Upgrade of ALICE Electromagnetic Calorimeter to enhance di-jet measurements

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Introduction

Back-to-back jet produced by hard parton scatterings (di-jet) is an unique and powerful probe to quantify the properties of Quark Gluon Plasma at LHC. In the ALICE experiment, the electromagnetic calorimeter (EMCal) provides a crucial role to reconstruct jets with a good energy resolution, together with the information by Time Projection Chamber (TPC).
In order to enhance the capability of back-to-back jet identification and yields of jets, photons, π^0 and their correlations, we are constructing an additional electromagnetic calorimeter, called DCal (Di-jet Calorimeter) in ALICE.

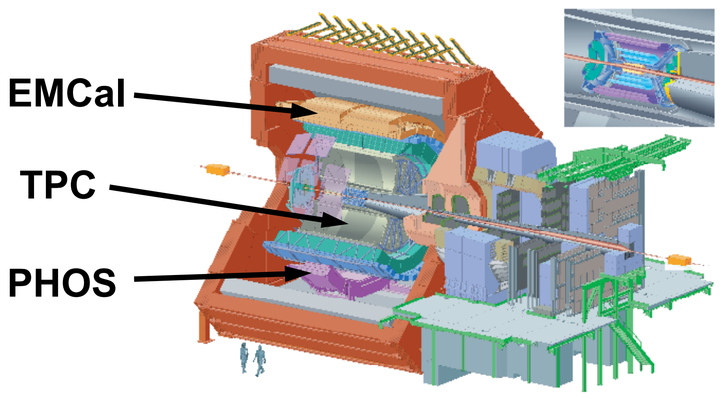


Fig.1 The ALICE detectors.

DCal Collaboration

China
- Huazhong Normal University

Finland
- University of Jyvaskyla

France
- LPSC Grenoble, Subatech Nantes, IPHC Strasbourg

Italy
- INFN Catania, LNF Frascati

Japan
- Hiroshima University, University of Tokyo, University of Tsukuba

Switzerland
- CERN

USA
- Lawrence Berkeley National Laboratory, Wayne State University, University of Houston, University of Tennessee, Lawrence Livermore National Laboratory Yale University, Oak Ridge National Laboratory, Creighton University, Cal Poly San Luis Obispo, Purdue University

Detector Design

DCal is Pb-Scintillator sampling calorimeter and read out by avalanche photodiode(APD). Energy resolution is about 10%/ $\sqrt{}$ E. DCal have 6 super module(SM). SM contain 16 strip modules, and each strip module consist of 12 towers.

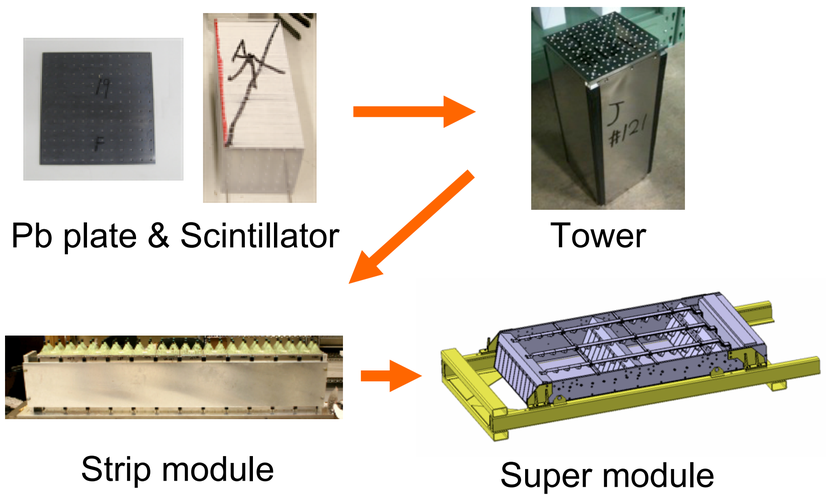


Fig.2 DCal structure

DCal will be placed on the opposite side of the EMCal in azimuth. DCal has the acceptance of $\Delta\phi$=60° and $\Delta\eta$=1.4 together with the Photon Spectrometer (PHOS). This acceptance allows back-to-back hadron-jet, di-jet measurements in ALICE, with R=0.4, up to p_T~150 GeV/c.

Fig.3 Left: perspective view of the DCal and PHOS. Right: beam view of EMCal and DCal.

Physics with DCal

We performed simulations to explore the physics capabilities by the DCal.
Simulation conditions:
- Event generator: qPYTHIA.
- Jet reconstruction: FastJet anti-kT algorithm R=0.4.

Di-jet energy balance(Δ) in p+p

Di-jet energy balance(Δ) in p+p and effect of gap between DCal and PHOS is shown in Fig.4 and Fig.5.

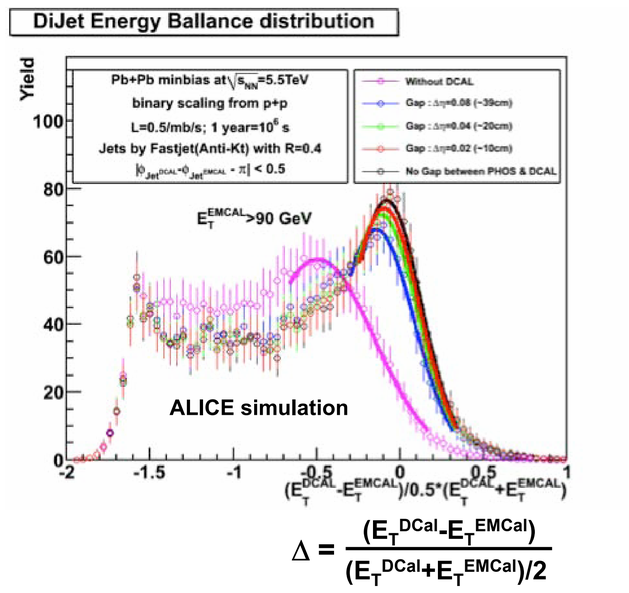


Fig.4 Di-jet energy balance distribution in p+p and effect of gap between DCal and PHOS.

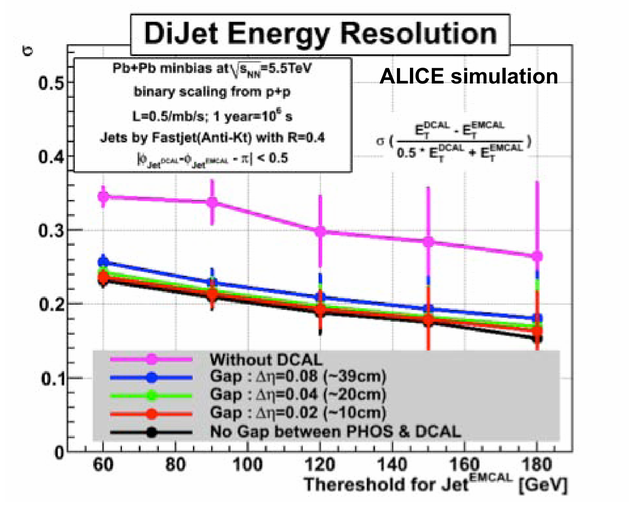


Fig.5 Dependence of peak width of di-jet energy balance on EMCal threshold E_T.

- True di-jet peak Δ~0 with DCal.(Fig.4)
- DCal improves Δ resolution 25%~ 35%.(Fig.5)
- Effect by gap between PHOS and DCal is small.

Path-length bias: π0+jet measurements

- Requiring trigger π0 in DCal, jet in EMCal.
- Producing strong geometry bias by hand, i.e. “control” the path length of jet.

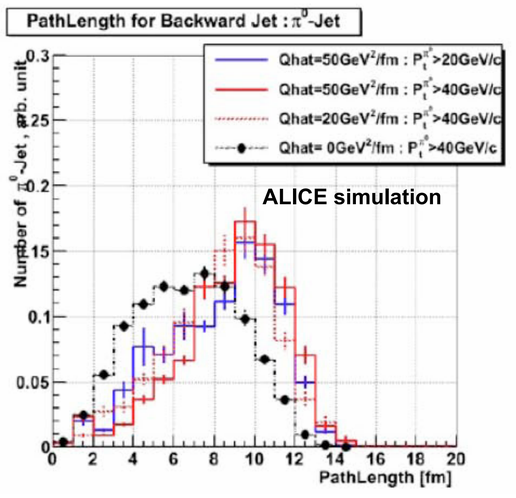


Fig.6 Recoil jet (EMC) vs path length.

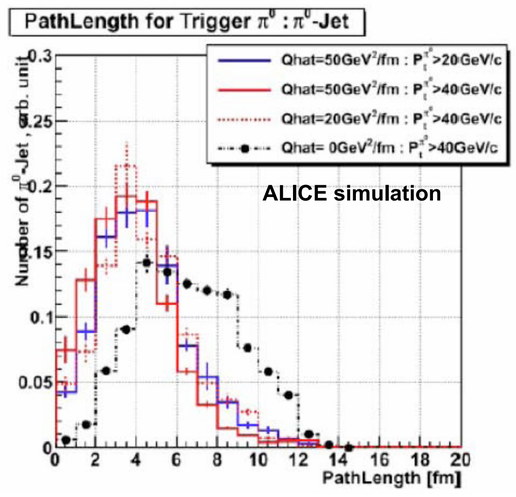
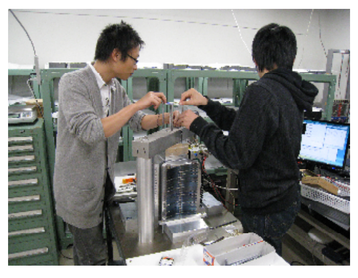


Fig.7 Trig π0 (DCal) vs path length.

- Recoil jet (Fig.6): Maximizing path length.
- Trigger π0 (Fig.7): Minimizing path length.
- Path length of jet medium, “control” experiment.
- Efficient trigger of π0 (Level1) is the key, and it is capable by utilizing existing level1 readout for EMC.

Current status & plan

Module production had been started and all module will ready by the end of 2011.
DCal will be installed in the ALICE experimental area during the long LHC shutdown in 2013.



Construction in Tsukuba

Shipping module

Cabling SM

Calibration of SM

Fig.5 Module construction