Curriculum Vitae
Taoli Cheng

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Research Interests

I am a physicist working at Mila, using deep learning techinques to help find new physics signals at the Large Hadron Collider (LHC). I have been an Analysis Consultant Expert (ACE) at CERN, designing new algorithms and developing machine learning strategies for experimental groups at the LHC. I have been working on physics-inspired neural net architectures; interpretability on domain-specific neural networks; and generative models for anomaly detection. Prior to my machine learning research regime, I was a theoretical physicist working on Supersymmetry phenomenology, precision calculation, and jet physics.

Education and Research Experiences

10/2020 - present	**IVADO Post-doctoral Fellow** Mila, Université de Montréal, Montréal, Canada
11/2018 - 09/2020	**Post-doctoral Fellow** **&** **ACE (Analysis Consultant Expert) @ CERN (European Organization for Nuclear Research)** Université de Montréal, Montréal, Canada
07/2016 - 10/2018	**Post-doctoral Researcher** School of Physics, University of Chinese Academy of Sciences, Beijing, China
09/2010 - 06/2016	**Ph.D. Theoretical Physics** Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing, China *Thesis Title*: Higgs Phenomenology in Beyond Standard Models at the LHC Advisor: Prof. Tianjun Li
10/2013 - 12/2015	**Joint Doctoral Promotion Programme** Max-Planck-Institut für Physik, Munich, Germany Advisor: Prof. Dr. Wolfgang Hollik
09/2006 - 06/2010	**B.Eng. Applied Physics** East China University of Science and Technology, Shanghai, China

Research Projects

Machine Learning in High Energy Physics: Physics-friendly Deep Neural Networks, Model-independent and Data-driven New Physics Search at the Large Hadron Collider, Deep Learning Model Interpretability, etc.

Collider Physics: Jet Physics, Higgs Phenomenology, New physics search at the LHC, etc.

Higher-Order Calculation: Next-to-Leading-Order Electroweak precision calculation, etc.

Beyond Standard Model (BSM) Physics: Supersymmetry, Two Higgs Doublet Models, etc.

Mila, Université de Montréal

- [**Analysis Consultant Expert**] help ATLAS experimental groups to implement VAEs algorithms for real data analysis.

- Data-based unsupervised learning approach (especially Variational Autoencoders) to search for new physics signals at the Large Hadron Collider.

- Learning valuable/expressive latent representations and multi-tasking models for particle identification problems at the Large Hadron Collider.

- Exploring physics interpretability in deep learning models for high energy physics, and building the bridge between deep neural networks and physics theory framework.

School of Physics, University of Chinese Academy of Sciences

- Exploring the performance of Recursive Neural Networks, which is motivated by jet clustering structure, in quark/gluon tagging at the Large Hadron Collider.

- Using visualization techniques to reverse-engineer a recursive network, in order to explore the relevant mechanism for jet tagging.

Max-Planck Institut für Physik

- Calculating the full next-to-leading-order Electroweak corrections for Higgs Stralung processes at the LHC in Two Higgs Doublet Models.

Institute of Theoretical Physics, Chinese Academy of Sciences

- Inspired by Supersymmetry search results at the LHC and the mass of Higgs boson observed, a Electroweak Supersymmetry (EWSUSY) scenario was proposed and carefully examined in both minimal supersymmetric Standard Model (MSSM) and next to minimal supersymmetric Standard Model (NMSSM), to fit with all the available experimental results, and search strategies were discussed.

- Natural Supersymmetry in NMSSM is carefully examined after the LHC 7TeV and 8 TeV Runs.

- Supersymmetry scenario with a heavy lightest supersymmetric particle, inspired by the null search results at the LHC and the naturalness problem, was discussed and examined.

Publications [inspire] [arXiv]

- **Taoli Cheng**, Jean-Franois Arguin, Julien Leissner-Martin, Jacinthe Pilette, and Tobias Golling, "Variational Autoencoders for Anomalous Jet Tagging". [arXiv:2007.01850] Project code at *GitHub*.

- **Taoli Cheng**, "Interpretability Study on Deep Learning for Jet Physics at the Large Hadron Collider", *Machine Learning and the Physical Sciences workshop*, **NeurIPS 2019**. [arXiv:1911.01872]

- **Taoli Cheng**, "Recursive Neural Networks in Quark/Gluon Tagging", **Computing and Software for Big Science** 2 (2018) no.1, 3 [arXiv:1711.02633].

- **Taoli Cheng**, Jinmian Li, and Tianjun Li, Supersymmetry with a Heavy Lightest Supersymmetric Particle , **Journal of Physics G** 42 (2015), no. 6 065004, [arXiv:1407.0888].

- **Taoli Cheng** and Tianjun Li, Electroweak Supersymmetry (EWSUSY) in the NMSSM , **Physical Review D** 88 (2013) 015031, [arXiv:1305.3214].

- **Taoli Cheng**, Jinmian Li, Tianjun Li and Qi-Shu Yan, Natural NMSSM confronting with the LHC7-8 , **Physical Review D** 89 (2014), no. 1 015015, [arXiv:1304.3182].

- **Taoli Cheng**, Jinmian Li , Tianjun Li, Dimitri V. Nanopoulos, Chunli Tong, Electroweak Supersymmetry around the Electroweak Scale, **The European Physical Journal C** 73 (2013) 2322, [arXiv:1202.6088].

- **Taoli Cheng**, Jinmian Li, Tianjun Li, Xia Wan, You kai Wang and Shou-hua Zhu, Toward the Natural and Realistic NMSSM with and without R-Parity, [arXiv:1207.6392].

Public Datasets

- **Taoli Cheng**, Test sets for jet anomaly detection at the LHC, Zenodo, 2020.

Fellowships & Awards

- IVADO Postdoctoral Fellowship, 2020.

- NeurIPS ML4PS Workshop Travel Award, 2019.

- Helmholtz-OCPC Postdoctoral Fellowship, 2018-2020. (declined)

- CAS (Chinese Academy of Sciences)- MPG (Max Planck Society) Doctoral Promotion Programme, 2013-2015.

Talks

Conference Talks

- *Variational Autoencoders for Anomalous Jet Tagging*, Anomaly Detection Mini-Workshop – LHC Summer Olympics 2020, Jul. 16-17, 2020.

- *Variational Autoencoders for Anomalous Jet Tagging*, ML4Jets 2020, New York University, Jan. 15-17 2020.

- *Decoding Physics Information in DNNs*, [3rd Inter-experimental Machine Learning (IML) workshop](#), CERN. Apr. 15 - 18, 2019.

- *Study of Recursive Neural Networks in Jet Tagging*, 10th International Workshop on Boosted Object Phenomenology, Reconstruction and Searches in HEP (BOOST 2018), Sorbonne Universit, Paris, France. July 16 - July 20, 2018.

- *Recursive Neural Networks in Quark/Gluon Tagging*, 2nd IML Machine Learning Workshop at CERN, Geneva Switzerland. Apr. 09 - Apr. 12, 2018.

- *Recursive Neural Networks in Quark/Gluon Tagging*, Machine Learning in Jet Physics Workshop, Lawrence Berkeley National Laboratory, United States. Dec. 11 - Dec. 13, 2017.

- *Exploring DNN Performance in Jet Physics*, Gordon Research Seminar, HKUST. June 24 - June 25, 2017.

- *NLO Electroweak Corrections to Higgs-Strahlung Processes at the LHC within THDM*, Second High Precision HEP Workshop, IHEP, Beijing China. June 13 - June 17 2016.

- *NLO Electroweak Corrections to Higgs-Strahlung Processes at the LHC within THDM*, Physics at the LHC and beyond, DESY Theory Workshop, Hamburg, Germany. Sep. 29 - Oct. 02 2015.

- *Electroweak Corrections to Higgs-Strahlung Processes at the LHC in THDM*, Young Scientist Workshop (YSW) 2015, Ringberg, Germany. July 06 - July 10, 2015.

Seminar Talks

- *Introduction to Deep Neural Networks in Jet Tagging at the LHC*, Yau Mathematical Sciences Center, Tsinghua University. May 17, 2018.

- *Recursive Neural Networks in Quark/Gluon Tagging*, Zhejiang University. Jan. 12, 2018.

- *Deep Neural Networks in Jet Physics*, East China University of Science and Technology. Jan. 11, 2018.

Posters

- *[Poster] Study of Jet Embedding Space and Saliency/Sensitivity Regularization to Improve Robustness of DNNs*, BOOST 2019, MIT, Jul. 21 2019 - Jul. 26, 2019.

Academic Services and Outreaches

- Facilitator for the deliberation workshop for *UNESCO Recommendation on AI Ethics in Artificial Intelligence*. Aug. 3, 2020.

- *Co-chair for [ML4Jets 2020](#) Workshop, New York University, Jan. 15-17 2020.*

- *Reviewer for 2020 Deep Learning and Reinforcement Learning Summer School (DLRLSS 2020).*

- Hosting and maintaining educational resources for machine learning in High Energy Physics: [ML4LHC Tutorial](#)

- *Co-supervision*

  - co-supervising master student, 2019-2020: Jacinthe Pilette, Université de Montréal
  - co-supervising summer student, 2019/2020: Julien Leissner-Martin, Université de Montréal

Skills

Programming Languages: C/C++, Fortran, Python, Mathematica, Bash, LaTeX

HEP Tools: FeynArts, FormCalc, LoopTools, FeynRules; MadGraph, Pythia, Delphes, FastJet; ROOT, etc.

Machine Learning Skills: CUDA programming, machine learning frameworks such as tensorflow, pytorch, scikit-learn, keras, etc.

Natural Languages: Chinese (native), English (proficient), Spanish (intermediate), French (intermediate)