Ziming Liu

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EDUCATION

09/2016-06/2020 **PEKING UNIVERSITY** Beijing, China

Bachelor of Science in Physics, School of Physics

- GPA: 3.77/4.0
- Computer Skills: Python, Mathematica, LaTeX, Matlab, C/C++/C#, Linux
- English: TOEFL 104, GRE 327 (157/V+170/Q+3.5/AW), GRE Physics Sub 990 (94% Below)

RESEARCH INTEREST

- Relativistic Heavy Ion Collisions and Quark Gluon Plasma(QGP)
- High Energy Physics
- Combining machine learning techniques with physics

RESEARCH

1) *Feb. 2018-July. 2018* **Predicting event-by-event initial fluctuations from emitted particles in Relativistic Heavy-Ion Collisions with Deep Learning**

Advisor: Huichao Song, Peking University

Results:

- In this project, I read reviews to get familiar with the Heavy-ion community. Apart from physics backgrounds, I did research on deep learning, took the online CS231n course(for "Computer Vision and Deep Learning") at Stanford University and learnt to use deep learning framework like Tensorflow and Pytorch.
- Based on GAN(Generative Adversarial Network) construction, which is popular in the deep learning community, I devised an advanced architecture called Hydro-GAN, which is adjusted to predict event-by-event initial fluctuations from spectra of emitted particles. Our network works pretty well on the training sets, and can approximately predict profiles of event-by-event initial fluctuations on testing sets.

2) *June. 2018-Dec. 2018* **Principal Component Analysis of Single Particle Distribution in Relativistic Heavy-Ion Collisions**

Advisor: Huichao Song, Peking University

Results:

- Principal component analysis(PCA), one of the best studied machine learning algorithms, has demonstrated great power in various fields of physics. I applied PCA to study flow in heavy-ion collisions, and revealed fascinating features hidden in large amount of data.
- Unlike traditional methods, we did not use any priori transformation(e.g. Fourier transformation) to define observables. On the contrary, we let PCA automatically determine features in particle distribution, from which we define new observables. New observables show advantages over traditional ones in many aspects, one of which is that observables defined by our method provides better predictions for initial eccentricities.
- ***The paper is in preparation (as first author).***
- ***The research was presented on 4th China LHC Physics Conference (oral).***

3) *Dec. 2018- present* **Detector inefficiency correction with deep learning**

Advisor: Huichao Song, Peking University

Results:

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- Particle missing is a serious problem in high energy experiments. Practically, response curve is determined with respect to particle identification and transverse momentum Pt, we would like to use simulated data as regularization to correct data in experiments.
- We have discussed with Prof. XiangLei Zhu from Tsinghua University to get familiar with the traditional methods for detector inefficiency correction. We also discussed with Prof. YaDong Mu from Department of Computer science. He gave us some advice on increasing the efficiency of the Neural Network architecture. Now we are working on how to add constraints of physics to the Neural Network.

4) *Jan. 2019- March.2019* **The advantages and limitations of Principal Component Analysis(PCA) to analyze experimental data**

Advisor: Jiangyong Jia, Department of Chemistry, Stony Brook University

Results:

- CMS collaboration had published results of leading modes and subleading modes in PbPb and pPb system by applying PCA to two-particle correlation. The results provide a natural way to describe factorization breaking(or 'decorrelation')
- However, the results might be vulnerable to different choice of pt range, as well as eta gap. We would like to investigate if this uncertainly hinders us from drawing a conclusion. I am using simulated data(Monte Carlo) to test the stability of this method.

MATHEMATICAL MODELING AND OTHER EXPERIENCES

- Led a group of eight competing for CUPT which requires us to solve real-life physics problems and won the second place in Peking University
- Used C# to develop an online Electrical Laboratory software with a group of four
- Worked with three in a data mining competition in Beijing and won the first place. The problem is concerned about factors of health for citizens in New York City.
- Held hydrodynamics seminars for students discussing about advanced topics

AWARDS AND HONORS

- Shenzhen Finance Institute scholarship (7^{th} place out of 220 students) 09/2018
- First place of 'DataOpen Challenge' in Beijing 05/2018
- Scholarship of China National Petroleum Corporation 09/2017
- First Prize for National Mathematics Modeling Contest 09/2017
- First Prize in Mathematics Competition for Undergraduates 12/2017

SELETED COURSES

Core courses

Solid State Physics	92	Seminar for Equilibrium Statistical Physics	98
Quantum Mechanics	96	Atomic physics	98
Computational Physics	93	Group Theory	91
Electrodynamics	88	Advanced Quantum Mechanics	100
Equilibrium Statistical Physics	97	Seminar for Quantum Mechanics	99

Advanced Graduate courses: Particle Physics, Nonlinear physics, General Relativity.