HCAL reconstruction software

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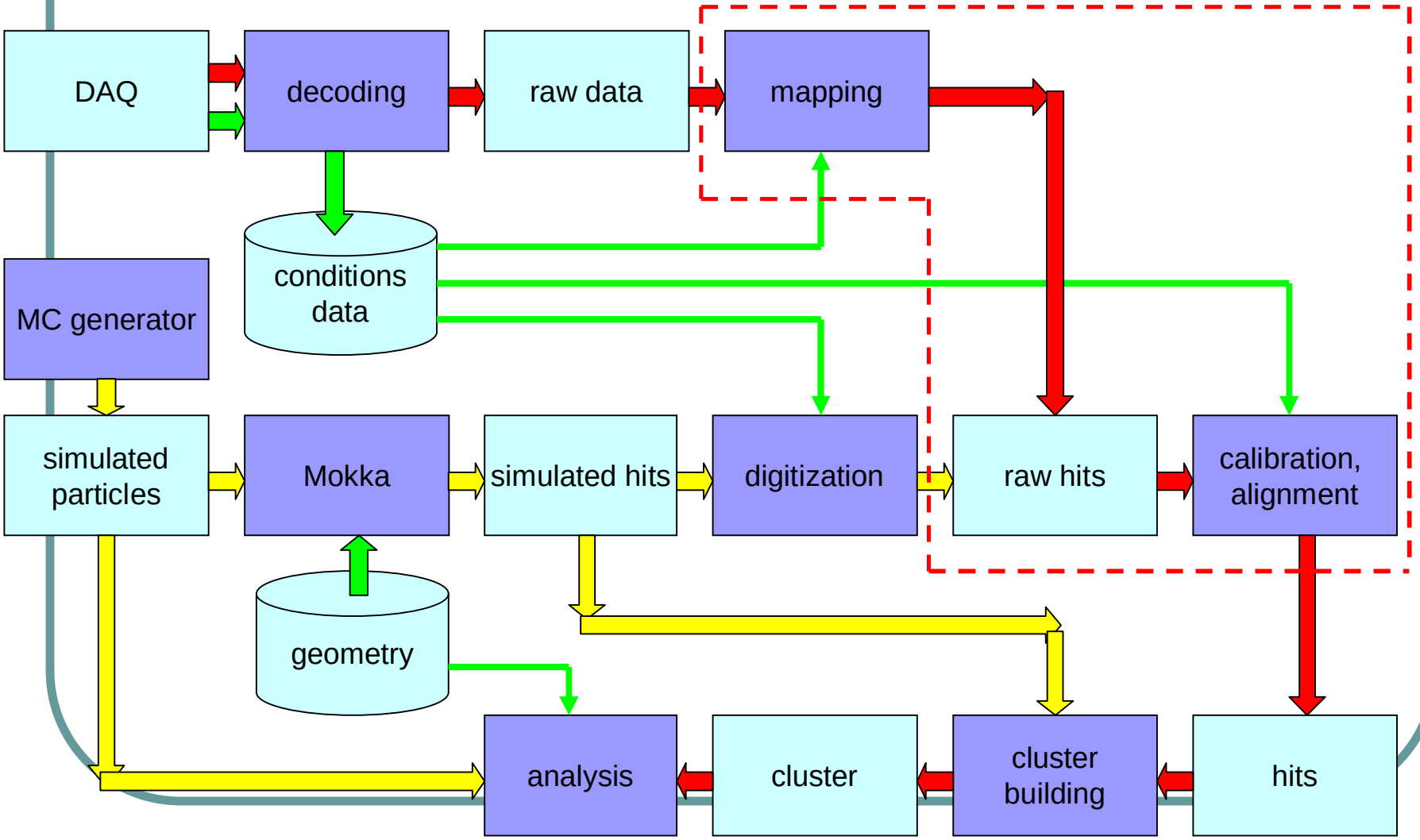
CALICE data streams



Current release of HCAL software

- Latest version hcal-v00-01-17 available since Xmas
- Complete HCAL reconstruction using modular Marlin processors for the calibration steps, “approved” calibration constants written to global data base
  - Will be used to provide a first version of the “official” HCAL calorimeter hits (like it is done already for the ECAL hits)
  - Positions of Subdetectors/Alignment not yet included
- Alternative: Quick reconstruction using flat files by SimpleHcalCalibrationProcessor, not time dependent
- Inclusion of core code into cvs version of calice-reco in progress
- Demo steering file available on the web (includes reconstruction chain, event display, trigger analysis, …)

HCAL analysis procedure

Pedestal subtraction: $A = A_0 - p$

Energy E deposited in one calorimeter cell [GeV]:

SiPM gain in ADC channels (taken in calibration mode)

Electronics inter-calibration between physics and calibration mode

$$E = N_{MIP} \cdot E_{MIP}^{MC} = \frac{f_{resp}\left(A \cdot \frac{I_{phys}^{calib}}{G_{pix}}\right)}{f_{resp}\left(A_{MIP} \cdot \frac{I_{phys}^{calib}}{G_{pix}}\right)} \cdot E_{MIP}^{MC} \approx \frac{A \cdot f_{corr}\left(A \cdot \frac{I_{phys}^{calib}}{G_{pix}}\right)}{A_{MIP}} \cdot E_{MIP}^{MC}$$

SiPM response function

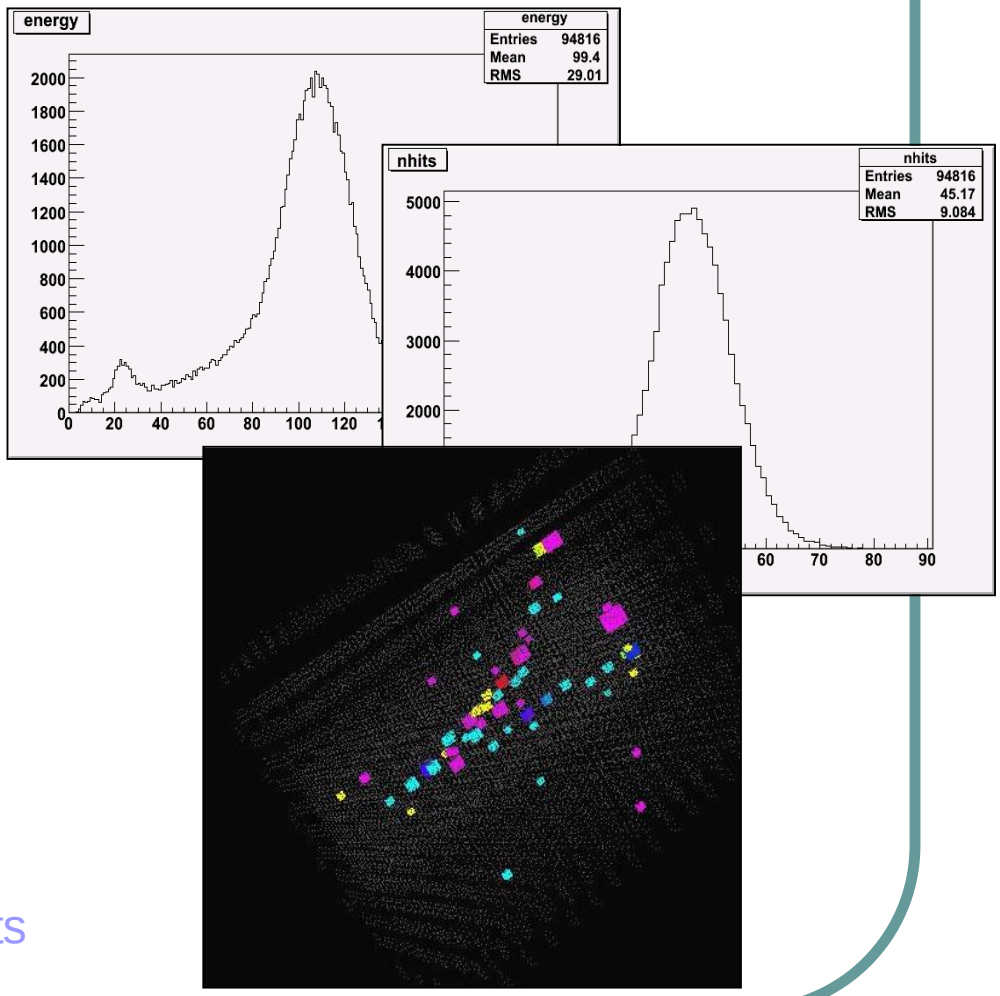
Light yield of one cell

$$N_{ph.e.} = f_{resp}(N_{pix}) = N_{pix} \cdot f_{corr}(N_{pix})$$

Current release of HCAL software

Complete recontruction chain:

- MappingI
  - ADCBlocks → CaliceHits1
- PedestalCalibration
  - CaliceHits1 → CaliceHits2
- GainCalibration
  - CaliceHits2 → CaliceHits3
- InterCalibration
  - CaliceHits3 → CaliceHits4
- SaturationCorrection
  - CaliceHits2, CaliceHits4 → CaliceHits5
- MIPCalibration
  - CaliceHits5 → CaliceHits6
- MappingII
  - CaliceHits6 → CalorimeterHits



Current release of HCAL software

- Additional processors
  - Processor which provides DAQ parameters (V_{calib}, hold value, …) for each module (crate/slot/fe→moduleID)
  - EventDisplay
  - Processor to treat noisy/dead cells (no data base entries yet)

Next* release of HCAL software

*if you are particularly interested in one of the topics ask me for an unofficial version

- Next release of HCAL reconstruction software to be expected soon
- Improvements in the environment
  - New streamlined installation routine for complete software
  - Data base viewer included
  - Programs to extract complete sets of conditions data from data base (beam, temperature, HV, …)
  - Interlinked doxygen documentation for all used packages (calice-userlib, calice-reco, calice-gui, lcio, lccd, marlin, …)

Next* release of HCAL software

*if you are particularly interested in one of the topics ask for an unofficial version

- Usage of new coordinate system for ECAL and HCAL reconstruction
- Preliminiary alignment of ECAL and HCAL
  - Filled into database (/cd_calice_cernbeam/DetectorPosition)
- PIN diode mapping
  - Code available (S. Schätzel), values for August and October written to global data base (/cd_calice_cernbeam/Hcal/PINmap)
- Utility processors by B. Lutz (trigger selection, sampling fraction studies)

ILC software issues

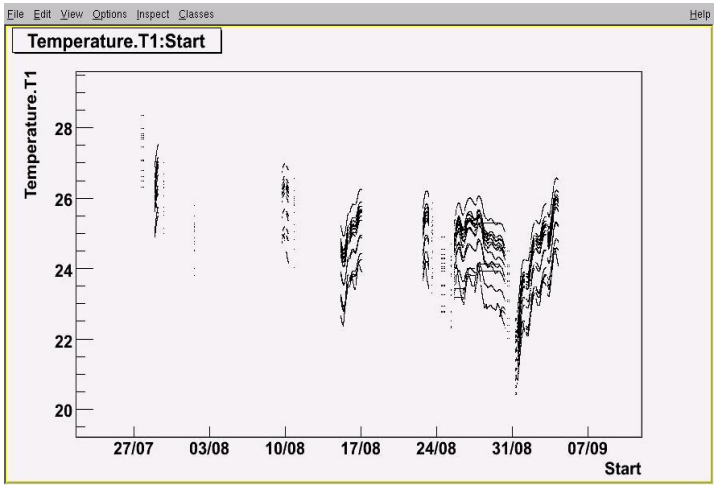
- LCCD bug causing heavy use of tcp connections fixed
- Envisaged extension of CalorimeterHit by optional error on energy
- Envisaged creation of CalibratedHit as replacement of unofficial FastCaliceHit
- No suitable official geometry package available on time range of CALICE test beam
- In general: IO performance of LCIO suboptimal (compare e.g. usage of .slcio file and .bin files with following on-the-fly conversion)
- Storage of collections in vectors in LCIO makes removing of objects (zero suppression!) expensive, lists instead of vectors would fit better for that purpose
- Use of shared libraries as Marlin “plugins” which have not to be linked with the complete Marlin executable would save compilation time

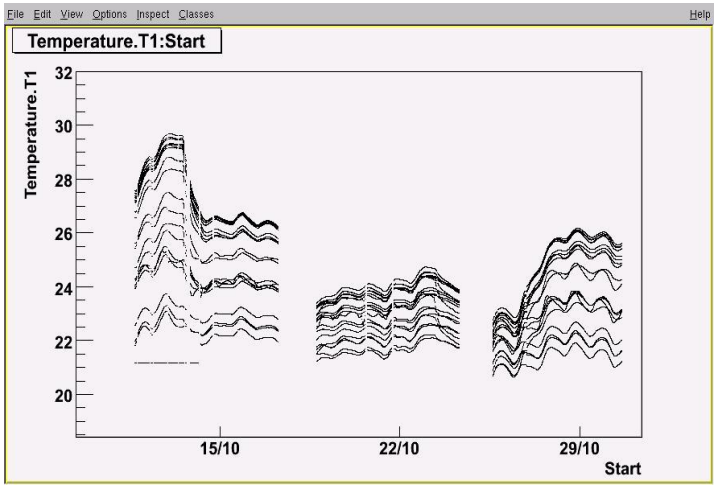
Exploiting our data base

- Conditions data are not yet widely used beyond Marlin processors
- Now: Important conditions data provided as root trees
  - Run properties (start time, end time, run types, …)
  - Slow control data (HCAL module HV, LV, temperatures, …)
  - Beam properties (magnet currents, instrumentation positions, …)

Exploiting our data base

- Quality of conditions data base content sometimes low
  - Temperature sensors got stuck, give unreasonably high values, are not read out correctly
  - High voltage of HCAL modules only available for HV channel 1
  - Run types lost during conversion to lcio
  - Ambiguous positions of beam instrumentation
- After fixing those problems manually/by educated guesses data gets interesting
- Should be supervised better during next running period





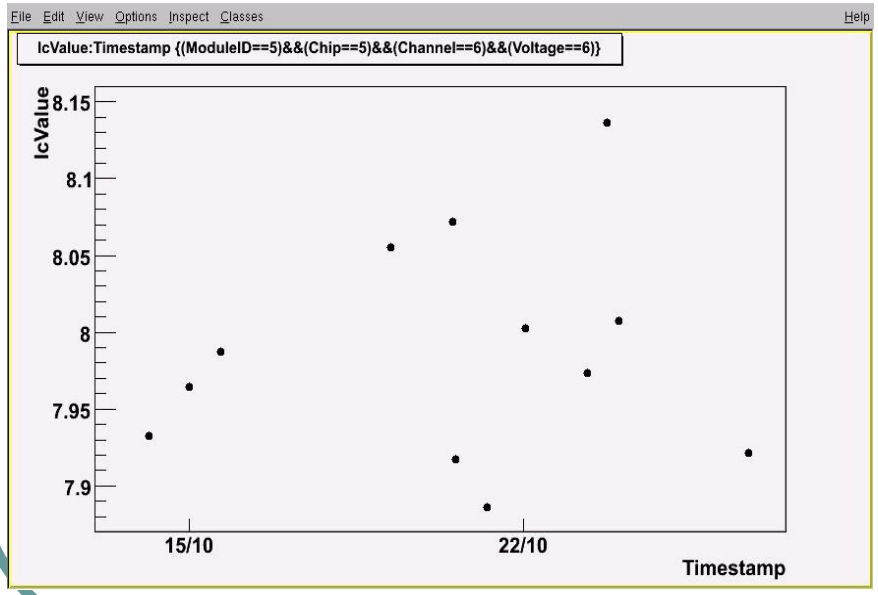
Exploiting our data base

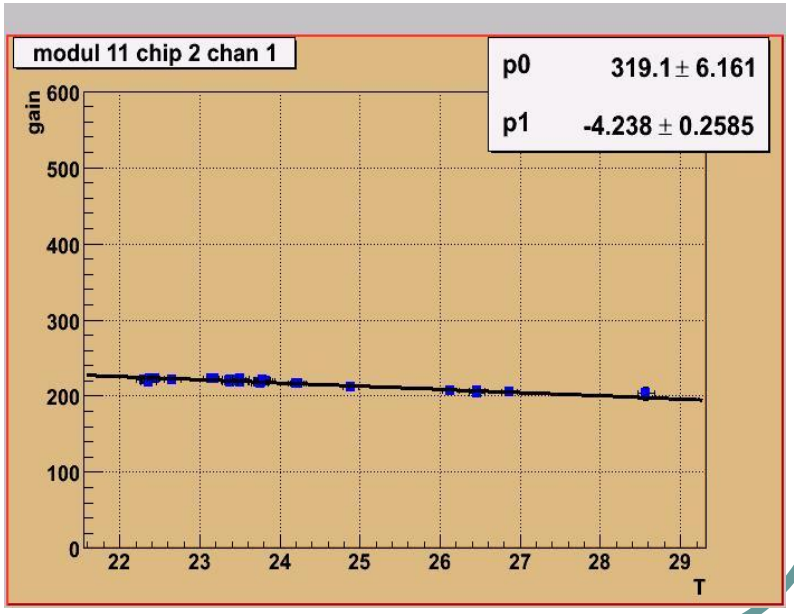
- Combine HV, beam instrumentation, run properties to run info tree
- Some bugs/typos in the elog have already been found by cross checking

Run number	Start time	duration	Beam instr.	Energy	Particles	Voltage	Run Type	
321050:	18.10.2006	11:05:40	00:02:23	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLedVcalibScan
321051:	18.10.2006	11:10:34	00:00:30	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLedVcalibScan
321052:	18.10.2006	11:11:09	01:36:54	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLedVcalibScan
321053:	18.10.2006	13:01:25	00:57:10	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcPmLedVcalibScan
321054:	18.10.2006	14:05:23	00:04:50	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLedVcalibScan
321055:	18.10.2006	14:13:43	00:04:02	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLed
321056:	18.10.2006	14:21:37	00:04:48	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLedVcalibScan
321057:	18.10.2006	14:29:43	00:04:46	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLedVcalibScan
321058:	18.10.2006	14:34:48	00:05:58	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcPmLedVcalibScan
321059:	18.10.2006	14:45:37	00:16:45	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcGain
321060:	18.10.2006	15:03:52	00:54:14	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLedVcalibScan
321061:	18.10.2006	15:58:30	00:05:31	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcPmLedHoldScan
321062:	18.10.2006	16:04:17	00:54:05	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcPmLedVcalibScan
321063:	18.10.2006	17:00:04	00:05:43	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcPmNoise
321064:	18.10.2006	17:06:03	00:05:44	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmNoise
321065:	18.10.2006	17:17:39	00:04:51	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcCmLedVcalibScan
321066:	18.10.2006	17:22:51	00:06:09	8mmPb 2 Air	80 GeV	pi-	Nom	ahc	ahcPmLedVcalibScan
321067:	23.10.2006	09:15:05	00:48:00	Air 1 ?	50 GeV	?	Nom+0.6V	beam	beamData
321069:	23.10.2006	11:04:42	01:25:43	Air 1 6mmPb	15 GeV	e+	Nom+0.6V	beam	beamData
321070:	23.10.2006	12:32:58	01:03:48	Air 1 6mmPb	20 GeV	e+	Nom+0.6V	beam	beamData
321071:	23.10.2006	13:40:29	02:29:29	Air 1 6mmPb	10 GeV	e+	Nom+0.6V	beam	beamData
321072:	23.10.2006	16:21:55	00:00:19	Air 1 6mmPb	50 GeV	e+	Nom+0.6V	beam	beamData
321073:	23.10.2006	16:27:05	00:48:55	Air 1 6mmPb	50 GeV	e+	Nom+0.6V	beam	beamData
321074:	23.10.2006	17:38:58	00:15:17	Air 1 6mmPb	10 GeV	e+	Nom+0.6V	ahc	ahcGain
321075:	23.10.2006	17:57:27	00:05:22	Air 1 ?	50 GeV	?	Nom+0.6V	ahc	ahcPmLedVcalibScan
321076:	23.10.2006	18:04:51	00:03:30	Air 1 6mmPb	10 GeV	e+	Nom+0.6V	ahc	ahcCmLedVcalibScan
321077:	23.10.2006	18:09:10	00:05:47	Air 1 6mmPb	50 GeV	e+	Nom+0.6V	ahc	ahcPmNoise
321078:	23.10.2006	18:17:42	00:11:24	Air 1 6mmPb	10 GeV	e+	Nom+0.6V	ahc	ahcCmNoise
321079:	23.10.2006	18:31:35	00:15:07	Air 1 6mmPb	10 GeV	e+	Nom+0.6V	ahc	ahcGain
321080:	23.10.2006	19:16:45	00:15:04	Air 1 6mmPb	50 GeV	e+	Nom+0.6V	ahc	ahcGain
321081:	23.10.2006	19:34:00	00:13:06	Air 1 6mmPb	10 GeV	e+	Nom+0.6V	ahc	ahcGain
321082:	23.10.20	:59:48	00:	Air	Ge	Nor	beam	bea	
321083:	23.10.20	:24:49	00:	Air	Ge	Nor	beam	bea	
321084:	23.10.20	:50:49	00:	Air	Ge	Nor	beam	bea	
321085:	23.10.20	:46:36	00:	Air	Ge	Nor	beam	bea	
321086:	23.10.20	:16:32	00:	Air	Ge	Nor	beam	bea	
321087:	23.10.20	:27:50	00:	Air	Ge	Nor	ahc	ahc	
321088:	23.10.20	:46:32	00:	Air	Ge	Nor	ahc	ahc	calibScan
321089:	23.10.20	:49:00	00:	Air	Ge	Nor	beam	bea	
321090:	23.10.20	:30:58	00:	Air	Ge	Nor	beam	bea	
321091:	23.10.20	:36:09	00:	Air	Ge	Nor	beam	bea	
321092:	23.10.20	23:44:44	00:	Air	Ge	Nor	beam	bea	

Exploiting our data base

- Root tree for calibration constant studies available
- Includes all intercalibration and gain measurements for all modules and cells
- Includes x, y of cell positions, extrapolated cell temperatures, module high voltage

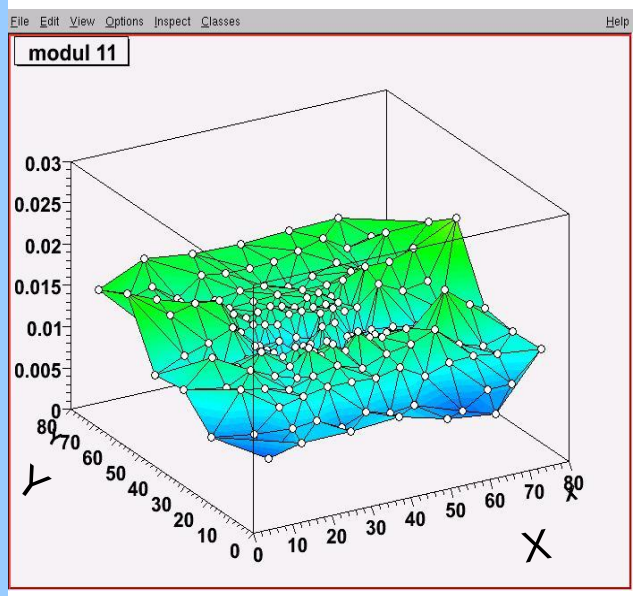


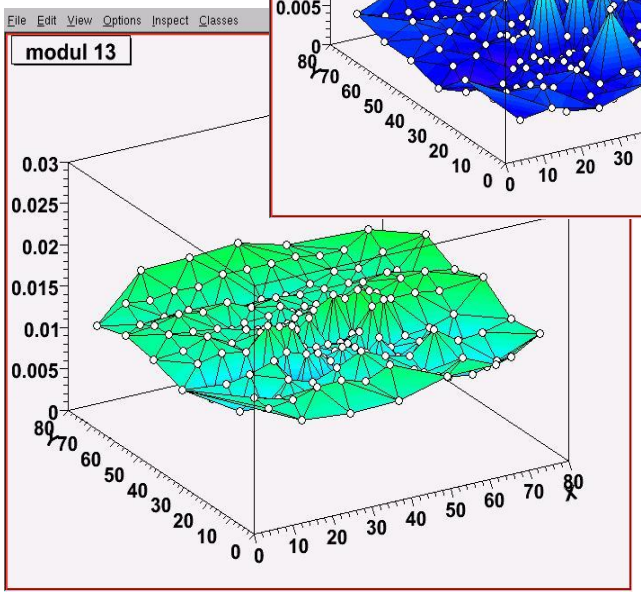


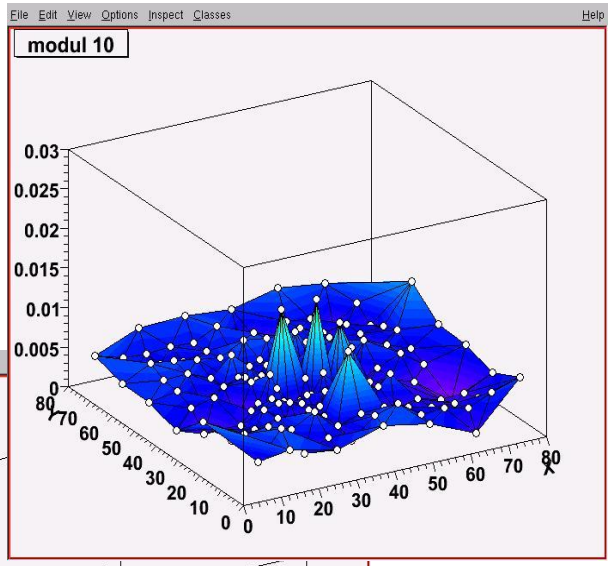
Exploiting our data base

- Next steps could be:
  - Study temperature gradients in different modules
  - Extract temperature dependent gain calibrations

Negative relative gain change per degree







Summary & outlook

- First version of complete HCAL reconstruction chain available since Xmas
- New version to be expected soon including:
  - Alignment, pin diode handling, trigger selection, improved installation, more documentation, data base tools, conditions data root trees, …
- Next steps planned
  - Include digitization into framework
  - Include tail catcher geometry and reconstruction
  - Temperature dependent calibration