

Improving discovery potential of Beyond
Standard Model Physics through detector,
software and analysis techniques in ATLAS and
PIONEER

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Abstract

The Standard Model has many theoretical deficiencies that need to be explained either through direct searches for a particular particle or indirect searches where experimental measurements invalidate the standard model's current predictions. The nature of these searches requires cutting-edge technology to enable high-precision measurements and help physicists search for rare physics processes. This presentation briefly describes some of the detector technology, software tools and analysis techniques developed by scientists at the Brookhaven National Laboratory (BNL). The presenter will start by presenting research and development conducted at BNL for A Highly Segmented Active Target (ATAR) detector component used in the PIONEER experiment, which will investigate Lepton Flavor Universality violation. The presenter will discuss how PIONEER intends to use low-gain avalanche diodes (LGAD) in the context of ATAR. Experiments use LGAD's for the detection of minimum ionizing particles. The added advantage of LGAD's is that they can also distinguish tracks belonging to different vertexes in the interaction point using their timing information. The challenge now is to demonstrate that LGAD's can be used not only for time and space measurements (4D) but also for measuring energy deposition of particles in the detector (5D). The presenter will then briefly present work done on tracking software used at the ATLAS experiment's inner detector, where an analysis is done on the current bottlenecks of the code. Lastly, the presenter will briefly describe the analysis of the ATLAS experiment, the motivation behind the analysis and the signal model used to generate a signal that mimics the sought-after signal. At the end of the talk, the presenter will talk about future work that will be done on each of the three projects and envisioned future collaborations with BNL.