# PRad HyCal Calibration Update PRad weekly meeting

Li Ye Mississippi State University 2016-09-16

#### cluster position



12 channels have abnormal ADC distribution G130 G131 G132 G133 G134 G135 G171 G572 G732 W528 W630 W891 find our the reason is dead Dynode channel

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		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	G18	G19	G20	G21	G22	G23	G24	0.05		0.07												
		G31	G32	G33	G34	G35	G36	G37	G38	G39	G40	G41	G42	G43	G44	G45	G46	G47	G48	G49	G50	G51	G52	G53	G54	625	GZB	GZ7	628	629	630									
	- (	G61	G62	G63	G64	G65	G66	007	000	009	070	671	672	673	G74	G75	G76	G77	G78	G79	G80	G81	G82	G83	G84	-G55	G56	G57	G58	G59	. 560	-		. D		щ	000	00	0	٦ <i>4</i>
		G91	G92	G93	G94	695	G96	G97	G98	699	G100	G101	G102	G103	G104	G105	G106	G107	G108	G109	9 G110	G111	G1 12	6113	G114	G85	G86	G87	G88	G89	G90	_	use	e K	lur	1#8	\$90	89.	3 85	14
10		G121	G122	G123	G124	G125	G126	G127	G128	3 G129	G130	G131	G132	G133	G134	G135	G136	G137	G138	G139	G140	G141	G142	G143	G144	G115	G116	G117	G118	G119	G120		10	<u>^0/</u>	′ .1	lat.	t.		C	5
40		6151	6152	6153	6154	6155	G156	6157	G158	3 6159	G160	1 6161	G162	G163	6164	G165	G166	G167	6168	G169	6170	6171	6172	6173	6174	G145	G146	GT#7	0148	6149	G150		10	0%	o a	lala	i si	uay	GC	))
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	G2	11 G2	12 G2	21.3 G2	14 G2	215 0	5216 W	03 104	105 106 W M	w и 107 108 w и	w м 109 110 w м	v N 111 112 V N	113 11- W N	4 115 1 W N	16 117 W	w w 11.8 119 w w	w w 120 121 w w	w w 122 123 W W	w w 124 125 W W	W W 126 1 W W	27 128 13	и 130 И	w N 131 132 W N	w w 133 134 W W	N N 136 138 N N	G235	G236	G237	G238	G239	G240									
	G24	41 G2	42 G2	243 G2	44 G2	245 0	5246	1 172 W 1	173 174	175 176 W H	177 178 W H	8 170 180 W N	181 18 W N	2 183 10 W M	84 185	185 187 W W	188 189	190 191 W W	192 193 W W	194 1 W W	95 198 11	23 164 27 198 W	199 200 W N	201 202 W W	20.5 204	G265	G266	G267	G268	G269	G270									
20	G2	71 G2	72 G2	273 G2	74 G	275 0	5276	05 206 : W 1 39 240 :	207 208 N M 241 242	209 210 W M 245 244	211 212 W M 245 248	2 215 214 W N 3 247 248	215 211 W N 249 25	6 217 2 W W 0 251 2	18 219 W 52 255	220 221 w w 254 255	222 223 W 258 257	224 W W 258 259	w w 260 281	408 1 W W 282 2	28 230 2 W W 85 284 24	51 232 W 55 265	233 234 267 268	235 236 269 270	237 238 H H 271 272	G295	G296	G297	G298	G299	G300	_	1194	- R	111	<b>h</b> #0	226	02	7 01	28
	G30	D1 G3	iO2 G3	503 G3	604 G.	305 0	306 2	73 274 : W 1	275 276	277 278 W M 311 312	279 280	281 282	283 28	4 286 2 W W	e6 287 w	268 289 W W	290 291 W W	292 293 W W	294 295 W W 478 328	296 2 M W	97 298 29 W W	89 300 W	301 302	303 304	305 305	G325	G326	G327	6528	G329	G330		usv		u	177 2	/20	92	192	20
	G33	31 G3	32 G3	533 G3	34 G	335 0	336	1 342	N M 343 344 N M	w и 345 346 w и	W M 347 348 W M	8 349 350 W N	W N 351 353 W N	2 353 3 W N	64 356 W	w w 366 357 w w	w w 368 359 w w	w w 360 361 w w	w w 362 363 w w	M W 364 3 M W	65 366 34 67 W W	и 57 365 И	W N 369 370 W N	W W 371 372 W W	M N 373 374 M N	G355	G356	G357	G358	G359	C360		10	<u>^0/</u>	ά d	late	a et	udv	W	$\gamma\gamma\gamma$
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	_ G39	91 G3	i92 G3	593 G3	94 G.	395 C	396	13 444 ·	445 446 W W 479 480	447 448 w # 481 482	449 450 W W 483 484	0 451 452 W N 4 485 488	453 45 W N 487 48	4 455 49 W W 8 489 49	56 457 W 90 491	458 459 W W 492 493	460 461 W W 494 495	462 463 W W 495 497	464 485 W W 498 499	466 4 M W 500 5	67 465 44 01 502 50	99 470 W 28 504	471 472 W N 505 505	473 474 W N 507 508	475 476 M M 509 510	6415	G416	G417	G418	G419	6420	_								
0	G42	21 G4	22 G4	123 G4	24 G4	125 0	G426	11 512 1	513 514	W W 515 016 W W	W W 517 618 W W 591 657	W N 3 519 620 W N	W N 521 525 W N	W W 2 523 50 W W	24 525	W W 525 527 W	W W 528 629 W	W W 530 531 W W	W W 532 533 W W	W W 534 5 W W	35 036 5. 4 W W	W 57 638 W	W N 539 640 W N 578 674	W N 541 542 W N 575 574	H N 545 544 H N 577 578	0445	0446	C447	C449	C449	0450									
0	G45	51 G4	52 G4	153 G4	54 G4	\$55 0	3456	W 1 9 580 1	N W 581 582 N W	W M 585 084 W M	W M 585 686 W M	V N 5 587 688 V N	W N 589 59	W W 0 591 59 W W	92 593	W 594 W W	W 697	W W 598 599 W W	W W 500 601 W W	W W 502 6	05 604 60 05 604 60	и 35 605 и	W N 607 608 W N	W W 609 610 W W	M N 511 612 W N	0440	0440	0447	0440	0449	0400									
	- G48	81 G4	82 G4	183 G4	-84 G4	185 0	3486	13 514 1 W 17 548 1	515 616 N M 549 550	617 618 W M 651 652	619 620 W W 653 654	0 621 622 W N 655 656	623 62- W N 657 650	+ 625 60 W W 8 559 60	26 627 W 60 561	628 629 W W 662 653	6.30 6.31 W W 664 655	632 633 W W 666 667	534 535 W W 568 659	636 6 W W 570 6	37 638 6. W W 71 672 6	99 640 M 73 674	641 642 W N 675 676	643 644 W N 677 678	545 546 H N 579 660	G475	G476	G477	6478	6479		-								
	G5 <sup>.</sup>	11 G5	12 G5	513 G5	514 G	515 0	3516 7	11 582 1 W 15 716	MB3 584 W M 717 718	685 686 W M 719 720	687 668 W H 721 722	8 689 690 W N 2 723 724	691 690 W N 725 721	2 693 69 W N 0 727 7.	94 595 W 28 729	696 697 W W 7.50 7.51	698 699 W W 732 753	700 701 W W 734 735	702 703 W W 736 737	704 2 W W 738 7	05 706 70 W W 39 740 74	07 708 W 1 742	709 710 W N 743 744	711 712 W W 745 746	71.5 714 H H 747 748	G505	G506	G507	G508	G509	G510									
	G54	41 G5	42 G5	543 G5	44 G	545 0	546	19 750 W	и и 751 752 и и	w и 753 754 w и	w и 755 756 w и	5 757 758	W N 759 754 W N	0 761 7	62 763 W	w w 764 765 w w	W W 766 767 W W	W W 768 769 W W	W W 770 771 W W	W W 772 7 W W	78 774 7: W W	и 75 776 и	W N 177 778 W N	W W 779 780 W W	W N 781 782 W N	G535	G536	G537	G538	G539	G540									
	G51	71 65	72 65	573 65	74 65	575 0	3576	17 818 1 W 1	785 786 W W 319 820 W W	W M 821 822 W M	785 750 W M 823 824 W M	V N 4 825 826	V N 827 821	4 /95 // W N 8 829 8 W N	40 /9/ 30 831	V W W 832 833 W W	800 801 W W 834 835 W W	802 803 W W 836 837 W W	804 805 W W 838 839 W W	800 0 W W 840 8 W W	07 808 84 41 842 84 41 942 94	ля 810 И ЦЗ 844 И	011 812 W N 845 846 W N	813 814 W W 847 848 W W	815 810 849 850 8 W	G565	G566	G567	G568	G569	6570 .	-								
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	G6.	31 G6	32 GE	533 GE	534 GE	535 C	3636	17 9585 1 W 1	и и 189 990 и и	W И 991 982 W И	W M 993 994 W M	V N R25 996 V N	W N 997 991 W N	W N 939 11 W N	w 000 1001 W	w w 1002 1905 W W	W W 1004 1005 W W	W W 1005 1007 W W	W W 1003 100 W W	W W 1010 1 W W	/ W W 011 1012 10 / W W	и 013 1014 И	W N 1015 1016 W N	W N 1017 1018 W N	M N 1019 102 M N	G655	G656	G657	G658	G659	G660									
	G66	61 G6	62 GE	563 G6	664 G6	665 0	3666	021 1022 W 1056 1056	1023 1024 N M 1057 1058	1025 1026 W M 1059 1060	1027 102 W M 1051 106	28 1029 1030 W N 52 1053 1064	1031 10 W N 1085 10	32 1033 10 W N 66 1067 10	034 1035 W 068 1069	1035 1037 W W 1070 1071 W W	1036 1039 W W 1072 1073	1040 1041 W W 1074 1075	1042 104. W W 1076 107	3 1044 1 W W 7 1078 1	045 1046 10 / W W 079 1050 10	247 1048 W 361 1052	1049 1050 W N 1083 1084	1051 1052 W W 1085 1086	1053 105 H N 1087 108	G685	G686	G687	G688	G689	G690 ·	-								
	G69	91 G6	92 GE	593 G6	94 G6	695 C	G696	1090 1090 W 123 1124	1091 1092 N M 1125 1126	1093 1094 W M 1127 1128	1095 109 W M 1129 113	36 1097 1098 W N 30 1131 1132	1099 111 W N 1133 113	00 1101 1 W N 34 1135 1	102 1103 W 136 1137	1104 1105 W W 1138 1139	1105 1107 W W 1140 1141	1108 1109 W W 1142 1143	0 1110 111 W W 5 1144 114	1 1112 1 W W 5 1146 1	113 1114 1 W W 147 1148 1	115 1118 M 149 1150	1117 1118 W N 1151 1152	1119 1120 W W 1153 1154	1121 112 W W 1155 115	g715	G716	G717	G718	G719	G720									
	G72	21 G7	'22 G7	723 G7	24 G	725 0	3726	5727	5728	G729 C	G730	G731 G	732 G	733 0	6734	G735 I	G736 G	737 G	5738 G	739	G740 G	741 (	6742	6743	6744 C	6745 G	746 G7	47 G7	48 G	'49 G7	50									
-40	G75	51 G7	'52 G7	753 G7	54 G	755 0	3756	757 0	5758	G759 0	5760	G761 G	762 G	763 C	5764	G765 I	G766 G	767 G	5768 G	769	G770 G	771 0	5772	5773 0	5774 0	5775 G	776 G7	77 G7	78 G7	79 G7	80	-								
	G78	81 G7	82 67	783 G7	'84 G	785	0	787	5788	G789 0	3790	G791 G	792 G	793 0	3794	G795 I	G796 G	797 G	798 G	799 (	G800 G	801 0	802	803 0	3804 0	805 G	806 G8	307 G8	108 G8	809 G8	10	_								
	G8	11 G8	12 G8	313 G8	514 G8	315	3816	817	818	G819	3820	G821 G	822 0	823 0	824	3825	G826 0	827 0	828 0	829	G830 0	831	832	833	834	835 0	836 05	37 08	38 09	39 68	40									
	G84	41 G8	42 G8	343 G8	44 G8	845 0	3846	947	040	0840	2850	0951 0	052 0	957 0	054	0055	0056	957 0	050 0	950		961	000	067	064	0000 000		67 09	60 00	00 00	70	1								
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	60				-	-4	0				-2	20				(	)				2	20				Z	10				6	50								

Calculate center module energy deposit percentage :

Percentage = reconstructed energy of this module\*100 / beam energy choose the best candidates











black No: ADC value on this module Yellow No: ADC\_module / ADC\_sum

#### W222 cluster ADC distribution 900 MeV



Sum 5 by 5 modules ADC get ADC\_sum for different energies pol1 is well fitting









#### G65 cluster ADC distribution 300 MeV



#### G65 cluster ADC distribution 900 MeV



### Orange line: pol1 line Red line: pol2 fitting





# For W channels :

center module energy deposit from 56.5% (300MeV) ~65.4% (900MeV)

# For G channels :

center module energy deposit

from 64.5% (300MeV) ~72.4% (900MeV)

cluster shape and distribution looks 'normal' as W channels
non-linear come from light collection efficiency
( bad reflection layer ? )

# Conclusion

- PbWO4 channels have linear relation between ADC value and beam energy, which indicate that gain factor should be constant
- Lead Glass channels have non-linear behavior which come from the hardware but not the cluster reconstruction Algorithm

