H35DEMO Analog Matrix #2 test

Sample : H35DEMO, Analog matrix #2 wire bonded, glued to FEI4, 200 Ohm-cm

23 rows x 300 columns of pixels, 750um thickness,

Type of pixels

- 100 columns with extra DPTUB for HV and high gain
- 100 columns without extra DPTUB for HV and high gain
- 100 columns without extra DPTUB for HV and low gain

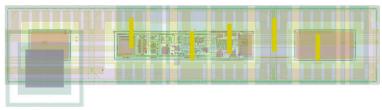
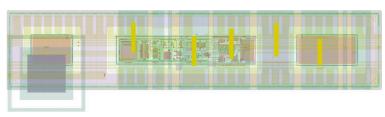


Fig. 22 Layout of the analog pixel with the extra DPTUB and high gain



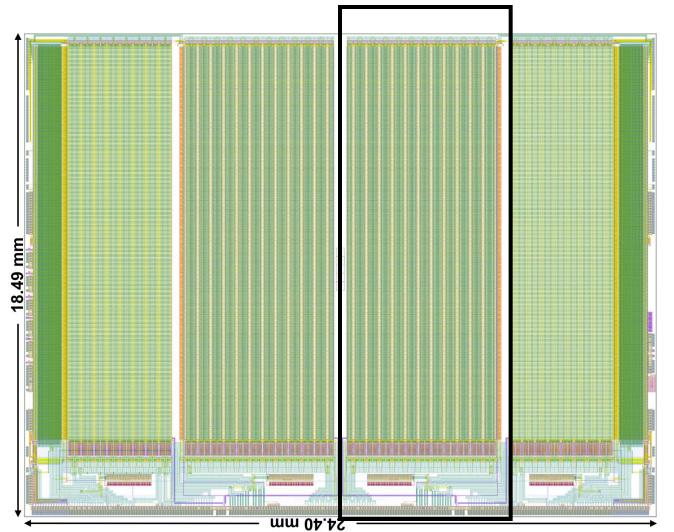
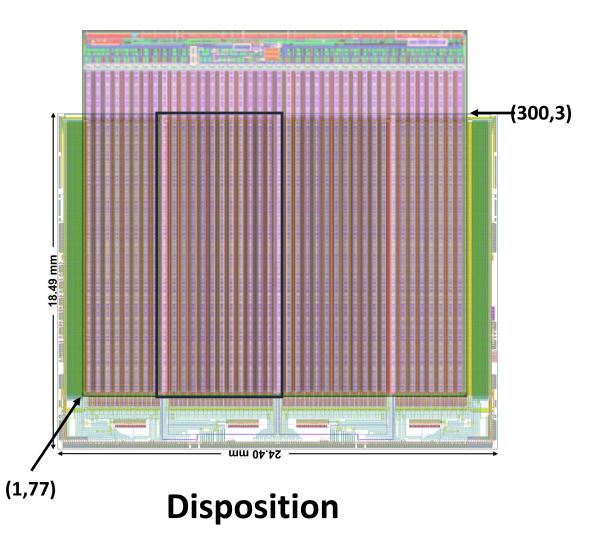
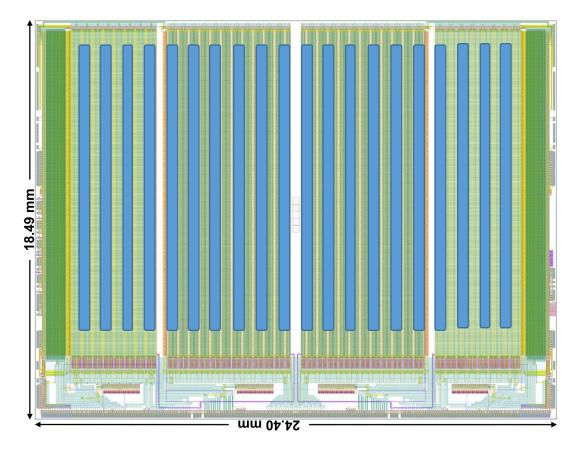


Fig. 23 Layout of the analog pixel without the extra DPTUB and low gain

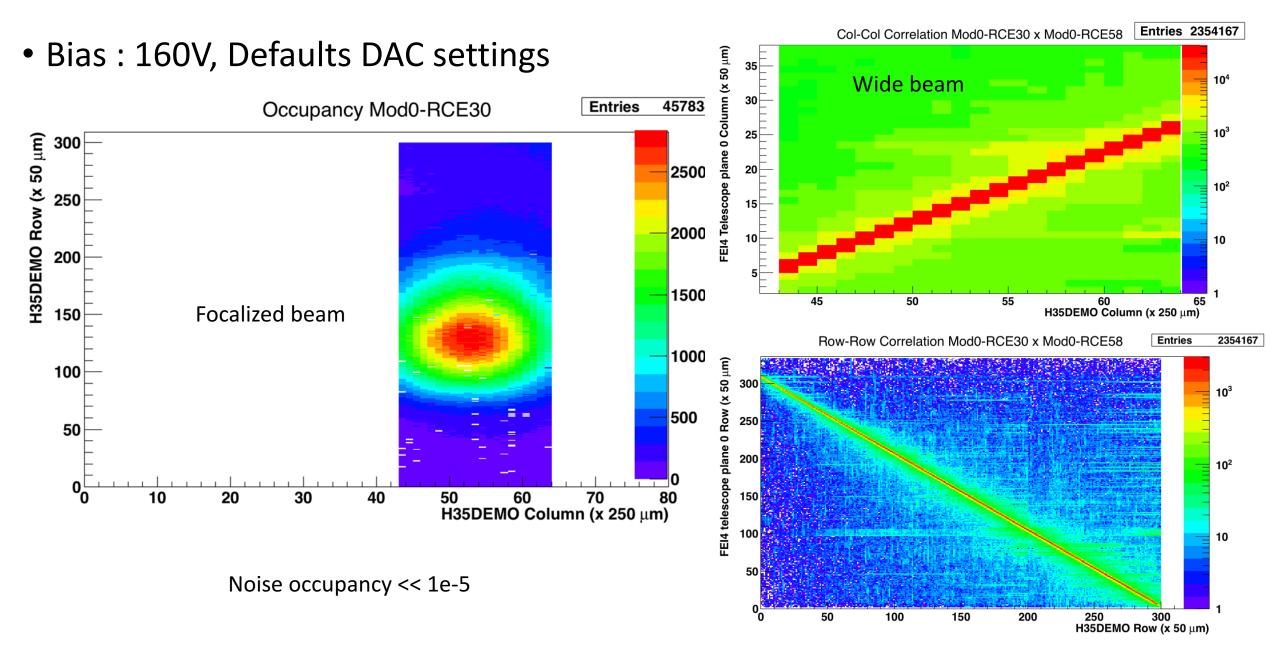
Sensor gluing



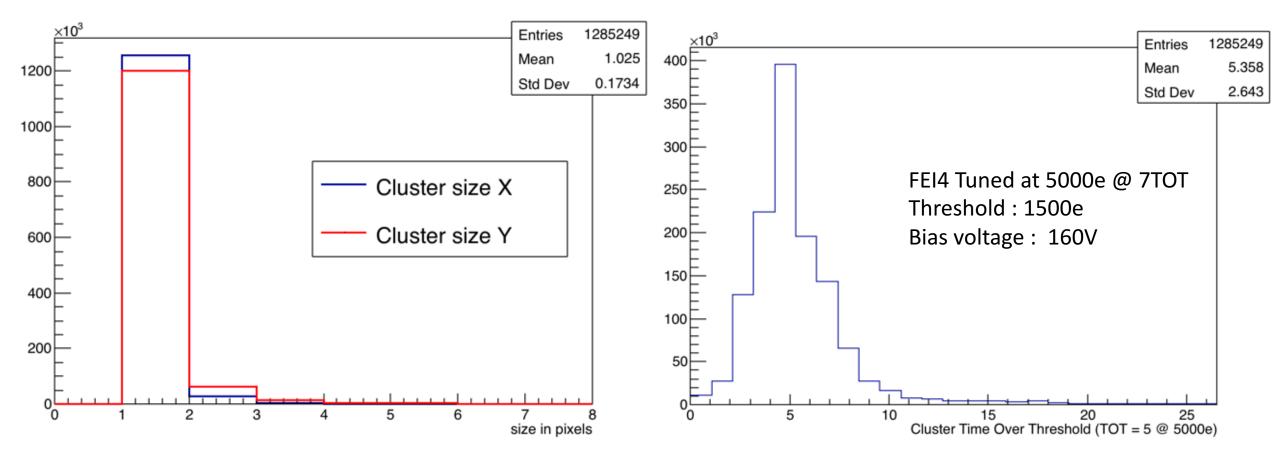


Glue pattern, Araldite 2011 20 lines with500um need tip, 3 bar pressure, 1mm/s Stopping at 500um from edge of matrix to avoid glue on bondinf pads

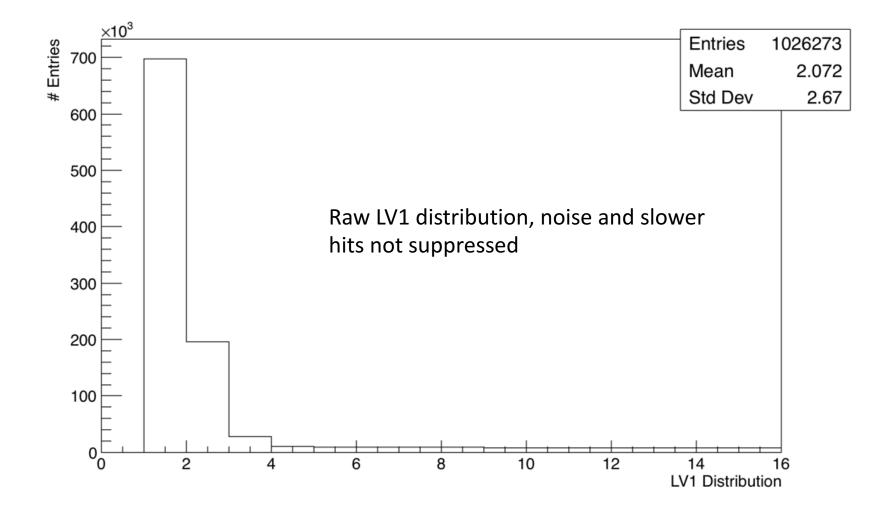
First beam spot image and correlation



Cluster properties

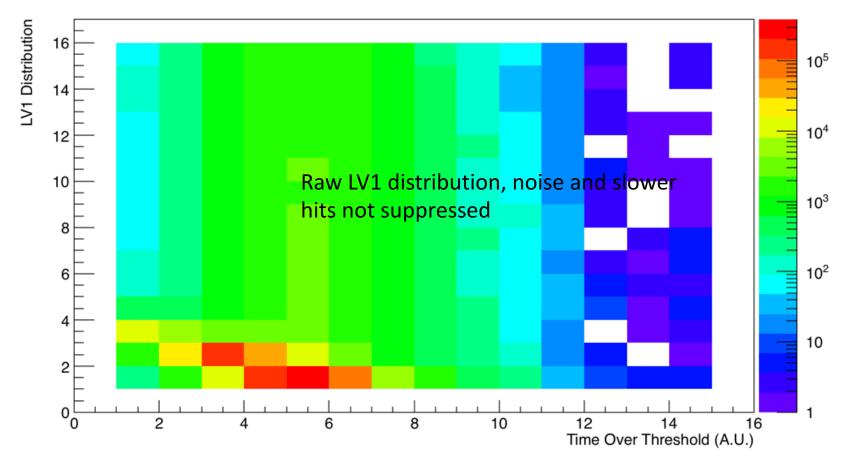


Timing properties



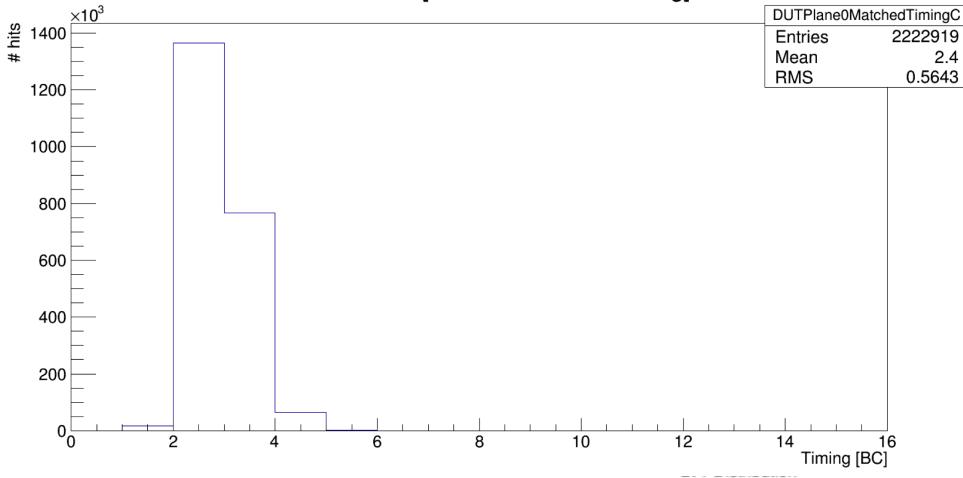
Timewalk

Timing:Value {Timing>0 && NHits<10}



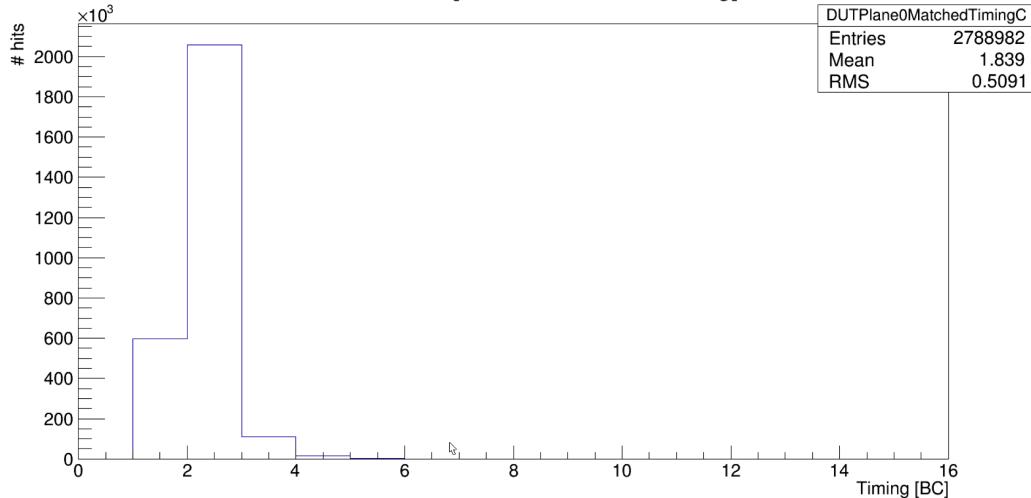
On track LV1 Distribution : Low Gain + no extra DPTUP

DUT - Plane0 [Matched tracks : Timing]

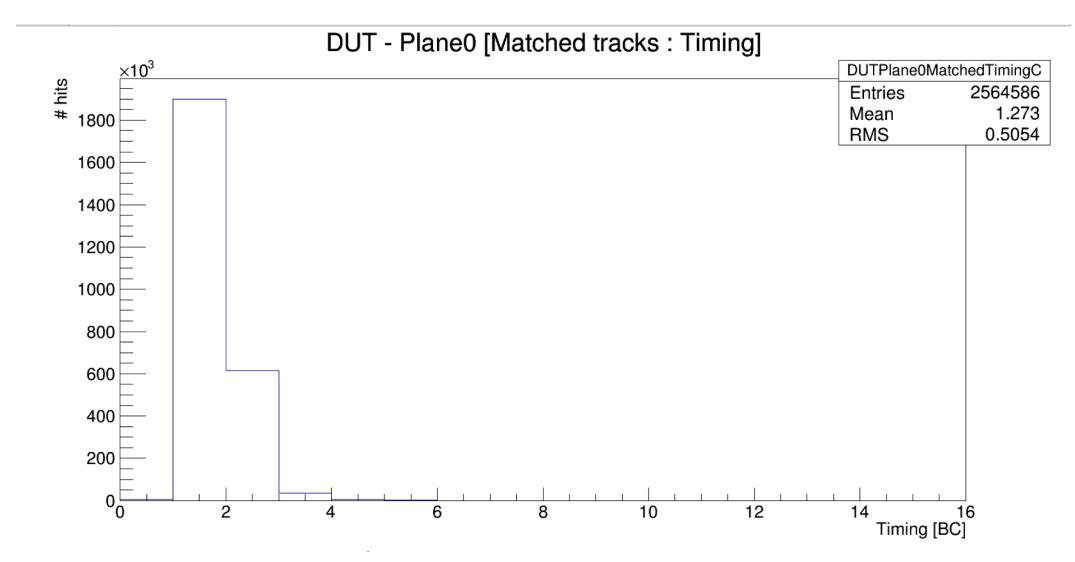


On-Track LV1 Distribution : High Gain + no extra DPTUP

DUT - Plane0 [Matched tracks : Timing]

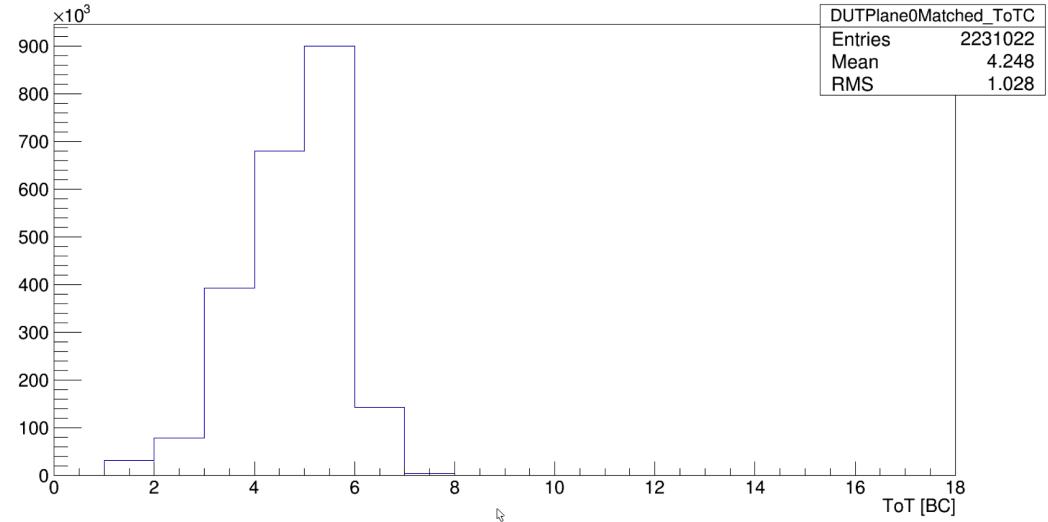


On-Track LV1 Distribution : High Gain + extra DPTUP



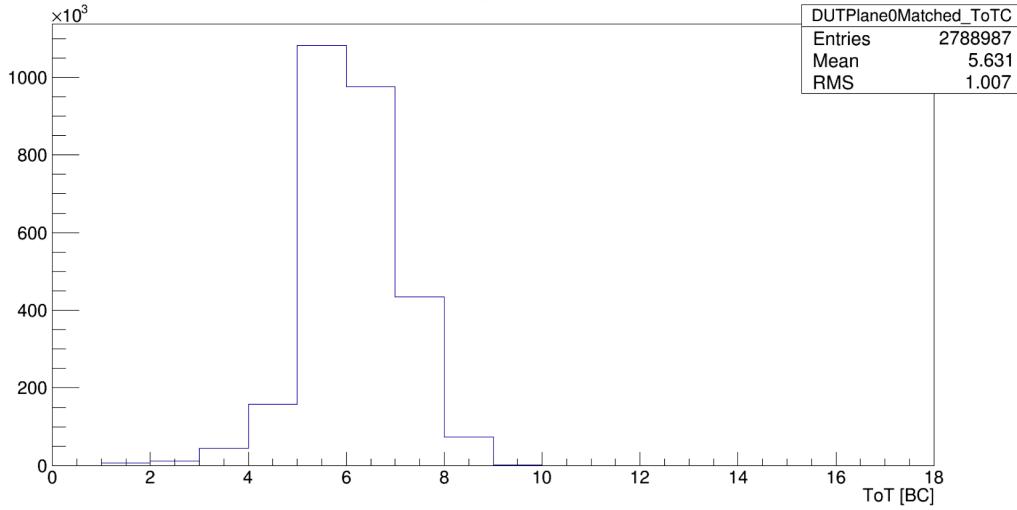
On-Track TOT Distribution : Low Gain + no extra DPTUP

DUT - Plane0 [ToT distribution]



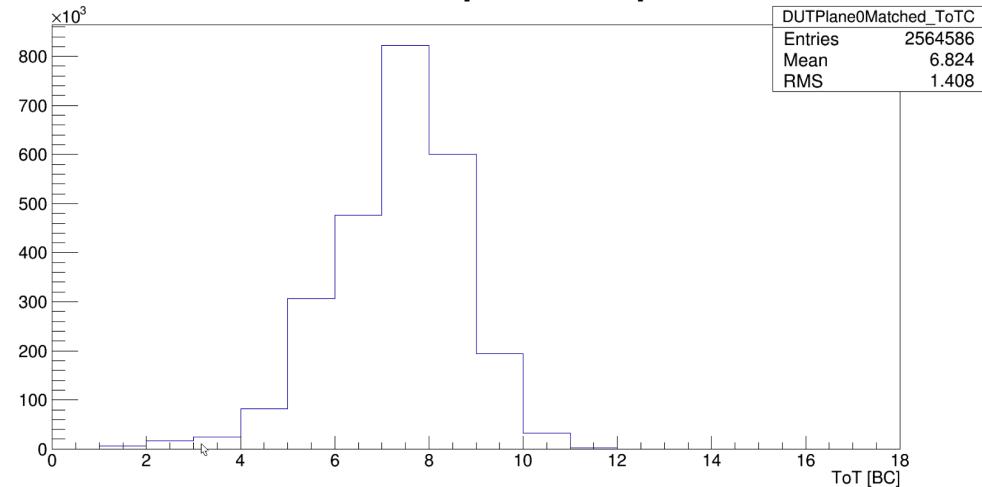
On-Track TOT Distribution : High Gain + no extra DPTUP

DUT - Plane0 [ToT distribution]

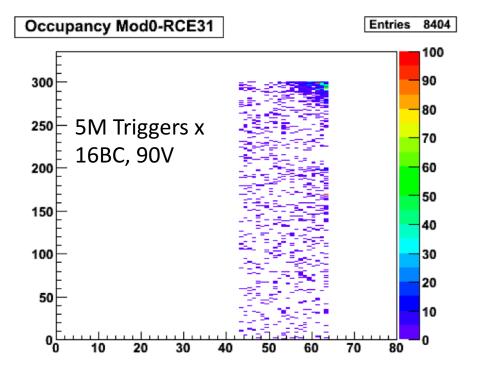


On-Track TOT Distribution : High Gain + extra DPTUP

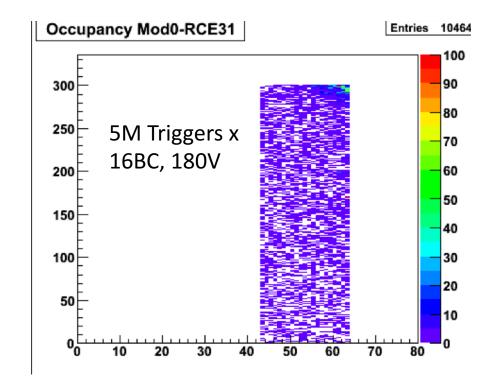
DUT - Plane0 [ToT distribution]



Noise occupancy



Noise occupancy very low, <1e-6, but noisier pixel at the corner of the low Gain and first High-gain matrix



Most single hit from pions as beam was on

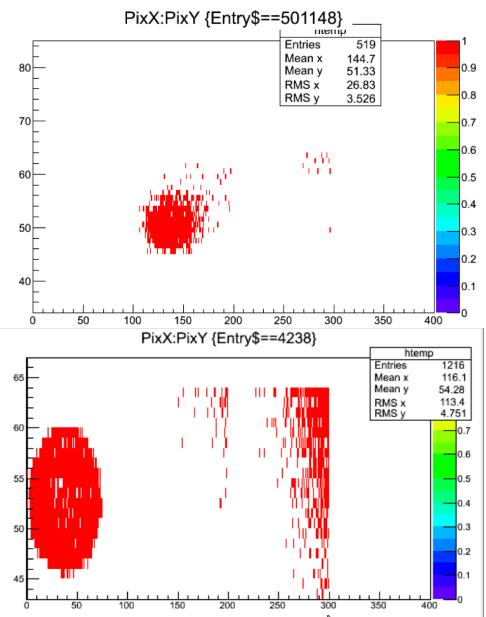
Strange hits : Nuclear interaction from bulk

Huge cluster with > 500, even > 1000 hits can be observed during data taking

These are most probably due to high energy deposition due to a nuclear interaction in the bulk of the sensor (750um thick)

These have sufficient energy to diffuse to the depleted zone, these hits have very late TOT. This would be compatible with TCAD results for 2000hmcm top biased sensor, showing a deep low field region in the bulk.

These are not observed when taking data with muons, but the statistics is much lower.



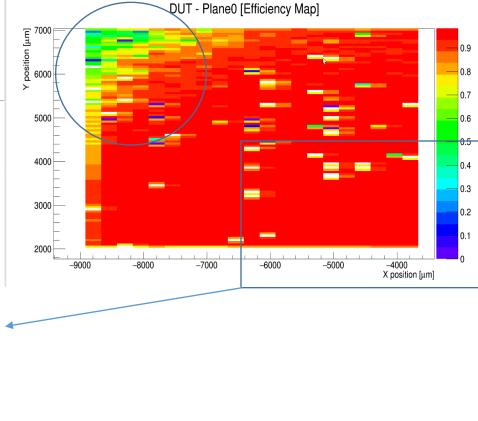
Efficiency Matrix 1 : Low gain

96-97% in the good area with proper coupling

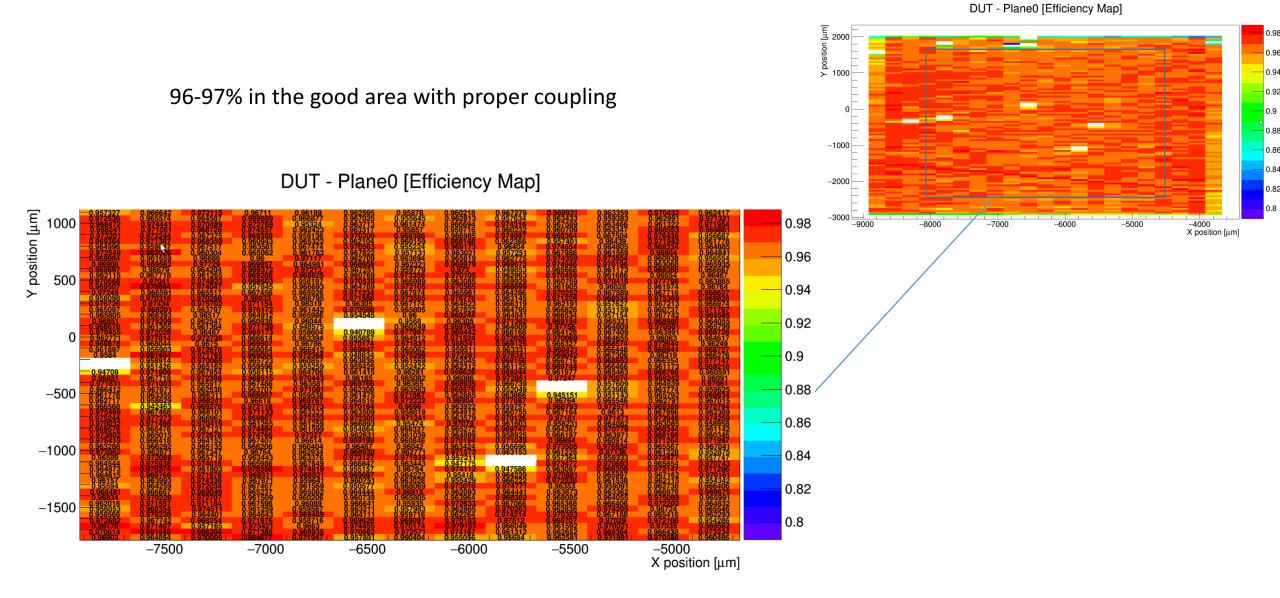
DUT - Plane0 [Efficiency Map]

	0.956343	0.95851	0.964557	0.971714	0.969838	0.952298	0.958333	0.96724	
3400	— 0.95486 9	0.955387	0.968304	0.96898	0.958796	0.966667	0.967944	0.964107	
	0.961478	0.969256	0.9632	0.961851	0.961203	0.959293	0.964313	0.964286	
3200 3000	0.966088	0.962418	0.963162	0.964433	0.966115	0.968504	0.973236	0.969597	
	0.961753	0.961377	0.962963	0.964063	0.964646	0.963149	0.962869	0.965577	0
	- 0.973663	0.962469	0.966088	0.957377	0.964595	0.972403	0.970497	0.96769	
	0.955472	0.973323	0.962588	0.963636	0.960618	0.966248	0.965099	0.957055	
	0.970747	0.959438	0.963247	0.962875	0.968101	0.972108	0.970787	0.973851	
	0.956307	0.966721	0.965072	0.963079	0.960098	0.963272	0.961789	0.959937	0
	- 0.965862	0.960254	0.95905	0.969624	0.964573	0.959936	0.967015	0.955441	0
	0.970833	0.968447	0.961538	0.949622	0.969267	0.964286	0.970874	0.958738	
2800	0.976798	0.967453	0.963367	0.962562	0.965805	0.964623	0.971626	0.964091	
	0.968726	0.96517	0.966459	0.965411	0.969512	0.963453	0.963262	0.960349	
	- 0.969531	0.958771	0.968896	0.970185	0.966667	0.965927	0.962045	0.964623	0
	0.971596	0.957868	0.964573	0.965012	0.96764	0.97621	0.964573	0.966527	
	0.963443	0.967033	0.972952	0.961927	0.96875	0.970161	0.967868	0.964197	
2600 2400 2200	0.95614	0.971345	0.962162	0.962728	0.969449	0.97992	0.974981	0.970023	
	- 0.969291	0.967391	0.966206	0.969088	0.963396	0.959215	0.967033	0.973242	
	0.967611	0.953809	0.958302	0.955269	0.960769	0.960438	0.971229	0.955701	0
	0.970419	0.969624	0.960816	0.9616	0.956765 😼	0.967374	0.969146	0.957465	0
	0.966642	0.954061	0.969579	0.969722	0.962085	0.960674	0.971139	0.968595	
	- 0.953452	0.960944	0.961424	0.969547	0.963362	0.96194	0.966309	0.96	
	0.961821	0.96131	0.974016	0.970092	0.970912	0.964202	0.96604	0.951684	
	0.965108	0.960456	0.966967	0.959969	0.95905	0.967095	0.963735	0.96946	
	0.960666	0.96648	0.960254	0.965106	0.959418	0.959167	0.969649	0.963816	0
	0.963275	0.958207	0.967611	0.965058	0.96371	0.967042	0.970183	0.950864	
	0.962264	0.955683	0.963097	0.948454	0.965072	0.959055	0.962575	0.970771	
	0.959701	0.958747	0.964018	0.963594	0.963902	0.960754	0.978916	0.971379	
F									0
_	5600 -5	5400 -520	0 –5000	-4800	-4600 -4	400 -420	0 -4000	-3800	0

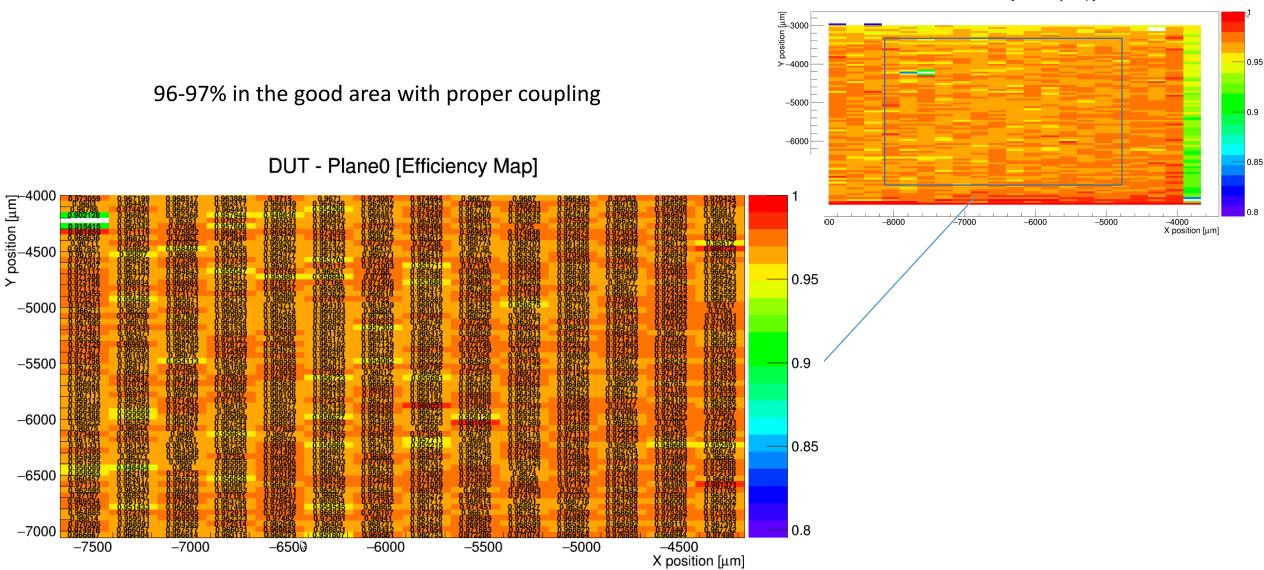
Low glue region



Efficiency Matrix 2 : High gain , no extra DPTUB



Efficiency Matrix 3 : High gain , extra DPTUB



DUT - Plane0 [Efficiency Map]

Summary

- Good performance from the #2 Analog matrix
 - Low noise, within specification
 - Resolution similar to planar sensor
 - Timing very comparable to planar sensor, High gain with no extra DPTUP performing the best
 - On track TOT spectrum show no tail due to small charge/chage sharing
- Efficiency 96-97% for most of the matrix at 180V bias
 - Big events may cause problem with desynchronization
 - Glue coupling might be insufficient , but TOT spectrum not showing this
 - Furth improvement In reconstruction might improve this
- More assembly in preparation, with thinner glue layer, thin sensors