

# Particle Identification in CLAS12 using Artificial Intelligence

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## Abstract

In this article we describe implementation of Artificial Intelligence models in track reconstruction software for CLAS12 detector at Jefferson Lab. The Artificial Intelligence based approach resulted in improved track reconstruction efficiency in high luminosity experimental conditions. The track reconstruction efficiency increased by 15% for single particle, and statistics in multi-particle physics reactions increased by 15% – 35% depending on number of particles in the reaction. Implementation of artificial intelligence in workflow also resulted in code speedup of 35%.

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## 1. Calorimeter

A primary goal of the CLAS12 physics program is to study internal dynamics of the nucleon . These experiments require accurate kinematical analysis of neutral and charged particles at high momentum. In particular, all CLAS12 electro-production experiments require the efficient detection and reliable identification of energetic electrons, photons, and neutrons using the forward electromagnetic calorimeter (ECAL).

One of the primary usages of ECAL system is separating electrons from other particles, like pions, using energy deposited in the calorimeters. To accommodate hexagonal design of CLAS12 detector ECAL is using triangular hodoscope layout. The scintillating layers have three alternating stereo readout planes named U,V and W, which are interleaved with layers of lead as shown on Figure ??

When particle enters the calorimeter it leaves signal in each of the layers (U,V and W), and is readout independently. For each layer a cluster (called peak) is constructed by grouping adjacent hit strips and peaks from all three sides are combined into a cluster if they intersect in one point on the surface. A typical cluster is shown on Figure ??.

## 2. Acknowledgments

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics under contract DE-AC05-06OR23177, and NSF grant no. CCF-1439079 and the Richard T. Cheng Endowment.

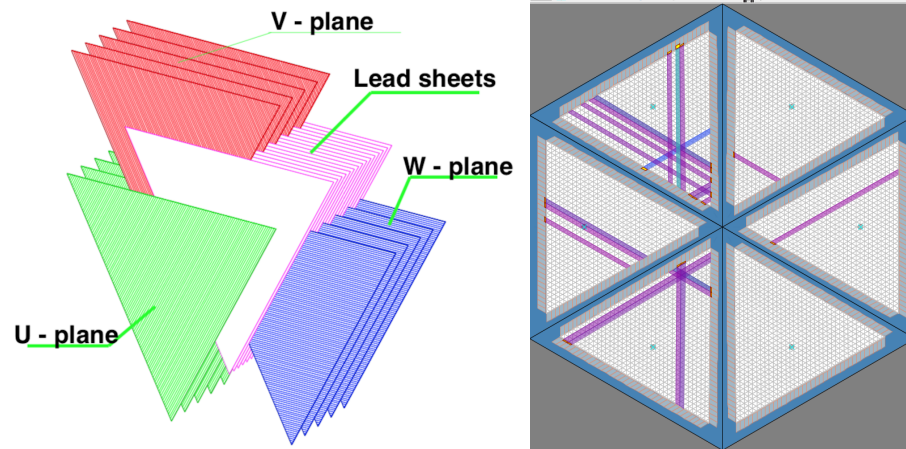


Figure 1: CLAS12 Electromagnetic Calorimeter structure description.