

# Calo4pQVAE: A calorimeter surrogate for high energy particle-calorimeter interactions using Dwave's Zephyr topology

*Tuesday 5 November 2024 17:00 (20 minutes)*

One potential roadblock towards the HL-LHC experiment, scheduled to begin in 2029, is the computational demand of traditional collision simulations. Projections suggest current methods will require millions of CPU-years annually, far exceeding existing computational capabilities. Replacing the event showers module in calorimeters with quantum-assisted deep learning surrogates can help bridge the gap. We propose a quantum-assisted deep generative model that combines a variational autoencoder (VAE) with a Restricted Boltzmann Machine (RBM) embedded in its latent space. The RBM in latent space provides further expressiveness to the model. We leverage D-Wave's Zephyr Quantum Annealer as a quantum version of an RBM. Our framework sets a path towards utilizing large-scale quantum simulations as priors in deep generative models and for high energy physics, in particular, to generate high-quality synthetic data for the HL-LHC experiments.

## Track

Detector simulation & event generation

**Authors:** ABHISHEK, Abhishek; GAY, Colin Warren (University of British Columbia (CA)); Mr SOGUTLU, Deniz (TRIUMF); Dr PAQUET, Eric (Digital Technologies Research Centre, National Research Council); Prof. FOX, Geoffrey (University of Virginia); JIA, Hao (University of British Columbia (CA)); Mr LU, Ian (TRIUMF); TOLEDO--MARIN, J. Quetzalcoatl (TRIUMF); SWIATLOWSKI, Maximilian J (TRIUMF (CA)); MELKO, Roger; Mr GONZALEZ, Sebastian (TRIUMF); Mr HOQUE, Sehmimul (University of Waterloo); FEDORKO, Wojtek (TRIUMF)

**Presenter:** TOLEDO-MARIN, J. Quetzalcoatl (TRIUMF)

**Session Classification:** Detector Simulation