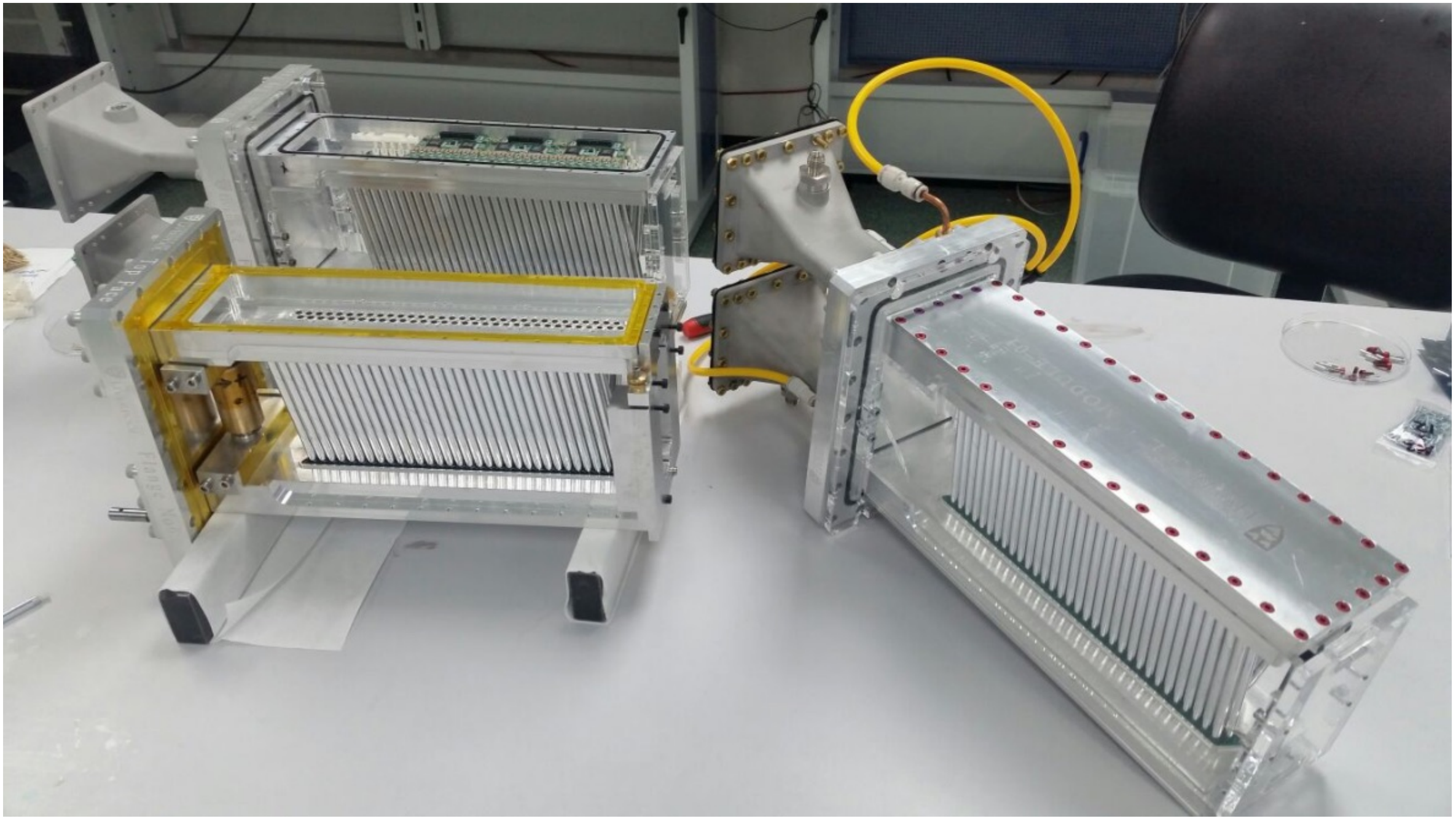
Tracker Hardware

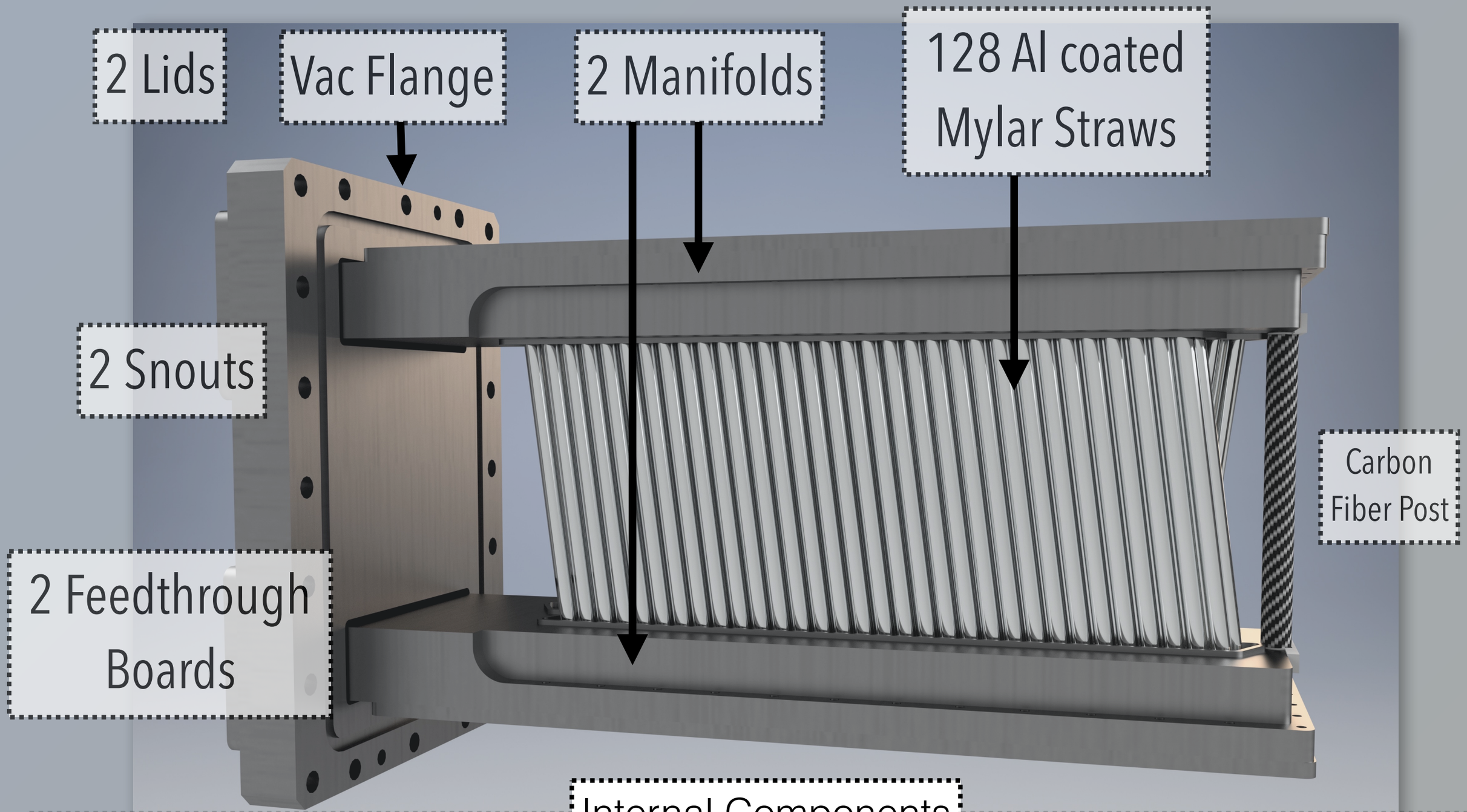


UNIVERSITY OF LIVERPOOL

Will Turner

Fermilab

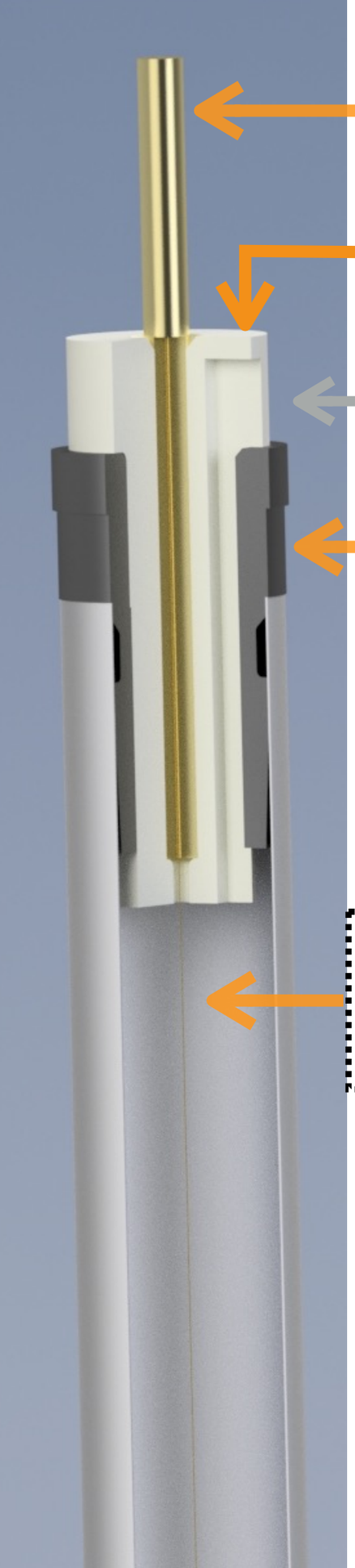
Straw Tracker Module



Internal Components

- 8 ASDQ boards
- 8 Cu Heatsinks
- 8 HV Cables
- 8 Flexi Cables

Internal Components - (Per Module)



256 x pins

256 x Plastic Inserts

Gas Inlet

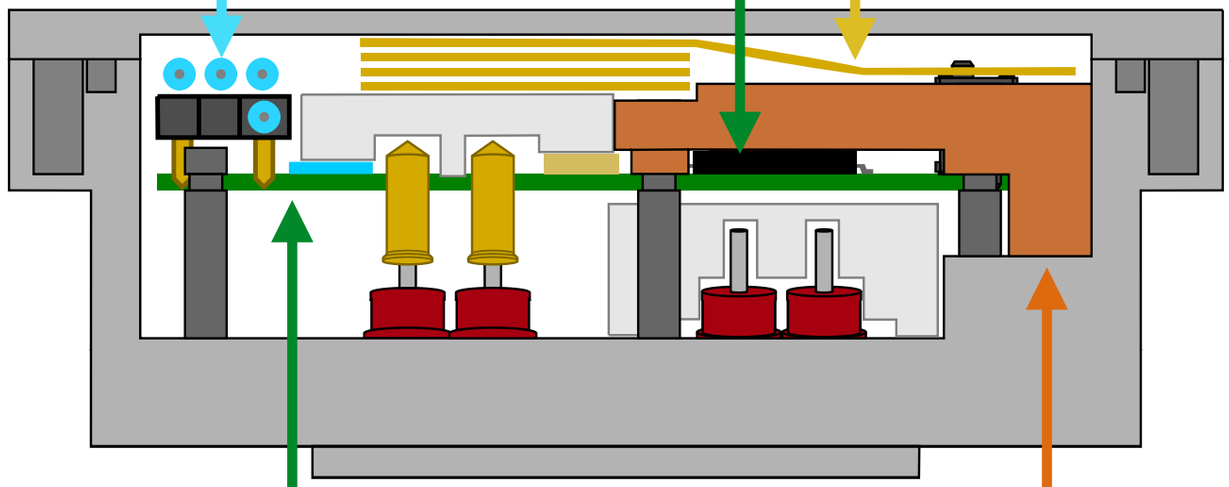
256 x Al End Pieces

128 x 25um Gold Plated Tungsten Wires

16 ASDQ Chips

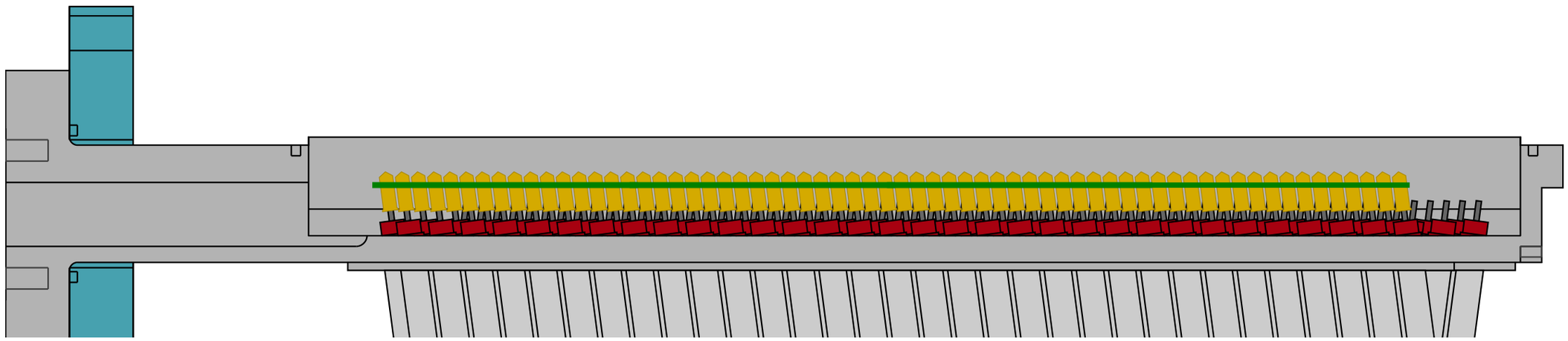
8 Internal HV Cables

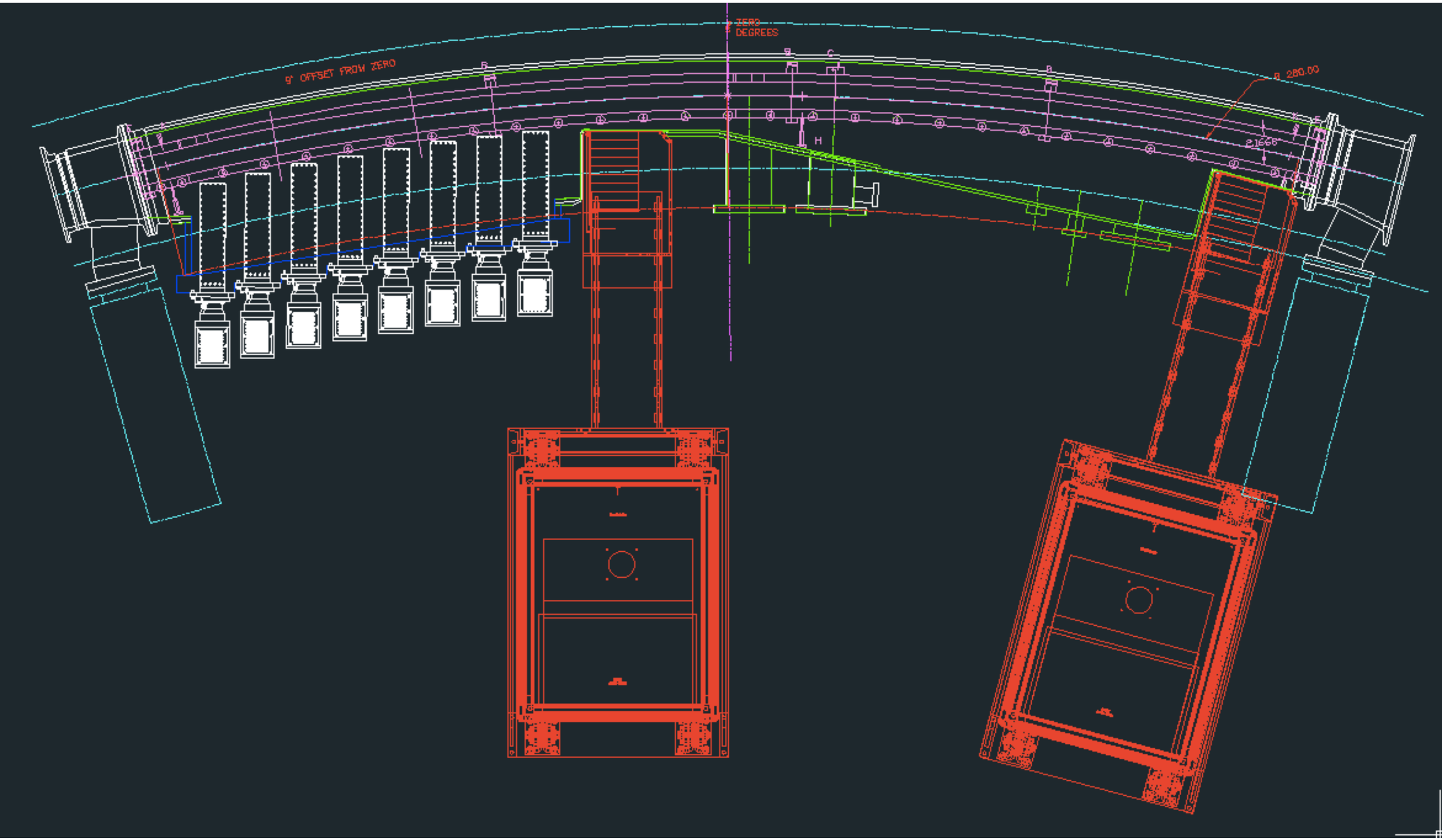
8 Flexi Cables



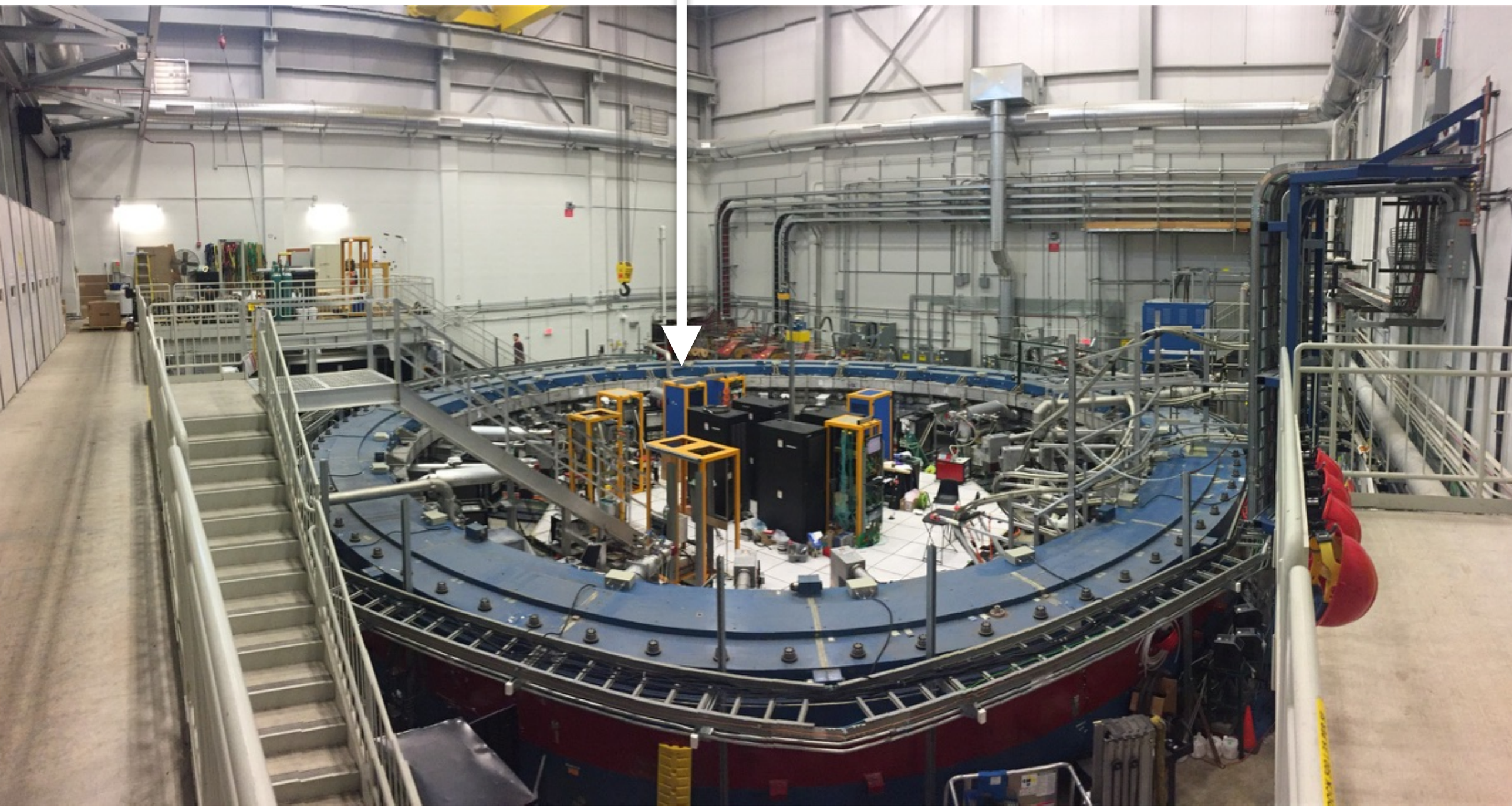
8 ASDQ boards

8 Cu Heatsinks

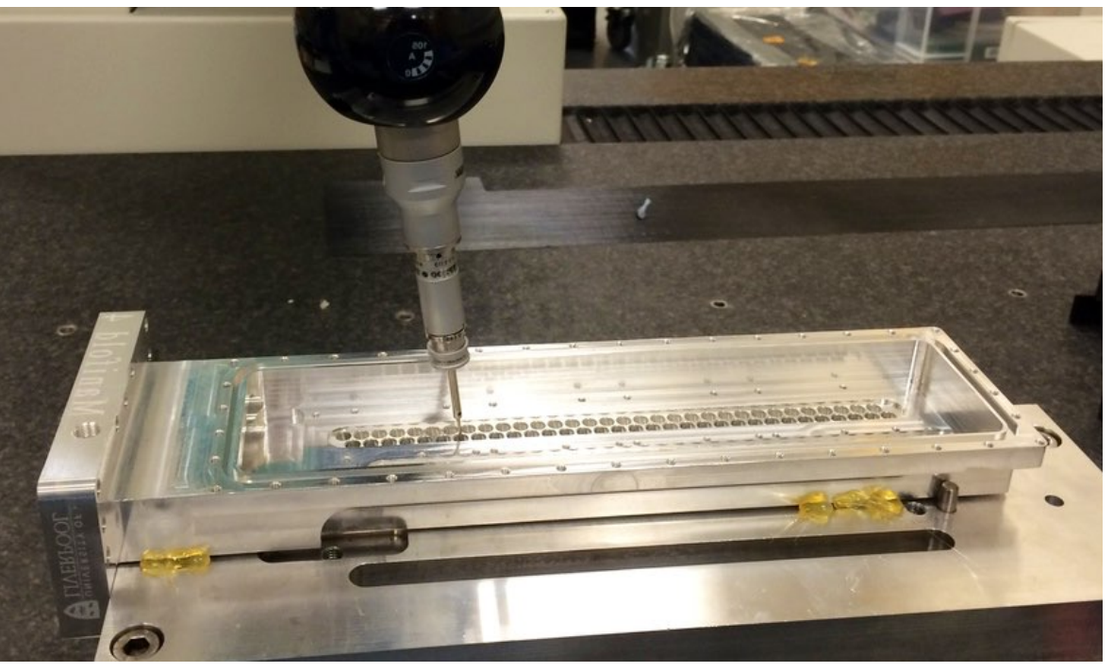


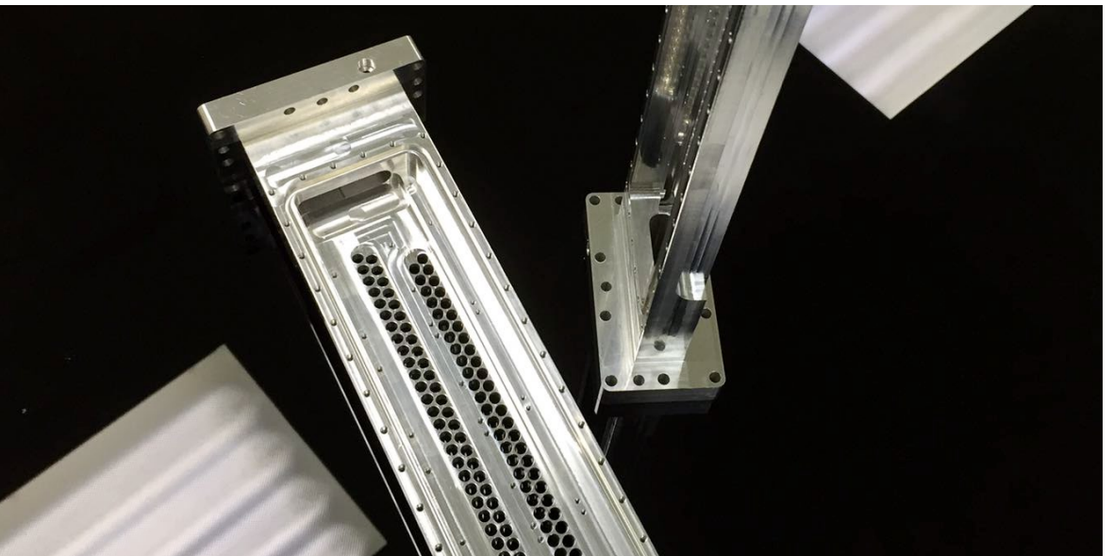

ZERO
DEGREES
9° OFFSET FROM ZERO
R 280.00
H

First Tracker Station to be installed here

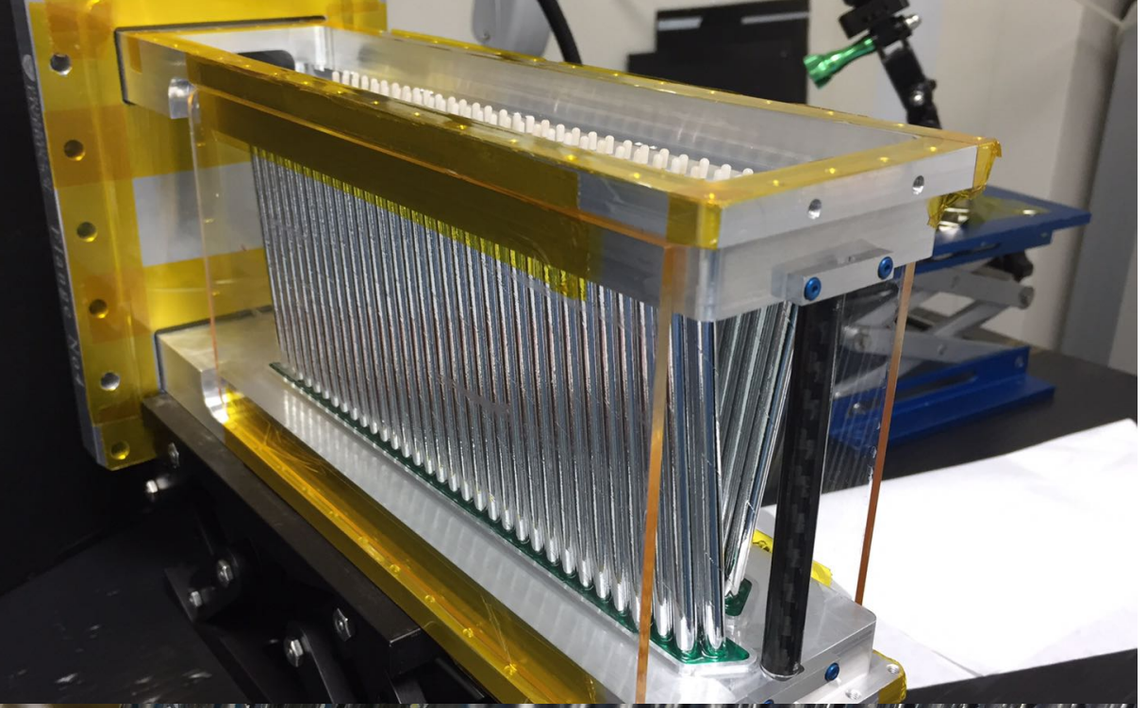


Manifold Production





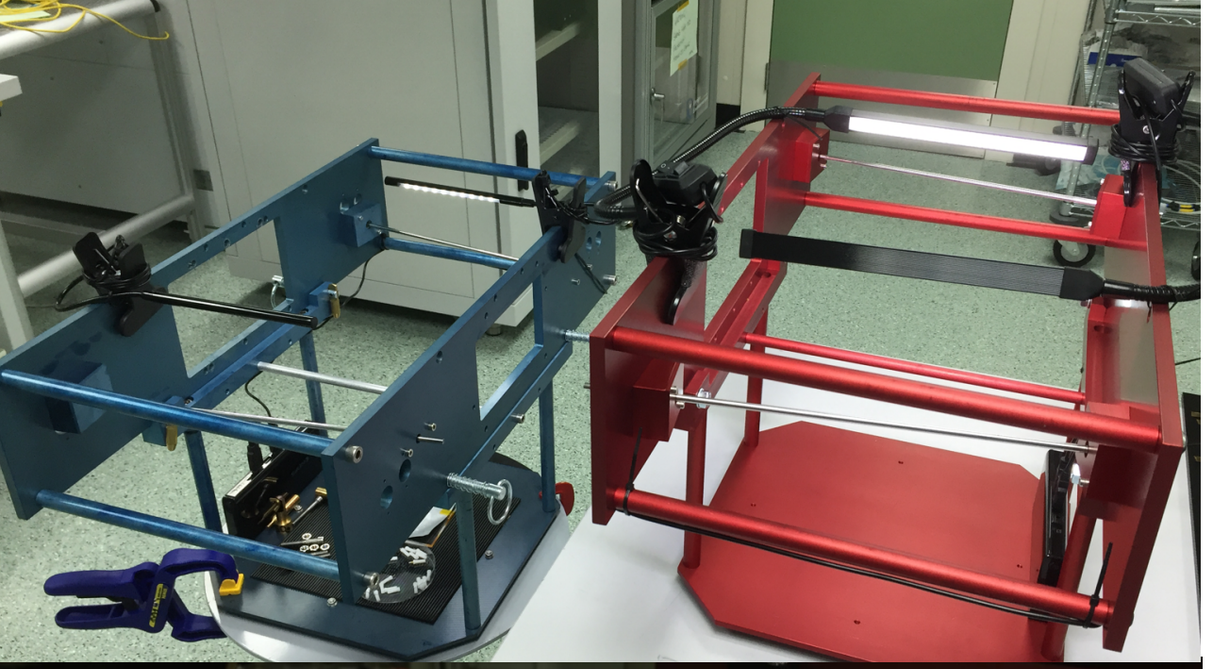
- Use two different CNC mills - 5-axis , 3-axis.
- Have three people trained to use the 5-axis CMM to inspect the manifolds throughout the production.
- Measure features of each manifold to a precision of 1um, and pair manifolds together accordingly.
- Fully automated script carries this out and takes approx 45mins per manifold.
- Once finished the report is assessed both manually and electronically.

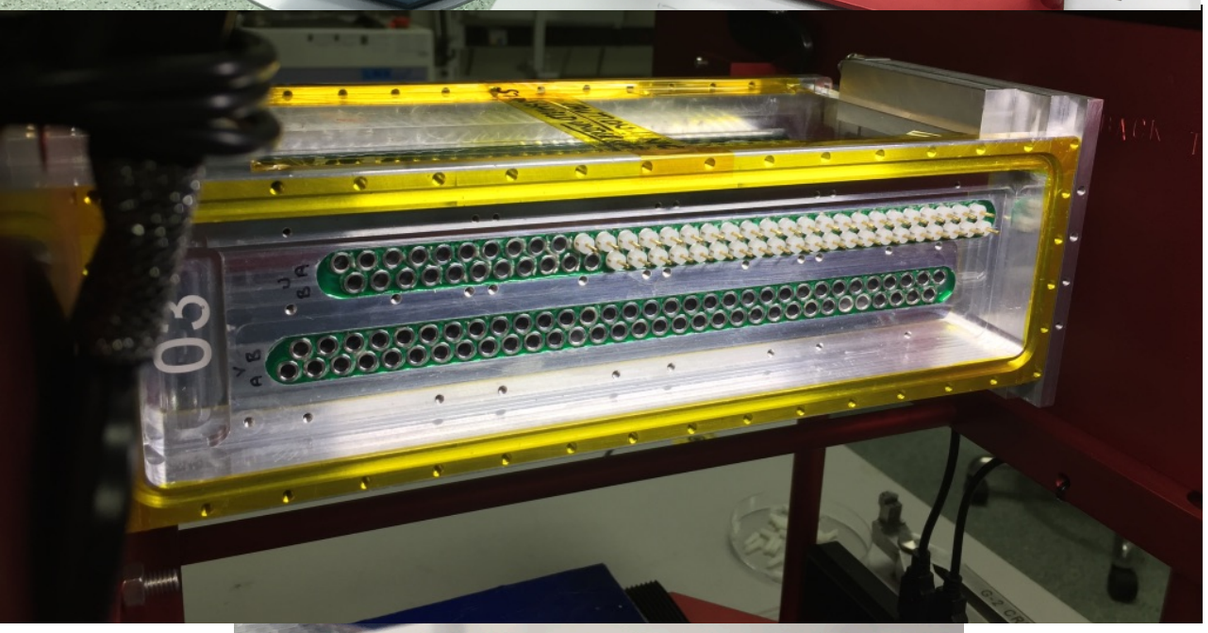


Straw Assembly

- Long straws are leak tested and must pass a leak rate limit of $40x10^{-5}$ cc/min
- Short straws are then cut using a custom made guillotine and have their end pieces glued in with silver epoxy.
- Straws glued into manifold to provide a gas seal using Araldite 20/20
- Applied by hand with syringes.
- This process takes a week to complete as you have to wait for glue to cure before rotating it and gluing the other manifold.

Stringing





- Store approx. 200 wires prepared ready for stringing, this means the short pin and plastic insert are threaded on to the wire and machine crimped in place.
- Pass the wire through the straw with a long nylon tube.
- Threading a module with 128 wires and hand crimping each pin takes ~1week.

Construction Database

- Store every useable piece of information about every item which goes into the module.
- Allows full traceback and accountability in the case of any problems.
- Module Overview page which allows quick viewing of an entire modules data.
- Integrated with the tracker hardware DB

Module 0

Flange	TopManifold	BotManifold
3	004	006

Components

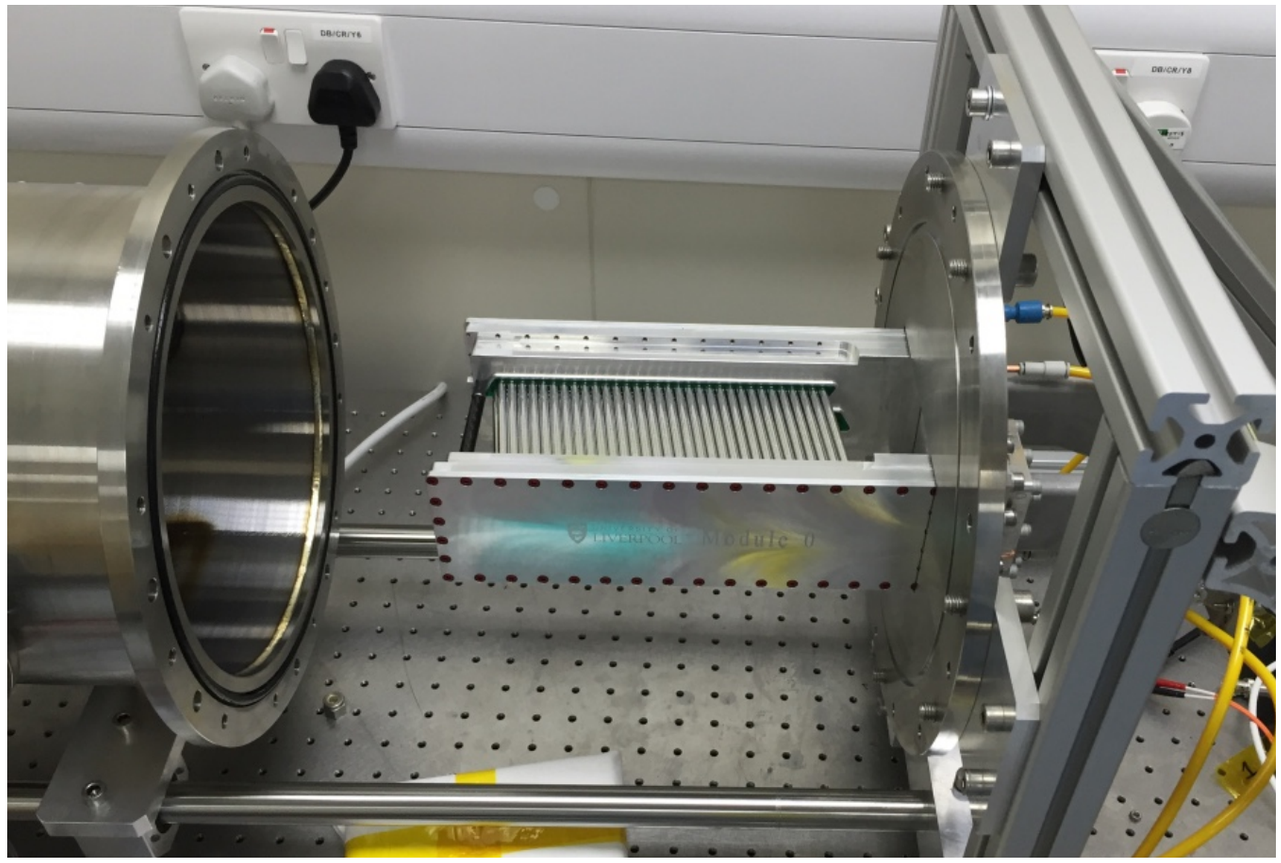
	Bottom				Top			
	U1	U2	U3	U4	V1	V2	V3	V4
ASDQ	gm2-ASDQ-2-005	gm2-ASDQ-2-006	gm2-ASDQ-2-007	gm2-ASDQ-2-008	gm2-ASDQ-2-001	gm2-ASDQ-2-002	gm2-ASDQ-2-003	gm2-ASDQ-2-004
HV int								
Flexi	Flexi-D02	Flexi-C02	Flexi-B02	Flexi-A02	Flexi-D03	Flexi-C03	Flexi-B03	Flexi-A03
Lid								
Feedthrough								
Logic	g2-LB-01-016				g2-LB-01-014			
TDCs	g2-TDC-01-035		g2-TDC-01-036		g2-TDC-01-039		g2-TDC-01-040	
HV Board								

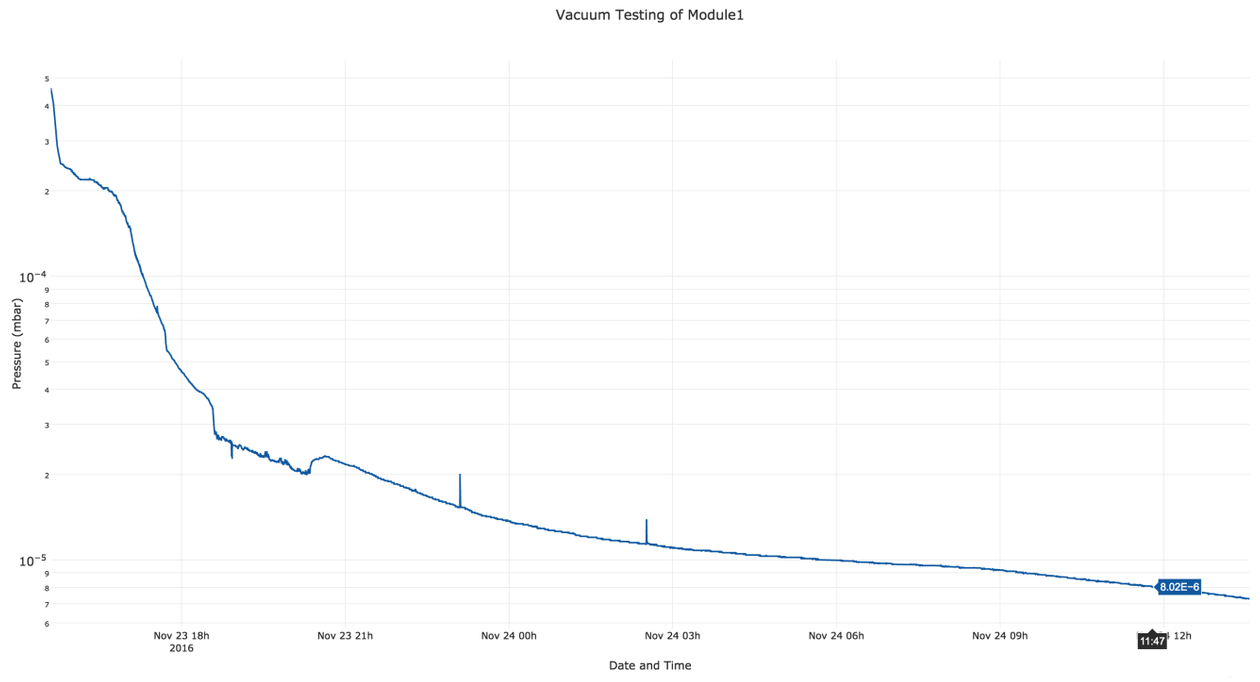
128 straws installed

UA Outer								UB Inner								VB Inner								VA Outer							
Manifold Hole #	Straw #	Stage	R Straw (Ohm)	Wire #	TensionB (g)	TensionA (g)	R Wire (Ohm)	Manifold Hole #	Straw #	Stage	R Straw (Ohm)	Wire #	TensionB (g)	TensionA (g)	R Wire (Ohm)	Manifold Hole #	Straw #	Stage	R Straw (Ohm)	Wire #	TensionB (g)	TensionA (g)	R Wire (Ohm)	Manifold Hole #	Straw #	Stage	R Straw (Ohm)	Wire #	TensionB (g)	TensionA (g)	R Wire (Ohm)
UA1	GS2-71-0009/Edit	G	18	1003		42	12	UB1	GS2-92-0001/Edit	G	18	1014		44	11	VB1	GS2-100-0003/Edit	G	16	926		47	10	VA1	GS2-108-0005/Edit	H	16	938		43	11
UA2	GS2-71-0010/Edit	G	19	1002		39	12	UB2	GS2-92-0002/Edit	G	16	1015		47	10	VB2	GS2-100-0004/Edit	G	15	927		39	11	VA2	GS2-108-0006/Edit	G	15	939		32	10
UA3	GS2-77-0001/Edit	G	17	1001		34	12	UB3	GS2-92-0003/Edit	G	19	1016		41	10	VB3	GS2-100-0005/Edit	G	15	928		34	10	VA3	GS2-108-0007/Edit	G	17	940		44	10
UA4	GS2-77-0002/Edit	G	17	999		39	13	UB4	GS2-142-0001/Edit	G	16	1017		41	12	VB4	GS2-100-0006/Edit	G	15	929		47	10	VA4	GS2-108-0008/Edit	G	15	941		34	12
UA5	GS2-77-0003/Edit	G	20	998		42	11	UB5	GS2-92-0005/Edit	G	14	1018		35	10	VB5	GS2-100-0007/Edit	G	16	931		36	12	VA5	GS2-108-0009/Edit	G	17	942		44	11
UA6	GS2-77-0004/Edit	G	16	997		44	11	UB6	GS2-92-0006/Edit	G	18	1019		32	11	VB6	GS2-100-0008/Edit	G	24	932		48	10	VA6	GS2-108-0010/Edit	G	15	943		36	11
UA7	GS2-77-0005/Edit	G	16	996		37	10	UB7	GS2-92-0007/Edit	G	15	1020		42	10	VB7	GS2-100-0009/Edit	G	16	933		31	12	VA7	GS2-115-0001/Edit	G	15	945		31	12
UA8	GS2-77-0006/Edit	G	17	995		39	11	UB8	GS2-92-0008/Edit	G	20	1013		45	10	VB8	GS2-100-0010/Edit	G	18	934		36	10	VA8	GS2-115-0002/Edit	G	18	946		44	11
UA9	GS2-77-0007/Edit	G	17	994		47	10	UB9	GS2-92-0009/Edit	G	20	1012		36	12	VB9	GS2-104-0001/Edit	G	16	935		38	10	VA9	GS2-115-0003/Edit	G	16	947		37	10
UA10	GS2-77-0008/Edit	G	18	993		38	10	UB10	GS2-92-0010/Edit	G	23	1011		40	10	VB10	GS2-104-0002/Edit	G	17	924		27	11	VA10	GS2-115-0004/Edit	G	16	948		31	12
UA11	GS2-77-0009/Edit	G	35	992		47	11	UB11	GS2-88-0001/Edit	G	23	1009		42	10	VB11	GS2-104-0003/Edit	G	14	923		50	10	VA11	GS2-115-0005/Edit	G	17	949		43	10
UA12	GS2-77-0010/Edit	G	19	990		48	10	UB12	GS2-88-0002/Edit	G	18	1008		32	11	VB12	GS2-104-0004/Edit	G	15	916		34	10	VA12	GS2-142-0003/Edit	G	15	937		51	11
UA13	GS2-82-0001/Edit	G	18	989		46	12	UB13	GS2-88-0003/Edit	G	19	1007		42	10	VB13	GS2-104-0005/Edit	G	15	915		47	10	VA13	GS2-115-0007/Edit	G	16	936		49	10
UA14	GS2-82-0002/Edit	G	17	988		37	11	UB14	GS2-88-0004/Edit	G	21	1006		34	12	VB14	GS2-104-0006/Edit	G	23	914		45	10	VA14	GS2-142-0004/Edit	G	16	922		39	10
UA15	GS2-82-0003/Edit	G	16	982		45	11	UB15	GS2-88-0005/Edit	G	19	1004		43	10	VB15	GS2-104-0007/Edit	G	17	913		37	10	VA15	GS2-115-0009/Edit	G	13	921		43	10
UA16	GS2-82-0004/Edit	G	18	981		43	10	UB16	GS2-88-0006/Edit	G	16	987		54	10	VB16	GS2-104-0008/Edit	G	16	912		46	10	VA16	GS2-115-0010/Edit	G	18	920		50	10
UA17	GS2-82-0005/Edit	G	16	980		50	10	UB17	GS2-88-0007/Edit	G	14	986		45	11	VB17	GS2-104-0009/Edit	G	16	911		48	10	VA17	GS2-116-0001/Edit	H	17	919		43	12
UA18	GS2-82-0006/Edit	G	24	964		27	10	UB18	GS2-88-0008/Edit	G	15	984		36	12	VB18	GS2-104-0010/Edit	G	15	910		39	10	VA18	GS2-116-0002/Edit	G	16	917		54	10
UA19	GS2-82-0007/Edit	G	20	963		42	10	UB19	GS2-88-0009/Edit	G	15	979		53	11	VB19	GS2-107-0001/Edit	G	17	901		39	11	VA19	GS2-116-0003/Edit	G	16	909		53	10
UA20	GS2-82-0008/Edit	G	20	962		42	10	UB20	GS2-88-0010/Edit	G	23	978		44	11	VB20	GS2-107-0002/Edit	G	15	900		53	10	VA20	GS2-116-0004/Edit	G	15	908		42	10
UA21	GS2-82-0009/Edit	G	16	961		51	11	UB21	GS2-90-0001/Edit	G	16	977		41	10	VB21	GS2-107-0003/Edit	G	15	899		51	10	VA21	GS2-116-0005/Edit	G	17	907		40	10
UA22	GS2-82-0010/Edit	G	18	960		44	12	UB22	GS2-90-0002/Edit	G	19	976		54	11	VB22	GS2-107-0004/Edit	G	19	898		45	45	VA22	GS2-116-0006/Edit	G	16	906		39	11
UA23	GS2-89-0001/Edit	G	15	959		45	11	UB23	GS2-90-0003/Edit	G	18	974		38	11	VB23	GS2-107-0005/Edit	G	16	897		33	10	VA23	GS2-116-0007/Edit	G	15	905		47	10
UA24	GS2-89-0002/Edit	G	16	958		55	10	UB24	GS2-90-0004/Edit	H	27	973		50	10	VB24	GS2-107-0006/Edit	G	16	896		50	10	VA24	GS2-116-0008/Edit	G	15	904		51	10
UA25	GS2-89-0003/Edit	G	16	957		48	10	UB25	GS2-90-0005/Edit	G	19	972		49	10	VB25	GS2-107-0007/Edit	G	15	895		54	11	VA25	GS2-116-0009/Edit	G	17	903		51	11
UA26	GS2-89-0004/Edit	G	15	956		49	10	UB26	GS2-90-0006/Edit	G	31	971		56	10	VB26	GS2-107-0008/Edit	G	22	894		49	10	VA26	GS2-116-0010/Edit	G	15	902		42	10
UA27	GS2-89-0005/Edit	G	16	955		44	12	UB27	GS2-90-0007/Edit	G	19	970		63	12	VB27	GS2-107-0009/Edit	G	17	840		46	10	VA27	GS2-142-0005/Edit	G	17	893		52	10
UA28	GS2-89-0006/Edit	G	15	954		33	12	UB28	GS2-90-0008/Edit	G	18	969		37	10	VB28	GS2-107-0010/Edit	G	17	839		31	11	VA28	GS2-142-0006/Edit	G	18	844		52	10
UA29	GS2-89-0007/Edit	G	14	953		50	11	UB29	GS2-90-0009/Edit	G	16	968		52	10	VB29	GS2-108-0001/Edit	G	17	838		45	11	VA29	GS2-142-0007/Edit	G	14	843		49	10
UA30	GS2-89-0008/Edit	G	17	952		60	10	UB30	GS2-142-0002/Edit	G	17	967		30	12	VB30	GS2-108-0002/Edit	G	20	836		45	10	VA30	GS2-142-0008/Edit	G	17	842		43	10
UA31	GS2-89-0009/Edit	G	15	951		50	10	UB31	GS2-100-0001/Edit	G	17	966		53	11	VB31	GS2-108-0003/Edit	G	15	834		44	10	VA31	GS2-142-0009/Edit	G	18	841		47	12
UA32	GS2-89-0010/Edit	G	14	950		31	10	UB32	GS2-100-0002/Edit	G	17	965		37	10	VB32	GS2-108-0004/Edit	G	15	832		53	10	VA32	GS2-142-0010/Edit	G	17	833		42	10
32 UA straws / 0,0,32 at Stages E,F,G								32 UB straws / 0,0,31 at Stages E,F,G								32 VB straws / 0,0,32 at Stages E,F,G								32 VA straws / 0,0,30 at Stages E,F,G							

Module Testing at Liverpool

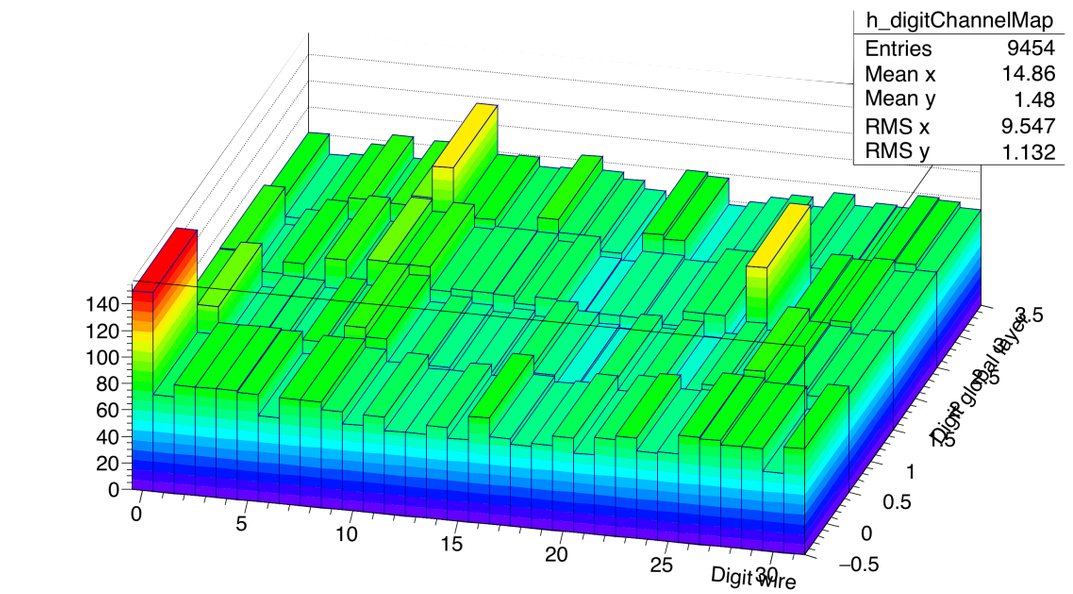
- At stages throughout the module production they are over pressurised to +200mbar then checked for leaks, continues production if it passes.
- Module is then bolted into vac tank and pumped down over a couple of days.
- Rate of rise tests are carried out to measure the overall leak rate of the module.

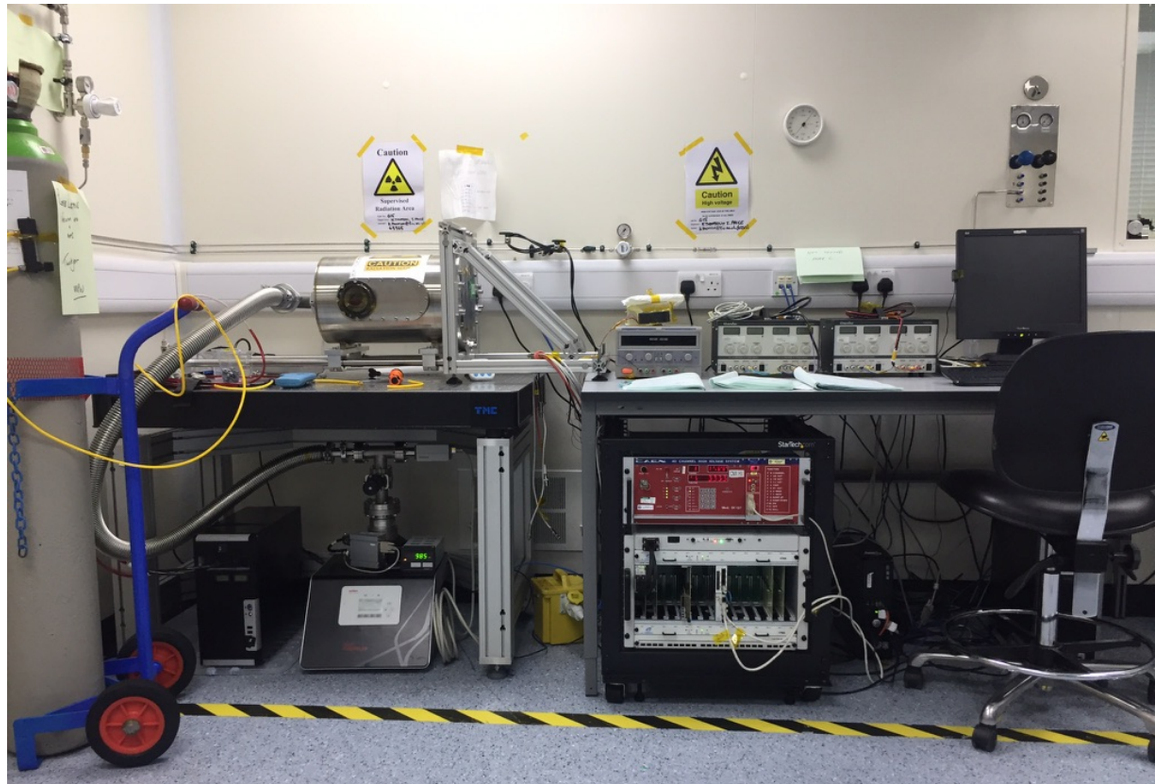




Module Testing at Liverpool

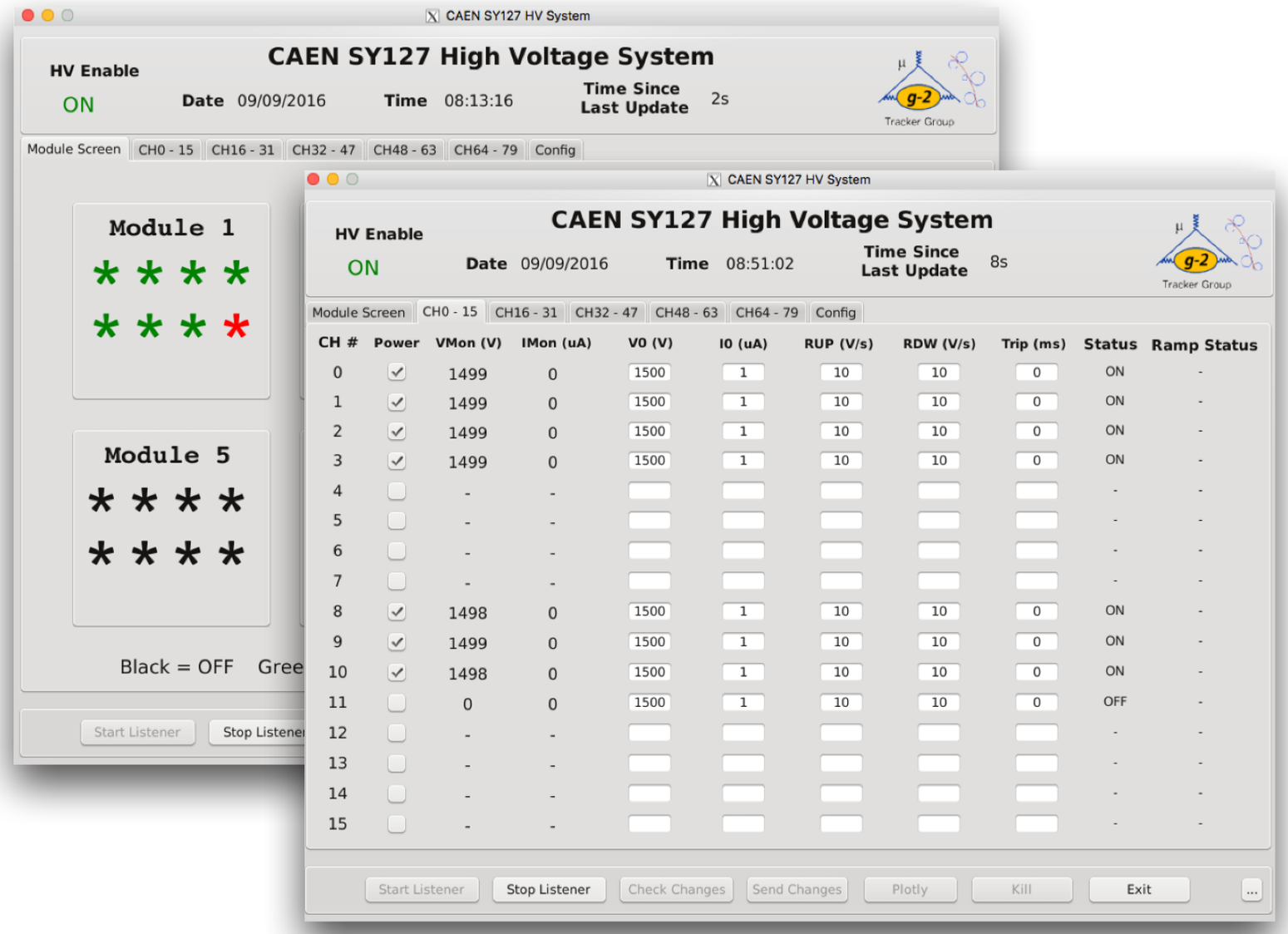
- Using the final E989 DAQ setup.
- Carry out noise scans to confirm internal electronics connections are correct.
- Scan over with a Sr90 source, check for dead channels / bad connections.
- Take long cosmic runs.

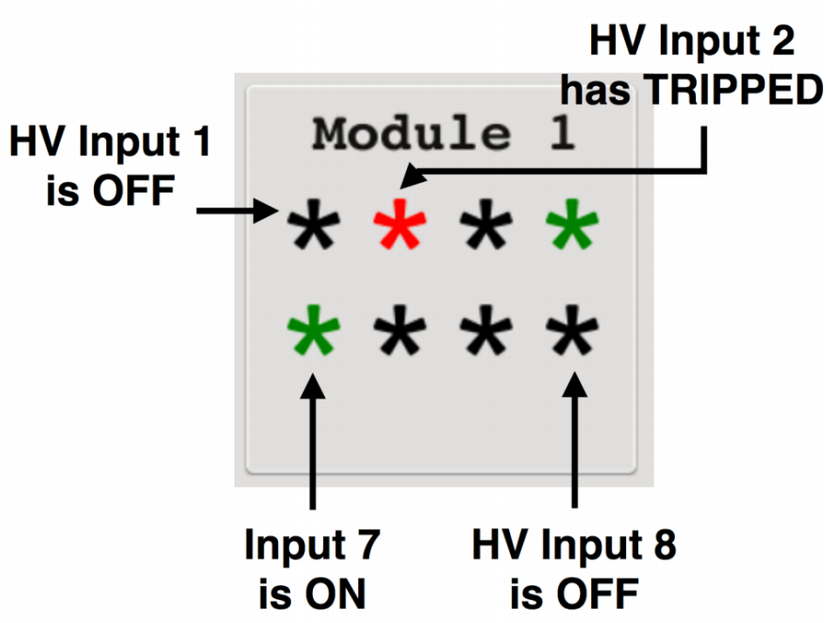




Module Testing

- Using a CAEN SY127 HV supply with A333 HV Cards
- Hold modules at 1500V for 24hrs with a trip current of 1uA.
- So far have only had to train 1 module to be able to hold 1500V
- Monitored + Controlled by HV GUI, developed at Liverpool.





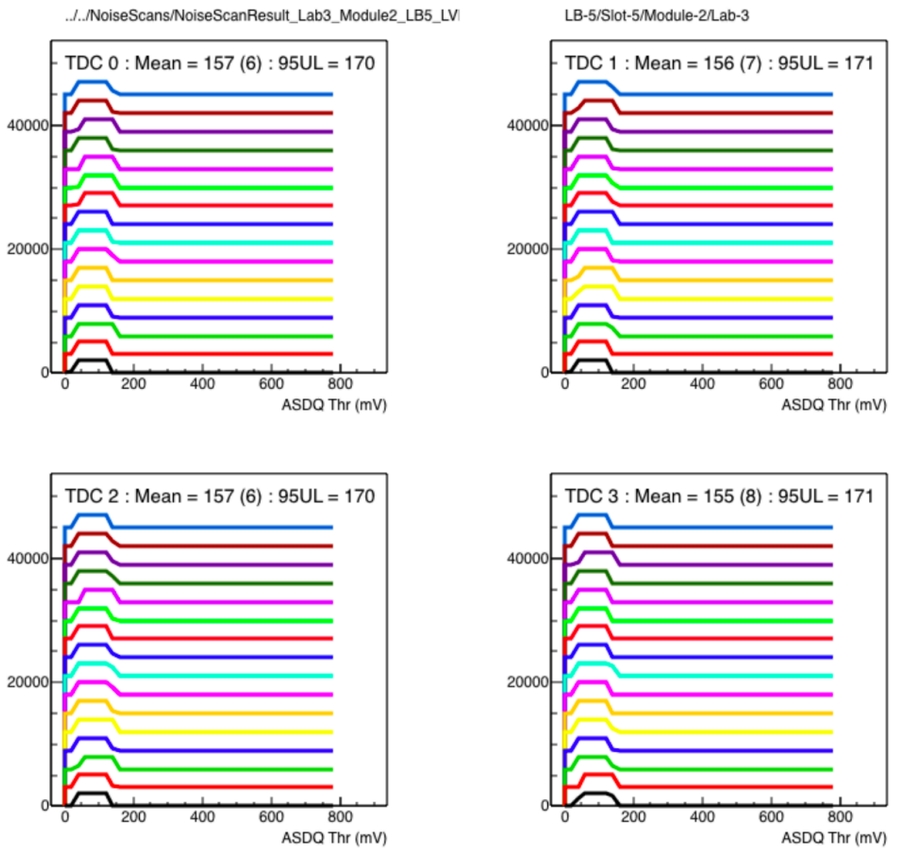
Tracker Electronics - Low Voltage

- All LV boards are now produced!
- Measured noise level is comparable to commercial benchtop supplies.
- Noise level has been measured in many different environments with different setups

- In test stands at L'pool / UCL / MC1 / Lab3
- With 1 tracker module up to a full tracker station
- With and without HV and gas

Aim -> Run at 200mV threshold

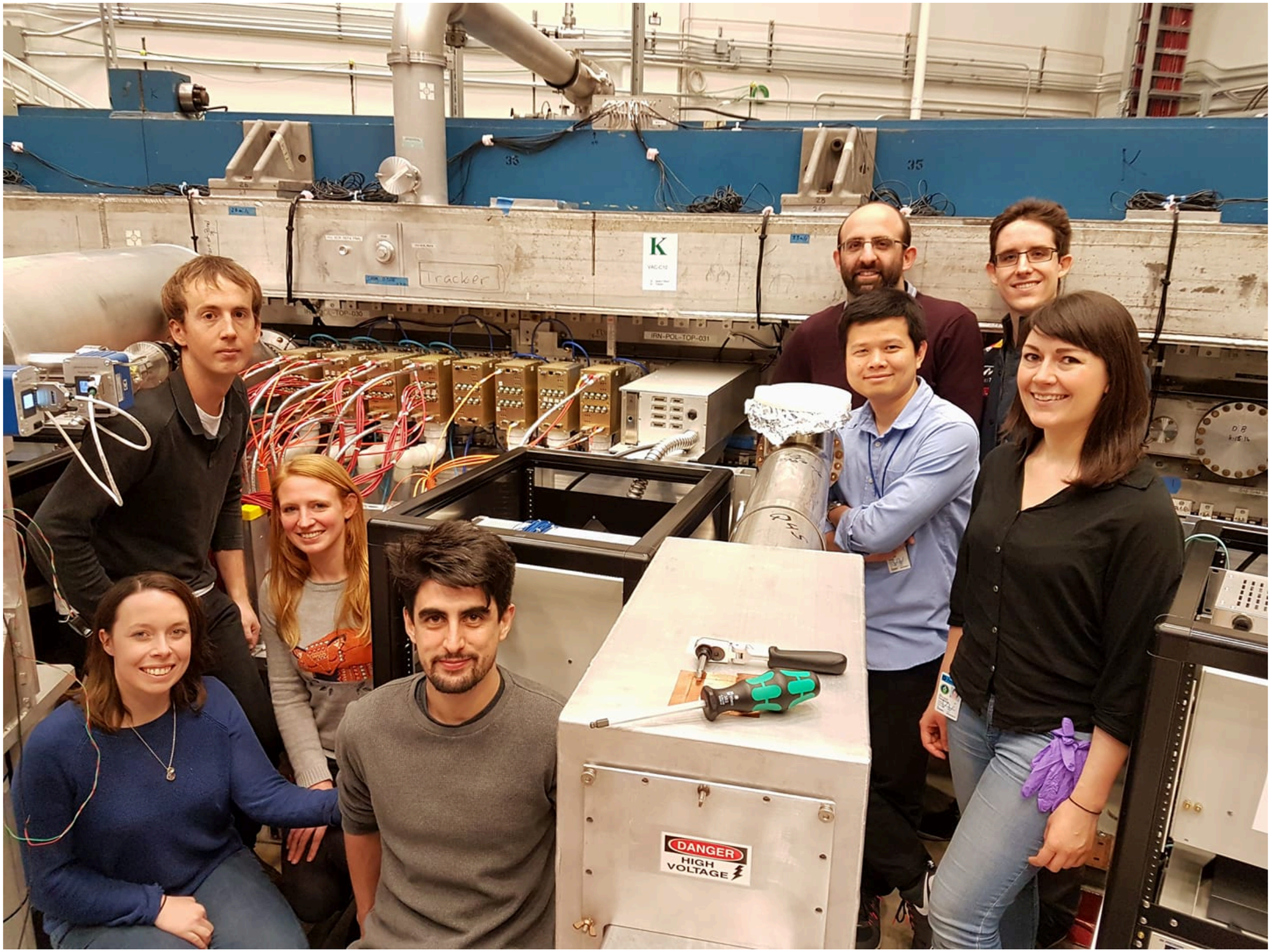
Reality -> Able to run at 180mV!!



Module Testing at FNAL

- Flown from MAN->ORD inside a pelicase as hand luggage.
  - *Yet to have any problems from this method*
- Undergoes the same tests on arrival in Lab 3 as done previously in Liverpool as well as being scanned in the source test stand - developed by NIU.

First Tracker Station Fully Installed!!



Thanks