Thea Klæboe Årrestad

Physics Institute, University of Zurich
Winterthurerstrasse 190, 8057 Zurich
+41 (0) 786 22 1212
thea.aarrestad@cern.ch

linkedin.com/in/thea-aarrestad
github.com/thaarres
thaarres.github.io

Education

FEB 2015 - MARCH 2019

Ph.D., Physics
University of Zurich, Switzerland / CMS experiment, CERN
Supervised by Prof. Dr. Ben Kilminster
Thesis committee: Prof. Dr. Jesse Thaler, Dr. Andreas Hinzmann,
Prof. Dr. Florencia Canelli, Prof. Dr. Ben Kilminster
”A Novel Multidimensional Search for Diboson Resonances in the Boosted Dijet Final State and Encoding Jet Substructure in a Deep Neural Network ”

FEB 2013 - OCT 2014

M.S., Physics
University of Zurich / Classes at ETH Zurich
Supervised by Prof. Dr. Ben Kilminster
"A dedicated boosted Higgs boson tagging algorithm at CMS"

SEP 2010 - DEC 2012

B.S., Physics
University of Bergen / 1 semester exchange ETH Zurich
Supervised by Prof. Dr. Per Osland
"Unstable Dark Matter in the Milky Way”

Research experience

ANALYSIS

Specialising in Beyond Standard Model physics with a focus on models attempting to solve the hierarchy problem, like composite Higgs and Warped Extra Dimensional (WED) theories.

Main author and analyst of the first 13 TeV search for diboson resonances in the all-hadronic final state. High-profile analysis due to excess observed (3.4σ) in 8 TeV data. Amongst first 13 TeV analyses published (within 5 months of data taking during my first Ph.D. year) and set the most stringent limits to date for vector boson final states.
2.6 fb^{-1} of 2015 data, published in 10.1007/JHEP03(2017)162

Main author and analyst of first CMS analysis using new, improved vector boson tagging (V-tagging) algorithm (which I also optimised and commissioned). Performed first 13 TeV search for excited quarks decaying to a quark and a W/Z. Only CMS search in this channel.
13 fb^{-1} of early 2016 data, published in CMS-PAS-B2G-16-021
37 fb^{-1} of 2016 data, published in 10.1103/PhysRevD.97.072006

Development of novel multi-dimensional fit method for diboson searches, improving search sensitivity by 35%. Allows us to search for BSM physics scenarios with new heavy and intermediate mass boosted bosons in one single analysis (July 2017 - present).
80 fb^{-1} of 2016+2017 data, cds.cern.ch/record/2668755, submitted to EPJC

ALGORITHMS

Demonstrated the first dedicated boosted Higgs tagging algorithm in CMS as part of master thesis. Helped develop version currently implemented in the CMS software, with a focus on tagger p_T/η de-correlation and performance against various backgrounds
July 2014 - July 2015, published in CMS-PAS-BTV-15-002

Studied, optimised and commissioned novel V-tagging algorithm and jet mass corrections, currently the default algorithm in CMS. Has better resilience against pile-up and is perturbatively robust compared to previous. Co-author of paper on jet algorithms performance in 13 TeV data. Improved method for calculating V-tagging scale factors, improving limits of diboson resonance search by up to 40%
Jan-Nov 2016, published in CMS-DP-2016-039, CMS-PAS-JME-16-003

Developing deep neural network for V-tagging that encode jet substructure into the DNN itself, improve signal efficiency by 50%.
Nov 2017 - present, work in progress

HARDWARE Calibration of the CMS pixel detector charge response after exposure to radiation. Implemented method to handle radiation effects affecting charge-injection system. Responsible for all 2018 gain calibrations
Jan 2018 - present

Talks and posters

CONFERENCES "Highlights on searches for new physics with vector bosons and Higgs bosons in boosted topologies", BOOST 2018, July 2018, Paris, France

"W/H tagging at CMS", BOOST 2017, July 2017, Buffalo, USA

"Search for heavy resonances in the W/Z-tagged dijet mass spectrum at CMS", Zurich PhD seminar 2015, Aug 2015, PSI, Switzerland

SEMINARS AND WORKSHOPS "Searching for VV resonances in the boosted dijet final state at 13 TeV", SLAC Experimental Seminar, January 2019, Stanford, CA (invited)

"Lorentz-invariance based DNN for W-tagging", Joint CMS/LHCb seminar, May 2018, Zurich (invited)

"A search for all-hadronic X→VV with multi-dimensional fit", B2G Spring Workshop May 2018, Hamburg

"Search for heavy resonances in the W/Z/H-tagged dijet mass spectrum", B2G Event, May 2016, LPC Fermilab (invited)

"Search for heavy resonances in the W/Z-tagged dijet mass spectrum", EXOTICA Workshop, Nov 15, Venice

INFORMAL SEMINARS "PUPPI softdrop for W-tagging", LPC chat, Oct 2016, Fermilab (invited)

"Groomers in CMS", LPC chat, Aug 2015, Fermilab (invited)

POSTERS "LoLa: Lorentz Invariance Based DNN for heavy-resonance tagging", UZH Open Day, Nov 2017, Zurich, https://www.physik.uzh.ch/en/news/news/Open-Day17 Poster 5, Awarded "Best Poster"

"Search for heavy resonances in the W/Z-tagged dijet mass spectrum at CMS", ESHEP2015, Sep 2015, Bulgaria

Organized events

WORKSHOPS & COURSES

"How to do ultrafast Deep Neural Network inference on FPGAs", main organizer, https://indico.cern.ch/event/FPGA4HEP, Feb 2019

"Machine Learning for High Energy Physics - a mini course", main organizer, https://indico.cern.ch/e/ML4HEP, Feb 2019

LECTURES

"Deep learning and future challenges at HL-LHC" by Jennifer Ngadiuba (CERN), main organizer, https://indico.cern.ch/e/ML4HEP, Feb 2019

"Scaling up TensorFlow on Accelerator" by Marvin Ritter (Google Brain), main organizer, https://indico.cern.ch/e/ML4HEP, Feb 2019

Selected publications

MAIN AUTHOR

"Search for massive resonances decaying into WW, WZ , ZZ , qW, and qZ with dijet final states at √ s = 13 TeV" (35.9 fb^{-1}), Physical Review D, *DOI: https://doi.org/10.1103/PhysRevD.97.072006*

"Search for massive resonances decaying into WW, WZ or ZZ bosons in proton-proton collisions at s√=13 TeV" (2.6 fb^{-1}), Journal of High Energy Physics, *DOI: https://doi.org/10.1007/JHEP03(2017)162*

"Jet algorithms performance in 13 TeV data", CMS Physics Analysis Summary, *https://cds.cern.ch/record/2256875*

"W-tagging performance in 13 TeV", CMS Detector Performance Note, CMS-DP-2016-039, https://cds.cern.ch/record/2202970

"Search for VV resonances in the all-hadronic final state with a multi-dimensional fit", *http://cds.cern.ch/record/2668755* (publish as CMS Physics Analysis Summary), submitted to *EPJC*

DIRECT CONTRIBUTOR

"Identification of double-b quark jets in boosted event topologies", CMS Physics Analysis Summary, *https://cds.cern.ch/record/2195743*

THESES

"A Novel Multidimensional Search for Diboson Resonances in the Boosted Dijet Final State and Encoding Jet Substructure in a Deep Neural Network", *Ph.D. Thesis, April 2019 (expected)*

"A dedicated boosted Higgs boson tagging algorithm at CMS", M.S. Thesis, Oct 2014, *https://thaarres.web.cern.ch/thaarres/MasterThesis_TAarrestad.pdf*

POPULAR ARTICLES

"The Beauty of Physics", article in Norway's 2nd largest newspaper, Oct 2011, *bt.no/btmeninger/kronikk/i/G0rnq/Vis-oss-fysikkens-skjonnhet*

Mentoring

MAIN SUPERVISOR

"Deep Neural Network to Identify High-Energy B Hadrons via their Hit Multiplicity Increase through Pixel Detection Layers", UZH Bachelor Thesis, M. Sommerhalder, Feb-Aug 2018, *github.com/msommerh/bTag_HitCount*

"A Deep Neural Network capable of discriminating between jets coming from the decay of longitudinally and transversely polarized W or Z bosons with a large Lorentz boost", CERN Summer Student, July 2018, Jan De Boer, Copenhagen University, *https://cds.cern.ch/record/2650187*

Teaching experience

Physics Lab for bachelor students, teacher, Feb-Dec 2015
Physics I for bachelor students, teaching assistant, Jan-Dec 2016
Physics II for chemists, classroom assistant, Feb 2017 - current

Skills

COMPUTING

Python, C++, Bash, Keras, TensorFlow, Theano, TMVA, ROOT, CMSSW.
Familiarity with Pandas, scikit-learn, NumPy, SciPy, SQLite, Cython

LANGUAGES

Norwegian (fluent), English (fluent), Swiss-German (fluent)

SCHOOLS

"Machine Learning for High Energy Physics" (Aug 2018, Oxford)
"Scientific Programming in Python" (June 2016, Zurich)
"CERN School of High Energy Physics" (Sep 2015, Bulgaria)

References

Jesse Thaler (jthaler@mit.edu)
Professor, Center for Theoretical Physics at MIT

Salvatore Rappoccio (*salvatore.rappoccio@cern.ch*)
Associate Professor, State University of New York at Buffalo

Maurizio Pierino (*maurizio.pierini@cern.ch*)
Research Staff, CERN

Ben Kilminster (*ben.kilminster@physik.uzh.ch*)
Professor, University of Zurich

Andreas Hinzmann (*andreas.hinzmann@cern.ch*)
Emmy-Noether Research Group leader, Universität Hamburg