EMCal LEDs Testing

Apurva Narde

University of Illinois Urbana-Champaign

May 1, 2023

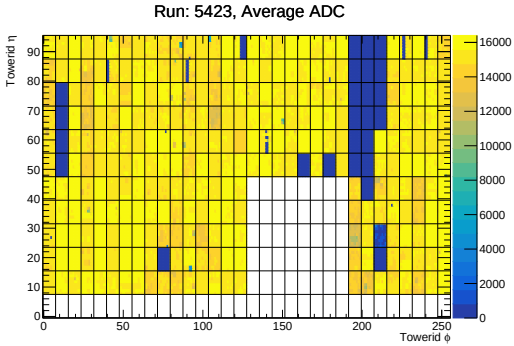
LEDs and Test Pulses

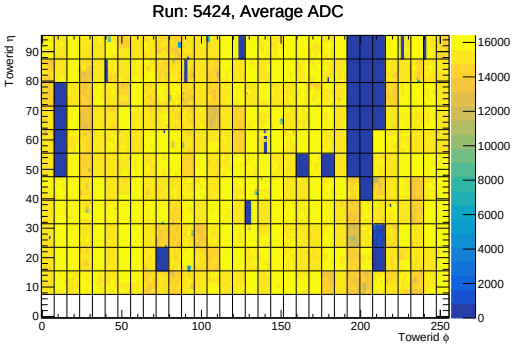
- Goal is to pulse LED's and preamplifier independently to test the performance of the SiPM's (Silicon Photomultipliers).
- Electronics to readout chain: Signal $\rightarrow$ SiPM $\rightarrow$ Readout.
- LED's go in place of "Signal".
- Test pulse circumvents the SiPM and goes directly to readout.
- Test pulses act as the ideal response whereas LEDs are used to measure the performance of the SiPMs.

Data Processing

- EMCal data: /direct/sphenix+lustre01/sphnxpro/commissioning/emcal/calib
  - Contains test pulse and led data.
- Files stored in PHENIX raw-data format (PRDF) contain the packets from the data-collection modules (DCMs).
- 1 sector = 2 packets, 1 packet = 3 IBs, 1 IB = 64 channels.
- Each event contains data for peak location, ADC, and pedestal for given channel.

Channel Performance, Average ADC

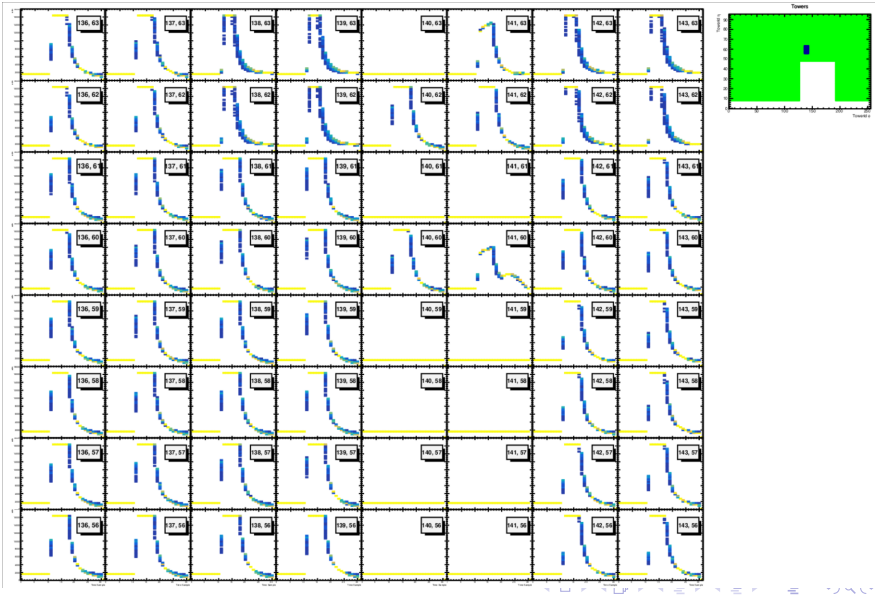




- Average ADC value shown per channel.
- Grid drawn to show groups of 64 channels (IB).
- Easy to identify which group of channels are under-performing and their location in terms of towerids.

Waveforms

- Waveforms aggregated over multiple events.
- Waveforms organized by IB.
- Allows us to identify bad readout channels.

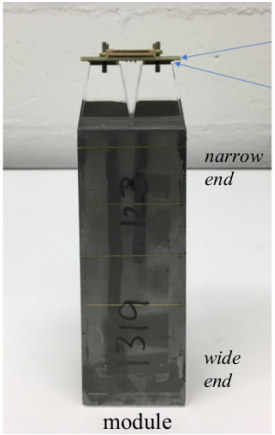


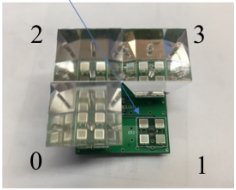
Summary

- Development of a framework to evaluate performance of the readout channels.
- Analyzing PRDFs collected from test pulses and LEDs.
- Identifying plotting schemes to quickly identify bad channels.

Blocks, Towers, and SiPMs

- Each block has four towers (readout channels) with four SiPMs (Silicon Photomultipliers) each, resulting in a total of:
  - 24,576 readout channels
  - 98,304 SiPMs
  - 16.5 million fibers.
- There are 1,560 scintillating fibers extending along the length direction are embedded in the block.
- Each tower represents 1 ADC (Analog-to-digital converter) readout channel and is equipped with a light guide coupled to 4 SiPMs that collect the light from the fibers.





4 towers per block
with channel ordering

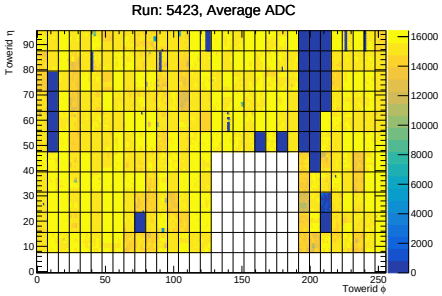
Readout Channels and Interface Board

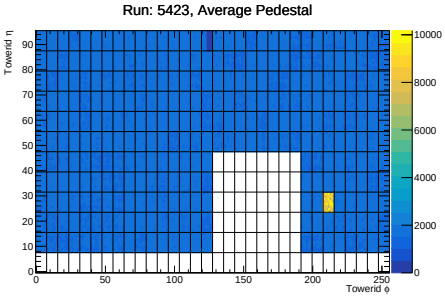
- There are $96 \times 4 = 384$ distinctive ADC channels in each sector.
- No physical boundary between neighboring readout towers within a block.
- Channels are organized into groups of 64, each group (6 total) controlled by an interface board (IB).

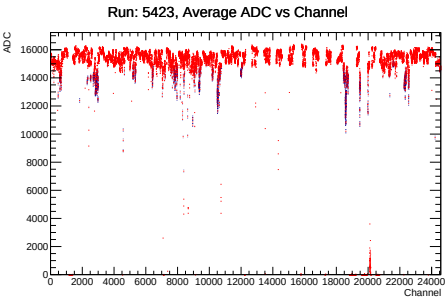
1 block	IB0								IB1								IB2								IB3								IB4								IB5							
	62	63	58	59	54	55	50	51	126	127	122	123	118	119	114	115	190	191	186	187	182	183	178	179	254	255	250	251	246	247	242	243	318	319	314	315	310	311	306	307	382	383	378	379	374	375	370	371
	60	61	56	57	52	53	48	49	124	125	120	121	116	117	112	113	188	189	184	185	180	181	176	177	252	253	248	249	244	245	240	241	316	317	312	313	308	309	304	305	380	381	376	377	372	373	368	369
	46	47	42	43	38	39	34	35	110	111	106	107	102	103	98	99	174	175	170	171	166	167	162	163	238	239	234	235	230	231	226	227	302	303	298	299	294	295	290	291	366	367	362	363	358	359	354	355
	44	45	40	41	36	37	32	33	108	109	104	105	100	101	96	97	172	173	168	169	164	165	160	161	236	237	232	233	228	229	224	225	300	301	296	297	292	293	288	289	364	365	360	361	356	357	352	353
	30	31	26	27	22	23	18	19	94	95	90	91	86	87	82	83	158	159	154	155	150	151	146	147	222	223	218	219	214	215	210	211	286	287	282	283	278	279	274	275	350	351	346	347	342	343	338	339
	28	29	24	25	20	21	16	17	92	93	88	89	84	85	80	81	156	157	152	153	148	149	144	145	220	221	216	217	212	213	208	209	284	285	280	281	276	277	272	273	348	349	344	345	340	341	336	337
	14	15	10	11	6	7	2	3	78	79	74	75	70	71	66	67	142	143	138	139	134	135	130	131	206	207	202	203	198	199	194	195	270	271	266	267	262	263	258	259	334	335	330	331	326	327	322	323
	12	13	8	9	4	5	0	1	76	77	72	73	68	69	64	65	140	141	136	137	132	133	128	129	204	205	200	201	196	197	192	193	268	269	264	265	260	261	256	257	332	333	328	329	324	325	320	321

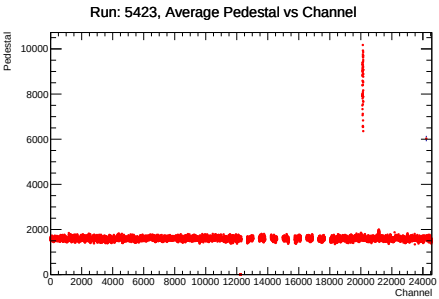
blocks 1-23 1 readout channel blocks 24

Run 5423 Evaluation

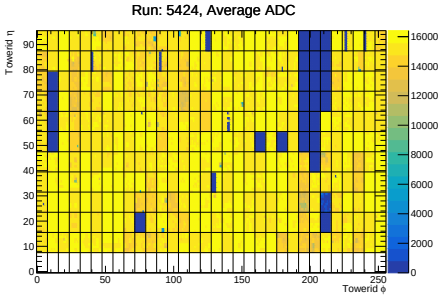


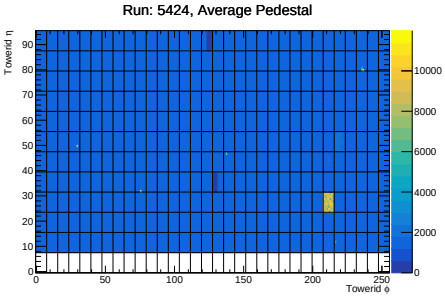


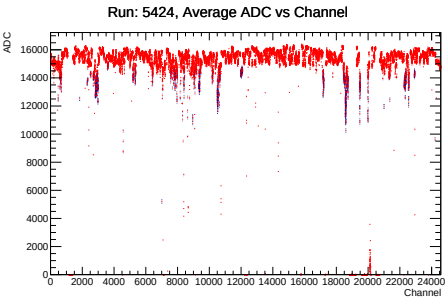


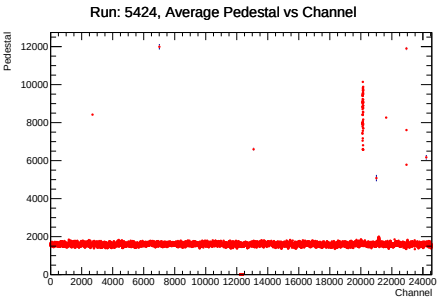


Run 5424 Evaluation

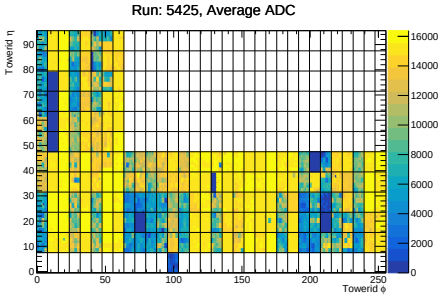


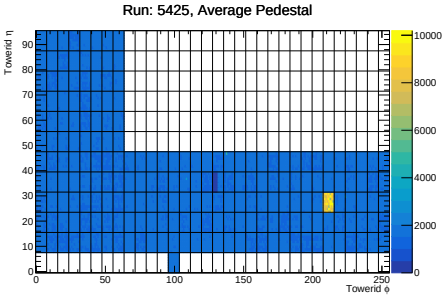


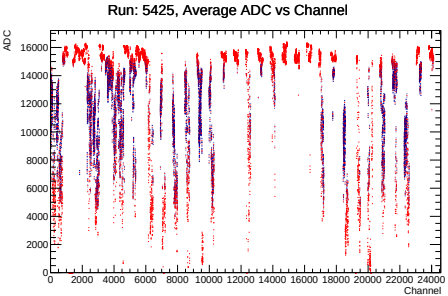


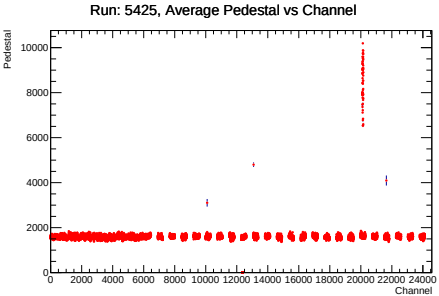


Run 5425 Evaluation

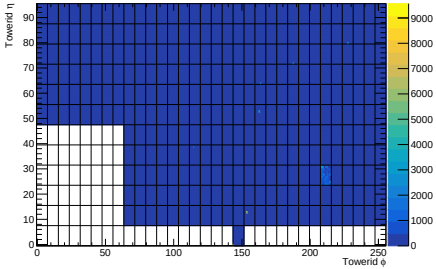


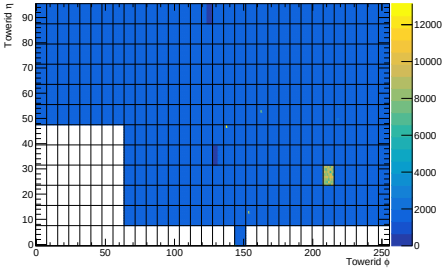


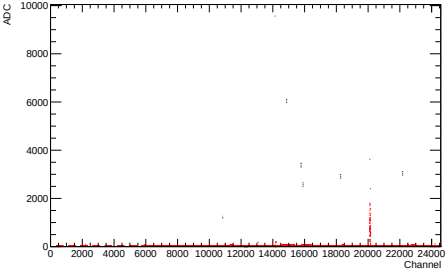


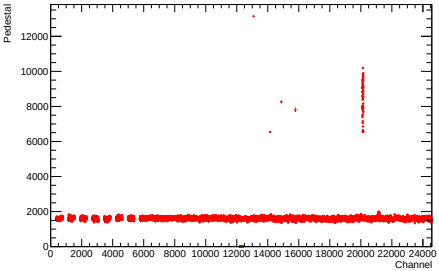
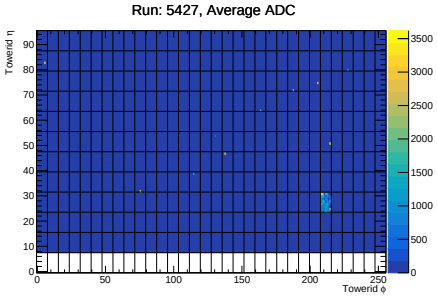
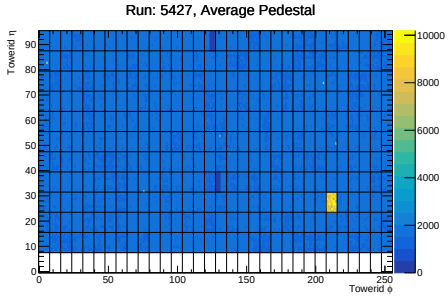
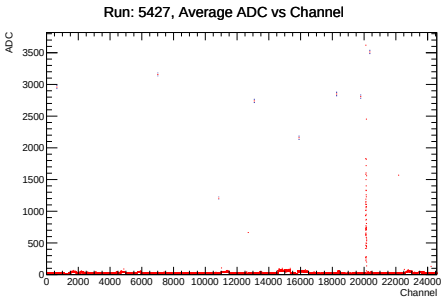
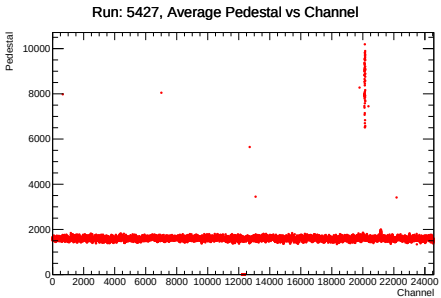


Run 5426 Evaluation









Run 5427 Evaluation