HMB Status

Firmware



EUDAQ Readout



EUDAQ Config Files



- Contains all Information for operate the Detector
- Is stored for each run
- Can contain optional information such as conditions
- Contains a threshold Value for each Channel
- Contains a global threshold value
- Actual threshold is calculated by: Thr_actual = Thr_global + Thr_channel

Calibration



- Threshold Scan using "Scaler Module" in Firmware
- Gauss Fit Thr_Channel
 = Gauss_mean – 5 * gauss_std
- Problem not all channels are as clean as the top one.

- Example File: run241_201121104115.raw Size: 1.3 GB
- Converting to CSV Size 5.1 GB
- Converting to ROOT Size 0.5 GB
- Extracting True Hits* Size 9.4 MB

- CSV files were created to use with pandas
 - → Files to big for pandas
 - → Converted it to root TTrees

* This file contains more then just True Hits

Conversion From CSV to ROOT



- Open output ROOT File
- Open input CSV
- Filter data for valid Plane ID
- X and Y Correspond to Channel Number and ASIC Number
- Convert to 1d Coordinates
 - Add Axis
 - Add Position
- Group by event number

*Could have been done directly from EUDAQ to ROOT

Extracting True Hits and Clustering Part 1

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_	macros > 🕒														
Q	137	void clu	stering(std::st	ring Inp	utFile, st	d::stri	ig outputF:	ile, int ru	ınNumber)	{		THE REAL PROPERTY.		
	<pre>138 139 auto configFile = config()[runNumber]; 140 auto m_file2 = Snew TFile(InputFile.c_str()); 141 auto raw_file = Snew EUTFile(m_file2); 142 TFile * out file1 = new TFile(outputFile.c_str(), "recreate"); 143 temp_var(raw_data) = raw_file->getCollection(collectionName_t("all_grouped"))->getPlane(ID_t(0)); 144 145 146 raw_data["trigger"] = lambda3(PlaneID.x, v) {</pre>														
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	151	}	recurir 1										-		
رهی	152	retu	rn 0;										10, 100, 100 (10, 10, 10, 10, 10, 10, 10, 10, 10, 10,		
	153	};													
	154	<u>var(tr</u>	igger) =	raw_da	ta[raw_d	lata["trigg	ger"] ==1	l];					, 222/02 /100000		
	155	temp_v	ar(data)	= raw_	data[raw	_data["tri	igger"] =	== 0];							
	156														
	157	temp_v	ar(data_	joined_u	with_tri	gger_valid	l_planes)) = join(da	ata, trigge	er, {"Plan	eID" , "Charge"	});			
	158														

- Load Analysis Config FileOpen Input ROOT File
- Open output ROOT File
- Determine which hit is a trigger Hit
- Splitting data and trigger
- Cross Correlate all trigger with all data (hits)

Extracting True Hits and Clustering Part 2

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Q	155	temp_va	ar(<u>data</u>) = raw_	data[raw_data["tri	gger"] == 0];								
1	157	<pre>temp_var(data joined with trigger_valid_planes) = join(data, trigger, {"PlaneID" , "Charge"});</pre>											
የօ	158		- ····································										
632	159												
	160	data_jo	oined_with_trig	ger_valid_planes["	isTriggered"] = 1	ambda3(PlaneID, <u>TimeSt</u>	tamp2, TimeStamp	<u>(1)</u> {					
±\$	161	auto if(co	delta = limest	amp2-limeStampi; TD] LookbackStart ·	fine < delta								
	163												
G	164	C	delta < configF	ile[PlaneID].Lookb	ackStop_fine){								
	165	return 1;											
н <mark>о</mark>	166 167	} if(co	onfigEilo[D]ano	TD] LookhackStant	< dalta								
ш	168		&&	IDJ.LOOKDACKStart	< ueita								
			delta < configF	ile[PlaneID].Lookb	ackStop){								
	170	r r	return 2;										
	171	}											
	172	retur ۱	rn 0;										
	174	temp va	ar(ref hits pro	to) = data joined (with trigger vali	d planes[data joined	with trigger va	alid planes["isT	riggered"] > 0];				
	175	var(ref	f_hits) = sct::	select(ref_hits_pr	oto, {"x1","y1","	TimeStamp1","TimeStan	np2","isTriggere	d", "Charge1","	Charge2","PlaneID"});				
	176												
	177	tomp v	n(truchite pro	to) - data joinad (with thiggon vali	d mlanas[data joinad	with thiggon w	lid planas["isT	niggonod"l 1].				
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	180	var(trı	ueHits) = sct::	drop(trueHits_prot	o, {"x2","y2","Ti	meStamp2","trigger1",	,						
	181				"trigger2","Ru	nNumber2","EventNumbe	er2",						
	182				"axis2","posit	ion2","isTriggered",							
	183				indexi, ind	ex2 , Charge2 });							
	185	var(clu	ustered) = sct:	:clustering(trueHi	ts,								
	186			<pre>cl_conf("position")</pre>	1", 1)+								
	187			<pre>cl_conf("axis1",</pre>	0) +								
	188			<pre>cl_conf("PlaneID" cl_conf("Change"</pre>	, 0)+ 0)								
	190);	er_conn(charge ,	0)								
8	191	raw_fi]	le->getProcesso	rCollection()->loo	p();								
	192	out_fi	le1->Write();										
£03	193	}											
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- Use determine the difference between each data hit and the trigger hit
- If time difference is smaller than lookback window mark hit as either coarse hit or as fine hit (true hit)
- Drop all unneeded coulumns
- Store ref hits (coarse hits + fine hits)
- Store true hits (fine hits)
- Cluster true hits
 - A cluster is absolute distance between two hits is not larger then:

cl_conf("position1", 1)+ // Adjasent hits

- cl_conf("axis1", 0) + // same axis
- cl_conf("PlaneID", 0)+
- // same planeID

Cluster Study







- Cluster Size is almost always zero
- Cluster ID: each cluster for each event gets a unique ID starting from 0

Ref_hits



- Collection ref_hits allows to investigate the signal to noise ratio
 - SNR = Signal in ROI / Expected noise hits in ROI
- Ref_hits is used to determine the 1d hit rate

Hitmaking

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	<pre>macros > G HitMaker.cc > 1 void HitMaker(std::string InputFile, std::string outputFile, int runNumber) { 2 3 auto m_file2 = Snew IFile(InputFile.c_str()); 4 auto raw_file = Snew EUTFile(m_file2); 5 IFile * out_file1 = new IFile(outputFile.c_str(), "recreate"); 6 temp_var(trueHits) = raw_file->getCollection(collectionName_t("trueHits"))->getPlane(ID_t(0)); 7 8 9 temp_var(trueHits_x) = trueHits[trueHits["axis1"] ==0]; 10 temp_var(trueHits_y) = trueHits[trueHits["axis1"] == 1];</pre>											
₿	11 12 13	<pre>11 temp_var(trueHits_2d_canditates) = join(trueHits_x, trueHits_y, {"PlaneID", "Charge"}); 12 13 trueHits_2d_canditates["x"] = lambda1(position11){ return position11; };</pre>										
\sum	15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	trueHi trueHi trueHi var(tr	<pre>ts_2d_canditate ts_2d_canditate ts_2d_canditate ts_2d_canditate ts_2d_canditate ueHits_2d) = sc "position11","p "TimeStamp11", "axis11","axis1 "RunNumber12"," "EventNumber12");</pre>	<pre>ss["y"] = lambda1(p ss["TimeStamp"] = 1 es["RunNumber"] = 1 es["EventNumber"] = st::drop(trueHits_2 position12", "TimeStamp12", 2","RunNumber11", 'ventNumber11", ',"index1","index2"</pre>	<pre>osition12){ return ambda1(TimeStamp11 ambda1(RunNumber11 ambda1(EventNumb d_canditates, { } }</pre>	n position12; };){ return TimeSt){ return RunNu per11){ return E	:amp11; }; imber11; }; iventNumber11; };					
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- Open Files
- Get Collection of true hits
- Separate 1d hits by axis
- Cross corelate 1d hits of different axis
- Rename columns to keep names consistent
- Drop unneeded columns

Correlate different planes (Track maker)

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		temp \	<pre>var(trueHits) =</pre>	raw file->getColle	ection(collectionN	ame t("trueHits"))->getPlane(ID t	(0));				
_ ₽						vinnan '						
		temp_\	<pre>var(trueHits_x)</pre>	<pre>= trueHits[trueHit</pre>	ts["axis1"] ==0];							
⊑ ⊘	10	<pre>temp_var(trueHits y) = trueHits[trueHits["axis1"] == 1]; temp_var(trueHits 2d conditates) = isis(trueHits x = trueHits y = ("Discorp" = "Charge"));</pre>										
_	12	temp_\	/ar(trueHits_2d_	canditates) = joir	(trueHits_x, true	Hits_y, { PlanelD	, Charge });					
ß	13	trueHi	its 2d canditate	s["x"] = lambda1(r	position11){ retur	n position11: }:						
	14					···, , , , ,						
\sum	15	trueHi	its_2d_canditate	s["y"] = lambda1(<pre>position12){ retur</pre>	<pre>n position12; };</pre>						
		trueHi	its_2d_canditate	es["TimeStamp"] =]	lambda1(TimeStamp1	1){ return TimeSt	amp11;					
	17	trueHi	ts_2d_canditate	s["RunNumber"] = 1	lambda1(RunNumber1	1){ return RunNu	mber11;					
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			"RunNumber12",'	'EventNumber11",								
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	20	temp_\	var(trueHits_2d	plane (2) = trueHi	its_20[trueHits_20]	["PlaneTD"] == 2];	1.					
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Get all 2d Hits from plane 2 and correlate them with all hits from plane 12

Time Correlation



Clear linear run off between the two Scrod boards

Correcting Jitter between the two Planes

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ပို ၀ ၀ <mark>32</mark>	151 152 153	<pre>temp_var(trueHits_x) = trueHits[trueHits["axis1"] ==0]; temp_var(trueHits_y) = trueHits[trueHits["axis1"] == 1]; temp_var(trueHits_2d canditates) = join(trueHits_x, trueHits_y, {"PlaneID", "Charge"});</pre>										
â	154 155	<pre>4 5 trueHits_2d_canditates["x"] = lambda1(position11){ return position11; };</pre>										
Ľ₫	<pre>156 157 158 159 160 160 160 179 160 160 179 160 179 160 179 160 179 160 179 179 179 179 179 179 179 179 179 179</pre>											
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$\mathbf{\Sigma}$		trueHi	ts_2d_candit	ates["EventNumber"]	= lambda1(EventNum	ber11){ return E	<pre>ventNumber11; };</pre>					n Arananan Mara
	164 165 166 167 168 169 170 171	var(tr	<pre>ueHits_2d) = "position11" "TimeStamp11 "axis11","ax "RunNumber12 "EventNumber);</pre>	<pre>sct::drop(trueHits_ "position12", ", "TimeStamp12", is12","RunNumber11", ","EventNumber11", 12","index1","index2</pre>	2d_canditates, { " }							
	<pre>171 172 temp_var(trueHits_2d_plane_2) = trueHits_2d[trueHits_2d["PlaneID"] ==2]; 173 temp_var(trueHits_2d_plane_12) = trueHits_2d[trueHits_2d["PlaneID"] == 12]; 174 temp_var(trueHits_2plane_2d_canditates) = join(trueHits_2d_plane_2, trueHits_2d_plane_12, 175 {"EventNumber"}); 176</pre>											
	177 178 179 180 181	trueHi re };	ts_2plane_2d turn TMath:	_canditates["isInTim :Abs(TimeStamp1 - Ti	e"] = lambda3(Time meStamp2) < confi	Stamp1,TimeStamp2 gFile[PlaneID1].T	,PlaneID1){ S_Cut ;					
8	182 183 184	var(tr raw_fi out_fi	ueHits_2plan le->getProce le1->Write()	e_2d) = trueHits_2pl ssorCollection()->lo ;	ane_2d_canditates[op();	trueHits_2plane_2	d_canditates["isInTi	ime"] > 0];				
£23		}										

- Correcting for Time Stamp drift
- Cut on time stamp



Correlation



Run 233



Run 234



- Low thresholds seem to block the readout
- Detector is always busy → blocked

Multiple readout Frames per Event



Unique Tracks

4	File Edit	Selection	View Go Run	Terminal Help	HitMaker	.cc - SCT_Correlations2 -	- Visual Studio Code						
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90 034	172 173 174	}; trueHi trueHi	<pre>}; trueHits_2d_canditates["RunNumber"] = lambda1(RunNumber11){ return RunNumber11; }; trueHits_2d_canditates["EventNumber"] = lambda1(EventNumber11){ return EventNumber11; };</pre>										
e⊳ ─	175 176 177	<u>var(tr</u>	<pre>pueHits 2d) = sc "position11","pe "TimeStarm11"</pre>	t::drop(trueHits_2 osition12",	d_canditates, {								
-0 -0	178 179 180		"axis11","axis1 "RunNumber12","	<pre>TimeStamp12 , 2","RunNumber11", EventNumber11", "indox1" "indox2"</pre>	l								
	181 182 183 184	temp);	, indexi , indexz	s 2d[trueHits_2d["PlaneTD"121.							
	184 185 186 187 188	temp_v temp_v var(tr {"Ever	<pre>temp_var(trueHits_2d_plane_2) = trueHits_2d[trueHits_2d["PlaneID"] ==2]; temp_var(trueHits_2d_plane_12) = trueHits_2d[trueHits_2d["PlaneID"] == 12]; var(trueHits_2plane_2d_canditates) = join(trueHits_2d_plane_2, trueHits_2d_plane_12, {"EventNumber"});</pre>										
	199 190 191 192 193	trueHi re };	its_2plane_2d_ca eturn TMath::Ab	nditates["isInTime s(TimeStamp1 - Tim	"] = lambda3(Time eStamp2) < confi	Stamp1,TimeStamp2 gFile[PlaneID1].T	?,PlaneID1){ S_Cut ;						
	194 195 196	var(tr	rueHits_2plane_2 rueHits_2plane_2	d) = trueHits_2pla d unique) = sct::e	ne_2d_canditates[numerate occurren	trueHits_2plane_2 ce(d_canditates["is:	InTime"] > 0];					
	197 198 199 200			trueH {"Tim);	its_2plane_2d, eStamp1", "TimeSt	amp2" ,"y1","y2",	"x1","x2" }						
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- Only take first occurrence of event
- Reduces the number of hits by a factor of 10
- Correlation plots stay unchanged
- Hit rate stay the same since the number of triggers is also reduced by a factor of 10
- First occurrence is either the first or the second data frame in event

1d Hit Efficiency

 $Efficiency = \frac{Count \ of \ Unique \ 1d \ true \ hits \ time \ stamps}{Count \ of \ Unique \ Trigger \ Time \ Stamps}$

Run227 1d Efficiency = 38%