Software Publication Plan for the CEPC Reference Detector

Weidong Li

on behalf of the CEPCSW Team

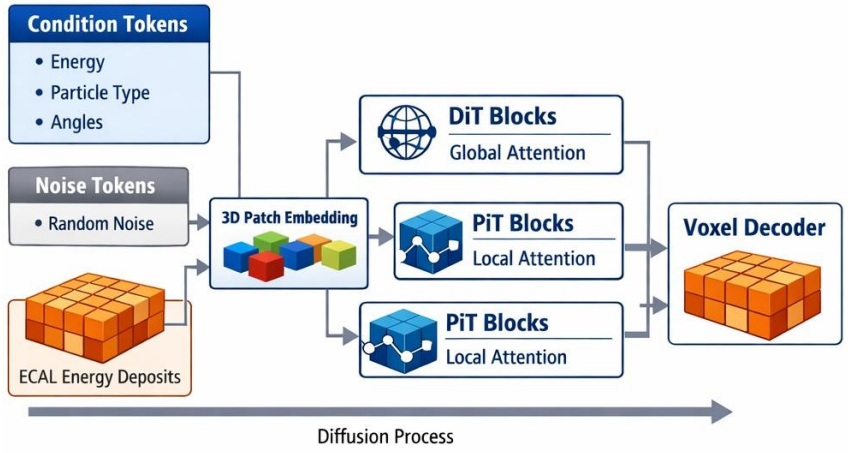
May 20, 2026

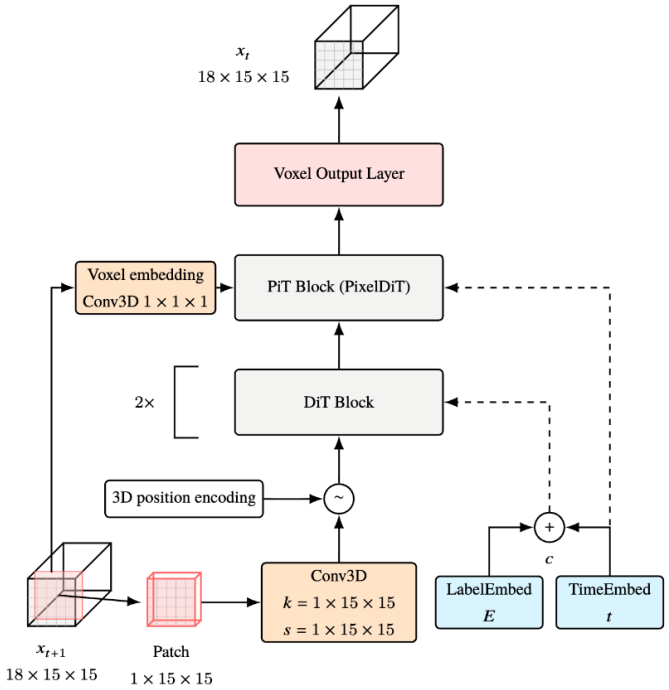
Publication Plan

Title	Main authors	Journal
dN/dx Reconstruction with Deep Learning for High Granularity TPCs	G. Zhao etc.	JHEP04 (2026) 021
An event visualization software based on Phoenix for the CEPC experiment	Zhengyun You etc.	NST (2026) 37
ACTS-Based Track Reconstruction for the CEPC Reference Detector	Yizhou Zhang, Weidong Li, etc.	RDTM (2026) 10
DiT-based Fast Simulation for the ECAL of CEPC Reference Detector	Zhihao Li, Weidong Li etc.	TBD (2027)
Application Quantumn Machine Leaning to the ECAL simulation	Haozhi Ying, Zhihao Li etc.	TBD (2027)
Software Development for the CEPC Reference Detector	Weidong Li etc.	TBD (2028)
Simulation framework for the CEPC Reference Detector	Tao Lin etc.	TBD (2028)
Machine-learning Based Tracking Algorithm for the CEPC Time Projection Chamber	Chengdong Fu etc.	TBD (2029)

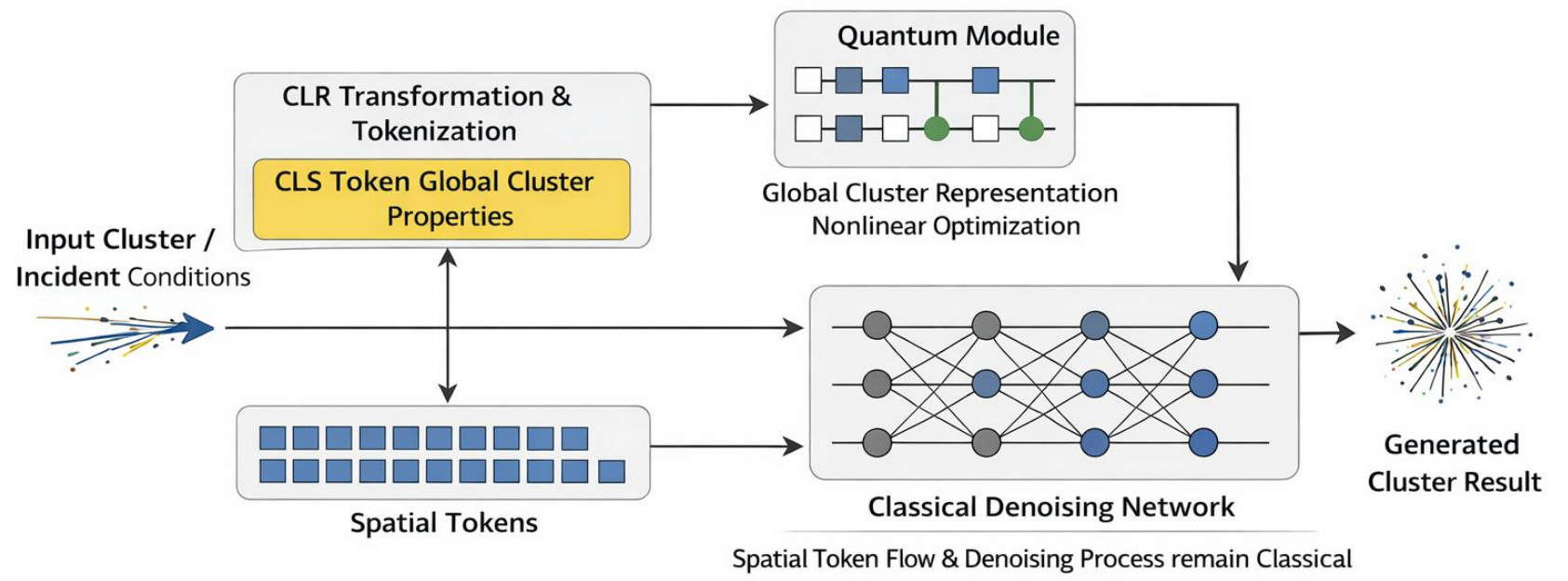
DiT-based Fast Simulation for the ECAL of CEPC Reference Detector

- Development of VoDiT4CAL for the fast simulation of crystal ECAL
  - VoDiT4CAL uses a Diffusion Transformer with condition tokens, voxelized ECAL data tokens, and combined DiT–PiT attention to model electromagnetic showers
- The model accurately reproduces electromagnetic showers, showing strong agreement with Geant4 in
  - total energy, layer-wise energy deposits, energy centers, and both longitudinal and transverse profiles.
- It runs at 0.3 s per event on CPU, providing about a 100× speedup over Geant4 for 50 GeV photons and maintaining energy-independent runtime.





Application Quantumn Machine Leaning to the ECAL simulation



- We present a hybrid generative framework that integrates Quantum Machine Learning with a Diffusion Transformer (DiT) to model high-dimensional detector responses.
- A parameterized quantum circuit provides compact nonlinear feature transformations, which are incorporated into the DiT backbone to enhance expressivity with minimal parameter overhead.
- By executing a full simulation pipeline on a quantum–classical hybrid system, the Quantum-DiT model achieves reconstruction performance competitive with classical diffusion-based approaches.

Thank You !

謝謝