

UNIVERSITÀ DEGLI STUDI DI MILANO

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## [Cristiano Fanelli] CURRICULUM VITAE

### INFORMAZIONI PERSONALI (NON INSERIRE INDIRIZZO PRIVATO E TELEFONO FISSO O CELLULARE)

COGNOME	FANELLI
NOME	CRISTIANO
DATA DI NASCITA	[ Giorno, mese, anno ] 1/11/1983

### EDUCATION

PhD in Physics, Sapienza University, Rome, Italy Thesis: "*Measurements of polarization transfers in real Compton scattering by a proton target at JLab: a new source of information on the 3D shape of the nucleon*" Advisors: Prof. Giovani Salme', Dr. Evaristo Cisbani , Jan 2015

M.S. in Physics (highest honors), Sapienza University, Rome, Italy Thesis: "*Exclusive search for a fermiophobic Higgs at CMS*" Advisors: Prof. Daniele Del Re, Prof. Shahram Rahatlou, Jun 2011

B.S. in Physics (highest honors), Sapienza University, Rome, Italy Thesis: "*Study of Bohr's complementarity in the neutral K-mesons system*" Advisors: Prof. Antonio Di Domenico, Jul 2007

### EMPLOYMENT

Senior Postdoctoral Associate, MIT 2015 - present

Visiting Researcher at Jefferson Lab, Feb 2015 - May 2015

### AWARDS AND HONORS

NVIDIA Grant, 2018.

JLEIC Fellowship, 2018.

Jefferson Lab, JSA Postdoctoral Fellow Prize, Grant, 2018

Jefferson Lab, PhD Thesis Prize, 2015

## TEACHING

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Visiting Lecturer: Fundamental Physics, Calculus, and Statistics, Shenzhen University 2019

Kaufman Teaching Certificate, MIT 2016

Teaching assistant: Physics II, and lectures of Optics, Sapienza University 2013-2015

Tutor: Calculus and Statistics, Sapienza University 2012

## STUDENTS SUPERVISED/MENTORING

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(i) supervision of an undergraduate student, MIT: as summer research project based on deep learning applied to PID with the GlueX DIRC detector (2020, ongoing); (ii) supervision of PhD student, MIT: mentoring and introduction to GlueX analysis framework (2018); (iii) MSc thesis co-supervision on machine learning applied to thermoelectric nanoporous material; The Polytechnic University of Turin, defended on 4/1/2020 (iv) Mentor – Multicultural Mentoring Program (MMP), MassBay College, 2018

## SERVICE

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Referee for European Physical Journal A, Physical Review & Physical Review Letters. Editorial Board member of Universe, MDPI.

## PUBLICATIONS

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Author of more than 100 articles with the CMS and JLab Collaborations. This section lists in reverse chronological order all publications for which I am a principal author or made major contributions.

1. L. Barion, E. Cisbani, M. Contalbrigo, A. Del Dotto, C. Fanelli et al RICH detectors development for hadron identification at EIC: design, prototyping and reconstruction algorithm, JINST 15 C02040, 2020.
2. C. Fanelli, Machine Learning for Imaging Cherenkov Detectors, JINST 15 C02012, 2020.
3. C. Fanelli and J. Pomponi 2020 Mach. Learn.: Sci. Technol. 1 015010, DeepRICH: Learning Deeply Cherenkov Detectors, arXiv:1911.11717v1 [physics.data-an].
4. E. Cisbani, A. Del Dotto, C. Fanelli, M. Williams et al, 2020 JINST 15 P05009, AI-optimized detector design for the future Electron-Ion Collider: the dual-radiator RICH case, arXiv:1911.05797 [physics.ins-det].
5. D. Winney, C. Fanelli, A. Pilloni et al (Joint Physics Analysis Center), Double Polarization Observables in Pentaquark Photoproduction near Threshold, Phys. Rev. D 100, 034019, JLAB-THY- 19-3004, 2019.

6. D. Aloni, C. Fanelli, Y. Soreq and M. Williams, Photoproduction of axion-like particles, *Phys. Rev. Lett.* 123, 071801, 2019.
7. The GlueX DIRC Collaboration, The GlueX DIRC detector, *Nucl. Instr. Meth. Phys. Res.* doi.org/10.1016/j.nima.2017.01.054 (2017).
8. C. Fanelli, The GlueX Experiment: First Results, *Few-Body Systems* 58 (3) doi.org/10.1007/s0060 (2017).
9. C. Fanelli and M. Williams, Photoproduction of leptophobic bosons, *J. Phys. G: Nucl. Part. Phys.* 44 014002 doi:10.1088/0954-3899/44/1/014002 (2016).
10. C. Fanelli, E. Pace, G. Romanelli, G. Salm`e and M. Salmistraro, Pion generalized parton distributions within a fully covariant constituent quark model, *Eur. Phys. J. C* (2016) 76: 253.
11. C. Fanelli, F. Sisti and G. Stagno, Time dependent friction in a free gas, *Journal of Mathematical Physics* 57, 033501 (2016).
12. C. Fanelli et al. Polarization Transfer in Wide-Angle Compton Scattering and Single-Pion Photoproduction from the Proton, *Phys. Rev. Lett.* 115, 152001 (2015).
13. The CMS Collaboration, Observation of a new boson with mass near 125 GeV in pp collisions at  $\sqrt{s} = 7$  TeV and 8 TeV, *J. High Energ. Phys.* (2013) 2013: 81.
14. The CMS Collaboration, A New Boson with a Mass of 125 GeV Observed with the CMS Experiment at the Large Hadron Collider, *Science* 21 Dec (2012): Vol. 338, Issue 6114, pp. 1569-1575.
15. The CMS Collaboration, Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC, *Physics Letters B*, 716(1):30-61, (2012).
16. The CMS Collaboration, Combined results of searches for the standard model Higgs boson in pp collisions at  $\sqrt{s} = 7$  TeV, *Phys.Lett. B* 710(1):26-48, (2012).
17. The CMS Collaboration, Search for the standard model Higgs boson decaying into two photons in pp collisions at  $\sqrt{s} = 7$  TeV, *Phys.Lett. B* 710(3):403-425, (2012).

As for [13,17] I am the author with other 90 people (the Higgs  $2\gamma$  group) of the analysis note CMS AN-2011/206 on the inclusive search of the Higgs boson decaying into two photons, and the principal author with D. Del Re, P. Meridiani and S. Rahatlou of CMS AN-2011/391 on the exclusive search of the Higgs in two photons. My name also appears in other analyses notes on the Higgs decaying in WW and ZZ channels.

## PRESENTATIONS

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This section lists my talks in reverse chronological order:

1. Invited speaker at the Joint GlueX-EIC-PANDA Machine Learning Workshop, 2020 (postponed)
2. Invited speaker at the Streaming ReadOut VI Workshop held virtually on May 13-15 2020, Jefferson Lab, AI-supported algorithms for Streaming Readout.
3. AI Optimized Detector Design, Invited Talk at the Working Group on Simulations during the “AI for Nuclear Physics Workshop” hosted at Jefferson Lab, Newport News, VA, Mar 4-6, 2020.
4. AI Opportunities at Jefferson Lab and the Electron Ion Collider, Invited Colloquium at William and Mary, VA, Feb 17 2020.
5. The Role of Artificial Intelligence in Exploring the Nature of Matter, Invited Colloquium at Virginia Tech,

VA, Feb 4 2020.

6. JLab Pentaquark Perspective, invited talk at the LHCb Implications Workshop, CERN, Oct 16-18, 2019.
7. Machine learning for RICH counters, invited talk at DIRC2019: Workshop on fast Cherenkov detectors, Photon detection, DIRC design and DAQ September 11 - 13, 2019 Castle Rauischholzhausen.
8. (Not so) Ordinary matter, invited Colloquium at the Physics Department at Shenzhen University, Shenzhen, China, July 2019.
9. Machine Learning in the online data acquisition, invited lecture on Machine Learning, INFN school for researchers, Genoa, May 2019.
10. Physics Opportunities with Photon Beams at JLab12, invited seminar, University of California, Riverside, May 2019.
11. Overview of bayesian optimization applied to the GlueX case, invited talk, Computing Round Table (2018), JLab, Newport News, VA, Nov 2018.
12. A deep learning approach to PID and alignment of the GlueX DIRC , plenary talk for postdoctoral prize award, JLab Users Group Workshop and Annual Meeting, Newport News, VA, June 2018.
13. Recent advances in the search for a leptophobic boson at GlueX, talk at APS Meeting, Columbus, OH, April 2018.
14. Keep the light on: exploring the structure of hadrons at JLab, invited colloquium at Catholic University of America, April 2018.
15. Exotic physics both within and beyond the Standard Model at GlueX, invited seminar at Stony Brook University, February 2018.
16. Search for the exclusive photoproduction of a leptophobic B boson at GlueX, talk at APS DNP Meeting, Pittsburgh, PA, October 2017.
17. After the Higgs: shedding light on ordinary matter by probing the strong interaction, invited colloquium at University of Regina, Canada, February 2017.
18. Exploring the Dark Sector at GlueX: Direct Photoproduction of Leptophobic Bosons, invited seminar at Florida State University, FL, February 2017.
19. Study of the  $\eta \rightarrow e^+ e^- \gamma$  decay at GlueX and Transition Form Factor, talk at APS DNP Meeting, Vancouver, Canada, October 2016.
20. The GlueX experiment: first results, plenary talk at Light Cone 2016 in Lisbon, Portugal, September 2016.
21. Enlightening the internal structure of the proton through new measurements of real Compton scattering at wide angle, plenary talk associated to the JLab thesis prize award, JLab Users Group Workshop

and Annual Meeting, Newport News, VA, June 2015.

22. A novel robust and efficient algorithm for charge particle tracking in high background flux , Journal of Physics: Conference Series, Volume 608, conference 1, parallel talk at ACAT 2014, Prague, Czech Republic, September 2014.

23. A neural network algorithm for charged-particle tracking in high background flux, parallel talk at 100<sup>th</sup> National Congress of the Italian Physics Society, Pisa, Italy, September 2014.

24. Tracking chambers based on GEM technology for high luminosity experiments, parallel talk at 100<sup>th</sup> National Congress of Italian Physics Society, Pisa, Italy, September 2014.

25. Investigating the proton by polarization transfers in real Compton scattering at JLAB, EPJ Web of Conferences, 73 (2014) 02015, parallel talk at 13th International Conference on Meson-Nucleon Physics and the Structure of the Nucleon, Rome, Italy, October 2013.

26. Study of the proton structure by measurements of polarization transfers in RCS at JLab, EPJ Web of Conferences 66, 06006 (2014), parallel talk at INPC 2013, International Nuclear Physics Conference, Florence, Italy, June 2013.

27. Search for a fermiophobic Higgs at LHC, XCVII National Congress of Italian Physics Society, L'Aquila, Italy, September 2011.

## RESEARCH ACTIVITY

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The list of research activities is presented in reverse chronological order in each subsection.

### **(MIT, JLab, EIC) August 2015 - present**

- Investigating the realization of a new aerogel radiator with Artificial Intelligence, in collaboration with Catholic University of America and INFN/Rome.
- External Advisor for Software development of CLAS12/JLab based on AI.
- I'm responsible for the development of high-level algorithms for streaming readout, for which I demonstrated the feasibility of online unsupervised clustering algorithms for the forward tagger calorimeter of CLAS12 analyzing real data. This is a project funded by the Italian Ministry of Foreign Affairs under the Projects of Great Relevance program within the Italy-US Scientific and Technological Cooperation. The 2019 EIC Detector R&D Progress Report on the streaming readout can be found [here](#).
- Principal Investigator of the project "TraQcking and fast detector alignment" at Oak Ridge Leadership Computing Facility: development of reconstruction algorithms based on quantum annealing for JLab experiments.
- Developed a deep learning architecture based on Variational Autoencoders called "DeepRICH" for fast and efficient particle identification with the Cherenkov detectors. The paper has been published on IOP, Machine Learning Science and Technology.

- Optimized design of the dual-RICH for EIC. The paper has been accepted on JINST.
- EIC PID consortium eRD14 FY20 proposal.
- Contact spokesperson of a Letter of Intent at JLab “Measurement of the parameters of the LHCb pentaquark states through double polarization asymmetries with SBS in Hall A”, submitted to PAC46.
- Run Coordinator for GlueX E12-06-102, Hall D at JLab.
- GlueX FCAL: I determined the energy resolution curve of the FCAL calorimeter using data-driven techniques, based on a sample of exclusive  $\omega$  particles (analysis note).
- R&D of the DIRC detector at GlueX.
- GlueX physics analyses and Monte Carlo development (dark sector searches, transition form factors, tracking). I am coordinating the analysis of a directly photoproduced leptophobic B boson at GlueX. I also developed the analysis strategy for the measurement of the  $\eta'$  TFF at GlueX.
- DIRC alignment (project awarded by JLab), particle identification and tracking algorithm with ML.
- Phenomenology studies: Pion generalized parton distributions, leptophobic B boson, photo-production of axion-like particles, all published.

**(Visiting Researcher, JLab) February 2015 - May 2015**

**(Sapienza, ISS/INFN) November 2011 - January 2015**

- Real Compton Scattering E07-002, Hall C (proton polarization transfers in Compton scattering and pion photoproduction, and measurement of the proton elastic electromagnetic form factors ratio from background events), published in Phys. Rev. Lett. and 2015 JSA Thesis Prize.
- Simulation studies and development of an MCMC algorithm to infer the normal polarization component.
- Design of a tracking algorithm in high background rate for the GEM tracker of Super BigBite, Hall A (presented in ACAT-2014).

**(Sapienza University, CMS) April 2010 - June 2011**

- Analysis (inclusive and exclusive) of the Higgs boson decay into two photons, which represented a fundamental channel for the discovery of the new boson at 125 GeV, contributing to the largest significance (4 sigma). These studies have been included in CMS notes and resulted in published papers.
- Characterization of the production mechanisms Vector Boson Fusion (VBF) and Higgs-strahlung (HSTRA).
- Determination of a 95% C.L. upper limit on the fermiophobic Higgs cross-section with 2010 data.
- Phenomenology studies: Two Higgs Doublet Model (2HDM) framework.

## **MEDIA**

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• Daily Press, Jefferson Lab brings the AI revolution to particle physics research, Feb 07, 2020  
<https://www.dailypress.com/news/dp-nw-jlab-artificial-intelligence-20200207-qpdcea3babd5tkwx3ciabeln5e-story.html>

• News wise, (DOE SCIENCE NEWS SOURCE), Postdoctoral prize, Oct 22 2018  
[https://www.newswise.com/doescience/?article\\_id=702596&returnurl=aHR0cHM6Ly93d3cubmV3c3dpc2UuY29tL2FydGljbGVzL2xpc3Q=](https://www.newswise.com/doescience/?article_id=702596&returnurl=aHR0cHM6Ly93d3cubmV3c3dpc2UuY29tL2FydGljbGVzL2xpc3Q=)

• Jefferson Lab news release, EIC fellow, July 18 2018  
<https://www.jlab.org/news/releases/eic-center-jefferson-lab-announces-fellowship-awards>

- Jefferson Lab, PhD thesis prize

[https://wiki.jlab.org/cugwiki/index.php/Ph.D.\\_Thesis\\_Prize](https://wiki.jlab.org/cugwiki/index.php/Ph.D._Thesis_Prize)

Data

20/5/2020

Luogo

Newport News