (hep-ex), CMS-SUS-23-004, CERN-EP-2025-025.

[30] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for vector-like leptons with long-lived particle decays in the CMS muon system in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (Mar. 2025). arXiv: 2503.16699 (hep-ex), CMS-EXO-23-015, CERN-EP-2025-021.

[31] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Measurements of the inclusive W and Z boson production cross sections and their ratios in proton-proton collisions at $\sqrt{s} = 13.6$ TeV"**. In: (Mar. 2025). arXiv: 2503.09742 (hep-ex), CMS-SMP-22-017, CERN-EP-2025-013.

[32] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Small-x evolution of gluon fields from incoherent J/ψ photoproduction in ultraperipheral PbPb collisions"**. In: (Mar. 2025). arXiv: 2503.08903 (nucl-ex), CMS-HIN-23-009, CERN-EP-2025-030.

[33] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for the associated production of a Higgs boson with a charm quark in the diphoton decay channel in pp collisions at $\sqrt{s} = 13$ TeV"**. In: (Mar. 2025). arXiv: 2503.08797 (hep-ex), CMS-HIG-23-010, CERN-EP-2025-010.

[34] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for new physics in jet scaling patterns of multilepton events at $\sqrt{s} = 13$ TeV"**. In: (Mar. 2025). arXiv: 2503.06726 (hep-ex), CMS-SUS-23-015, CERN-EP-2024-310.

[35] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Luminosity measurement for lead-lead collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV in 2015 and 2018 at CMS"**. In: (Mar. 2025). arXiv: 2503.03946 (hep-ex), CMS-LUM-20-002, CERN-EP-2025-018.

[36] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Observation of the charged-particle multiplicity dependence of $\sigma_{\psi(2S)}/\sigma_{\mathrm{J}/\psi}$ in pPb collisions at 8.16 TeV"**. In: (Mar. 2025). arXiv: 2503.02139 (nucl-ex), CMS-HIN-24-001, CERN-EP-2025-006.

[37] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for medium effects using jet axis decorrelation in inclusive jets from PbPb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV"**. In: *JHEP* 06 (2025), p. 120. DOI: 10.1007/JHEP06(2025)120. arXiv: 2502.13020 (nucl-ex), CMS-HIN-24-010, CERN-EP-2024-345.

[38] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Development of systematic uncertainty-aware neural network trainings for binned-likelihood analyses at the LHC"**. In: (Feb. 2025). arXiv: 2502.13047 (hep-ex), CMS-MLG-23-005, CERN-EP-2025-005.

[39] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Evidence for similar collectivity of high transverse momentum particles in pPb and PbPb collisions"**. In: (Feb. 2025). arXiv: 2502.07525 (nucl-ex), CMS-HIN-23-002, CERN-EP-2024-332.

[40] Aram Hayrapetyan et al. [CMS Collaboration]. **"Observation of Λ hyperon local polarization in pPb collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV"**. In: (Feb. 2025). arXiv: 2502.07898 (nucl-ex), CMS-HIN-24-002, CERN-EP-2024-328.

[41] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for bosons of an extended Higgs sector in b quark final states in proton-proton collisions at $\sqrt{s} = 13$ TeV"**. In: (Feb. 2025). arXiv: 2502.06568 (hep-ex), CMS-SUS-24-001, CERN-EP-2024-335.

[42] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for γH production and constraints on the Yukawa couplings of light quarks to the Higgs boson"**. In: (Feb. 2025). arXiv: 2502.05665 (hep-ex), CMS-HIG-23-011, CERN-EP-2025-007.

[43] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Measurements of Higgs boson production cross section in the four-lepton final state in proton-proton collisions at $\sqrt{s}$ = 13.6 TeV"**. In: *JHEP* 05 (2025), p. 079. DOI: 10.1007/JHEP05(2025)079. arXiv: 2501.14849 (hep-ex), CMS-HIG-24-013, CERN-EP-2024-336.

[44] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Search for a heavy pseudoscalar Higgs boson decaying to a 125 GeV Higgs boson and a Z boson in final states with two tau and two light leptons in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (Jan. 2025). arXiv: 2501.14825 (hep-ex), CMS-HIG-22-004, CERN-EP-2024-313.

[45] Aram Hayrapetyan et al. [CMS Collaboration]. **"Evidence for CP violation and measurement of CP-violating parameters in $B_s^0 \to J/\psi\,\phi(1020)$ decays in pp collisions at $\sqrt{s}$ = 13 TeV"**. In: (Dec. 2024). arXiv: 2412.19952 (hep-ex), CMS-BPH-23-004, CERN-EP-2024-300.

[46] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for a neutral gauge boson with nonuniversal fermion couplings in vector boson fusion processes in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (Dec. 2024). arXiv: 2412.19261 (hep-ex), CMS-EXO-21-015, CERN-EP-2024-326.

[47] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Identification of low-momentum muons in the CMS detector using multivariate techniques in proton-proton collisions at $\sqrt{s}$ = 13.6 TeV"**. In: *JINST* 20.04 (2025), P04021. DOI: 10.1088/1748-0221/20/04/P04021. arXiv: 2412.17590 (hep-ex), CMS-MUO-24-001, CERN-EP-2024-325.

[48] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Determination of the strong coupling and its running from measurements of inclusive jet production"**. In: *Phys. Lett. B* 868 (2025), p. 139651. DOI: 10.1016/j.physletb.2025.139651. arXiv: 2412.16665 (hep-ex), CMS-SMP-24-007, CERN-EP-2024-327.

[49] Aram Hayrapetyan et al. [CMS Collaboration]. **"Measurement of the W boson decay branching fraction ratio $\mathcal{B}(W \to cq)/\mathcal{B}(W \to \mathrm{q\bar{q}'})$ in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (Dec. 2024). arXiv: 2412.16296 (hep-ex), CMS-SMP-24-009, CERN-EP-2024-314.

[50] Aram Hayrapetyan et al. [CMS Collaboration]. **"Measurement of light-by-light scattering and the Breit-Wheeler process, and search for axion-like particles in ultraperipheral PbPb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV"**. In: (Dec. 2024). arXiv: 2412.15413 (nucl-ex), CMS-HIN-21-015, CERN-EP-2024-284.

[51] Vladimir Chekhovsky et al. [CMS Collaboration]. **"High-precision measurement of the W boson mass with the CMS experiment at the LHC"**. In: (Dec. 2024). arXiv: 2412.13872 (hep-ex), CMS-SMP-23-002, CERN-EP-2024-308.

[52] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for heavy neutral resonances decaying to tau lepton pairs in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: (Dec. 2024). arXiv: 2412.04357 (hep-ex), CMS-EXO-21-016, CERN-EP-2024-292.

[53] Vladimir Chekhovsky et al. [CMS Collaboration]. **"Model-agnostic search for dijet resonances with anomalous jet substructure in proton-proton collisions at $\sqrt{s}$ = 13 TeV"**. In: *Rept. Prog. Phys.* 88.6 (2025), p. 067802. DOI: 10.1088/1361-6633/add762. arXiv: 2412.03747 (hep-ex), CMS-EXO-22-026, CERN-EP-2024-291.

[54] Aram Hayrapetyan et al. [CMS Collaboration]. **"Measurement of the inclusive WZ production cross section in pp collisions at $\sqrt{s}$ = 13.6 TeV"**. In: *JHEP* 04 (2025), p. 115. DOI: 10.1007/JHEP04(2025)115. arXiv: 2412.02477 (hep-ex), CMS-SMP-24-005, CERN-EP-2024-293.

[55] Aram Hayrapetyan et al. [CMS Collaboration]. **"Search for heavy neutral Higgs bosons A and H in the $\mathrm{t\bar{t}}$Z channel in proton-proton collisions at 13 TeV"**. In: *Phys. Lett. B* 866 (2025), p. 139568. DOI: 10.1016/j.physletb.2025.139568. arXiv: 2412.00570 (hep-ex), CMS-B2G-23-006, CERN-EP-2024-301.

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