

Micromegas Commissioning status report

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On behalf of the Micromegas Commissioning Team

Muon Week 02-05/02/2021

Micromegas overview before refurbishment

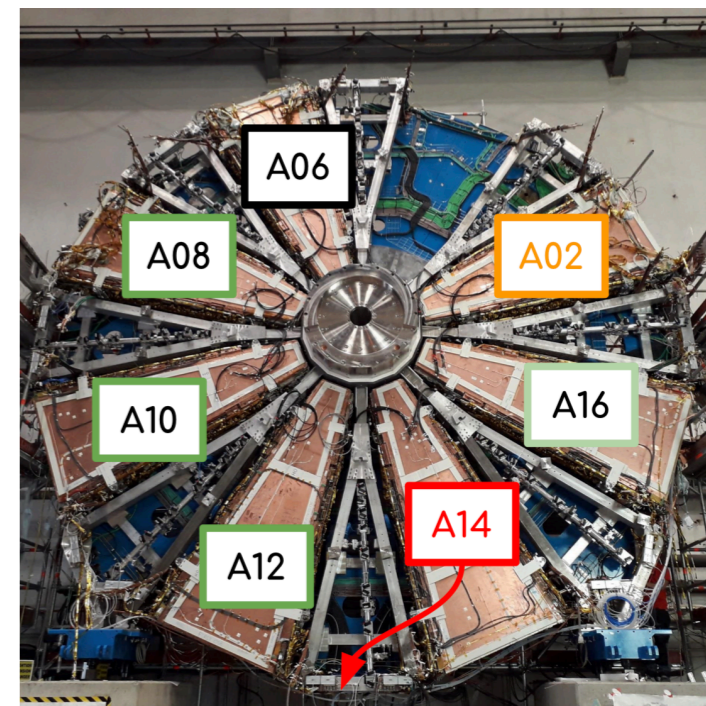
Sector		PRE-INSTALLATION VALIDATION				CONNECTION ACTIVITIES & VALIDATION							HV COMMISSIONING		ELX				TRIGGER							
Update:21/12/2020		Installed	Ext. Cable	GND tests	Splitter box configuration	ICS cables	LVDB glued	Water reg.	Cooling	Gas Leak + Impedance tests	LV cables (polarity & GND tests)	HV Cables	Fibers	T-sens.	T-monitor	Gas flush	HV raise	Config/Monitor	Baselines	Trimmers	Pulser	Noise	Phase II	Connectivity	Phases	Cosmics
A14	27/Feb	ok	ok	ok	ok	glued	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	drifts.	ok	ok	ok	ok	ok	ok	ok	ok	ok
A12 new	10/Aug	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ADDC	ADDC	
A16	27/Jul	ok	ok	ok	ok	glued	ok	ok	ok	ok	ok	ok	2 to ch	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	1 fiber		
A10	3/Aug	ok	ok	ok	ok	glued	ok	ok	ok	ok	ok	ok	2 to re	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
A08	28/Aug	ok	ok	ok	ok	glued	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	noise	ok	ok	ok	ok
A02	2/Sept	ok	ok	ok	ok	glued	ok	ok	ok	ok	ok	ok	2 miss	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
A06	11/Sept	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok

All small sectors on NSW-A apart from A14 were installed by September and were being commissioned

In November it was decided that all sector would be brought down and refurbished

All sectors were commissioned before dismantling to check for potential issues

- ▶ Two central drift HV layers were short to GND in A14 MM
- ▶ LV MM white connectors overheating
- ▶ High elx noise w.r.t BB5 (details presented by Luigi)
 - ▶ Each sector showed each own noise behavior
 - ▶ A14 showed huge noise when sTGC went ON
- ▶ Other issues like an A12T MTP-36 fiber, broken C, faulty MMFE8 etc

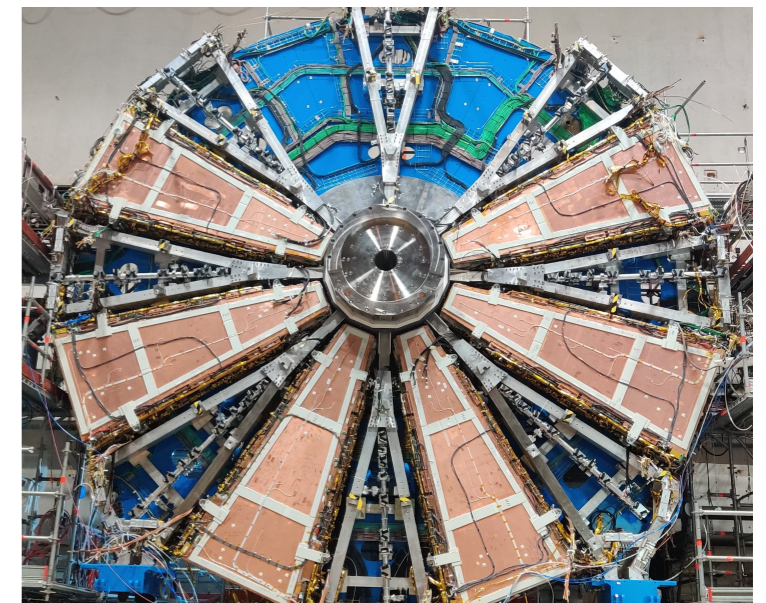


Micromegas overview after refurbishment

Sector	PRE-INSTALLATION VALIDATION						CONNECTION ACTIVITIES & VALIDATION							HV COMMISSIONING		ELX					TRIGGER					
	Installed	Ext. Cable	GND tests	Splitter box configuration	ICS cable installation	LVDB glued	Water reg.	Cooling	Gas Leak + Impedance tests	LV cables (polarity & GND tests)	HV Cables	Fibers	T-sens.	T-monitor	Gas flush	HV raise	Config/Monitor	Baselines	Trimmers	Pulser	Noise	Phase II	Connectivity	Phases	Cosmics	
A14	11/Dec	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
A12	16/Dec	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ongoing,	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
A10	17/Dec	ok	ok		ok	ok	ok	ok	ok		to re-d	ok	ok	ok			ok	to re-do,	to re-do,	to re-do,						
A16	11/Jan	ok	ok		ok	ok			ok		polarity to do,															
A08	18/Jan	ok	ok		ok	ok					polarity to do,															
A02	25/Jan	ok	ok		ok	ok					polarity to do,															
A06		ok	ok		ok	ok																				

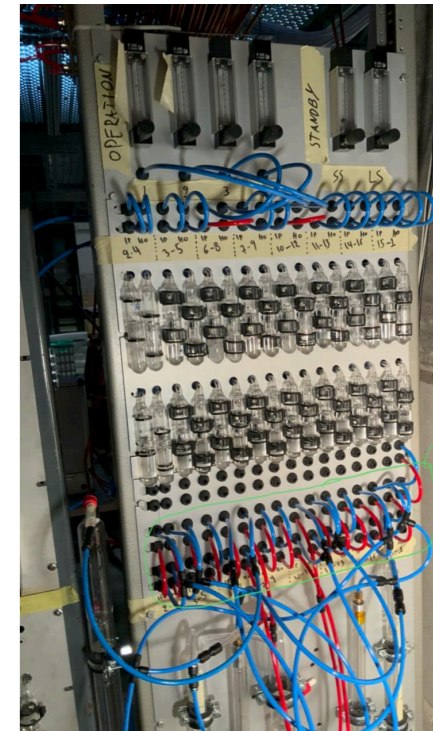
News

- * A12, A14 were tested on concrete blocks, and now A13 is being under tests
 - ▶ The noise has very much improved (more later)!
- * Improvements on DAQ system in order to resolve open parallelization issues (support from DAQ team)
- * The commissioning has been ongoing but not without some hiccups
 - ▶ When performing GND tests we found low resistance between MM and JD in various sectors (more later)
 - ▶ The ICS have been modified -> Lower noise in some areas
 - ▶ Re-tests
 - ▶ The EN/EL has replaced the LV connectors on the detector side
 - ▶ Re-do polarity tests on the wheel
 - ▶ Migrated to new HV system (more later)
 - ▶ Only 2 splitter boxes were available, so to protect



Gas leak tests & flushing

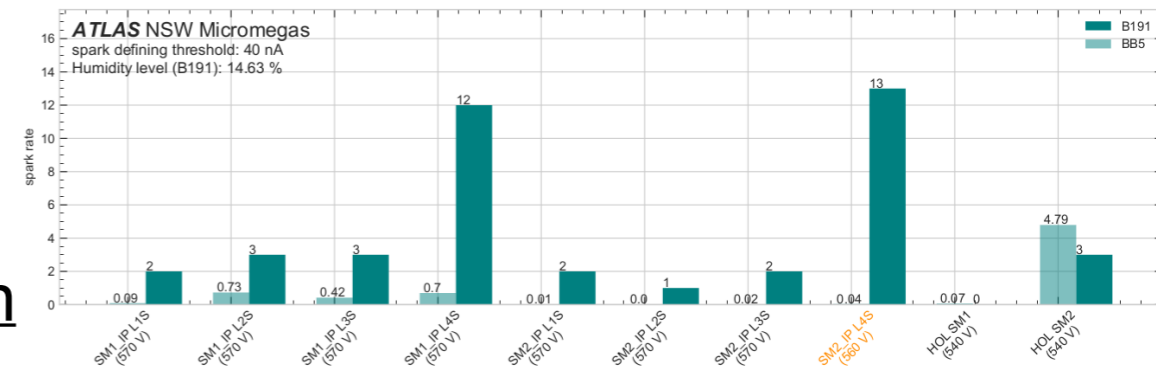
- * One gas line is connected to two sector single wedges (e.g. A14/A16 IP)
 - ▶ Two lines is one complete sector
 - ▶ Use alla BB5 portable gas leak tester
- * Gas leak tests have been ok up to now
 - ▶ All measurements are taken under stable P_{atm}
 - ▶ We are performing leak vs. P_{atm} correlation investigation to apply as a future correction to gain time
- * We can currently flush 40 L/h on two sectors
- * We bought larger output bubblers to set the P_{out} limit up to 7 mbar



Sector	IP (mL/h)	HO (mL/h)	Comments
A14	70	78	
A12	56	10	Underestimation on HO due to P_{atm} variations
A16			
A10	63	120	Overestimation on HO due to P_{atm} variations

High Voltage Validation

- * We migrated to the high granularity system in the beginning of January
 - ▶ We have a system with 2 splitter boxes, a 7038 AP power supply
 - ▶ We use extra DB 37 and coaxial cables to not stress the SB connectors
- * DCS and analysis: We use the BB5 DCS and analysis code for now
 - ▶ We are working on updating our summary plots
- * We compare our data to the BB5 sign-off documents
 - ▶ OK PCB:
 - ▶ max 6 s.p.m above 100 nA
 - ▶ Average current 40 nA



A14 has been validated and A12 is under validation

A14 differences w.r.t BB5:

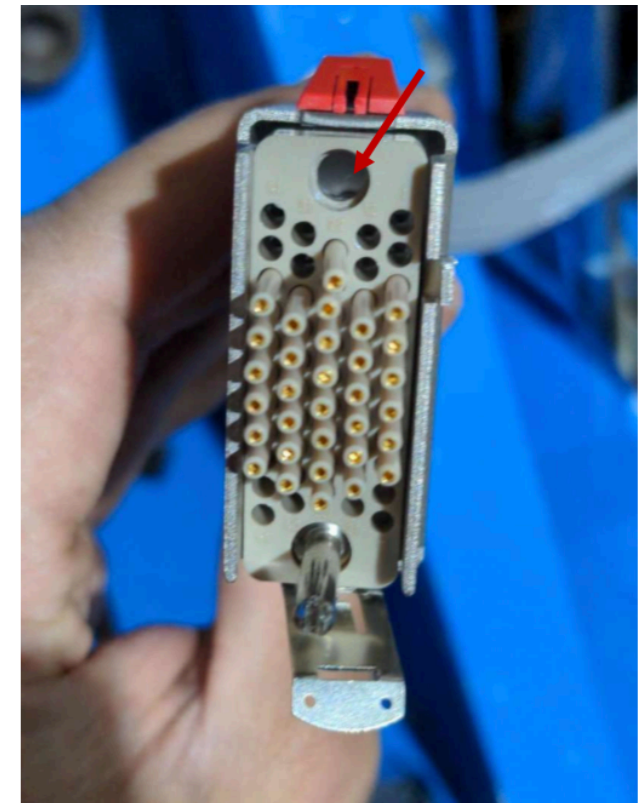
Qplet	Improvements	Deteriorations
SM1 IP	L3P3: 530 (525)	
SM1 HO		
SM2 IP	L3P7: 530 (520), L4P6: 525 (520)	
SM2 HO		L1P6: 560 (570), L1P7: 545 (570), L2P7: 565 (570), L3P6: 555 (570), L4P7: 535 (560)

Note: SM2 IP and HO was not passivated

High Voltage Validation

Issues encountered:

- * It can take a few days to reach nominal voltage due to high RH, increased the flow to reduce time
- * Damaged REDEL connectors
 - ▶ Connectors missing alignment pin (A14)
 - ▶ EN/EL team came to fix them
 - ▶ Detracted pins (A14 and A12), some of them were visually ok before trying to connect them
 - ▶ Evidence of improper connectorization
 - ▶ Missing connector parts
 - ▶ Visually checked the connectors of all the other sectors
 - ▶ Another test to perform?
- * REDEL connectors at brackets might need to be re-done due to potential bad crimping
 - ▶ Stelian will test them



These issues were discussed and the BB5 team now controls and protects the connectors before transportation

LV connections/fibers/T-sensors

- * Test contact between sTGC/MM and MM/JD before and after services
 - ▶ Issues in next slide
- * Perform polarity checks on all cables coming from the ICS
- * Check cooling and surface temperatures, and keep an eye on elx T
- * Issues encountered:
 - ▶ Branch controller flat cable shielding: Improved version
 - ▶ Short fibers
 - ▶ Re-routing needed
 - ▶ A bent ADDC fiber in A08
 - ▶ Unaccessible due to Faraday cage
 - ▶ Sector was brought down for replacement and re-installed again (thanks to Theo V. And the NSW TC team)
 - ▶ White connectors overheating
 - ▶ New 13 A connectors were installed on side A, to
 - ▶ Broken T-sensors
 - ▶ It is a usual issue even if BB5 protects them in transportation
 - ▶ Trained Panos how to remove the sensor and clean up the holes
 - ▶ Stelian replaces them and adds glue



Eix Commissioning - Low MM-JD Resistance

- * Had noticed lower resistances (500-600 Ω) before the refurbishment
 - ▶ Shorts due to gas-cooling pipes in contact on sectors close to brackets
 - ▶ In a couple of cases 500-600 Ω but we were unable to find the source of it
- * After the refurbishment the situation deteriorated (see table) and was not stable
 - ▶ In case of A12 we disconnected and un-routed all services but the problem remained
 - ▶ We disconnected the wedge GND in order to isolate the problem, no luck
 - ▶ We uninstalled the sector and that lead us to the conclusion that the problem were the kinematic supports (more from Partick)
 - ▶ In the meantime we connected A10 and took baselines/noise runs to test
 - ▶ The noise was acceptable

We decided to move on with the commissioning of the rest of the sectors

Sector	Resistance between MM and JD
A14	600 Ω
A12	100 Ω
A10	180 Ω
A16	1 M Ω before services , 3 k Ω after
A08	73 k Ω
A02	3 k Ω after fixing shorts from pipes

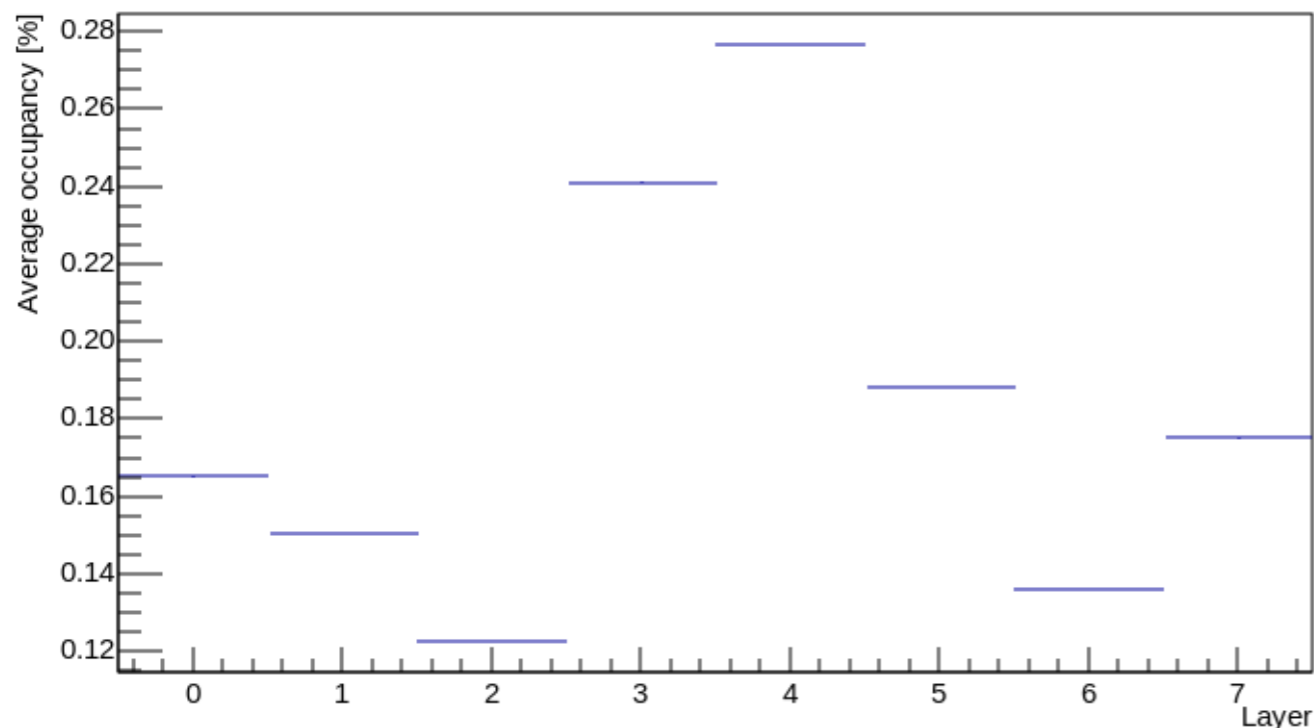
Elx Commissioning

Thanks to: DAQ team, trigger team

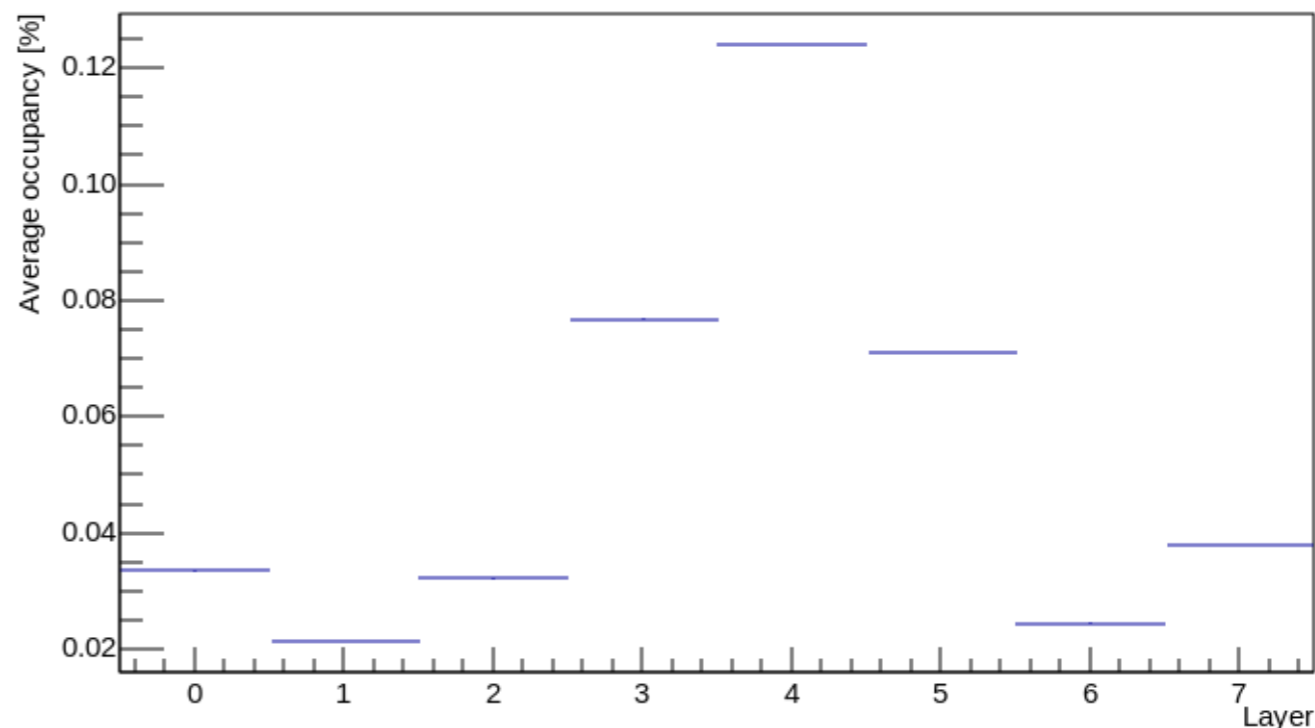
- * Many DAQ improvements in order to facilitate sector parallelization
- * New Felix PCs, fibers and ALTIs in order to completely separate the DAQ of two sectors
- * Working on improving trimmers code and noise run post-processing
 - ▶ Masking noisy channels & removing disconnected strips from threshold calculation
- * Trigger commissioning has been going smoothly on A12 and A14 (thanks A.Tuna)
- * Tested A14, A12 and A10 on wheel and the noise is acceptable
- * We are now testing A13 on the concrete blocks with a SS and LS ICS configuration

Noise run results with improved post-processing

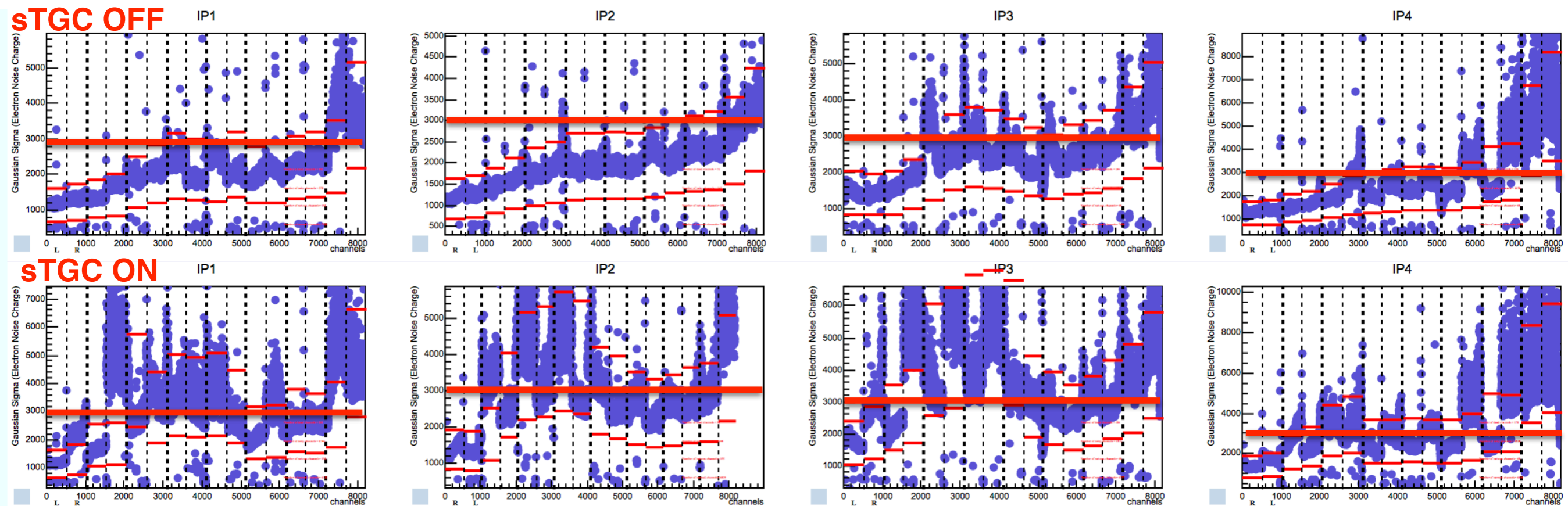
Sector occ. = 0.18 % (1.1% of channels above 3% occ.)



Sector occ. after masking = 0.053 %



Noise on A14 on wheel (August)

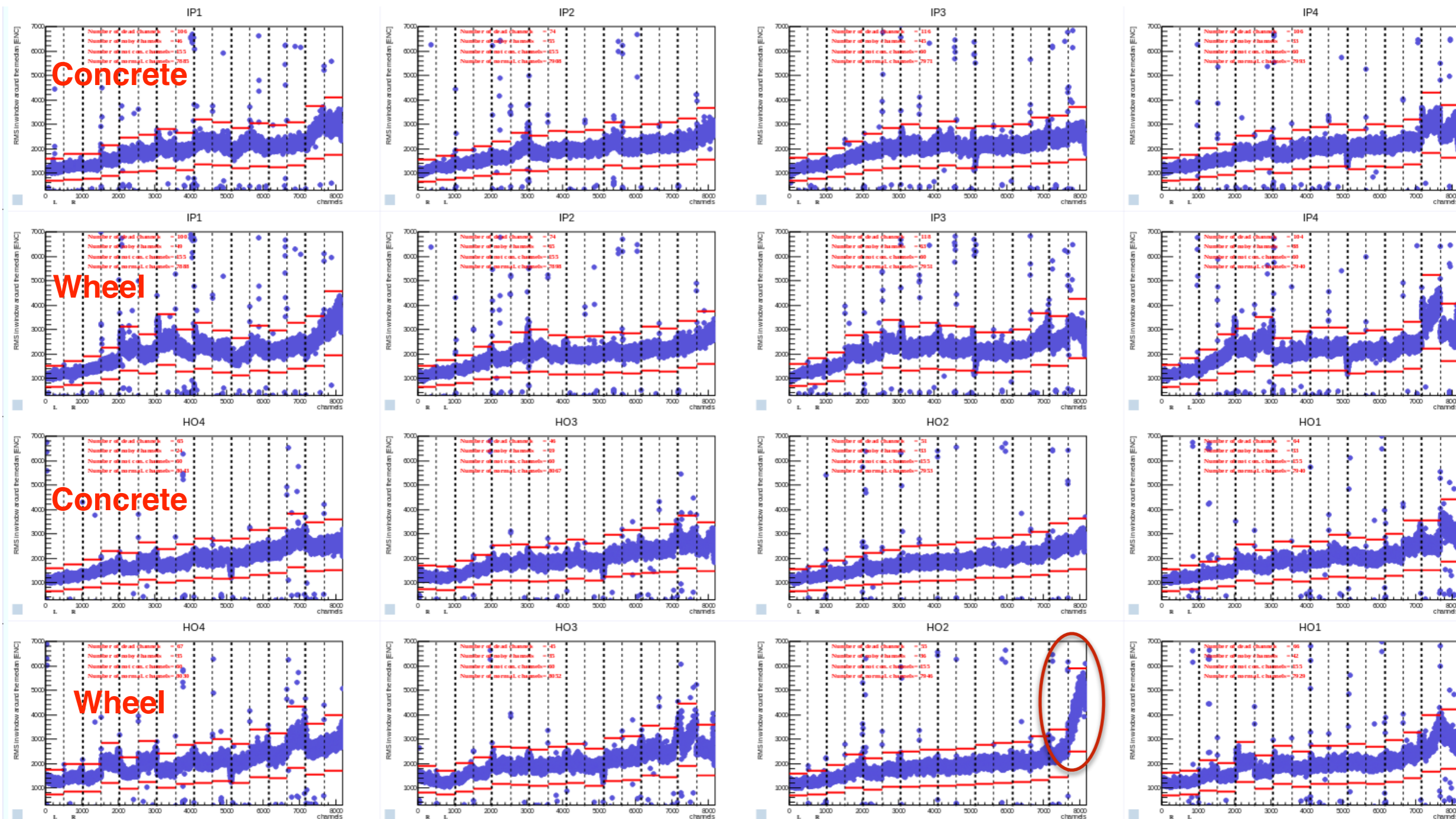


Performed hundreds of tests in order to try to find the source of this noise

- * Through all these tests at 191 and BB5 it was understood that the noise peaks in PCB 3 and 6 were due to the ADDC FEAST noise (support from E. Romano) -> Faraday cages
- * The grounding was also improved by adding thicker GND cables
- * A14 was also tested off-wheel but unfortunately after re-opening sTGC
 - ▶ Could not reproduce sTGC affecting MM (at least not to such extent)
 - ▶ After the refurbishment we were able to track that it was probably due to lack of ICS BC GND

We were able to reduce the general noise levels through improved GND (also thanks to BB5)

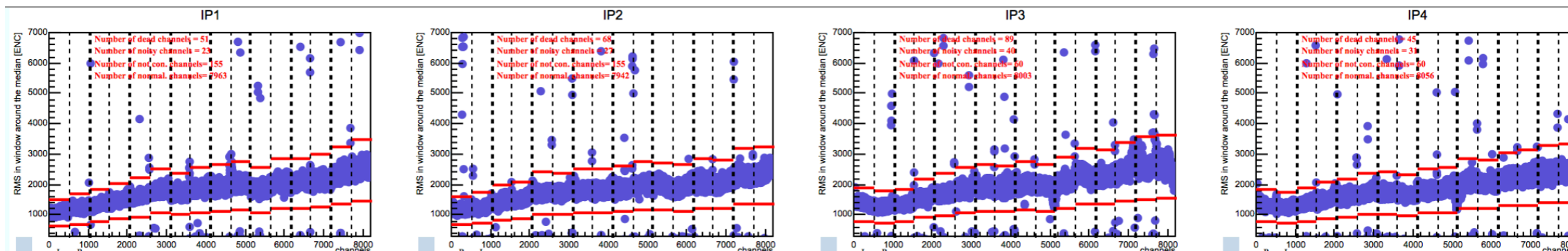
A14 summary plots on-wheel



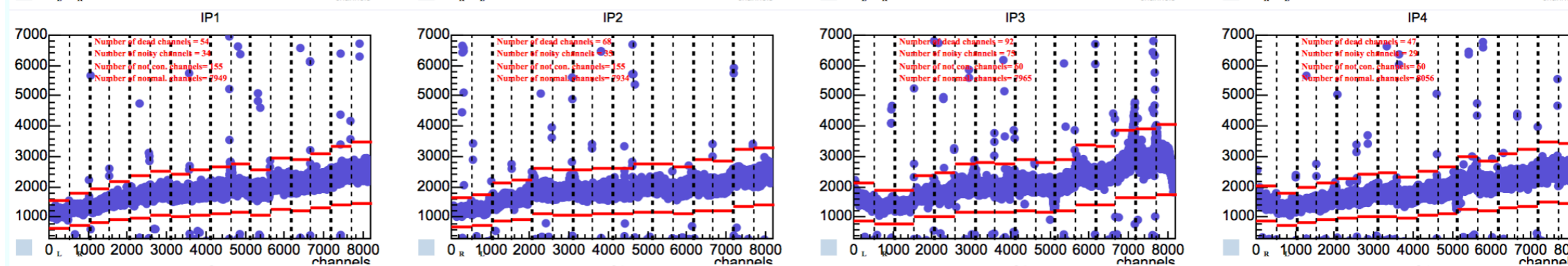
- ▶ sTGC ON did not make any difference in noise
- ▶ HV ON (new scheme) introduced a bit of noise, but non-significant

A12 summary plots on-wheel

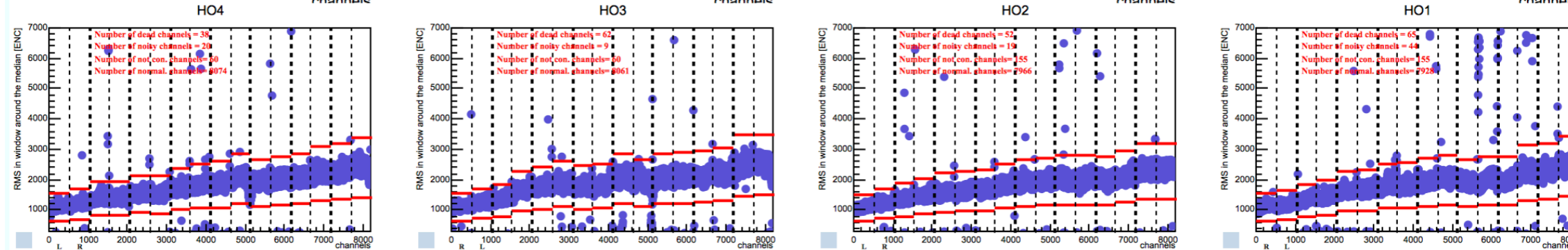
Concrete



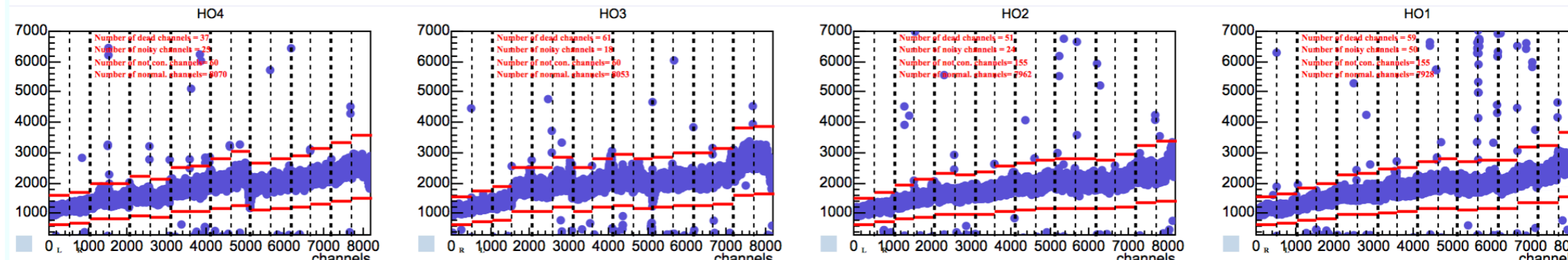
Wheel



Concrete



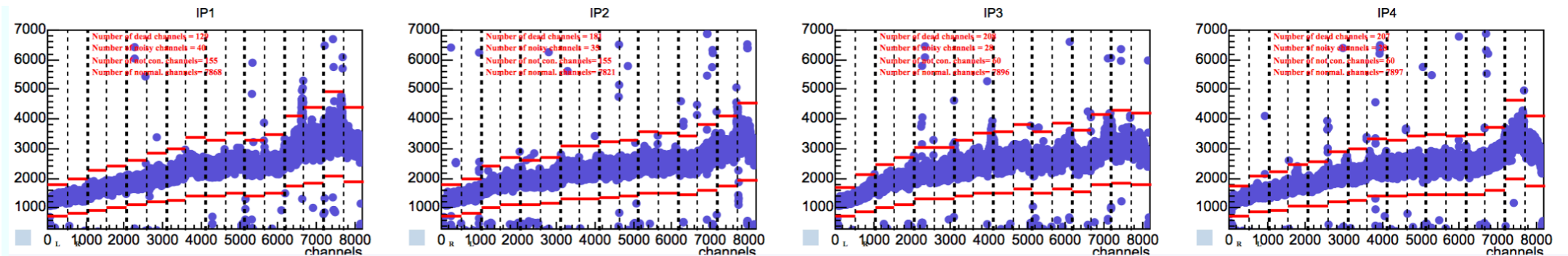
Wheel



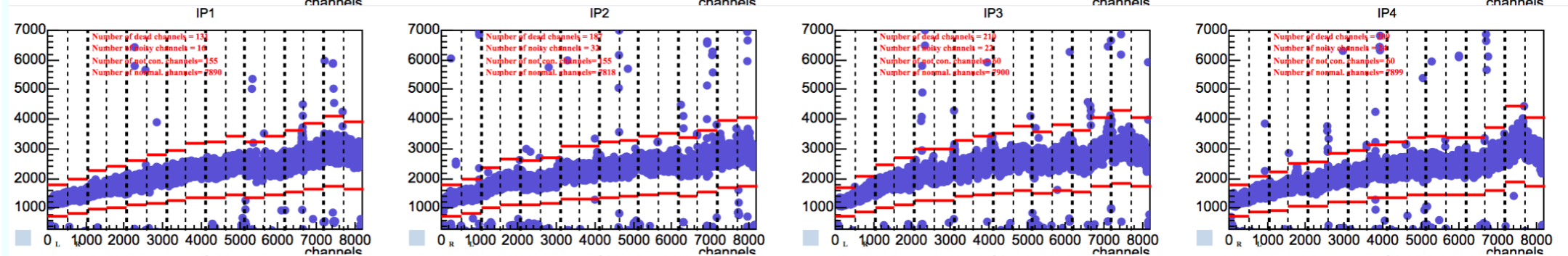
► sTGC ON did not make any difference in noise

A13 summary plots on concrete blocks (sTGC OFF)

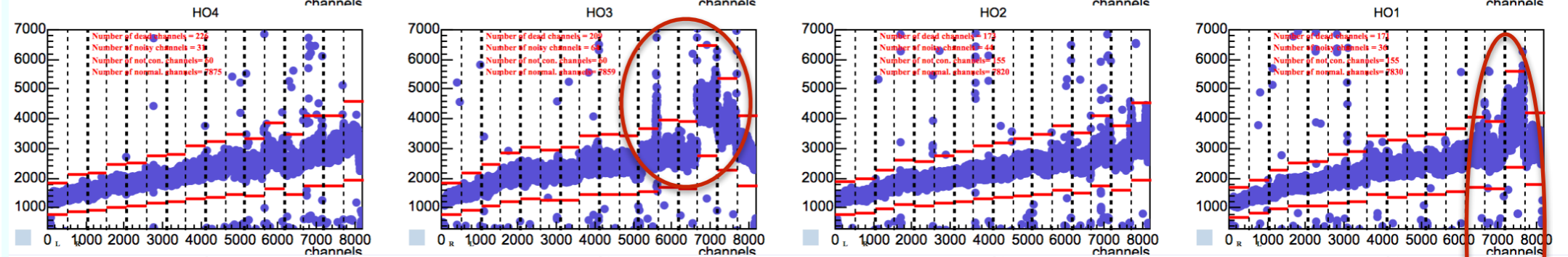
Un-modified ICS



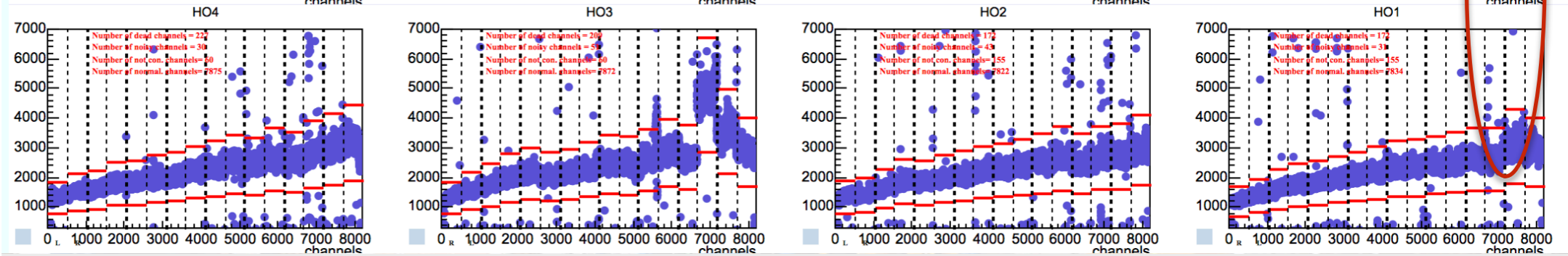
Modified ICS



Un-modified ICS



Modified ICS



- ▶ Noise reduced with modified ICS front panels (especially HO1)
- ▶ Testing A13 with ICS large sector, to test with sTGC ON

Personpower

NAME	STATUS
Henri Bachacou	Here until Summer, is becoming the 191 DAQ expert
Ottilia Ducu	20%, working on HV
Felix Klitzner	70%, here until Summer
Athina Kourkoumeli Charalampidi	Here at least until April/May
Peter Kramer	Qualification on noise run post-processing
Nikos Stouras	HV DCS support, general support (Here until March?)
Olivera Vujinovic	Online support, data analysis, documentation
Sahal Yacoob	Here until end of March or later

- + Support from Luigi Longo/Aimilianos Koulouris
- + Panos Paschalias: Technical support until April
- + Emanuele Romano: Support on electronics (when here)

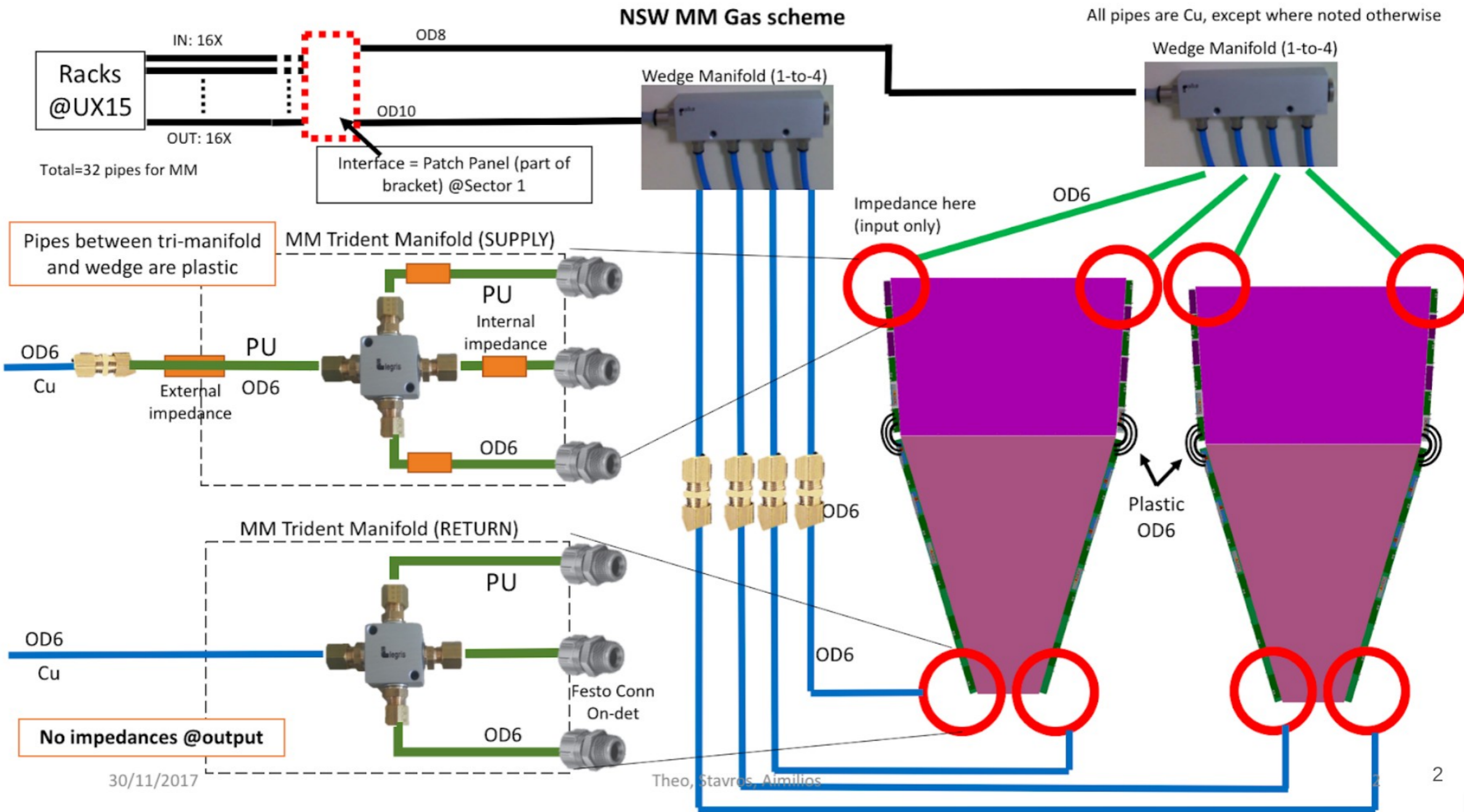
We will need more person-power soon, working on that

Conclusions

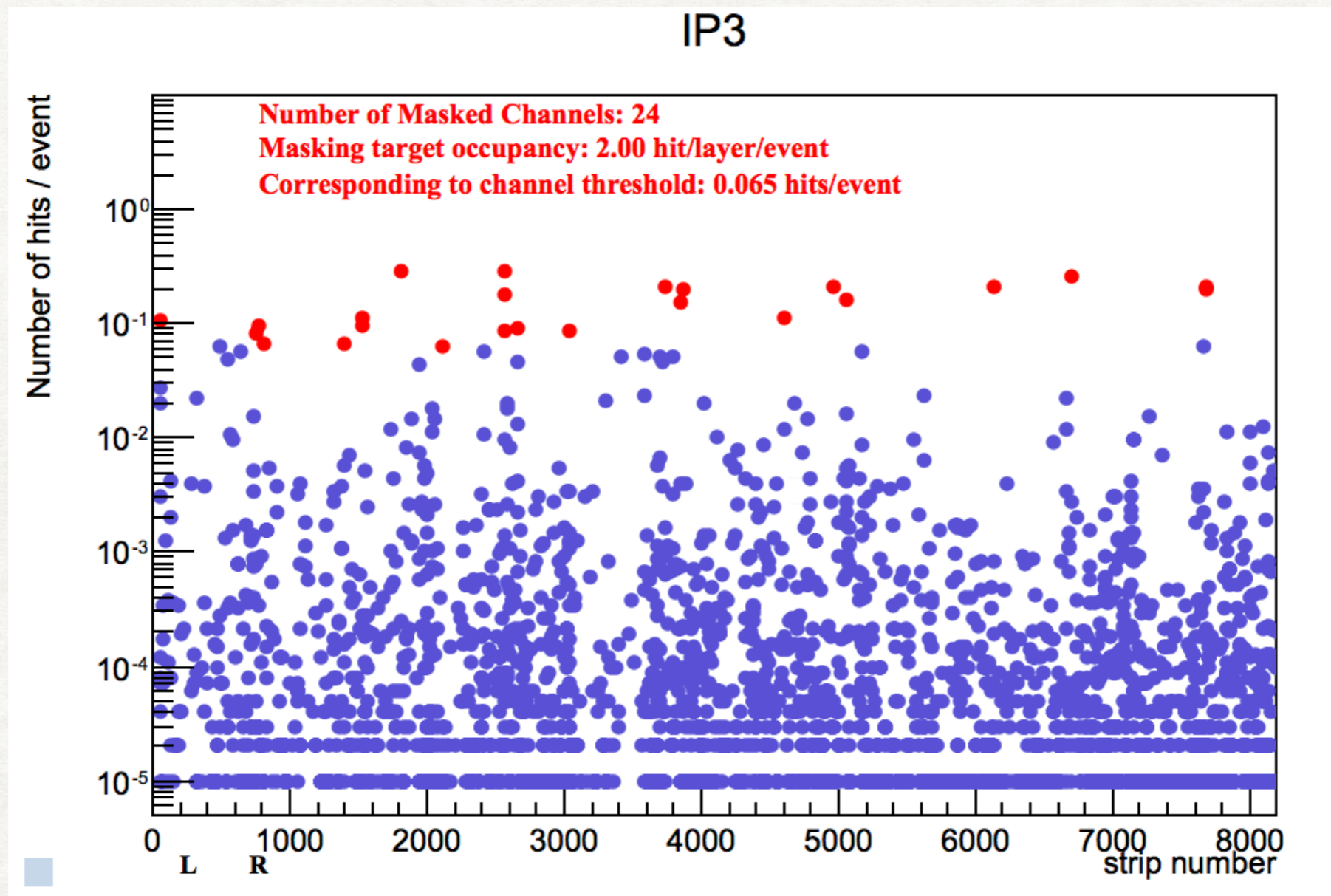
The Micromegas Commissioning steadily progresses despite the issues

- * **The team has been going through a learning curve, becoming more efficient**
 - ▶ Task responsibilities have been assigned, but people are being trained on various tasks
 - ▶ Some will leave shortly, need to be replaced
- * **The sector re-installment came (and comes) with some hiccups**
 - ▶ LV and Elx: Low resistance issue, some noise peaks to debug, connector changing, ICS pin re-crimping, modified ICS to test on-wheel
 - ▶ HV: REDEL connector issues, new system to adapt to
- * **We are working on ensuring the “one week commissioning”**
 - ▶ HV: New configuration allows for faster debugging
 - ▶ Elx and LV: Many noise issues resolved
 - ▶ DAQ: Significant improvements, new parallel system (to test), significantly reduced the time needed to take baselines
 - ▶ Data analysis: Improved post-processing (work ongoing)
 - ▶ Learn to quickly identify problems
 - ▶ Overall this is feasible and in various cases we have achieved this in the past

Gas connection scheme



LATEST NOISE RESULTS (NOISE RUNS)



Noise occupancy after masking < 2 hits/layer/event
(~ 70 from cavern BG)

Max 1.5% masked channels/layer for all sectors !!!

EFFICIENCY PLOTS FROM THRESHOLDS

Threshold-to-efficiency dependence based on BB5 cosmics data

