Title:

Study of the rare decays $B^0_{(s)} \to \mu^+ \mu^-$ in ATLAS, new simulation techniques for ATLAS events, and development of fast timing detectors for future particle physics experiments

Abstract:

The rare decays $B^0 \to \mu^+\mu^-$ and $B^0_{(s)} \to \mu^+\mu^-$ have measurable deviations of their rates from the Standard Model (SM) predictions in many Beyond the Standard Model (BSM) extensions, such as the Minimal Supersymmetric, Minimal Flavor Violation, and Two Higgs-Doublet models. The SM predictions for these decays are in tension with the most recent combined LHC results. The branching ratio measurement uses the reference channel $B^+ \to J/\Psi[\to \mu^+\mu^-]K^+$. I will discuss data analysis methods for extraction of the reference channel yield, including Monte Carlo modeling, simultaneous functional fits, and systematic error extraction for the partial Run 2 analysis and for analysis which is in development for the Full Run 2 data. The HL-LHC upgrade will increase the fluence by a factor of 10. In response to increased pileup, the high granularity timing detector (HGTD), comprising of Low Gain Avalanche Detectors (LGADs), is being installed in the forward regions of the ATLAS detector. I will present radiation damage studies performed on LGAD prototypes exposed to the full HL-LHC expected proton and gamma dose. 80 % of simulation time is consumed inside the calorimeters. ATLFAST3 is a simulation suite designed to speed up the calorimeter simulation. I will present the parameterization of the ATLAS calorimeters using FastCaloSim for Run 3.