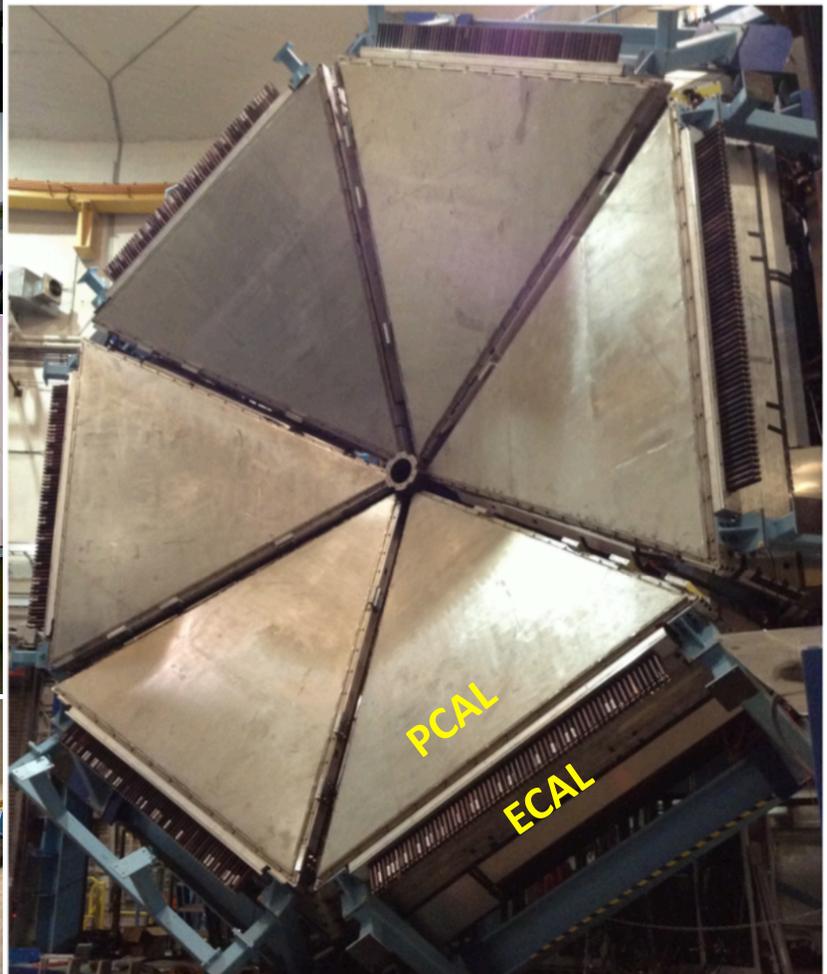
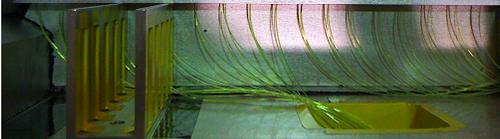
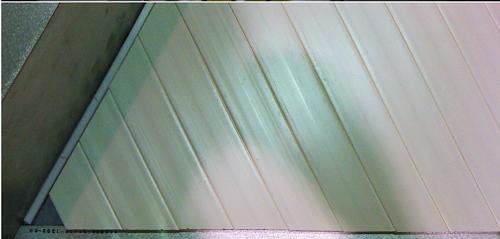


CLAS12 ECAL-PCAL (EC)

The CLAS12 detector package uses the existing electromagnetic calorimeters of the CLAS detector (ECAL) and a new pre-shower calorimeter (PCAL) installed in front of it. Calorimeters in CLAS12 will be used primarily for identification of electrons, photons, $\pi^0 \rightarrow \gamma\gamma$ decays, and neutrons.

The PCAL and ECAL are sampling calorimeters consisting of six modules. Each module has a triangular shape with 54 (15/15/24, PCAL/ECAL-inner/ECAL-outer) layers of 1-cm thick scintillators segmented into 4.5/10-cm (PCAL/ECAL) wide strips and sandwiched between 2.2-mm thick lead sheets. The total thickness is about 20.5 radiation lengths. Scintillator layers are grouped into three readout views with 5/5/8, PCAL/ECAL-inner/ECAL-outer, layers per-view providing several cm resolution of energy clusters. Light from each scintillator readout group is routed to PMTs via flexible optical fibers.



EC Detector - TECHNICAL PARAMETERS

PARAMETER	PCAL DESIGN VALUE
Calorimeter type	Sampling, lead-scintillator
Number of modules	6
Coverage area	45 meter square (a triangle base 394 cm height 385 cm)
Distance from the target	7 meters
Angular coverage	θ : 5° to 35° ; ϕ coverage: 50% at 5° → 85% at 35°
Number of scintillator/lead layers	15/14 per module
Number of stereo readout views	3 (5 scintillator layers per view)
Number of readout channels	192 per module (U:V:W=68:62:62)
Number of scintillator strips	1200 per module
Scintillator strips	1x4.5 cm ² up to 432 cm long, extruded (FNAL) with two holes along the strip, and 0.25 mm TiO ₂ coating
Lead sheets	2.2 mm thick, triangular shape (two pieces per layer)
Readout via WLS fibers	1 mm OD, Y-11 Kuraray, 4800 fibers per module
Readout	1" PMT, Hamamatsu R6095
Light yield	11-12 photo-electrons/MeV
PARAMETER	ECAL DESIGN VALUE
Calorimeter type	Sampling, lead-scintillator
Number of modules	6
Coverage area	49 meter square (a triangle base 420 cm height 389 cm)
Distance from the target	7.5 meters
Angular coverage	θ : 5° to 35° ; ϕ coverage: 50% at 5° → 85% at 35°
Number of scintillator/lead layers	39/38 per module
Number of stereo readout views	3 (5/8 scintillator layers per view for inner/outer parts)
Number of readout channels	216 per module (inner/outer U:V:W=36:36:36)
Number of scintillator strips	1200 per module
Scintillator strips	1x10 to 12 cm ² up to 441 cm long, BC-412
Lead sheets	2.387 mm thick, triangular shape
Readout via optical fibers	3 mm OD, BCF98, 4752 fibers per module
Readout	2" PMT, Philips XP2262 and EMI 9954
Light yield	3-4 photo-electrons/MeV
EXPECTED PERFORMANCE	VALUE
Energy resolution	10%/√E
Position resolution	0.5 cm
Time resolution	500 ps

- **Construction Strategy and Project Leadership:**

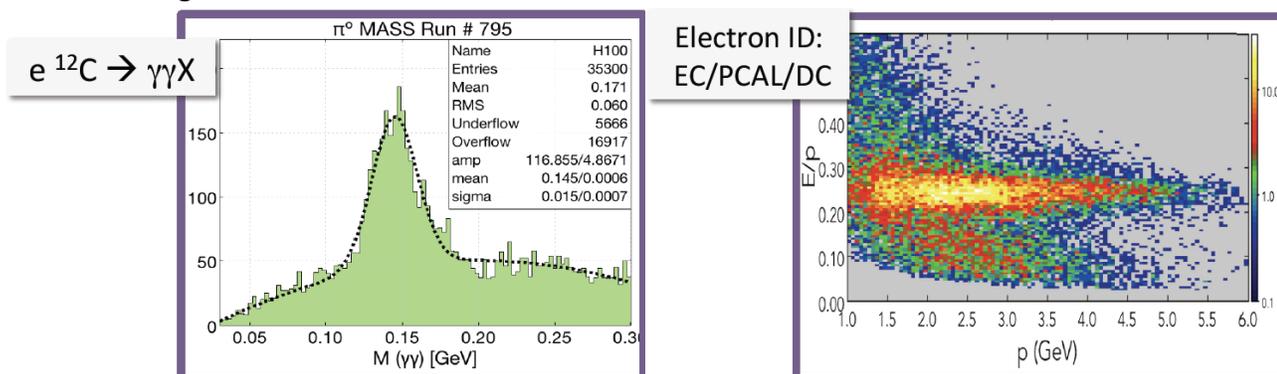
- Project is led by JLab (lead scientist S. Stepanyan) and includes Ohio University (OU), James Madison University (JMU), Collage of William and Mary (CWM), Norfolk State University (NSU), University of Virginia (UVA), and Yerevan Physics Institute (YerPhi).
- ECAL was refurbished on the Forward Carriage after dismantling the CLAS detector. The main upgrade for ECAL was readout electronics and cables.
- The assembly and testing of all six modules of PCAL took 2.5 years and was done at JLab. Many components were prepared at the collaborating universities.

- **Significant Dates:**

- Design of the PCAL components was completed in August 2010
- Components started to arrive in February 2011
- Assembly of the first module started on May 3rd 2011
- Assembly of the last module completed in May 2013
- Installation of the last PCAL module took place in December 2013

- **Project Status:**

Calibration of PCAL and ECAL using cosmic muons has been ongoing since 2015. During the CLAS12 KPP run, using PMT gains and scintillator strip attenuation lengths deduced from cosmic calibrations, π^0 mass peak in two cluster invariant mass distribution, assuming clusters are from photons, and reconstructed electron energy have been obtained within hours of data taking.



Last updated: March 16, 2017

Jefferson Lab

JSA

U.S. DEPARTMENT OF ENERGY

Contact: C. Smith (lsmith@jlab.org), S. Stepanyan Detector Lead (stepanyan@jlab.org) 757-269-7196
 L. Elouadrhiri, Control Account Manager (latifa@jlab.org) 757-269-7303
 G. Young, Associate Project Manager for Physics (young@jlab.org) 757-269-6904
 V. D. Burkert, Hall B Group Leader (burkert@jlab.org) 757-269-7540