

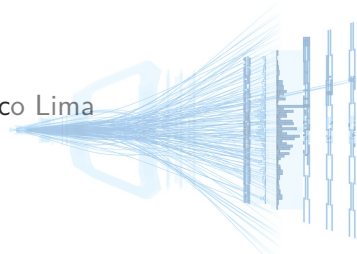


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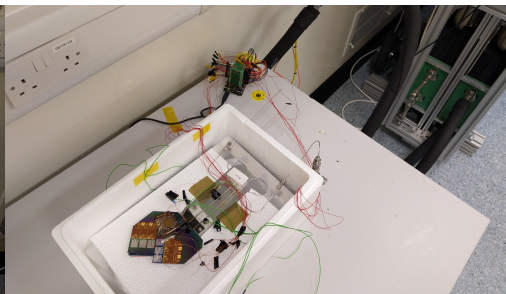
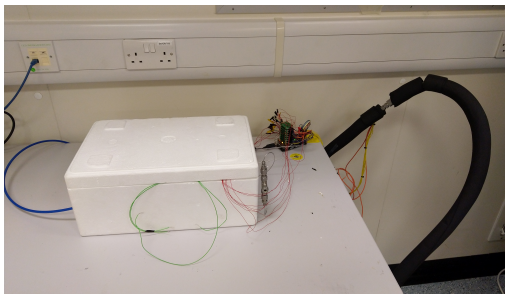
Cooling @ Liverpool

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07/10/19



- ❖ LUCASZ is commissioned and operational.
- ❖ First set of rudimentary tests were performed end of July.
- ❖ Current test setup includes:
 - ❖ Variable pre-heater up to $\sim 230\text{W}$ with six temperature sensors;
 - ❖ Connected, tested, working;
 - ❖ Two real microchannels, each with 4 DC heaters mimicking tiles and 4 pt100;
 - ❖ Ready-to-connect, tested, working;
 - ❖ Custom arduino temperature readout;



```
Thermistor Disconnected
MODULE TEMP ALARM
Time: 2427 Temperature: 0.73|0.52|0.31|0.41|0.20|1.04|22.73|22.73|23.99|25.25|23.99|22.73|22.73|23.99
Thermistor Disconnected
MODULE TEMP ALARM
Time: 2429 Temperature: 0.73|0.52|0.31|0.52|0.09|1.15|22.73|22.73|23.99|25.25|23.99|22.73|22.73|23.99
Thermistor Disconnected
MODULE TEMP ALARM
Time: 2431 Temperature: 0.62|0.62|0.41|0.52|0.20|1.15|22.73|22.73|23.99|25.25|23.99|22.73|22.73|23.99
Thermistor Disconnected
MODULE TEMP ALARM
Time: 2434 Temperature: 0.73|0.62|0.41|0.52|0.20|1.15|22.73|22.73|23.99|25.25|23.99|22.73|22.73|23.99
Thermistor Disconnected
MODULE TEMP ALARM
Time: 2436 Temperature: 0.62|0.62|0.41|0.62|0.20|1.15|22.73|22.73|23.99|25.25|23.99|22.73|22.73|22.73
Thermistor Disconnected
MODULE TEMP ALARM
Time: 2438 Temperature: 0.73|0.62|0.41|0.52|0.31|1.15|22.73|22.73|23.99|25.25|23.99|22.73|22.73|23.99
Thermistor Disconnected
MODULE TEMP ALARM
Time: 2440 Temperature: 0.83|0.73|0.52|0.62|0.20|1.15|22.73|21.47|23.99|25.25|23.99|22.73|22.73|23.99
Thermistor Disconnected
```

- ❖ With the current test setup we **can**:
 - ❖ Fully test LUCASZ;
 - ❖ Calibrate internal bypasses;
 - ❖ Make the plant VELO-commissioning ready;
[To be completed by the end of the month]
- ❖ With the current test setup we **cannot**:
 - ❖ Test the actual experimental system;
- ❖ Some great info on predicted total dP, dP over the longest and shortest lines, etc. already shown by Oscar [here](#);
- ❖ Our understanding is that we are being asked to provide the parameters of the finished VELO halves, such as total dP, dP/dT vs. FlowRate, etc.
- ❖ This can only be feasible if...

- ❖ We wait until the entire VELO half is finished;
 - ❖ Reliant on delivery of parts and modules from upstream on the chain of production;
 - ❖ Will certainly not be before the end of winter;
 - ❖ Would require for everything on the project to go 100% smoothly from now on;
 - ❖ Would, in theory, provide us with **complete** information on the system;

- ❖ We produce a custom solution for temporary partial assembly of the VELO half;
- ❖ Still reliant on delivery of some parts and a couple of modules;
- ❖ Could **possibly** be achieved before the end of the year;
- ❖ Would require the redistribution of already tight person-power (**everything** else in Liverpool temporarily grinds to a halt);
- ❖ Would provide us with only **partial** information on the system (ie. longest-shortest line, etc.);

- ❖ We have an operational LUCASZ plant;
- ❖ We will soon have it tested with real micro-channels;
- ❖ We cannot provide the cooling group with the final systems characteristics on a short timescale;
- ❖ We have Option A:
 - ❖ Proceed with current work and timeline;
 - ❖ Full system characteristics; **earliest** spring 2020;
- ❖ and Option B:
 - ❖ Refocus to produce a temporary partial assembly;
 - ❖ Partial system characteristics; **earliest** end of year;
 - ❖ Other VELO assembly work essentially stops;
- ❖ We absolutely welcome any suggestions!

Backup



Phase I

Secondary Vacuum

Parts

C-side Hood
Cooling access & tool port covers
Blanking flanges :- 3 x 6 card
2 x 4 card
3 x Lower FT's

CF flange bar C-side
& 26 CF blanking flanges

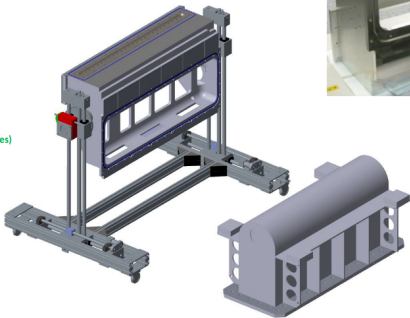
Vacuum port flange
& DN40 fittings
O-rings
Sundries

Tooling

Assembly Trolley No1
Vacuum bath
& Assembly tool plate
Crane (slings)
Vacuum pumps (tubes & gauges)
Helium Sniffer (Helium)

Other

Guides for vacuum bath.



Tests

Sec. Yo Vacuum test (10-6mbar)
Leak test

Phase IIa

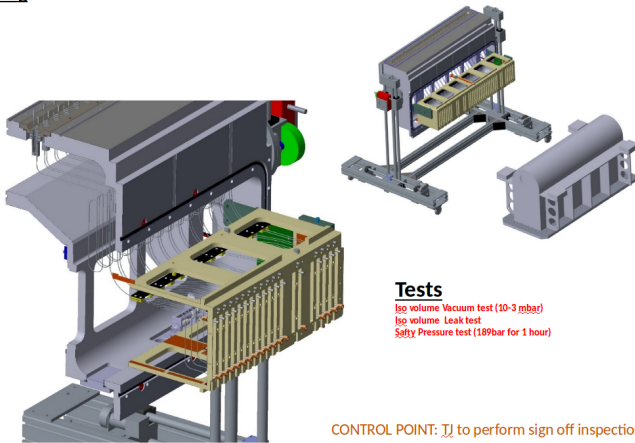
Secondary Cooling

Parts

26 cooling loops
26 return links
CF gaskets
VCR gaskets
Support arms *assy.*
Cooling constraint *assy.*
C-side support base

Tooling

Constraint hanger



Tests

Iso volume Vacuum test (10-3 mbar)
Iso volume Leak test
Safety Pressure test (189bar for 1 hour)

CONTROL POINT: JJ to perform sign off inspection

Phase IV

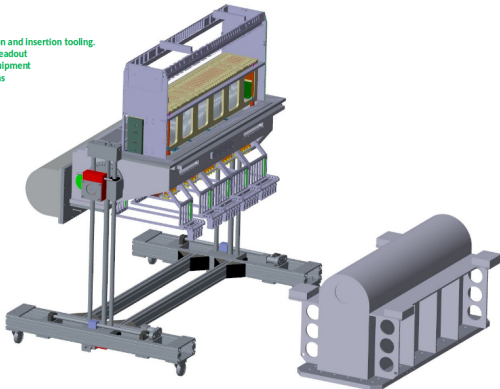
Module Tooling, DAQ

Parts

Dummy modules for trial runs
Modules No 1 to 5
VCR pin hole gaskets

Tooling

Module inspection and insertion tooling.
DAQ cables and readout
Electrical test equipment
Protection screens
Torque wrench
Sundries



Tests

Electrical tests continuity test on HV cables, **thermographic** resistance test & any additional testing of data cables specified by CERN
Final cooling commissioning test.
Run system for 24 hours with liquid CO₂ and temperature readout via PT100
Reference **photogrammetry** prior to beginning of Stage V

Control Point: TJ to perform sign off inspection prior to module mounting

Phase Va

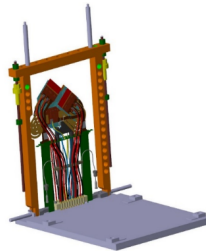
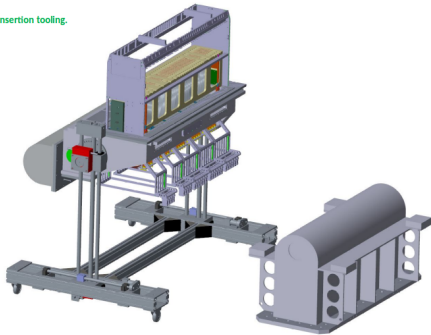
Module Mounting Training (1 to 5)

Parts

Dummy modules for trial runs
Modules No 1 to 5
VCR pin hole gaskets

Tooling

Module inspection and insertion tooling.
Protection screens
Torque wrench
Sundries



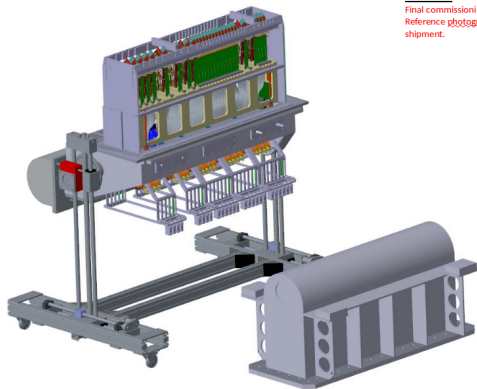
Tests

Test with prototype module
Module groups to specify mechanical,
electrical & cooling tests to qualify
acceptance
Reference [photogrammetry](#) after each
pair of modules.

Control Point: Module group to perform sign off inspection of 1st module

Phase VI

System Qualification



Tests

Final commissioning tests.
Reference ~~photogrammetry~~ prior to shipment.

Control Point: IJ to perform final sign off of detector half.