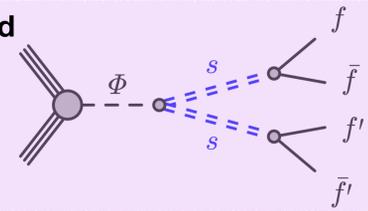


Search for neutral long-lived particles decaying into displaced jets in the ATLAS calorimeter



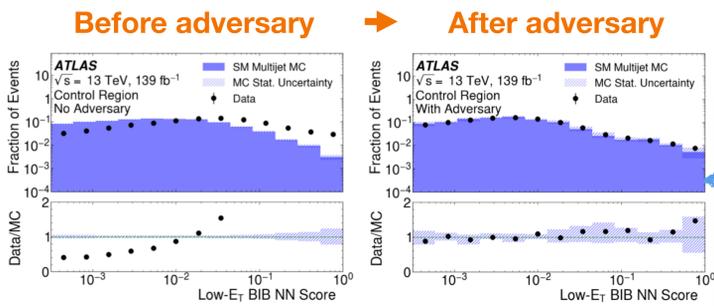
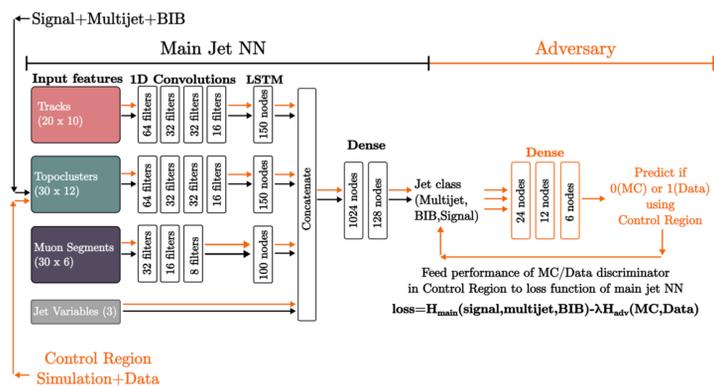
Introduction

- Many scenarios proposed to address open questions of the Standard Model (SM) predict the existence of **neutral Long-lived particles (LLPs)** [1]
- Most LHC searches focus on promptly decaying particles and could overlook the unique detector signatures of LLPs
- Benchmark model: **hidden sector** weakly coupled to the SM by a heavy mediator Φ which decays to two long-lived neutral scalars (s) [2]. The LLPs decay into SM fermions (f) with Higgs-like coupling proportional to fermion mass.



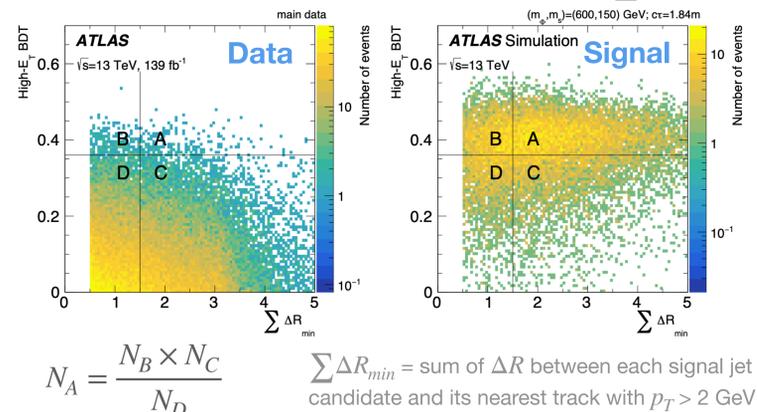
Per-jet Neural Network

- Input are low-level features associated with each jet
- Combination of 1D convolutional and long short-term memory (LSTM) Neural Networks (NNs)
- Training samples: **simulated signal and SM multi jets** events and **BIB data** (BIB data contaminated by SM multi jets)
- **Training Adversary** reduces the impact of mismodeling in Monte Carlo simulation



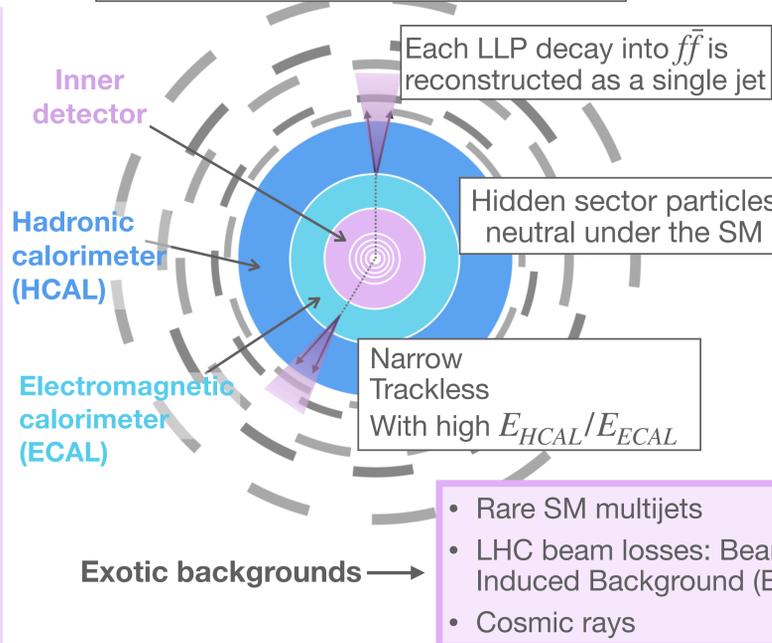
Background estimation

- **Data-driven ABCD method:** two uncorrelated variables subdivide plane into four regions
- Background and signal models fitted simultaneously to account for signal contamination in control regions
- ABCD plane defined by per-event BDT and $\sum \Delta R_{min}$



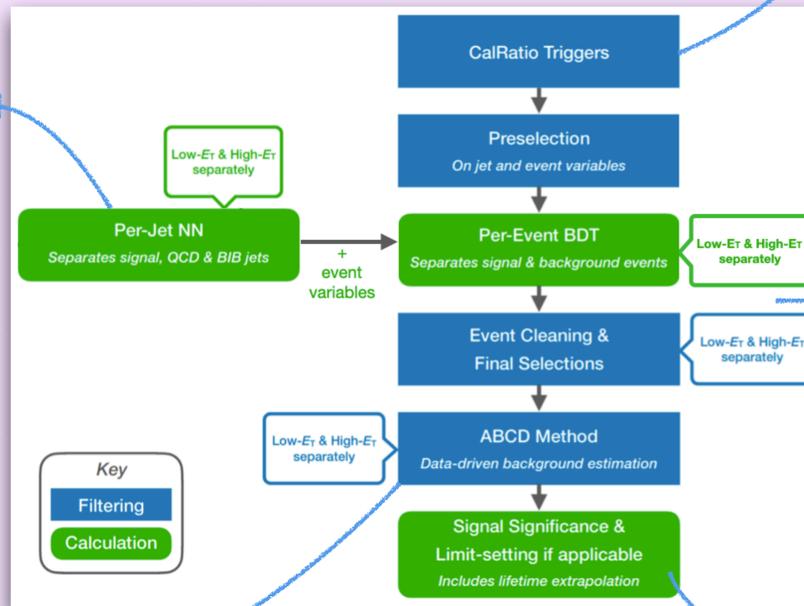
[1] J. Alimena et al., arXiv:1903.04497
 [2] M. J. Strassler and K. M. Zurek, arXiv: hep-ph/0604261
 [3] ATLAS Collaboration, ATL-PHYS-PUB-2022-007

Signal objects are two displaced jets



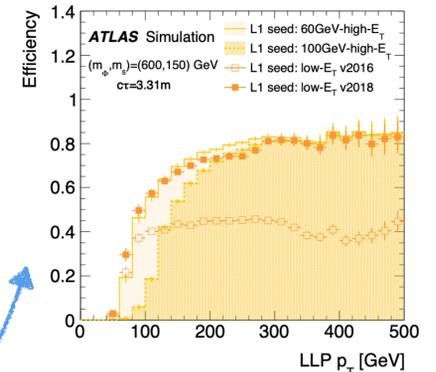
Search strategy

- Two selections optimized for low- E_T ($m_\Phi \in [60, 200]$ GeV) and high- E_T ($m_\Phi \in [400, 1000]$ GeV) signal samples



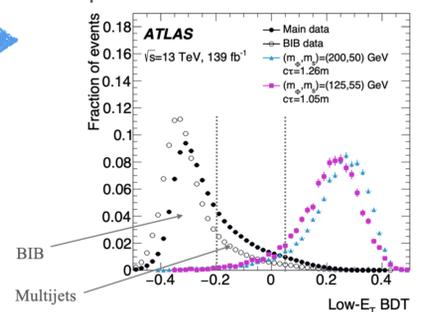
CalRatio Triggers

- At high level trigger: Identify narrow, trackless jets with $\log(E_{HCAL}/E_{ECAL}) > 1.2$ using two L1 seeds:
 - High- E_T L1 trigger: narrow jet with $E_T > 60$ GeV in HCAL + ECAL
 - Low- E_T L1 trigger: narrow jet with $E_T > 30$ GeV, isolated from ECAL deposits



Event Selection

- **Per-event BDT** trained signal samples against BIB data using NN outputs for the most signal/BIB-like jets and event-level information
- Trigger matching, per-event BDT score and cleaning cuts reject BIB and spurious events



Results

- Analyzed data from pp collisions at $\sqrt{s} = 13$ TeV during Run 2
- No significant excess found and upper limits on cross section times branching ratio set

