

# Song Cheng

Assistant Researcher

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## Education

- 2014.9-2019.6 **Ph.D in Theoretical physics**, *Institute of Physics, Chinese Academy of Sciences*, Beijing, China.  
Supervisors: Prof. Tao Xiang and Prof. Lei Wang
- 2010.9-2014.6 **B.S. in Physics**, *Sichuan University*, Chengdu, China.

## Skills

- Traditional Tensor Networks algorithms (Written: DMRG, TEBD, TRG, SRG, HOTRG, HOSRG, TNR, loop-TNR. Well understood: MERA, CTMRG, Fermion PEPS, PESS)
- Machine Learning models (neural nets., graphical models, autoregressive models, flow models, etc.) and frameworks (tensorflow/pytorch)
- Some TN machine learning model, such as the MPS for image classification/generation and the Tree TN for image generation.
- Python/Matlab language

## Research Interest

- I'm interest in both the traditional tensor network algorithms (on many body physics) and its new application on classical and quantum machine learning.

## Publications

- total citation: 201

- [1] **Tree Tensor Networks for Generative Modeling.**  
S. Cheng, L. Wang, T. Xiang, P. Zhang, Physical Review B, 99, 155131
- [2] **Information perspective to probabilistic modeling: Boltzmann machines versus born machines.**  
S. Cheng, J. Chen, L. Wang, Entropy 2018, 20, 583.
- [3] **Simulating Noisy Quantum Circuits with Matrix Product Density Operators.**  
Song Cheng, Chenfeng Cao, Chao Zhang, Yongxiang Liu, Shi-Yao Hou, Pengxiang Xu, Bei Zeng. arXiv:2004.02388
- [4] **Equivalence of restricted Boltzmann machines and tensor network states.**  
J. Chen, S. Cheng, H. Xie, L. Wang, T. Xiang, Physical Review B, 97 (8), 085104.
- [5] **Compressing deep neural networks by matrix product operators.**  
Z. F. Gao, S. Cheng (co-author), R. Q. He, Z. Y. Xie, H. H. Zhao, Zhong Y. Lu, and T. Xiang, arXiv:1904.06194
- [6] **Phase Transition of the q-State Clock Model: Duality and Tensor Renormalization.**  
Chen, J., Liao, H.-J., Xie, H.-D., Han, X.-J., Huang, R.-Z., Cheng, S., et al. 2017, Chinese Physics Letters, 34, 050503.
- [7] **Quantum entanglement: from quantum matter states to deep learning.**  
Cheng Song, Chen Jing, Wang Lei. Physics 46 (7), 416-423 (This journal is in Chinese)

## Conferences

- 1 **Tree Tensor Network for Generative Modeling**  
The APS March Meeting, Boston, 2019.
- 2 **Born machine: generative modeling using tensor network states.**  
The 8th Workshop on Quantum Many-Body Computation, Huangzhou, 2018, Invited talk.
- 3 **A brief review on the application of tensor networks to the machine Learning problem.**  
Workshop on the Statistical Physics and Machine Learning, Anqing, 2018, Invited talk.
- 4 **Pixel Correlation and Mutual Information: Implication to Unsupervised Learning.**  
Fall Meeting of the China Physics Society, Chengdu, 2017, Invited talk.