

# Abideh Jafari

✉ [ajafari@cern.ch](mailto:ajafari@cern.ch)  
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## Main research interests

### Experimental particle physics at the energy frontier.

- Precision measurements & model independent searches, esp. in top quark physics
- Experimental approaches in global Effective Field Theory interpretations
- Search for new phenomena in the heavy boson sector of the standard model

## Current position

- 2020 **Assistant professor**, *Isfahan University of Technology (IUT)*, Iran.
- 2019 **Young Investigator Group (YIG) Leader**, *DESY*, Hamburg, Germany.  
Leading an independent research group for top quark physics within a 6-years program

## Previous positions, including breaks

- 2017–2019 **Research fellow**, *CERN*, Switzerland.  
Career break: on maternity leave during 2017
- 2014–2016 **Chargée de Recherche**, *Université catholique de Louvain*, Belgium.
- 2012–2014 **Post-doctoral researcher**, *Institute for Research in Fundamental Sciences (IPM)*, Iran.  
In the framework of the experimental particle physics (ExPP) program in Iran, I was encouraged to join IPM aiming to further develop this new field of research in the country.
- 2011 **PhD candidate**, *Vrije Universiteit Brussel (VUB)*, Belgium.  
I was awarded a joint PhD degree with VUB, as part of the “transfer of knowledge” in Iran’s dedicated program for the ExPP.
- 2005–2011 **PhD student & candidate**, *Sharif University of Technology (SUT) and IPM*, Iran.  
In 2005 I started my PhD in theoretical physics. Attending the CERN Summer School programme in 2006, I was attracted by ExPP and eventually in 2007 became a PhD candidate in ExPP with the CMS experiment at CERN

## Education

- 2005–2011 **PhD**, *SUT and VUB*, Iran-Belgium, Greatest Distinction.
- 2004–2005 **MSc**, *SUT*, Tehran, Ranked 7<sup>th</sup> in the *concour* among more than 5000 participants.
- 2000–2004 **BSc**, *SUT*, Tehran, Always ranked 1<sup>st</sup>–3<sup>rd</sup> in the department.  
Ranked 200<sup>th</sup> in the *concour* among more than 1,000,000 participants

## Grants, awards and recognitions

- Sep 2017 **Helmholtz Young Investigator Group (YIG) Leader**, A scientific grant to support early independence of young scientists in all disciplines (1.8 M Euro), Germany.
- Jan 2014 **FNRS Chargée de Recherche**, Independent grant for an innovative research (150 k Euro), Belgium.
- May 2012 **Ali-Mohammadi Prize Winner**, Prestigious nation-wide Iranian prize for an outstanding PhD thesis, in *all* fields of physics (links: 1, 2).

2005 **Eligible for Direct PhD program**, Special offer for recognized BSc students at Sharif University to directly start PhD before obtaining the MSc degree.

## Leadership and responsibilities

- Sep 2022–24 **CMS physics communication officer**, Assisting the physics coordination team to ensure the visibility of the CMS physics results within the expert community as well as to general public., Added to management and communication skills, the job requires a broad knowledge and overview of all ongoing physics analyses in the collaboration and their impact .
- Sep 2021–23 **CMS Top convener in LHCEFTWG**, Representing the CMS top quark physics group activities on effective field theory in the LHC EFT working group. The group consists of leading experts in theory and experiment with the mission of performing a global EFT fit across all LHC experiments..
- 2019–2021 **Co-leader of the CMS top quark physics analysis group, TOP PAG**, Coordination of all top quark analysis activities performed by teams from CMS institutions around the world. Proposing priority topics and following the progress of the analyses with the help of 10 subgroup conveners. Communication with other CMS groups and placing requests for necessary resources, such as simulated samples, triggers and calibration, – *a Level-2 management role in the experiment*.
- 2017–2019 **CMS NMSSM representative in LHCHXSWG**, CMS Contact with theoreticians and other experiments at the LHC. Identifying benchmark points for Next-to-Minimal-SuperSymmetric-Standard-Model (NMSSM), in collaboration with theory experts, to propose relevant physics searches to the experiments within the LHC Higgs Cross Section Working Group (LHCHXSWG).
- 2017–2019 **CMS EFT representative in LHCtopWG**, Coordinator of activities within CMS regarding Effective Field Theory (EFT) interpretations of top quark measurements. CMS Contact with theoreticians and other experiments at the LHC. Refining theory recommendations for the EFT analyses within the LHC top quark Working Group (LHCtopWG).
- 2014–2016 **Convener of the single-top subgroup**, Coordination of a CMS TOP subgroup dedicated to the electroweak production of top quark. Handling the early stage of the analysis review, helping with the design of the analysis and its progress., – *a Level-3 management role in the experiment*.
- 2015–2018 **CMS Single-top representative in LHCtopWG**, CMS Contact, developer and the main analyst. ATLAS and CMS combination of single-top quark measurements within LHCtopWG.
- 2010–2015 **Expert and contact person**, Developing new tools in view of upcoming data-taking, namely, data quality monitoring and online selection requirements (HLT) for top quark physics in CMS.

## Peer reviews and hiring committees

- Since 2020 **Assessment of research proposals**, *Research Grants Council*, Hong Kong, China.
- Since 2019 **Reviewer of Particle Data Group**, *top quark measurements*.
- Since 2019 **Member of DESY hiring committees**, *for PhD students, and recently, for tenure-track and staff scientist positions*.
- Since 2017 **Referees for scientific journals**, *high-impact journals, including “The European Physical Journal C” (EPJC), “Physics Letters B” (PLB)*.
- Since 2015 **CMS internal review committees**, *I have served as member or chair in committees for several analyses, full list can be found in “CMS ARC details”*.

## Recent key publications

A more extensive list of publications with my direct contribution is in Section “Selected journal articles”.

**Inclusive and differential cross section measurements of single top quark production in association with a Z boson in proton-proton collisions at  $\sqrt{s} = 13$  TeV**, *JHEP 02 (2022) 107*.

**Probing effective field theory operators in the associated production of top quarks with a Z boson in multilepton final states at  $\sqrt{s} = 13$ , *JHEP* 12 (2021) 083.**

**Combinations of single-top-quark production cross-section measurements and  $|f_{LV}V_{tb}|$  determinations at  $\sqrt{s} = 7$  and 8 TeV with the ATLAS and CMS experiments, *JHEP* 05 (2019) 088.**

**Search for an exotic decay of the Higgs boson to a pair of light pseudoscalars in the final state with two muons and two b quarks in pp collisions at 13 TeV, *Phys. Lett. B* 795 (2019) 398.**

**Search for light bosons in decays of the 125 GeV Higgs boson in proton-proton collisions at  $\sqrt{s} = 8$  TeV, *JHEP* 10 (2017) 076.**

**Cross section measurement of t-channel single top quark production in pp collisions at  $\sqrt{s} = 13$  TeV, *Phys. Lett. B* 72 (2017) 752.**

## **(Inter)national organization committees**

A selection of my recent contribution in organization committees of national and international workshops and conferences. Detailed list available in "Organization of conferences and workshops"

**12<sup>th</sup> National Conference on Particles and Fields, *Scientific Committee*, (2022), Shahroud, Iran.**

**2<sup>nd</sup> workshop for the collaboration of Iranian universities with the CMS experiment at CERN, *Scientific Program – Organizing Committee*, (2021), Isfahan, Iran.**

**13<sup>th</sup> International Workshop on Top Quark Physics, *International Advisory Committee*, (2020), Durham, UK.**

**29<sup>th</sup> International Symposium on Lepton Photon Interactions at High Energies, *Scientific Program – Member of Advisory Committee for parallel sessions*, (2019), Toronto, Canada.**

**7<sup>th</sup> Edition of the Large Hadron Collider Physics Conference, *Scientific Program – Convener of sessions for top quark physics*, (2019), Puebla, Mexico.**

**Standard Model at the LHC 2019, *Scientific Program – convener of sessions for top quark physics*, (2019), Zürich, Switzerland.**

**10<sup>th</sup> International Workshop on the CKM Unitarity Triangle, *Scientific Program – Convener of sessions for High- $p_T$  flavor physics*, (2018), Heidelberg, Germany.**

## **Notable oral presentations**

Detailed list available in "Selected oral presentations"

**In memory of Dr. Nicolas Tonon (1993–2021), *Probing EFT operators in top-Z associated production with Machine Learning*, 14<sup>th</sup> Physics at Terascale Helmholtz Alliance Meeting & LHC top Working Group Open meeting, Switzerland & Germany.**

**The 50<sup>th</sup> Anniversary of Hadron Colliders at CERN, *Standard Model Physics at the LHC – I was honored to present the highlights from ATLAS, ALICE, CMS and LHCb experiments in this event, in the middle of inspiring talks by big names in the field including the Nobel Prize winner, Carlo Rubbia*, (2021), Geneva, Switzerland.**

**Invited Colloquium Seminars, *Learning to detect top quark interactions*, Karlsruhe Institute für Technologie (DE), Purdue University (US), Iran Physics Society (IR), (2021).**

**11<sup>th</sup> National Conference on Particles and Fields, *Invited talk: "LHC news on top quark physics"*, PSI & Sharif Uni. of Tech., (2021), Tehran, Iran.**

**144<sup>th</sup> LHCC Meeting - Open Session, *CMS Status Report – elected by the CMS management to present the status of the experiment on physics and detector upgrade to the CERN committee*, (2020), Geneva, Switzerland.**

**XII International Conference on Interconnection between Particle Physics and Cosmology**, *Plenary talk: "Rare, Exotic, and Invisible Higgs boson at the LHC"*, (2018), Zürich, Switzerland.

**38<sup>th</sup> International Conference on High Energy Physics**, *Parallel talk: "CMS measurements of top quark properties in single top processes"*, (2016), Chicago, USA.

## Supervision and promotion of young talents

Detailed list available in "Supervision and promotion"

- 2019–2021 **Dr. N. Tonon**, *Postdoc, YIG, DESY*, Machine-Learning (ML) based analyses of top quark electroweak couplings within EFT framework.
- 2020–present **Dr. A. Saggio**, *DESY Postdoc Fellow, YIG associated*, Search for tWZ production using ML.
- 2019–present **D. Walter**, *PhD, YIG, DESY*, Differential measurement of tZq production with ML.
- 2020–present **B. Lopes**, *PhD, YIG, DESY*, Differential  $t\bar{t}\gamma/t\bar{t}$  ratio measurement & search for exclusive  $t\bar{t}$  production using precise proton spectrometer.
- 2021–present **M. Mormile**, *PhD, YIG, DESY*, The associated production of WZ with 3<sup>rd</sup> generation quarks.
- 2020–2021 **F. Colombina**, *MSc, YIG, DESY*, ML based search for tZq in dilepton final state.
- 2022–present **M. Sichani**, *MSc, IUT*, ML based measurement of pure electroweak photon production at the LHC.
- 2020–present **E. Khazaei**, *PhD, IUT*, Co-supervisions, main supervisor: Dr. H. Bakhshiansohi, Search for exotic Higgs decays to two light pseudoscalars in  $\mu\mu b\bar{b}$  final state.
- 2021–present **K. Tauqeer**, *PhD, Karlsruhe Inst. für Tek., the university partner of YIG*, Co-supervisions, main supervisor: Prof. T. Müller, Search for longitudinally polarized W boson production .

## Selected synergic activities and outreach

Full list is available in "Community-based activities"

**Joining a new institute to the CMS collaboration**, *Fostering Iran ExPP program with special attention to undergraduate education*, I initiated and followed the membership process of Isfahan University of Technology to the CMS experiment. This was following my passion to help the scientific growth in my country while introducing yet another stream of new talents to the collaboration. The process requires a good knowledge of ongoing activities and demands within the experiment as well as the existing potentials in the new institute. The case started upon the request of the university in Dec. 2017 and was approved in a CMS collaboration board meeting in Sep. 2019. Besides research, we aim at a long-term educational program in the university in which undergraduate students are educated with basic, yet essential, ExPP topics, Switzerland, Germany & Iran.

**Talks in National Physics Clubs**, *The story of particles discovery: from lightest to heaviest*, Isfahan & Yazd, Iran.

**Member of PSI International Committee**, *extend and strengthen international bonds of Physics Society of Iran with similar NGO's worldwide*, Tehran, Iran.

**Invited Lectures on Top Quark Physics**, *10<sup>th</sup> NCP School on LHC Physics*, Islamabad, Pakistan.

**Member of AcademiaNet**, *An initiative by Swiss National Foundation to promote the contribution of outstanding female scientists e.g. in decision making committees*.

**Interview for the CERN "LHC Physics at Ten" series**, *A review LHC results ten years after first collisions*, Hamburg, Germany.

**Personal touch of CMS ICHEP**, *Short video on my top-Higgs work*, Seoul, Korea.

**Interview for the CERN "In practice"**, *A series about the experimental physicists at CERN*, Geneva, Switzerland.

**Virtual visits to CMS and ATLAS experiments**, for students and high-school teachers in Iran, Tehran & Geneva.

## Other activities

**Teaching**, my recent teaching experience includes basic and advanced topics in Karlsruher Inst. für Tek. and Isfahan Uni. of Tech., namely: Physics I, Teilchenphysik II, and Basics Concepts and Tools in ExPP.

**Technical work**, I have acted as Shift Leader, Detector Safety shifter and Data Quality Monitoring shifter in the CMS control room during data taking. In addition, I was involved in the detector Fast Simulation, Pileup studies and offline DQM.

## References

- **Prof. Hessemaddin Arfaei**, Sharif University of Technology,  
**Tel:** +98 21 6616 4505  
**Email:** arfaei@sharif.edu
- **Prof. Florencia Canelli**, Universität Zürich, Physics coordinator, CMS collaboration  
**Tel:** +41 44 635 57 84  
**Email:** Canelli@physik.uzh.ch
- **Prof. Jorgen D'Hondt**, Vrije Universiteit Brussel, CMS collaboration  
**Tel:** +604 82 29 240  
**Email:** jorgen.D'hondt@cern.ch
- **Prof. Andrea Giammanco**, Université Catholique de Louvain, CMS collaboration  
**Tel:** +41 22 76 71269  
**Email:** Andrea.Giammanco@cern.ch
- **Dr. Luca Malgeri**, CERN, Spokesperson, CMS collaboration  
**Tel:** +41 75 411 5888  
**Email:** Luca.Malgeri@cern.ch
- **PD Dr. Andreas Meyer**, DESY, Deputy chair of publication committee, CMS collaboration  
**Tel:** +49 40 8998 9 3136, +41 75411 2302  
**Email:** Andreas.Meyer@desy.de
- **Prof. Roberto Tenchini**, Pisa, CMS collaboration  
**Tel:** +41 22 76 76411, +41 75 411 0659  
**Email:** Roberto.Tenchini@cern.ch

## CMS ARC details

**Search for new physics in top quark production with additional leptons in proton-proton collisions at  $\sqrt{s} = 13$  TeV using effective field theory**, *JHEP* 12 (2021) 083, the internal review started in 2019. I left the committee once appointed as TOP PAG convener, still continued with the scrutiny of the analysis in my new role as well as top-EFT contact and expert.

**Search for the single top quark s-channel production at 13 TeV**, TOP-18-001, the internal review started in 2018. I left the committee once appointed as TOP PAG convener, continued with the scrutiny of the analysis as convener..

**Anomalous couplings in the  $t\bar{t}+Z$  final state at the HL-LHC**, FTR-18-036, included in the Report from Working Group 1 on the Physics of the HL-LHC, and Perspectives at the HE-LHC.

**Search for new physics in top quark production in dilepton final states in proton-proton collisions at  $\sqrt{s} = 13$  TeV**, *Eur. Phys. J. C* 79 (2019) 886.

**Measurements of differential cross sections of top quark pair production as a function of kinematic event variables in proton-proton collisions at  $\sqrt{s} = 13$  TeV**, *JHEP* 06 (2018) 002.

**Search for the standard model Higgs boson in the dilepton plus a photon channel in pp collisions at  $\sqrt{s} = 13$  TeV**, *JHEP* 11 (2018) 152.

**Measurement of double differential cross sections for top quark pair production in pp collisions at  $\sqrt{s} = 8$  TeV**, *EPJC* 77 (2017) 459, [Chair](#).

**Measurement of differential cross sections for top quark pair production using the lepton+jets final state in proton-proton collisions at 13 TeV**, *Phys. Rev. D* 95, 092001 (2017).

**Observation of top quark pairs produced in association with a vector boson in pp collisions at  $\sqrt{s} = 8$  TeV**, *JHEP* 01 (2016) 096.

**Measurement of the inclusive and differential top quark pair production cross sections in lepton+jets final states at  $\sqrt{s} = 13$  TeV**, CMS-PAS-TOP-15-005.

**Measurement of differential top quark pair production cross sections as a function of kinematic event variables in pp collisions at  $\sqrt{s} = 13$  TeV**, CMS-PAS-TOP-15-013.

**Measurement of the W boson helicity using  $t\bar{t}$  events in the dilepton final state at  $\sqrt{s} = 8$  TeV**, CMS-PAS-TOP-14-017.

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## Selected journal articles

The list of my selected publications [h-index = 26 (or 22 excluding self-citations)] represents my direct contribution at different levels, from being initiator and/or the leader of the work to a CMS internal peer reviewer. In my role as CMS TOP PAG convener (2019–2021), I was involved in 25 publications [LINK], as well as preliminary results [LINK], not listed below. As member of the CMS collaboration, I am also a co-author of more than 900 publications with an h-index of 144 [INSPIRE]

**Keywords:** Main Author = MA, Co-Author = CA, Leading Role = LR, Contribution = C, Review = R

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### 2022

**Search for central exclusive production of top quark pairs in proton-proton collisions at  $\sqrt{s} = 13$  TeV with tagged protons, approved by CMS, in preparation to submit to JHEP, [CA].**

**Inclusive and differential cross section measurements of single top quark production in association with a Z boson in proton-proton collisions at  $\sqrt{s} = 13$  TeV, JHEP 02 (2022) 107, [LR].**

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### 2021

**Probing effective field theory operators in the associated production of top quarks with a Z boson in multilepton final states at  $\sqrt{s} = 13$ , JHEP 12 (2021) 083, [LR].**

**Search for new physics in top quark production with additional leptons in proton-proton collisions at  $\sqrt{s} = 13$  TeV using effective field theory, JHEP 03 (2021) 095, [R] on EFT analysis.**

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### 2020

**Measurement of top quark pair-production in association with a Z boson in pp collisions at 13 TeV, JHEP 03 (2020) 056, [R] on EFT analysis.**

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### 2019

**Combinations of single-top-quark production cross-section measurements and  $|f_{LV}V_{tb}|$  determinations at  $\sqrt{s} = 7$  and 8 TeV with the ATLAS and CMS experiments, JHEP 05 (2019) 088, [MA].**

**Search for an exotic decay of the Higgs boson to a pair of light pseudoscalars in the final state with two muons and two b quarks in pp collisions at 13 TeV, Phys. Lett. B 795 (2019) 398, [MA].**

**Search for associated production of a Higgs boson and a single top quark in proton-proton collisions at  $\sqrt{s} = 13$  TeV, Phys. Rev. D 99, 092005 (2019), [CA].**

**Measurement of the top quark polarization and  $t\bar{t}$  spin correlations in dilepton final states in pp collisions at  $\sqrt{s} = 13$  TeV, Phys. Rev. D 100, 072002 (2019), [R] on EFT analysis.**

**Search for standard model production of four top quarks with the single-lepton and opposite-sign dilepton final states in proton-proton collisions at  $\sqrt{s} = 13$  TeV, JHEP 11 (2019) 082, [R] on EFT analysis.**

**Search for new physics in top quark production in dilepton final states in proton-proton collisions at  $\sqrt{s} = 13$  TeV, Eur. Phys. J. C 79 (2019) 886, [R].**

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### 2018

**Search for the standard model Higgs boson in the dilepton plus a photon channel in pp collisions at  $\sqrt{s} = 13$  TeV, JHEP 11 (2018) 152, [R].**

**Measurements of differential cross sections of top quark pair production as a function of kinematic event variables in proton-proton collisions at  $\sqrt{s} = 13$  TeV, JHEP 06 (2018) 002, [R].**

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### 2017

**Search for electroweak production of charginos in final states with two tau leptons in pp collisions at  $\sqrt{s} = 8$  TeV, JHEP 04 (2017) 018, [CA].**

**Measurement of differential cross sections for top quark pair production using the lepton+jets final state in proton-proton collisions at 13 TeV, Phys. Rev. D 95, 092001 (2017), [R].**

**Measurement of double-differential cross sections for top quark pair production in pp collisions at  $\sqrt{s} = 8$  TeV and impact on parton distribution functions, EPJC 77 (2017) 459, [R], [chair](#).**

**Search for anomalous  $Wtb$  couplings and flavour-changing neutral currents in t-channel single top quark production in pp collisions at  $\sqrt{s} = 7$  and 8 TeV, JHEP 02 (2017) 028, [C, R], see [DRA](#).**

**Search for associated production of a Z boson with a single top quark and for tZ flavour-changing interactions in pp collisions at  $\sqrt{s} = 8$  TeV, JHEP 07 (2017) 003, [R].**

**Search for light bosons in decays of the 125 GeV Higgs boson in proton-proton collisions at  $\sqrt{s} = 8$  TeV, JHEP 10 (2017) 076, [MA].**

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### 2016

**Cross section measurement of t-channel single top quark production in pp collisions at  $\sqrt{s} = 13$  TeV, Phys. Lett. B 72 (2017) 752, [LR, CA].**

**Search for s-channel single top-quark production in pp collisions at  $\sqrt{s} = 7$  and 8 TeV, *JHEP* 09 (2016) 027, [C, R], see DRA.**

**Measurement of top quark polarisation in t-channel single top quark production, *JHEP* 04 (2016) 073, [R].**

**Search for anomalous single top quark production in association with a photon in pp collisions at  $\sqrt{s} = 8$  TeV, *JHEP* 04 (2016) 035, [R].**

**Observation of top quark pairs produced in association with a vector boson in pp collisions at  $\sqrt{s} = 8$  TeV, *JHEP* 01 (2016) 096.**

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## 2015

**Measurement of the W boson helicity fractions in events with a single reconstructed top quark at  $\sqrt{s} = 8$  TeV, *JHEP* 01 (2015) 053, [MA].**

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## 2014

**Measurement of the t-channel single-top-quark production cross section and of the  $|V_{tb}|$  CKM matrix element in pp collisions at  $\sqrt{s} = 8$  TeV, *JHEP* 06 (2014) 090, [CA], see DRA.**

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## 2013

**Measurement of the  $t\bar{t}$  production cross section in pp collisions at  $\sqrt{s} = 7$  TeV source with lepton + jets final states, *PLB* 720 (2013) 83, [CA], see DRA.**

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## 2011

**Measurement of the t-Channel Single Top Quark Production Cross Section in pp Collisions at  $\sqrt{s} = 7$  TeV, *Phys.Rev.Lett.*107,091802 (2011), [CA], see DRA.**

**Measurement of the  $t\bar{t}$  Production Cross Section at  $\sqrt{s} = 7$  TeV using the Kinematic Properties of Lepton + Jets Events, *EPJC* 9 (2011) 1721, [CA], see DRA.**

**Measurement of the  $t\bar{t}$  Pair Production Cross Section at  $\sqrt{s} = 7$  TeV using b-quark Jet Identification Techniques in Lepton + Jet Events, *Phys. Rev. D* 84, 092004 (2011), [CA], see DRA.**

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## Selected public results

As member of the CMS collaboration, I also been directly involved in the production of many public notes, the most important of which are listed below. Some details can be found in Section "Description of research activities" (DRA). The list does not comprise results published in journal publications or those with my involvement as the CMS TOP PAG convener.

**Keywords:** Main Author = MA, Co-Author = CA, Leading Role = LR, Contribution = C, Review = R

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## 2018

**Anomalous couplings in the  $t\bar{t}+Z$  final state at the HL-LHC, *FTR-18-036*, [R], included in the Report from Working Group 1 on the Physics of the HL-LHC, and Perspectives at the HE-LHC.**

**Interpreting top-quark LHC measurements in the standard-model effective field theory, *arXiv:1802.07237 [hep-ph]*, [C], providing feedback from the CMS experiment, following my role as CMS EFT contact in the LHCtopWG.**

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## 2016

**Measurement of the differential cross section for t-channel single-top-quark production at  $\sqrt{s} = 13$  TeV, *CMS-PAS-TOP-16-004*, [R].**

**Legacy LHC combination of single top + W boson measurements at 8 TeV, *CMS-PAS-TOP-15-019*, [MA].**

**Search for exotic decays of the Higgs boson to a pair of new light bosons with two muon and two b jets in final states at 8 TeV, *CMS-PAS-HIG-14-041*, [MA].**

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## 2015

**Early Measurement of the t-channel single-top cross section using 42 pb<sup>-1</sup> of the 13 TeV data, *CMS-PAS-TOP-15-004*, [LR, CA].**

**Measurement of the inclusive and differential top quark pair production cross sections in lepton+jets final states at  $\sqrt{s} = 13$  TeV, *CMS-PAS-TOP-15-005*, [R].**

**Measurement of differential top quark pair production cross sections as a function of kinematic event variables in pp collisions at  $\sqrt{s} = 13$  TeV, *CMS-PAS-TOP-15-013*, [R].**

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## 2014

**Measurement of the W boson helicity using  $t\bar{t}$  events in the dilepton final state at  $\sqrt{s} = 8$  TeV, *CMS-PAS-TOP-14-017*, [R].**



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2011

**Measurement of b-tagging efficiency using  $t\bar{t}$  events**, *CMS-PAS-BTV-11-003*, [C], exercising the method with the first LHC collisions, see DRA.

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## Organization of conference and workshp

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### 2022

18–19 May **12<sup>th</sup> National Conference on Particles and Fields**, *Scientific Committee*, Shahroud, Iran.

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### 2021

11–14 Sep. **2<sup>nd</sup> workshop for the collaboration of Iranian universities with the CMS experiment at CERN**, *Scientific Program – Organizing Committee*, Isfahan, Iran.

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### 2020

13–18 Sep. **13<sup>th</sup> International Workshop on Top Quark Physics**, *International Advisory Committee*, Durham, UK.

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### 2019

20–21 Nov. **6<sup>th</sup> CMS TOP Group Workshop**, *Co-chair, Scientific Program and Local Organizing Committee*, Hamburg, Germany.

05–10 Aug. **29<sup>th</sup> International Symposium on Lepton Photon Interactions at High Energies**, *Scientific Program – Member of Advisory Committee for paralell sessions*, Toronto, Canada.

20–25 May. **7<sup>th</sup> Edition of the Large Hadron Collider Physics Conference**, *Scientific Program – Convener of sessions for top quark physics*, Puebla, Mexico.

23–26 Apr. **Standard Model at the LHC 2019**, *Scientific Program – convener of sessions for top quark physics*, Zürich, Switzerland.

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### 2018

28–30 Nov. **Fifth CMS Single-top workshop**, *Organizing Committee, Scientific Program*, Oviedo, Spain.

17–21 Sep. **10<sup>th</sup> International Workshop on the CKM Unitarity Triangle**, *Scientific Program – Convener of sessions for High- $p_T$  flavor physics*, Heidelberg, Germany.  
Proceeding: arXiv:1901.04196

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### 2017

8–10 Jun. **Fourth CMS Single-top workshop**, *Co-chair, Organizing Committee, Scientific Program*, Karlsruhe, Germany.

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### 2016

2–3 Jun. **Third CMS Single-top workshop**, *Co-chair, Organizing Committee, Scientific Program, Closing session: "Closing talk or opening for future work?!"*, Strasbourg, France.

27–28 Apr. **First Introductory workshop about CERN for high school physics teachers**, *Chair, Organizing Committee, Scientific Program*, Tehran, Iran.

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### 2015

23 Dec. **One-Day Workshop on Experimental Particle Physics for undergraduates at SUT**, *Scientific committee, Introductory talk: "Standard Model open questions and the experimental answer-hunters"*, Sharif University, Tehran, Iran.

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### 2014

21–22 May **21<sup>st</sup> IPM Physics Spring Conference**, *Organizing Committee, Scientific Program*, Tehran, Iran.

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## Selected oral presentations

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### 2021

1–3 Dec. **LHC top Working Group meeting – Open session**, *Probing EFT operators in top-Z associated production with Machine Learning – in memory of Dr. Nicolas Tonon (1993–2021)*, Geneva, Switzerland.

23–24 Nov. **14<sup>th</sup> Physics at Terascale Helmholtz Alliance Meeting**, *Probing EFT operators in top-Z associated production with Machine Learning – in memory of Dr. Nicolas Tonon (1993–2021)*, Hamburg, Germany.

14 Oct. **The 50<sup>th</sup> Anniversary of Hadron Colliders at CERN**, *Standard Model Physics at the LHC – I was honored to present the highlights from ATLAS, ALICE, CMS and LHCb experiments in this event, in the middle of inspiring talks by big names in the field including the Nobel Prize winner, Carlo Rubbia*, Geneva, Switzerland.

Jul.–Sep. **Invited for Colloquium Seminars**, *Learning to detect top quark interactions*, Karlsruhe Institute für Technologie (DE), Purdue University (US), Iran Physics Society (IR).

19–20 May **11<sup>th</sup> National Conference on Particles and Fields**, *Invited talk, LHC news on top quark physics*, PSI & Sharif Uni. of Tech., Tehran, Iran

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## 2020

18–19 Nov. **144th LHCC Meeting - Open Session**, *CMS Status Report – elected by the CMS management to present the status of the experiment on physics and detector upgrade to the CERN committee*, Geneva, Switzerland.

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## 2019

28–29 Nov. **15<sup>th</sup> Vienna Central European Seminar**, *Invited talk: “Status of Top Quark Physics at the LHC”*, Vienna, Austria.

11–13 Sep. **D-CMS Workshop 2019**, *Invited plenary talk: “Top Quark Physics at CMS”*, Karlsruhe, Germany.

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## 2018

20–24 Aug. **XII International Conference on Interconnection between Particle Physics and Cosmology**, *Plenary talk: “Rare, Exotic, and Invisible Higgs boson at the LHC”*, Zürich, Switzerland.

26–27 Mar. **The 14<sup>th</sup> Workshop of the LHC Higgs Cross Section Working Group**, *NMSSM status and plans*, Geneva, Switzerland.

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## 2016

3–10 Aug. **38<sup>th</sup> International Conference on High Energy Physics**, *Parallel talk: “CMS measurements of top quark properties in single top processes”*, Chicago, USA.  
Proceeding: PoS(ICHEP2016)662

15 Jun. **Seminar at DESY**, *Selected topics on top quark and Higgs physics and current results from CMS*, Hamburg, Germany.

15–21 May **Higgs Tasting Workshop**, *Invited talk: “Search for an extended Higgs sector at the LHC”*, Benasque, Spain.

18–23 Apr. **CMS Week at CERN**, *Plenary talk: “Status and plans of the top quark analysis group in CMS”*, Geneva, Switzerland.

6–12 Mar. **Les Rencontres de Physique de la Vallée d’Aoste**, *Plenary talk: “Top quark production in CMS”*, La Thuile, Italy.  
Proceeding: Nuovo Cim. C39 (2017) no.4, 339

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## 2015

20 Dec. **Colloquium seminar at Sharif University of Technology**, *From top quark to Higgs boson in the CMS experiment at CERN*, Tehran, Iran.

31 Aug. - 5 Sep. **Third annual conference on Large Hadron Collider Physics**, *Plenary talk: “Top quark production at the LHC”*, St. Petersburg, Russia.  
Proceeding: CERN CMS-CR-2015-326

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## 2014

4–5 Dec. **Second CMS Single-top workshop**, *Plenary talk: “Single-top in the standard model: experimental summary”*, Naples, Italy.

29 Sep. - 3 Oct. **7<sup>th</sup> International Workshop on Top Quark Physics**, *Plenary talk: “Single top measurements and  $|V_{tb}|$  extraction at the LHC”*, Cannes-Mandelieu, France.  
Proceeding: arXiv:1411.7521

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## 2013

19–20 Dec. **First CMS Single-top workshop**, *Closed session: “W-helicity measurement in single-top topology”*, Naples, Italy.

7–11 Oct. **Second IPM meeting on LHC physics**, *Plenary talk: “Status of single-top physics in CMS”*, Tehran, Iran.

13–18 May **First Large Hadron Collider Physics Conference**, *Parallel talk: “Measurement of top quark properties with CMS”*, Barcelona, Spain.

27–28 Jan. **Third national conference on the physics of particles and fields**, *Plenary talk: “W-helicity fractions and  $tWb$  new physics in single-top”*, Tehran, Iran.

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## 2012

11 Jul. **One day workshop on Higgs and the recent results of the LHC**, *Plenary talk: “TOP@CMS.CERN.CH”*, Tehran, Iran.

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## 2011

23–24 Nov. **Second national conference on the physics of particles and fields**, *Plenary talk: “b-tagging efficiency measurement using top-quark events from the first LHC collisions”*, Semnan, Iran.

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## 2009

20–24 Apr. **First IPM meeting on LHC Physics**, *Plenary talk: “Measurement of the  $t\bar{t}$  cross section with  $10\text{ pb}^{-1}$  of CMS data”*, Isfahan, Iran.

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2008

18–24 May

**Second International Workshop on Top Quark Physics**, *Poster: “Single-top t-channel production in CMS”*, Biodola, Italy.

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## Supervision and promotion

- Dr. N. Tonon **Machine-Learning (ML) based analyses of top quark electroweak interactions within EFT framework**, *Postdoctoral researcher, YIG, DESY*, it was an honor to work with Dr. Tonon (1993–2021), such a brilliant reaseacher and outstanding personality. Our collaboration led to JHEP 12 (2021) 083 which the first ever type of such analyses at the LHC, (2019–2021).
- Dr. A. Saggio **Search for top quark production in association with a W and a Z boson using ML**, *DESY Postdoctoral Fellow, YIG associated*, (2020–present).
- Mr. D. Walter **First differential measurement of tZq production with ML and advanced unfolding methods**, *PhD student, YIG, DESY*, his work has recently been published (JHEP 02 (2022) 107). He has another publication in the pipeline: precision luminosity measurements using Z bosons, (2019–present).
- Ms B. Lopes **First differential ratio measurement of  $t\bar{t}\gamma/t\bar{t}$  using top quark observables and a search for exclusive  $t\bar{t}$  production using precise proton spectrometer**, *PhD student, YIG, DESY*, her work on exclusive  $t\bar{t}$  production is being submitted to journal while the other analysis is ongoing, (2020–present).
- Mr M. Mormile **The associated production of WZ with 3<sup>rd</sup> generation quarks**, *PhD student, YIG, DESY*, (2021–present).
- Ms F. Colombina **ML based search for tZq in dilepton final state**, *MSc student, YIG, DESY*, (2020–2021).
- Mr M. Sichani **ML based measurement of photon production through pure electroweak interactions at the LHC**, *MSc student, Isfahan Uni. of Tech.*, (2022–present).

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## Co-supervisions

- Ms E. Khazaei **Search for exotic Higgs decays to two light pseudoscalars in  $\mu\mu bb$  final state**, *PhD student, Isfahan Uni. of Tech.*, Main supervisor: Dr. H. Bakhshiansohi, joint with a similar search in  $\tau\tau bb$  final state from Princeton University, her work is in publication pipeline. Ms Khazaei serves as the contact (main editor) of the joint paper in CMS, (2020–present).
- Mrs K. Tauqeer **Search for longitudinally polarized W boson production in semi-leptonic final state**, *PhD student in Karlsruhe Inst. für Tek., the university partner of my YIG program in DESY*, Main supervisor: Prof. T. Müller, (2021–present) .
- Dr. M. Komm **Differential measurements of t-channel electroweak top quark production**, *PhD student in Uni. Cat. de Louvain during my term as FNRS Chargée de Recherche and my mandate as CMS single-top subgroup convener*, Main supervisor: Prof. A. Giammanco, (2015–2016).
- Mr M. M. Hajimaghshood **Background modeling of pure electroweak photon production at the LHC and the EFT interpretation of the signal**, *MSc student, Isfahan Uni. of Tech.*, (2020–present).
- Ms F. A. Nada **Top quark width measurement by b-jet charge identification**, *CERN summer student*, (2017).

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## Community-based activities

- May 2022 **Invited article in the CERN Courier**, *Pushing the precision frontier in the occasion of the LHC Run-3 start up*, Isfahan, Iran.
- March 2022 **Interview in NewScientist**, *Dutch NewScientist Magazine interviewed eight top young scientists in the occasion of its 100<sup>th</sup> edition*, Isfahan, Iran.
- 2021–2022 **Talks in National Physics Clubs**, *The story of particles discovery: from lightest to heaviest*, Isfahan & Yazd, Iran.
- Aug. 2021 **Invited Lectures on Top Quark Physics**, *10<sup>th</sup> NCP School on LHC Physics*, Islamabad, Pakistan.
- Mar. 2021 **Member of AcademiaNet**, *An initiative by Swiss National Foundation to promote the contribution of outstanding female scientists e.g. in decision making committees*.
- Dec. 2020 **Interview for the CERN “LHC Physics at Ten” series**, *A review LHC results ten years after first collisions*, I was interviewed for stories on precision measurements of the Standard Model and the surprising phenomena, Hamburg, Germany.
- Jan. 2020 **Member of PSI International Committee**, *extend and strengthen international bonds of Physics Society of Iran with similar NGO's worldwide*, Tehran, Iran.
- 2017–2019 **Joining a new institute to the CMS collaboration**, *Fostering Iran ExPP program with special attention to undergraduate education*, I initiated and followed the membership process of Isfahan University of Technology to the CMS experiment. This was following my passion to help the scientific growth in my country while introducing yet another stream of new talents to the collaboration. The process requires a good knowledge of ongoing activities and demands within the experiment as well as the existing potentials in the new institute. The case started upon the request of the university in Dec. 2017 and was approved in a CMS collaboration board meeting in Sep. 2019. Besides research, we aim at a long-term educational program in the university in which undergraduate students are educated with basic, yet essential, ExPP topics, Switzerland, Germany & Iran.
- Jul. 2018 **Personal touch of CMS ICHEP results**, *Short video for CMS*, Describing my contribution to the search for single top quark production in association with the Higgs boson, Seoul, Korea.
- Jun. 2016 **Interview for the CERN “In practice” project**, *Following the “In theory series”*, Chosen for my expertise in top quark measurements and searches, Geneva, Switzerland.
- Jan. 2016 **A journey to The Particle World**, *Night Sky – Iran Astronomy Organization*, A pedagogical seminar in the context of particle physics to broad audiences, Tehran, Iran.
- Apr. 2016 **Iran physics teachers virtual visits to CMS experiment**, *Organizer in collaboration with CMS outreach team and students from Sharif Uni. of Tech.*, part of the “1<sup>st</sup> Introductory workshop about CERN for high school physics teachers”.
- Sep. 2014 **Shiraz University’s virtual visits to ATLAS control room**, *Organizer in collaboration with ATLAS outreach team and students from Sharif Uni. of Tech.*, failed because of poor connection.
- 2012–2013 **Member of the editorial board**, *Journal of Iran physics society, Physic-e-rooz*.
- 2009 **Persian translator and interpreter**, *CMS media contents and its statements on scientific achievements*.  
– present
- 2008 **Several interviews with Persian social media and science magazines for public**, *LHC and CMS projects, the Higgs boson discovery and Nobel prize, Iran contributions and achievements in CMS, ....*  
–present
- 2008 **Persian reporter at CERN**, *Live report of the first LHC collisions to IRIB news*.
- 2007 **IPHO Referee**, *Referee of the International Physics Olympiad (IPHO), passed off in Iran*.
- 2007-2008 **Referee and advisor**, *Innovative projects by high-school students in Iran National Organization for Development of Exceptional Talents (NODET)*.
- 2005–2008 **Head of the scientific board**, *The journal of the physics department at Sharif Uni. of Tech.*, **Takaneh**.
- 2005 **Science parks for all, Science parks for kids**, *Organizing committee, Scientific program, Presenter*, In the occasion of World Year of Physics, Tehran, Iran.
- 2005 **Part-time researcher**, *“Creative Young Researchers” sector of Iran Research Institute of Petroleum, IRIP*, The research project entitled “Statistical physics bases of Hydrocarbon Reservoirs Thermodynamics”.

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## Teaching

**Lecturer**, *Physics I, Mechanics and Thermodynamics*, Isfahan Uni. of Tech..

**Lecturer**, *Teilchenphysik II, Top-Quarks und Jets am LHC*, Karlsruher Inst. für Tek., the university partner of my Helmholtz Young Investigator Group grant.

**Lecturer**, *Special topics: Basics Concepts and Tools in Experimental Particle Physics*, Isfahan Uni. of Tech..

**Teaching assistant**, *Several elementary and advanced courses at Uni. of Tech..*

**Pedagogical experiments**, *Designer and organizer of live experimental demonstrations along with scientific discussions for undergraduate students at Sharif Uni. of Tech..*

**High school physics teacher**, *Teaching in NODET schools*), In preparation for the Worldwide Physics Olympiad.

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## Technical works

- 2016 **CMS Shift Leader**, *Coordinating the implementation of the run plan and responsible for the safety of the people and of the experiment.*
- 2015 **Fast Simulation**, *Validation of hit reconstruction in CMS.*
- 2014 **DCS Shifter**, *Ensure the CMS detector readiness for Physics data-taking.*
- 2009–2013 **DQM Shifter, online and offline**, *Ensure the proper functioning of subdetectors (online) and the validity of all pieces of the recorded data (offline).*

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## Description of research activities

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### Ultimate precision on top quark electroweak interactions

Jan. 2019  
- present

In the context of my YIG program and with my PhD students and post-docs, I am pushing forward the first differential measurements of the  $tZq$  process where at the same time, we are designing a simultaneous measurement of the top-Z EFT couplings in  $tZq$  and  $t\bar{t}Z$  processes. The team also contributes to the  $t\bar{t}\gamma$  differential measurements which sheds light on top quark electroweak interactions from another corner. In addition thorough studies of  $tWZ$  production in resolved and boosted regions are ongoing.

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### Search for the standard model VBF production of $\gamma$ +jets and limits on TGC at 13 TeV

Mar. 2018  
- present

Following my interest in precise measurements and EFT, I am analyzing the LHC data to make the first observation of the VBF  $\gamma$ +jets. The processes is sensitive to BSM effects in triple gauge couplings and can be used to constrain such interactions. The analysis (SMP-19-005) got a pause with my appointment as CMS TOP PAG convener.

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### Search for anomalous top-Higgs couplings in $tH(\rightarrow \gamma\gamma)q$ process at 13 TeV

2017–2019

**Phys. Rev. D 99, 092005 (2019).**

The single top associated production of the Higgs boson provides a unique opportunity to investigate the relative sign of the Higgs interactions with fermions and bosons. The constructive interference of  $HWW$  and  $Ht\bar{t}$  couplings with the same sign leads to a large enhancement of the  $tHq$  cross section compared with the SM prediction. The current search exploits the leptonic decay of the top quark and the Higgs to diphoton decay to achieve the best sensitivity. Additional gain is expected through exploiting the  $t\bar{t}H$  events falling into the selected sample. The analysis is ongoing and aims at TOP2017 workshop. My contribution is based on my expertise in single top and Higgs analyses.

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### The LHC legacy combination of single top quark measurements and $|V_{tb}|$

2016–2019

**JHEP 05 (2019) 088.**

The single top production cross section is expected to be proportional to  $|V_{tb}|^2$  where  $|V_{tb}|$  is the magnitude of the corresponding CKM matrix element. The precise measurements of  $t$ -channel and  $tW$  single top production in ATLAS and CMS as well as the ATLAS evidence for the  $s$ -channel process are combined to extract a direct and precise estimate for  $|V_{tb}|$ . I am the main author of the analysis according to my role as the CMS contact in the LHC $_{top}$ WG.

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### Search for light pseudo scalar bosons from the decay of the discovered Higgs boson in the $\mu^+\mu^-b\bar{b}$ final state

2017–2019

**Phys. Lett. B 795 (2019) 398.**

A similar search as described below using the 2016 LHC data at  $\sqrt{s} = 13$  TeV

2015–2017

**CMS-PAS-HIG-14-041, joint paper, [JHEP 10 (2017) 076], with similar searches in  $\mu^+\mu^-\tau^+\tau^-$  [CMS-PAS-HIG-15-011] and  $\tau^+\tau^-\tau^+\tau^-$  [CMS-PAS-HIG-14-022].**

Despite the consistency of the recently discovered Higgs boson ( $h$ ) measurements with the standard model (SM) the possibility of the exotic Higgs decays to new lighter bosons is not entirely excluded. The current data, including constraints from the Higgs boson observation in different SM channels, allows for Higgs decays to states beyond the standard model (BSM) with a rate of  $\mathcal{O}(20\% - 50\%)$  [see e.g. A. Djouadi et al, B. Dobrescu et al]. Such decays are well motivated in the context of NMSSM and extensions to Two Higgs Doublet models where the existence of a scalar singlet is foreseen [D. Curtin et al]. The new light boson is expected to decay to SM fermions by virtue of mixing with the Higgs.

I performed a search for the exotic decay of the Higgs boson to  $\mu^+\mu^-b\bar{b}$  through a pair of  $a_1$  pseudo scalars, with  $25 < m_{a_1} < 65$  GeV, considering the gluon fusion Higgs production. No statistically significant excess is observed in data and a limit of  $\mathcal{B}(h \rightarrow a_1a_1 \rightarrow \mu^+\mu^-b\bar{b}) < 9 \times 10^{-4}$  is obtained for the entire mass range at 95% confidence level.



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## Measurement of the t-channel single-top quark cross section in LHC Run II

2015–2017 **JHEP 10 (2017) 076, superseding CMS-PAS-TOP-15-004.**

The production of the top quark through electroweak interactions at the LHC is of particular interest. It provides an effective testing ground for the study of QCD and electroweak processes, specifically at the  $tWb$  vertex, as well as the measurement of the CKM matrix element  $V_{tb}$ . Single-top has been thoroughly studied in the LHC Run I [JHEP 06 (2014) 090, JHEP 01 (2015) 053, JHEP 04 (2016) 073, CMS-PAS-TOP-14-004] where I contributed to the first publication by early sensitivity studies with optimized observables.

In particular I had a leading role in the first LHC measurement of single top quark cross section, at the highest-ever-reached center-of-mass energy of 13 TeV, using the very first collisions and a single discriminating variable [CMS-PAS-TOP-15-004]. I am involved in the continuation of the analysis, with the larger data sample of 2015, to precisely measure the cross section and  $|V_{tb}|$  together with " $\sigma_t/\sigma_{\bar{t}}$ " that can eventually constrain the proton PDF parameterization [arXiv:1610.00678 [hep-ex], submitted to PLB]. The analysis makes use of MVA techniques.

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## Search for chargino pair production in di- $\tau$ final states

2014–2017 **JHEP 04 (2017) 018.**

With the strong limits set by LHC on the mass of supersymmetric partners of quarks and gluons, search for the third generation supersymmetric particles as well as the electroweak production of SUSY have become a crucial part of the LHC physics program.

I contributed in a SUSY search with two  $\tau$  leptons accompanied by large missing energy, produced in the cascade of chargino decays. The  $\tau$  leptons can both decay hadronically or one of them decays to a muon, or an electron. The power of the  $m_{T2}$  variable is exploited in this analysis. Observing no statistically significant excess in the data, in the context of simplified model spectra, charginos lighter than 417 GeV are excluded at 95% confidence level in the case of massless neutralino.

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## Measurement of the W boson helicity fractions in events with a single reconstructed top quark

2012–2014 **JHEP 01 (2015) 053.**

The polarization of the W bosons from top quark decays is sensitive to non-SM  $tWb$  couplings [J.A.Aguilar-Saavedra et al]. The current experimental results for the W boson helicity fractions [D0, CDF, ATLAS, CMS], all extracted using top-pair events, are in good agreement with the SM predictions [A.Czarnecki et al].

I performed for the first time a measurement of the W boson helicity fractions using events with the t-channel single top quark topology, with a precision comparable to many of top-pair results. The data sample corresponds to an integrated luminosity of  $19.7 \text{ fb}^{-1}$  at 8 TeV. The measured helicity fractions are used to set limits on the real part of the  $tWb$  anomalous couplings.

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## Trigger design and efficiency measurements for single-top analyses

2012–2014 **Inputs to single-top analyses using single-lepton or single-lepton-plus-b-jet triggers.**

Single-top events, produced via t-channel process and decaying leptonically, are triggered by the presence of a single lepton. More efficiency can be achieved by lowering the lepton  $p_T$  threshold and asking for a b-quark jet ( $t \rightarrow W(\ell\nu)b$ ).

I have lead the group to design such trigger for the 8 TeV data and calculate the trigger efficiencies at 7 TeV. The main challenge was to understand the correlations between the online and offline b-jet identification algorithms in terms of the jet flavor and kinematics. The outcome of these efforts is being used in different single-top analyses which are either published or under the final publication procedure [JHEP 06 (2014) 090, arXiv:1610.03545 [hep-ex], JHEP 09 (2016) 027]. Towards Run II, I was involved in the single-lepton trigger design for the early analyses [CMS-PAS-TOP-15-004]

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## Measurement of the b-tagging efficiency in the CMS experiment with the first LHC collisions

2009–2011 **PhD thesis, CMS-TS-2011/54.**

The identification of jets arising from bottom quarks plays a very crucial role in the analysis of the LHC data. The use of such identification ranges from the precise measurements in SM, the Higgs discovery and search for the Higgs couplings to fermions to beyond SM. In addition to developing precise algorithms to identify the b-quark jets, the efficiency and mis-identification rate of such algorithms should be measured the most accurately possible, and preferentially from data to avoid any bias in the analyses. Given the exclusive top quark decay to b quark and W boson, the top-pair events, with their large production rate at the LHC, are rich sources for such efficiency determination [CMS-BTV-11-003].

Using the first  $36 \text{ pb}^{-1}$  of the LHC data at  $\sqrt{s} = 7 \text{ TeV}$ , I developed a method to measure the b-quark jet identification efficiency with no reference to simulation. The method exploits the invariant mass of the lepton and the b-quark jet from the same top quark to make a jet sample enriched in b-quark jets. The use of  $t\bar{t}$  events allow also for a simultaneous measurement of the b-quark jet identification efficiency and the top-pair cross section, leading to a smaller total uncertainty on  $\sigma_{t\bar{t}}$ . Given the size of the data sample at the time, the precision of the measured efficiencies were statistically limited. The b-quark jet identification efficiencies obtained from a larger data samples using the same method can be found in [JINST 8 (2013)P04013]. The precision on the b-tagging efficiency is crucial for the measurements using top quark events [PLB 720 (2013) 83, Phys. Rev. D 84, 092004 (2011)] and for SM and BSM analyses with top quark events being background.

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## Lepton identification efficiencies for top quark cross section measurements

2010–2011 **Related systematic uncertainties in  $t\bar{t}$  events. Input to number of early CMS publications.**

Compared with leptons ( $e/\mu$ ) from the decay of hadrons within jets, the leptons from the W boson in top quark decays are expected to be isolated with no much detector activity around. The efficiency of the identification and isolation requirements are measured from data and the MC simulated events are corrected for the data/MC efficiency differences. The  $Z \rightarrow \ell\ell$  events are used in data and MC to determine the efficiencies and data/MC correction factors. Applying the correction factors from Drell-Yan events to top quark events with different topology is accompanied by systematic uncertainties that are obtained from MC. The results of these studies were used in several early publications of the LHC [EPJC 9 (2011) 1721, Phys. Rev. D 84 (2011), Phys. Rev. Lett. 107 (2011), PLB 720 (2013) 83].