Updates for PrimEx-II HyCal Reconstruction Code

PrimEx Note 70

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1 Introduction

HyCal reconstruction code has been updated for PrimEx-II. Timing information from individual TDCs has been added to cluster information. Central area of HyCal has high hit occupancy in comparison with PrimEx-I conditions. To increase reconstruction efficiency the algorithm needs to be able to resolve close hits. 5x5 algorithm has minimum distance between two clusters about 10cm to be reconstructed. New island clustering algorithm has been added and tuned for PrimEx-II experimental conditions. New tables have been added to PrimEx *caldb*.

2 HyCal Timing

HyCal has been upgraded with 480 new TDCs for individual modules in the central part of the calorimeter and 52 TDCs for 6x6 cell groups. 394 TDC channels has been working Ok during the whole run time period. New module *HYCALTHIT_GetHycalTHits.cc* has been added to hycal code analogous to *HYCALTHIT_GetHycalHits.cc*. It fills new bank *HYCALTHIT* analogous to *HYCALHIT* with timing information from individual TDCs.

Cluster attribute time is filled for the cluster in case if the central id of the cluster has timing information. In case if the central id does not have normal working individual TDC this time is set to -9999. Otherwise cluster will have time stamp. In case of multiple TDC hits for the central id the closest to zero value is used, in case of no hit is observed for normal working TDC the time is set to +9999. Time resolution for HyCal TDCs $\approx 0.8\,ns$ for $4...5\,GeV$ energy hits and $\approx 1.5\,ns$ for $1.5...2.5\,GeV$

Tables added to *caldb*: *system = crystal*, *tdc_alignment* - time shift to individual TDCs in counts (1 count = $0.1\,ns$); *tdc_status* =-1 if no TDC for this channel, =0 if TDC is Ok, $\geq$1 means TDC problem.

3 Island Clustering Algorithm

New island algorithm has been added to *prim_ana*. New files added to hycal directory: *adcgam_bk.inc, call_island.cc, cphoto.inc* - include files, *island.F* - file with the reconstruction code, *call_island.cc* - call to island code for each sector of HyCal separately and glueing clusters near transition region. File *HYCALCLUSTER_GetHycalClusters.cc* has been modified to call island algortihm in case of clustering scheme (in *hycal.h*) is set to new value 12 (for 5x5 algorithm it is 5). Maximum number of clusters is increased from 100 to 250 (MAX_CLUSRERS in *hycal.h*) to simplify clutser glueing procedure. Maximum number of cluster elements is increased from 40 to 60 (MAX_CC in *hycal.h*). *Makefile* in *prim_ana* directory has been updated: cernlib library has been added.

Algorithm first finds islands as connected areas in separate HyCal

sectors. Each island is subject to search for maxima. In case of many maxima are found each of them will be associated with the separate hit. Each single hit is also subject to test if it could be split into two close hits (second step of separation). Clusters found in all HyCal sectors are subject to merge in case if they pass the close-enough test. The second step of separation was suppressed by high cut values because it can split single clusters with probability of few percent and real hits will be close enough to be subject of this step only in fraction of percent of all events. Thus the algorithm mostly seprates hits which produce different maxima. The minimum distance between them to be resolved is 3...4 cm.

Algorith has the following controls (file *island.F*): *subroutine gams_hyc*: chisq1 = 90.0 (increased, regular value = 3.0); chisq2 = 50.0 (increased, regular value = 1.2); $minpk = max(1, nint(7. * log(1. + 0.01 * idsum)))$ (could be as low as 1); *subroutine gamma_hyc*: xm2cut = 1.7 (can vary between 1 and 3); *subroutine tgamma_hyc*: delch = 10 (increased, regular value = 4).

Tables added to *caldb*: *system = crystal* and *glass*, *pi0_gain_isl* - gain factors related to the island algortihm obtained with pi0 calibration. These tables are automatically loaded in *hycal_brun.cc* in case of clustering scheme is set to 12 (island).

Tabulated shower profile data were added to $PRIMEX_MY/tools/misc/ directory: *prof_lg.dat, prof_pwo.dat*. Usage precalculated data instead of analystical calculation each time makes *prim_ana* work faster 6-8 times.

Run intervals covered by the separate tables: 64704-64780, 64781-64794, 64795-64810, 64811-64904, 64905-64952, 64953-65034, 65035-end.