

Brunella D'Anzi - Curriculum Vitae

Personal and Contact Information

Date of birth: 03/03/1997 — Age 28

Place of birth: Matera (MT), Italy

Nationality: Italian

Pronouns (Gender): She, her, hers (Female)

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Summary

Profile: I am currently a Postdoc Researcher at University of California San Diego with a PhD in Experimental Particle Physics from University and INFN of Bari, previously a Nova Global Top Talent member. I am part of the Compact Muon Solenoid (CMS) Collaboration from CERN, Geneva, and a Doctoral and INFN Student at CERN for many years.

Areas of Interests: My major research interest concerns the double Higgs boson searches via the data analysis of CMS experiment proton-proton collision events, starting with my Master's thesis studies. I mostly work with data analysis and data science tools, together with computer programming algorithms, in order to extract physics results from data, such as constraints on the Higgs boson self-couplings constants. I am also interested in improving and monitoring the current tracking reconstruction algorithms performance in the CMS experiment, as my many contributions during the last years prove. I am also fascinated by gaseous detector technologies development, as it demonstrates my Micropattern Gaseous Detector prototype studies during the 3-months INFN internship at CERN, and especially beam tests data-taking as my talks about beam test results show. The high academic standards of my education and professional work inspires me to apply for this activity which can be a fertile ground for collaborative and forward-thinking ideas.

Education

University of Bari (3 Nov 2021–7 April 2025)

Position (EQF Level 8): Doctor of Philosophy (Ph.D.) in Experimental Particle Physics

Research project: [Search for \$HH \rightarrow b\bar{b}\mu\mu\$ events with the CMS experiment and future Higgs boson factories](#)

Advisor: Prof. Nicola De Filippis (Polytechnic and INFN Bari)

Grade: Excellent with honors

Attended Courses: C++, Geant4, Effective field theories and Physics Beyond the Standard Model, Advanced Machine Learning, Trigger and DAQ for Particle physics, Big Data modeling and learning, Physics signal treatments, Making a Brief Technical Presentation in English

Summary: Starting from the knowledge acquired for my Master's thesis project in performing double Higgs searches, this research work presents a search for Higgs boson pair production (HH) using datasets corresponding to proton-proton collision data produced at a center-of-mass energy of $\sqrt{s} = 13$ TeV and collected by the CMS experiment at the CERN LHC. The analysis specifically looks at uninvestigated signal signature of events where one Higgs decays into two b-quarks

and the other decays into two muons ($HH \rightarrow b\bar{b}\mu^+\mu^-$), focusing on the HH nonresonant gluon-gluon fusion production mechanism. HH production gives access to the Higgs boson trilinear self-coupling and is sensitive to the presence of BSM physics. The search is particularly challenging due to the small branching ratio of the channel under study, leading to a low signal yield compared to the background. To address this, a considerable effort has been devoted to the development of an extension of the current seeding algorithm, for the online and offline reconstruction of charged particle tracks, which is going to be integrated into the data taking to face the particle detection failures expected due to the aging of tracking detectors as the LHC transitions to Run 3 and HL-LHC operations. The algorithm implementation included dedicated fake and duplicate rejection criteria to incorporate data from strip tracker detectors and enhance track momentum resolution and tracking efficiency up to 20%. Its structure, optimization and implementation, its commissioning for the LHC data-taking at $\sqrt{s} = 13.6$ TeV, and the measurement of its performance are presented. The algorithm is an essential element in the search for HH production. Additionally, a new strategy has been implemented for evaluating muon tracking performance at the offline track reconstruction level using the tag-and-probe technique. To investigate the $HH \rightarrow b\bar{b}\mu^+\mu^-$ process, a dedicated event selection and categorization are developed and optimized to enhance the sensitivity, and multivariate techniques are applied for the first time to this final state to separate the signal from the background. Results are derived using an integrated luminosity of 137 fb^{-1} . Upper limits are set on the nonresonant HH production cross section and constrain the parameter space of the anomalous Higgs boson couplings. The expected upper limits are about 170 times the SM prediction. Looking forward, this thesis also explores prospects for future measurements of HH production at the FCC-ee and FCC-hh. A new particle identification technique based on cluster counting is proposed to enhance of a factor 2 the particle discrimination power in high-luminosity environments. Finally, prospects for future measurements of HH production at the LHC are presented by extrapolating the current results to an integrated luminosity of 3000 fb^{-1} under different detector and analysis performance scenarios.

Music Conservatory Niccolò Piccinni of Bari (2016–21st March 2022)

Position (L-30): Bachelor of Science (B.Sc.) in Violin

Dissertation's title (Italian language): [Comparison between the genius of the physicist Albert Einstein and the genius of the musician Ludwig Van Beethoven](#)

Grade: 110/110 with honors [[Transcripts](#)]

Advisor: Prof. Carmelo Andriani (Music Conservatory of Bari)

University of Bari (2019–26th October 2021)

Position (LM-17): Master of Science (M.Sc.) in Nuclear, Subnuclear and Astroparticle Physics

Dissertation's title (English language): [Search for double Higgs events produced via a vector boson fusion mechanism in the decay channel \$b\bar{b}4l\$ with the CMS experiment at the LHC.](#)

Grade: 110/110 with honors [[Diploma Supplement](#)]

Advisor: Prof. Nicola De Filippis (Polytechnic and INFN Bari)

Summary: The Higgs boson discovery at the Large Hadron Collider (LHC) in 2012 led to a new era of High Energy Physics studies in the scalar sector and to the search for new physics signals beyond the Particle Physics standard model. Also, after the precision measurements of the main parameters of the Higgs boson including its mass, one of the main objectives of research is the measure of the couplings of the Higgs with itself, strictly linked to the shape of the scalar po-

tential describing the Brout-Englert-Higgs mechanism. In particular, the studies of the trilinear self-coupling of the Higgs boson λ_{HHH} and the coupling of a pair of Higgs with a pair of gauge bosons (λ_{VVHH} , with $V = W^\pm, Z$) involve processes with production of a pair of Higgs bosons. The double Higgs production process via gluon-gluon fusion is the main mode of production of double Higgs at the Run 2 collision energies of LHC, useful for setting constraints on the value of λ_{HHH} , while the vector boson fusion mechanism provides the only means of access to the VVHH coupling. Therefore, the thesis in question aimed to search for double Higgs boson (HH) non-resonant production events through the fusion mechanism of vector bosons (VBF), when the two Higgs bosons decay in two b-jets (the highest branching ratio for the Higgs boson production at LHC) and $ZZ \rightarrow 4$ charged leptons (benefit from a clean signature), respectively, and are accompanied by two very energetic forward jets; for this purpose, we performed the analysis using Monte Carlo samples scaled to data collected during the 2018 data-taking campaign of Run 2 of the Compact Muon Solenoid (CMS) experiment at Large Hadron Collider (LHC). The tricky task of the research was related to the small cross section that characterizes the VBF HH process, the second highest for LHC energies, after the mode of gluon-gluon fusion production (ggHH). Indeed, the production rate of 1.723 fb is about 15 times smaller than ggHH. Moreover, the branching ratio is 2.79×10^{-4} for $H \rightarrow ZZ \rightarrow 4l$, with $l = e, \mu$. The presence of anomalies in the self-couplings of the Higgs due to the contributions of new physics leads to an increase in the production rate of signal. Therefore, the strategy adopted was the detailed study of the characteristics of events at a few points in the coupling parameter space and then generalize the analysis. We used multivariate analysis techniques of machine learning to improve signal sensitivity above background being dominated by single Higgs production in fusion topology vector bosons and from double Higgs via gluon-gluon fusion. To be more specific, we implemented and optimized a Deep Neural Network for the discrimination of the signal from the background events to be used to obtain a physics result in terms of upper limit on the cross section of the process.

University of Bari (2016–30th September 2019)

Position (L-30): Bachelor of Science (B.Sc.) in Physics, 2019

Dissertation's title (Italian language): [Two quantum-states systems](#)

Grade: 110/110 with honors [[Diploma Supplement](#)]

Advisor: Prof. Leonardo Angelini (University and INFN Bari)

Employment and Experience

Postdoctoral researcher at University of California San Diego (UCSD) (October 2024–Present).

After PhD studies in Italy, I have been continuing di-Higgs and tracking research activities for the CMS experiment at CERN, Geneva (Switzerland).

Facilitator for the *Tracking and Vertexing Short Exercise in the Hamburg CMS Data Analysis School 2025* (10–19 October 2025).

[Hamburg CMS Data Analysis School](#) is the first opportunity for European MSc. and PhD students to get familiar with the CMSSW framework to perform data analysis and go for the publication procedure within the CMS Collaboration.

Official CERN Guide (April 2023–Present).

I am a volunteer as a CERN Guide for Visitor Tours in many CERN areas such as the CERN Science Gateway Labs, Exhibitions, Science Shows and CMS Experiment Cavern.

Facilitator for the *Tracking and Vertexing Short Exercise in the Hamburg CMS Data Analysis School 2025 (17–22 June 2024)*.

[CERN CMS Data Analysis School](#) is the first opportunity for European MSc. and PhD students to get familiar with the CMSSW framework to perform data analysis and go for the publication procedure within the CMS Collaboration.

CMS Internal Work and Leadership: Technical Shifter and Shift Leader for the CMS experiment (April 2023–Present).

During CMS Run 3 data taking, I am a shifter to monitor the High Voltage CMS sub-detectors and security system (underground and surface) as a Technical Shifter and lead the daily data taking program as a Shift Leader.

Tutor for the *Drift Tube Characterization hands-on exercise in the 2023 EURIZON Detector School (17–28 July 2023)*.

The EURIZON Detector School is organized for training young scientists on state-of-the-art particle detection technologies in the fields of particle-, heavy-ion- and neutron-physics. The main program of the school comprises morning lectures by world experts in their fields, and hands-on exercises on various technologies in the afternoons.

CERN Supervisor for the Non-Member State CERN Summer Student Eliacim Velez (July–August 2023).

Summer Student Supervisor under my research project *Search for double Higgs events in muon pairs and b-jets with the CMS experiment*.

Tutor in the Fourth Machine Learning INFN Hackathon. (21–23 June 2023).

Tutor for 6 INFN members/associates in the [Fourth Machine Learning INFN hackathon](#) proposing Higgs searches at the LHC as a Jupyter Notebook exercise running at the CNAF Tier 1 using simulated samples scaled to the Run 2 CMS integrated luminosities.

Facilitator for the *Tracking and Vertexing Short Exercise in the CERN CMS Data Analysis School 2023 (5–10 June 2023)*.

[CERN CMS Data Analysis School](#) is the first opportunity for European MSc. and PhD students to get familiar with the CMSSW framework to perform data analysis and go for the publication procedure within the CMS Collaboration.

Invited Chair in the *Large Hadron Collider (LHC) Job Matching Event Spring '23 and Fall '23. (3 May 2023–24 October 2023)*.

The [Sprint](#) and [Fall](#) JMEVs are organized by a team of volunteers, members of the LHC Early Career Scientists Fora, which comprises the ALICE Junior Representatives, ATLAS Early Career Scientist Board, CMS Young Scientists Committee and the LHCb Early Career, Gender and Diversity Office.

Tutor for the Programming workshop: Build your first website with the help of CERN coaches in the Django Girls Geneva Event (21–22 April 2023).

The [Django Girls workshop](#) offers a crash course in computer programming for beginners aged 15 and over. The aim is to introduce digital technologies to the uninitiated, especially women, who are underrepresented in this field.

Education Volunteer for Save The Children Italia (February 2023–June 2025).

The [Volunteers for Education](#) project aims to recover the motivation to study of children and adolescents, aged 9 to 17, affected by the educational crisis produced by the Covid-19 pandemic.

Supervisor for the MSc. HEP Thesis by Michele Barbieri (January 2023–April 2023).

Master's Degree Supervisor for the thesis under my research project *Search for double Higgs events in muon pairs and b-jets with the CMS experiment*.

Lead Contact Facilitator for the Tracking and Vertexing Short Exercise and Facilitator for the Short Muon Short Exercise in the Fermilab CMS Data Analysis School 2023 (9 Jan 2023–15 Jan 2023).

[Fermilab CMS Data Analysis School](#) is the first opportunity for American MSc. and PhD students to get familiar with the CMSSW framework to perform data analysis and go for the publication procedure within the CMS Collaboration.

INFN Local Team responsible for the outreach path *L'Intelligenza Artificiale incontra la Fisica* in the INFN Scienza per Tutti project (Sep 2022–Present).

Scienza Per Tutti is the scientific communication site of the National Institute of Nuclear Physics. The INFN research community collaborates in this communication project to make all topics of science, in particular physics, and technology accessible. In the section [Percorsi Divulgativi](#) an outreach section will be added about the above-cited topic.

CMS Internal Work and Leadership: Data Quality Monitoring (DQM) Online shifter for the CMS experiment (April 2022–June 2022).

To have a better overview of the CMS experiment sub-detector components, I have been the “CMS eyes” for 20 shifts as the only trained person looking at each CMS sub-detectors physics quantities summary plots along with Detector-On-Call experts.

CMS responsible for the Tracking efficiency performance using the data-driven Tag and Probe technique (April 2022–June 2022).

A new software framework has been developed to speed up the computation using Apache Spark, and, in Early Run 3 data, misalignment and miscalibration effects has been spotted in high η muon regions.

Didactic Tutor and Assistant Professor for Physics and Laboratory course (March 2021–March 2023).

Topics: Classical Mechanics, Thermodynamics and Electromagnetism for Biotechnology bachelor's student at University of Bari.

INFN Local Team in the INFN outreach *What Next? Giovani che raccontano il futuro* project (Feb 2021–Present).

A [short film](#) of the one-day experience with High-School and University students has been made public from the 5th October 2022.

Tutor for the Second Machine Learning INFN Hackathon. (13th–15th December 2021).

Tutor for 6 INFN members/associates in the [Second Second Machine Learning INFN hackathon](#) proposing Higgs searches at the LHC as a Jupyter Notebook exercise running at the CNAF Tier 1 using simulated samples scaled to the Run 2 CMS integrated luminosities.

Grants, Honors, Awards, and Professional Memberships

[Breakthrough Prize in Life Sciences](#) awarded to CMS Collaboration ([April 2025](#))

[Selection as one of the McKinsey Forward Program participants](#) ([July 2024](#))

[Selection as one of the McKinsey Next Generation Women Leaders EMEA participants](#) ([April 2024](#))

[Nova Global Top Talent Member](#) ([December 2023](#))

[Best CMS Technical Shifters 2023](#) ([September 2023](#))

[Invitation to contribute to collaborative articles for LinkedIn Machine Learning, Statistics and Research](#) ([August 2023–Present](#))

[Selection as one of the two CERN PhDs for the CDI and CERN Ideasquare Innovation 4 Change \(I4C\) Program - Iren Group Challenge \(Committee composed by Fabiola Giannotti, John Elkan, Francesco Profumo and other International Leaders in Innovation\)](#) ([1st February 2023–4 July 2023](#))

[INFN CERN Doctoral Student Fellowship](#) ([1st March 2023–1st March 2024](#))

[Invitation to be on 100th Suonare News Magazine as representative of Music Conservatory Niccolò Piccinni](#) ([February 2023](#))

[2022 CMS Data Analysis School 3rd Prize Team](#) ([4th–15th January 2022](#))

[Best Poster Awards ACAT 2021](#) ([29th November 2021–3rd December 2021](#))

[University of Bari 3-years Ph.D. Scholarship and INFN Associate](#) ([3rd Nov 2021–June 2025](#))

[CSN1 INFN 3-months Scholarship at International Laboratories \(CERN\) for 12 best High Energy Physics students Call n.21706/2019](#) ([26th July 2021–3rd November 2021](#))

[Winner of two monthly competition “Scienza per tutti” organized by INFN](#) ([14th December 2017–14th September 2021](#))

[Private ECOMAP facility Scholarships for best Italian students](#) ([2016–2022](#))

[University of Bari Book Scholarships for its best 300 students](#) ([2016–2020](#))

Research

HEP and Machine learning/Double Higgs searches at the CMS experiment (2021–Present). My research focuses on understanding rare Higgs Boson processes, including its self-interaction, and developing precision time-of-flight instrumentation for particle physics. Measuring the Higgs self-coupling through double Higgs production at the LHC helps test the electro-weak vacuum’s stability and explore potential new physics. I am focusing on the Run 3 search for HH to two photons and two b-jets, one of the most sensitive channels to the self-coupling due to its clean diphoton signature. To improve this Run 3 analysis, I’m incorporating a boosted category using the

ParticleNet tagger and developing a machine learning algorithm to better discriminate between signal and background. In the past years, I have been working on more di-Higgs searches into muon pairs (ZZ into charged leptons) and b-jets.

HEP and Machine learning/Track building algorithms at the CMS experiment (2025–Present).

My research focuses on setting a new charged particle track building algorithm baseline for the future Phase-2 data taking of the CMS experiment, both in the online and offline reconstruction. Preliminary results with the adoption of the mkFit and Line Segment Linking (LST) algorithm have been published on behalf of the CMS Collaboration.

HEP and Machine learning/Track seeds algorithms at the CMS experiment (2023–Present).

My research focuses on either improving pre-exisint algorithm for the estiamte of charged particle trakcs in collision events at the CMS experiment. Over the years, CMS track reconstruction has seen significant advancements and modifications. The studies involve the seeding step in both offline and online reconstruction processes. My research focuses on extending the current Cellular Automaton (CA) seeding algorithm by incorporating data from the first layers of the outermost tracking layers, by optimizing via Machine Learning techinques the corresponding algorithm’s parameters. These contributions are expected to significantly impact the 2026 Run 3 and future 2030 Phase-2 CMS data-taking.

HEP/CMS Tracking efficiency using the Tag and Probe technique (March 2022–July 2024).

Accurate reconstruction of charged particle trajectories and measurement of their parameters (tracking) is one of the major challenges of the CMS experiment. A precise and efficient tracking is one of the critical components of the CMS physics program as it impacts the ability to reconstruct the physics objects needed to understand proton-proton collisions at the LHC. I measure the tracking performance in data and Monte Carlo using the tag and-probe technique via the high statistics $Z \rightarrow \mu^+ \mu^-$ di-muon resonances for all reconstructed muon trajectories and the subset of trajectories in which the CMS Tracker is used to seed the measurement. The performance is assessed using early LHC Run 3 data at collision energy of 13.6 TeV.

Gaseous detectors/Future Circular Collider (FCC) Cluster counting particle identification technique for the IDEA Drift chamber(Jan 2022–Present).

IDEA (Innovative Detector for an Electron-positron Accelerator) is an innovative general-purpose detector concept, designed to study electron-positron collisions in a wide energy range provided by a very large circular leptonic collider. The IDEA drift chamber is designed to provide an efficient tracking, a high precision momentum measurement and an excellent particle identification by exploiting the application of the cluster counting technique. The cluster counting technique represents a very promising alternative to the traditional ways of integrating the ionization charge for the purpose of particle identification in drift chambers. It takes advantage of the Poisson nature of the primary ionization process and offers a more statistically robust method to infer mass information. To investigate the potential of the cluster counting techniques on physics events simulation studies and Beam Test data-taking are ongoing.

Gaseous detectors/Assembly and Test of a Fast timing Micropattern gaseous detector (FTM)

(July 2021–October 2021). The present generation of Micro-Pattern Gaseous Detectors (MPGDs)

are radiation hard, rate capable of several MHz/cm^2 , while exhibiting good spatial resolution ($\leq 50\mu\text{m}$) and a time resolution of 5–10 ns, which satisfies the current generation of experiments (HL-LHC upgrades CMS & ATLAS) but is not sufficient for bunch crossing identification of fast timing systems at FCC-hh or for vertex identification in order to reduce the effective pile-up from $\mathcal{O}(1000)$ to manageable levels $\mathcal{O}(25)$. New developments for MPGDs point at the use of resistive materials naturally spark protected devices (crucial for high backgrounds) and improved time resolution for triggering and vertex identification. Diamond Like Carbon (DLC) has been introduced in my MPGD prototype during the INFN 3-months Scholarship at CERN. It is a very promising material of which the resistivity can be produced at will, opening the roads to spark-protected single amplification stage detectors on the one hand and stacks of such devices to improve time resolution on the other hand. After performing the same quality controls applied to the GEM detectors in CMS for the high voltage and gas leaks tests, measurements with the $\text{ArCO}_2(70:30)$ gas mixture and the irradiation with an X-ray (Ag) source were carried out. The aim was measuring the detector gain by checking the anode, ground and drift currents in presence and absence of the radioactive source. No differences have been detected by our instruments demonstrating that more investigation in the prototype design should be done and the usage of more sophisticated techniques for the holes production in the resistive foils is needed.

Phenomenology HEP/Azimuthal correlations of high transverse momentum jets at next-to-leading order in the parton branching method (November 2021–January 2022). The azimuthal correlation between two jets has been measured in pp collisions at a center-of-mass energy of 7, 8, and 13 TeV by the CMS Collaboration. When measurements of azimuthal correlations of di-jets are compared with LO or NLO computations supplemented by parton showers, deviations of 50% are observed in the medium $\Delta\phi_{12}$ region even at NLO, which required a more detailed understanding. In the $\Delta\phi_{12} \rightarrow \pi$ region, deviations of up to 10% are observed, significantly larger than the experimental uncertainties. Since initial state parton radiation moves the jets away from the $\Delta\phi_{12} = \pi$ region, it is appropriate to investigate the implications of transverse momentum dependent parton densities (TMDs) in the description of the $\Delta\phi_{12}$ measurements. I contributed to the investigation in detail of the high- p_T dijet production by applying the Parton-Branching formulation of TMD evolution together with NLO calculations of the hard scattering process in the *MadGraph5_aMC(NLO)* framework.

Certifications and Licensure

Machine learning/Courses and Schools. *"Machine Learning", Stanford University – "Addressing LHC Challenges by Machine Learning", HSE University – 2nd Terascale School of Machine Learning, DESY (2021–Present)*

High Energy Physics/Courses, Schools and Hackathons. *13th, 14th, 16th and 19th CMS Patatrack Hackathon – FCC Software Hands-on Tutorial 2022 – CMS Data Analysis School (CMSDAS) 2022 – Virtual Monte Carlo School – PB TMDs with CASCADE – CERN Webfest annual hackathon 2021 – ESCAPE Summer School on Data Science for Astronomy, Astroparticle and Particle Physics, Laboratoire d'Annecy de Physique des Particules, Annecy, France – SHINE Autumn School: Detectors and Data Processing, CERN – SHINE Autumn School: Physics and Facility, CERN – Terascale Virtual Summer School 2020, DESY – Online Reduced Terascale Statistics School 2020, PHYSTAT – "Particle Physics:an*

introduction", Geneva University – "Terascale Summer School: QCD and Monte Carlo techniques", DESY (2021–Present)

Programming Languages/Courses and Schools. *"The complete SQL Bootcamp" "Data Week April 2023" – "Edition IV Boolean Coding Week 2023" "Edition III Boolean Coding Week 2022" – "Programming Foundations with JavaScript, HTML and CSS", Duke University – "Learning Cloud Computing: Core Concepts" – "Learning LabVIEW" – "Python Data Analysis" – "Python: Programming Efficiently" – "Artificial Intelligence Concepts" – "HTML course" – "Java course" – "SQL course" – "MATLAB: Fundamentals" (2021–Present).*

Trasversal skills/Courses. *Cultivating mentor relationships, UCSD IOP Publishing Peer Review Excellence Certificate – CERN Safety and Experimental Training Courses – "Certified Peer Reviewer Course", Elsevier – "Becoming a peer reviewer", Elsevier – Public speaking and scientific writing – "Technical Writing", Moscow Institute of Physics and Technology, "Introduction to Overleaf", CERN – "Professional Skills: Interpersonal Skills" – "Professional Skills: Solving Problems with Critical and Creative Talking" (2021–Present).*

Community Service

Save The Children Education Volunteer – Official CERN Guide Volunteer

Publications and Conference Proceedings

As an active member of the CMS Collaboration, I am an author of every physics paper since 8th November 2022. I am an author of the FCC and CEPC future colliders design reports, IDEA detector concept experiment since 2023. Selected publications, notes, and conference proceedings to which I gave a substantial contribution are listed below.

- [1] B. D’Anzi, *Signal/background discrimination for the VBF Higgs four lepton decay channel with the CMS experiment using Machine Learning classification techniques*, Last accessed 13th November 2022, April 2021, <https://confluence.infn.it/pages/viewpage.action?pageId=53906361>.
- [2] I. S. Group et al., *The idea detector concept for fcc-ee*, tech. rep. FERMILAB-PUB-25-0189-PPD, e-Print: 2502.21223 [physics.ins-det] (FERMILAB, Feb. 2025), p. 77, <https://arxiv.org/abs/2502.21223>.
- [3] "Performance of mkFit and LST algorithms in the CMS Phase-2 High Level Trigger Tracking", (2025), <https://cds.cern.ch/record/2941438>.
- [4] M. Abbrescia et al., "Advancements in tracking techniques for future circular collider experiments", in *Pos ichep2024*, Contribution to: ICHEP2024, 1104 (Dec. 2024), p. 1104, <https://doi.org/10.22323/1.476.1104>, Contribution to: ICHEP2024, 1104.

- [5] W. Elmetenawee et al., “Advancing particle identification in helium-based drift chambers: a cluster counting technique study through beam tests”, in **Pos ichep2024**, Contribution to: ICHEP2024, 1067 (Dec. 2024), p. 1067, <https://doi.org/10.22323/1.476.1067>, Contribution to: ICHEP2024, 1067.
- [6] C. Collaboration et al., “Tag and probe technique tracking efficiency results at cms”, in **Pos ichep2024**, Contribution to: ICHEP2024, 931 (Dec. 2024), p. 931, <https://doi.org/10.22323/1.476.0931>, Contribution to: ICHEP2024, 931.
- [7] C. Collaboration, *Tracking performance using tag and probe with $Z \rightarrow \mu^+ \mu^-$ in 2022 and 2023*, tech. rep. CMS-DP-2024-054; CERN-CMS-DP-2024-054 (CERN, July 2024), p. 27, <https://cds.cern.ch/record/2904367/>.
- [8] G. Chiarello et al., “Implementation of the Cluster Counting and Timing technique on FPGA for the reduction of transferred data and stored information”, **Nucl. Instrum. Meth. A** **1045**, 167542 (2023), doi:10.1016/j.nima.2022.167734.
- [9] C. Caputo et al., “Particle identification with the cluster counting technique for the IDEA drift chamber”, in 15th Pisa Meeting on Advanced Detectors: Frontier Detectors for Frontier Physics, Under Review (Nov. 2022), [arXiv:2211.04220](https://arxiv.org/abs/2211.04220).
- [10] C. Caputo et al., *Cluster counting algorithms for particle identification at future colliders [Poster]*, Presented at ACAT2022, Oct. 2022, doi:10.13140/RG.2.2.17515.62243.
- [11] B. D’Anzi et al., *CMS tracking performance in Run 2 and early Run 3 data using the Tag-and-Probe technique [Poster]*, Presented at ACAT2022, Oct. 2022, doi:10.13140/RG.2.2.30937.39525.
- [12] B. D’Anzi et al., “Signal to background discrimination for the production of double Higgs boson events via vector boson fusion mechanism in the decay channel with four charged leptons and two b-jets in the final state at the LHC experiment”, in ACAT2021, Accepted by the Conference Editor (Sept. 2022), [arXiv:2209.11649](https://arxiv.org/abs/2209.11649).
- [13] M. I. Abdulhamid et al., “Azimuthal correlations of high transverse momentum jets at next-to-leading order in the parton branching method”, **Eur. Phys. J. C** **82**, 36 (2022), doi:10.1140/epjc/s10052-022-09997-1, [arXiv:2112.10465](https://arxiv.org/abs/2112.10465).
- [14] “CMS Tracking performance in Early Run-3 data using the tag-and-probe technique”, (2022), <https://cds.cern.ch/record/2839918>.
- [15] F. Cuna et al., “Particle identification with the cluster counting technique for the IDEA drift chamber”, **PoS ICHEP2022**, 335 (2022), doi:10.22323/1.414.0335.
- [16] B. D’Anzi, “Search for double Higgs events produced via a vector boson fusion mechanism in the decay channel $b\bar{b}4l$ with the CMS experiment at the LHC”, Presented 26 Oct 2021 (2021), <https://cds.cern.ch/record/2788946>.

Conference, Workshop, and Seminar Presentations

CMS General Meeting: WGM 716, Plenary Talk(September 2025)

Nonresonant HH to bbgammagamma analysis with 2022 and 2023 data

CMS General Meeting: WGM 716, Plenary Talk*(August 2025)*

Performance of mkFit and LST algorithms in the CMS Phase-2 High Level Trigger Tracking

PPD Workshop 2024, Plenary Talk*(November 2024)*

Tracking Physics Object Group - Status and Plans

CMS Italia Workshop 2024, Plenary Talk*(October 2024)*

Detector Performance Groups and Physics Objects Groups Report for Run 3 in CMS experiment

42nd International Conference on High Energy Physics 2024 (ICHEP2024), Poster*(July 2024)*

Tag-and-probe technique tracking efficiency results at CMS

June CMS Week 2024, Plenary Talk*(June 2024)*

Tracking Performance during Run 3 at the CMS Experiment.

Higgs 2023 Conference, Beijing, China, Talk in HEP Parallel session *(November 2023)*

Non resonant double Higgs searches at the CMS Experiment.

109th National Congress of the Società Italiana di Fisica (SIF2023), Talk in HEP Parallel session
(14th September 2022)

Ricerca di eventi di produzione di coppie di bosoni di Higgs con l'esperimento CMS.

Fourth Edition Machine Learning INFN hackathon - Starting level, Plenary session *(23rd June 2023)*

Signal/background discrimination for the VBF Higgs four lepton decay channel with the CMS experiment using Machine Learning classification techniques

CERN CMS Data Analysis School (2023), Short Exercise Session *(5th June 2023)*

CMS Tracking and Vertexing

IAS Program on High Energy Physics (HEP 2023), Talk in Mini-Workshops in Theory and Experiment and Detector *(13th February 2023)*

IDEA Drift Chamber

CMS Data Analysis School (2023), Talk in Short Exercise Session *(9th January 2023)*

CMS Tracking and Vertexing

21st International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT2022), Poster *(27th October 2022)*

Cluster counting algorithms for particle identification at future colliders

The 2022 International Workshop on the high energy Circular Electron-Positron Collider (CEPC2022), Talk in Gaseous Detectors Parallel session *(26th October 2022)*

Beam test results on cluster counting

21st International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT2022), Poster (24th October 2022)

CMS tracking performance in Run 2 and early Run 3 data using the tag-and-probe technique

INFN Workshop for Future Detectors (IFD2022), Talk in Plenary session (18th October 2022)

The IDEA drift chamber at FCC-ee and CEPC and related Electronics

CMS Physics Performance and Dataset (PPD) General Meeting, Approval Talk

Detector Performance note approval: CMS tracking performance in Run 2 and early Run 3 data using the tag-and-probe technique

CMS General Meeting Tracker and Tracking Detector Performance Groups (DPG), Pre-approval Talk (28th September 2022)

Pre-approval for Muon tracking performance in the CMS Early-Run 3 data using the tag and probe technique

108th National Congress of the Società Italiana di Fisica (SIF2022), Talk in HEP Parallel session (13th September 2022)

CMS tracking performance in the early Run 3 data using the tag-and-probe technique on behalf of the CMS Collaboration

15th Pisa Meeting on Advanced Detectors Edition 2022 (PM2022), Poster (27th May 2022)

Particle identification with the cluster counting technique for the IDEA drift chamber

Higgs at CMS Italia Workshop (HIG @CMS Italia), Talk in Plenary Session (12th May 2022)

Double Higgs bbmumu analysis

Learning To Discover Conference, Talk in Plenary Session (28th April 2022)

Looking for rare di-Higgs events at the LHC with Machine (Deep) Learning technique

Second Machine Learning INFN Hackathon - Talk in Plenary session and Hackathon Tutoring (15th December 2021)

Signal/background discrimination for the VBF Higgs four lepton decay channel with the CMS experiment using Machine Learning classification techniques

20th International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT2021), Poster and Lightning Talk in Plenary session for Posters Awards (3rd December 2021)

Signal to background discrimination for the production of double Higgs boson events via vector boson fusion mechanism in the decay channel with four charged leptons and two b-jets in the final state at the LHC experiment.

Date

Signature

September 21, 2025

Bonella D'Ami

All Other Publications

All other publications are listed here.

- [1] B. D’Anzi, *Signal/background discrimination for the VBF Higgs four lepton decay channel with the CMS experiment using Machine Learning classification techniques*, Last accessed 13th November 2022, April 2021, <https://confluence.infn.it/pages/viewpage.action?pageId=53906361>.
- [2] I. S. Group et al., *The idea detector concept for fcc-ee*, tech. rep. FERMILAB-PUB-25-0189-PPD, e-Print: 2502.21223 [physics.ins-det] (FERMILAB, Feb. 2025), p. 77, <https://arxiv.org/abs/2502.21223>.
- [3] “Performance of mkFit and LST algorithms in the CMS Phase-2 High Level Trigger Tracking”, (2025), <https://cds.cern.ch/record/2941438>.
- [4] M. Abbrescia et al., “Advancements in tracking techniques for future circular collider experiments”, in *Pos ichep2024*, Contribution to: ICHEP2024, 1104 (Dec. 2024), p. 1104, <https://doi.org/10.22323/1.476.1104>, Contribution to: ICHEP2024, 1104.
- [5] W. Elmetenawee et al., “Advancing particle identification in helium-based drift chambers: a cluster counting technique study through beam tests”, in *Pos ichep2024*, Contribution to: ICHEP2024, 1067 (Dec. 2024), p. 1067, <https://doi.org/10.22323/1.476.1067>, Contribution to: ICHEP2024, 1067.
- [6] C. Collaboration et al., “Tag and probe technique tracking efficiency results at cms”, in *Pos ichep2024*, Contribution to: ICHEP2024, 931 (Dec. 2024), p. 931, <https://doi.org/10.22323/1.476.0931>, Contribution to: ICHEP2024, 931.
- [7] C. Collaboration, *Tracking performance using tag and probe with $Z \rightarrow \mu^+ \mu^-$ in 2022 and 2023*, tech. rep. CMS-DP-2024-054; CERN-CMS-DP-2024-054 (CERN, July 2024), p. 27, <https://cds.cern.ch/record/2904367/>.
- [8] G. Chiarello et al., “Implementation of the Cluster Counting and Timing technique on FPGA for the reduction of transferred data and stored information”, *Nucl. Instrum. Meth. A* **1045**, 167542 (2023), doi:10.1016/j.nima.2022.167734.
- [9] C. Caputo et al., “Particle identification with the cluster counting technique for the IDEA drift chamber”, in 15th Pisa Meeting on Advanced Detectors: Frontier Detectors for Frontier Physics, Under Review (Nov. 2022), [arXiv:2211.04220](https://arxiv.org/abs/2211.04220).
- [10] C. Caputo et al., *Cluster counting algorithms for particle identification at future colliders [Poster]*, Presented at ACAT2022, Oct. 2022, doi:10.13140/RG.2.2.17515.62243.
- [11] B. D’Anzi et al., *CMS tracking performance in Run 2 and early Run 3 data using the Tag-and-Probe technique [Poster]*, Presented at ACAT2022, Oct. 2022, doi:10.13140/RG.2.2.30937.39525.
- [12] B. D’Anzi et al., “Signal to background discrimination for the production of double Higgs boson events via vector boson fusion mechanism in the decay channel with four charged leptons and two b-jets in the final state at the LHC experiment”, in ACAT2021, Accepted by the Conference Editor (Sept. 2022), [arXiv:2209.11649](https://arxiv.org/abs/2209.11649).

- [13] M. I. Abdulhamid et al., “Azimuthal correlations of high transverse momentum jets at next-to-leading order in the parton branching method”, *Eur. Phys. J. C* **82**, 36 (2022), doi : 10 . 1140/epjc/s10052-022-09997-1, arXiv:2112.10465.
- [14] “CMS Tracking performance in Early Run-3 data using the tag-and-probe technique”, (2022), <https://cds.cern.ch/record/2839918>.
- [15] F. Cuna et al., “Particle identification with the cluster counting technique for the IDEA drift chamber”, *PoS ICHEP2022*, 335 (2022), doi:10.22323/1.414.0335.
- [16] B. D’Anzi, “Search for double Higgs events produced via a vector boson fusion mechanism in the decay channel $b\bar{b}4l$ with the CMS experiment at the LHC”, Presented 26 Oct 2021 (2021), <https://cds.cern.ch/record/2788946>.