UNIVERSITÄT BERN

AEC
ALBERT EINSTEIN CENTER
FOR FUNDAMENTAL PHYSICS

ArgonCube

LABORATORIUM FÜR HOCHENERGIEPHYSIK
LHEP
UNIVERSITÄT BERN

Testing Plan at Bern

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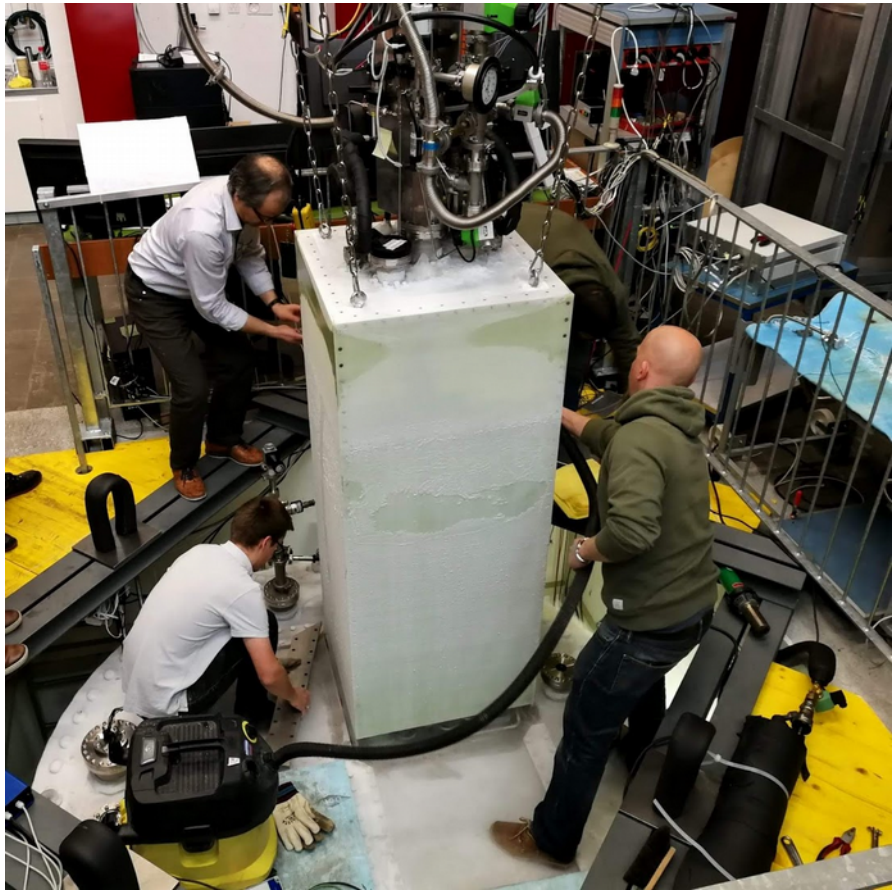
DUNE Near Detector Workshop, May 25th 2019, Fermilab

Purity Module Experiment

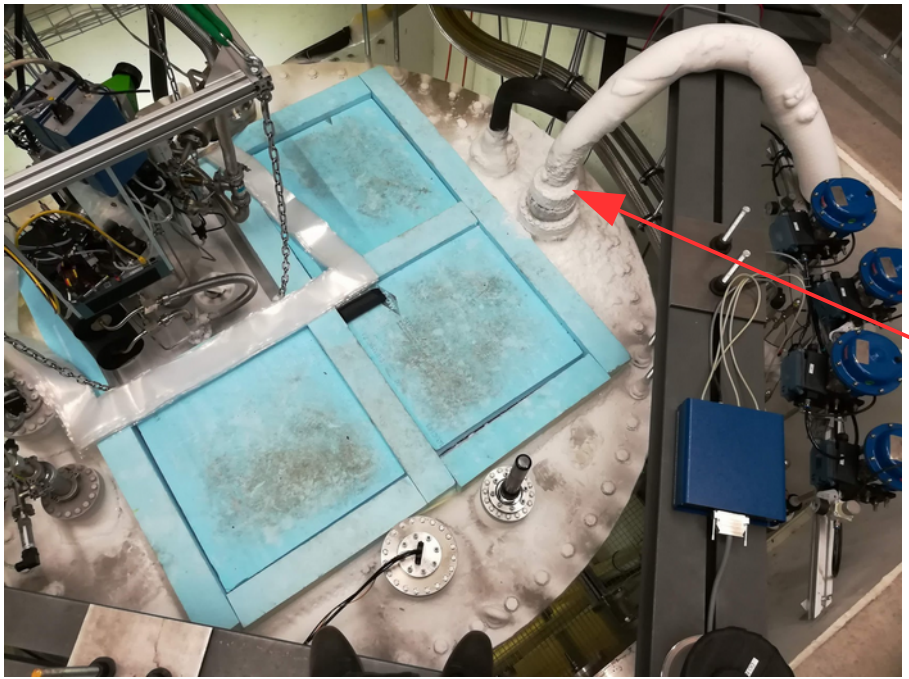


First module extraction

February 25th - March 15th

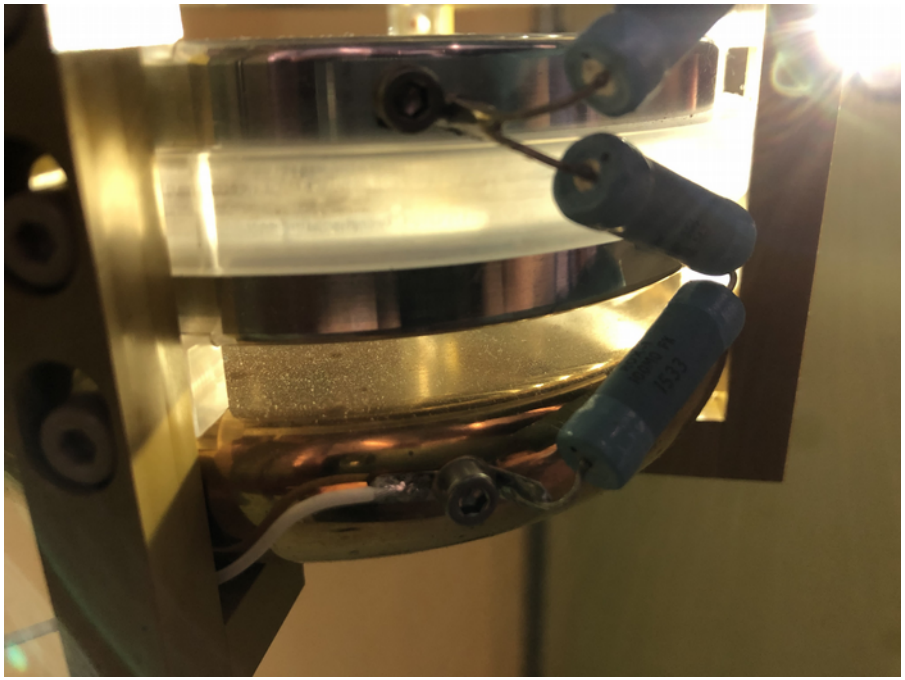
- Operated 2x2 cryostat for 3 weeks
- Several extractions / insertions
  → gained experience in those tasks
- Learned a lot about the properties of 2x2 (e.g. heat-losses, etc.)
- Found many weak points / possible points of improvement

Module Tests in Bern – Weak Points

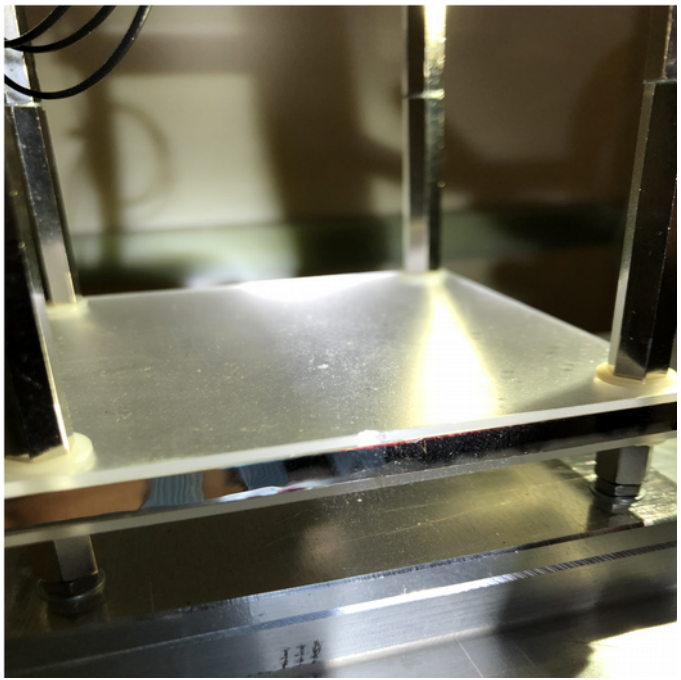


- Copper dust from LAr filters
- High noise level from pump VFD
  - → electrically isolated pump and shield lines
  - → moved pump further away
- Cryostat exhaust valve
  - → got stuck several times
- Liquid check-valves for level/pressure-control
  - → not possible for manual control
- Panel-wall design had many leak paths

Copper Dust



Cathode of the 60 cm drift TPC in the module

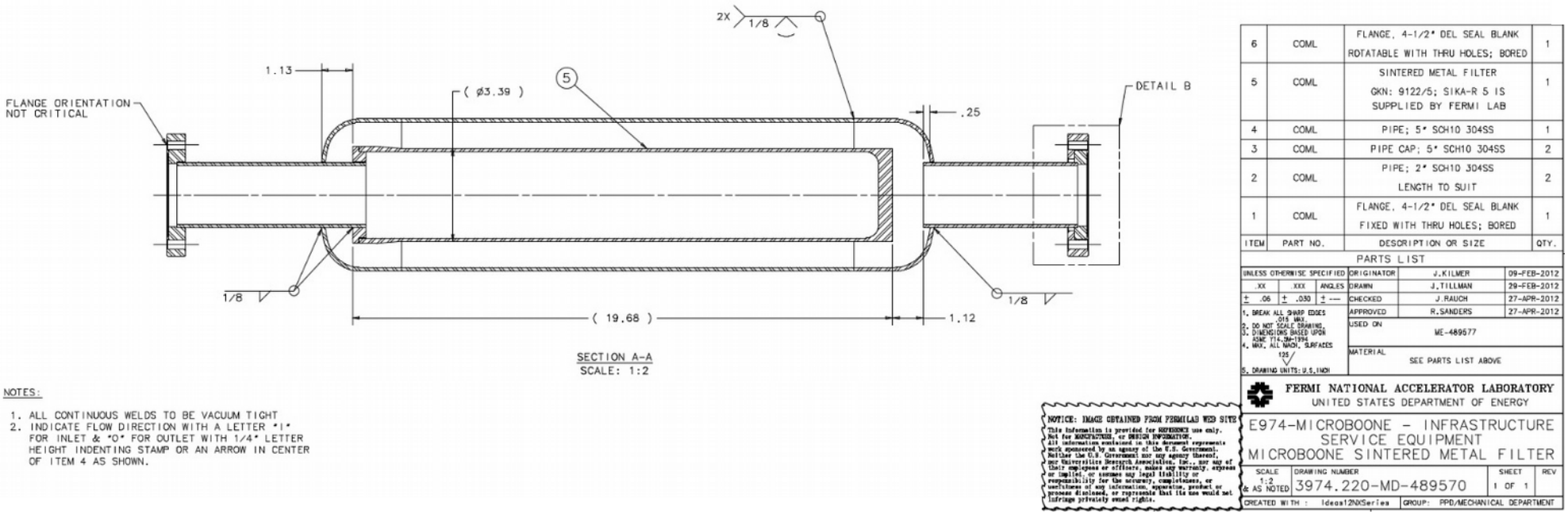


Scintillator tile on top of the TPC

Copper dust in module originating from LAr purification filters
(picture taken after purification was running for ~50 hours)

➞ **developing new filters incorporating a particle trap**

New LAr Filter Design



NOTES:

1. ALL CONTINUOUS WELDS TO BE VACUUM TIGHT
2. INDICATE FLOW DIRECTION WITH A LETTER "I" FOR INLET & "O" FOR OUTLET WITH 1/4" LETTER HEIGHT INDENTING STAMP OR AN ARROW IN CENTER OF ITEM 4 AS SHOWN.

ITEM	PART NO.	DESCRIPTION OR SIZE	QTY.
6	COML	FLANGE, 4-1/2" DEL SEAL BLANK ROTATABLE WITH THRU HOLES; BORED	1
5	COML	SINTERED METAL FILTER GKN: 9122/5; SIKA-R 5 IS SUPPLIED BY FERMI LAB	1
4	COML	PIPE; 5" SCH10 304SS	1
3	COML	PIPE CAP; 5" SCH10 304SS	2
2	COML	PIPE; 2" SCH10 304SS LENGTH TO SUIT	2
1	COML	FLANGE, 4-1/2" DEL SEAL BLANK FIXED WITH THRU HOLES; BORED	1

PARTS LIST

UNLESS OTHERWISE SPECIFIED .XX ± .06 .XXX ± .030 ANGLES ± ---	ORIGINATOR	J.KILMER 09-FEB-2012
	DRAWN	J.TILLMAN 29-FEB-2012
	CHECKED	J.RAUCH 27-APR-2012
1. BREAK ALL SHARP EDGES .015 MAX. 2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES 125 5. DRAWING UNITS: U.S.INCH	APPROVED	R.SANDERS 27-APR-2012
	USED ON	ME-489677
	MATERIAL	SEE PARTS LIST ABOVE

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

E974-MICROBOONE - INFRASTRUCTURE SERVICE EQUIPMENT
MICROBOONE SINTERED METAL FILTER

SCALE	DRAWING NUMBER	SHEET	REV
1:2 & AS NOTED	3974.220-MD-489570	1 OF 1	

CREATED WITH : Ideas12NXSeries GROUP: PPD/MECHANICAL DEPARTMENT

NOTICE: IMAGE OBTAINED FROM FERMILAB WEB SITE
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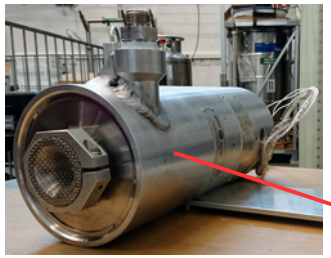
Special thanks to Fritz

→ New design with particle trap is ongoing
(using either sintered material or membrane)

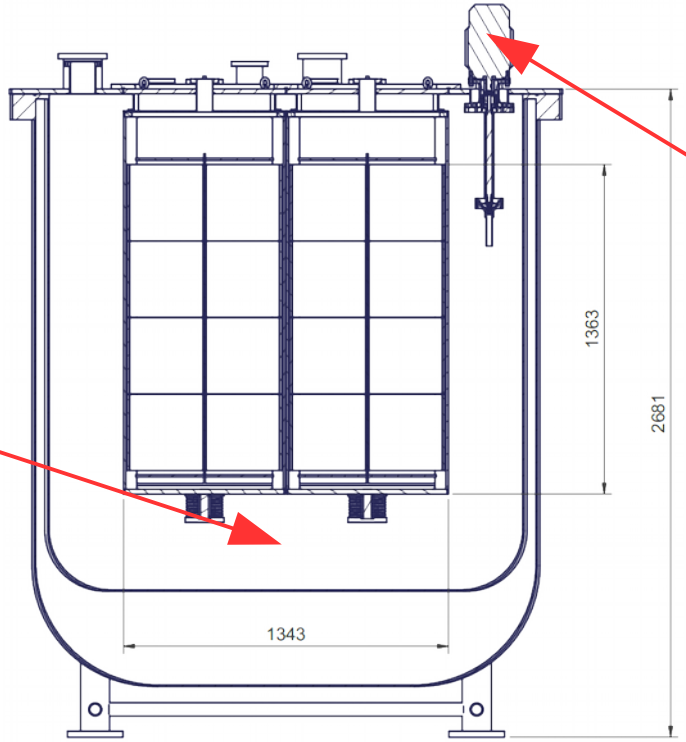
Electrical Noise from Pump VFD

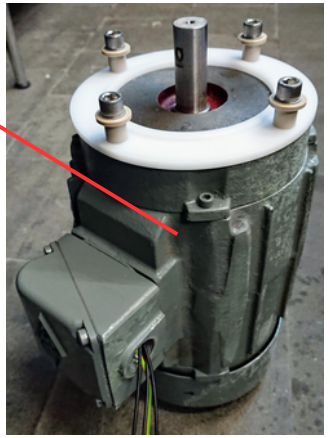
Problem: Pump's power supplies (3 phases) and detector need separate GND

→ electrically isolate pump (only possible for recirculation pump)



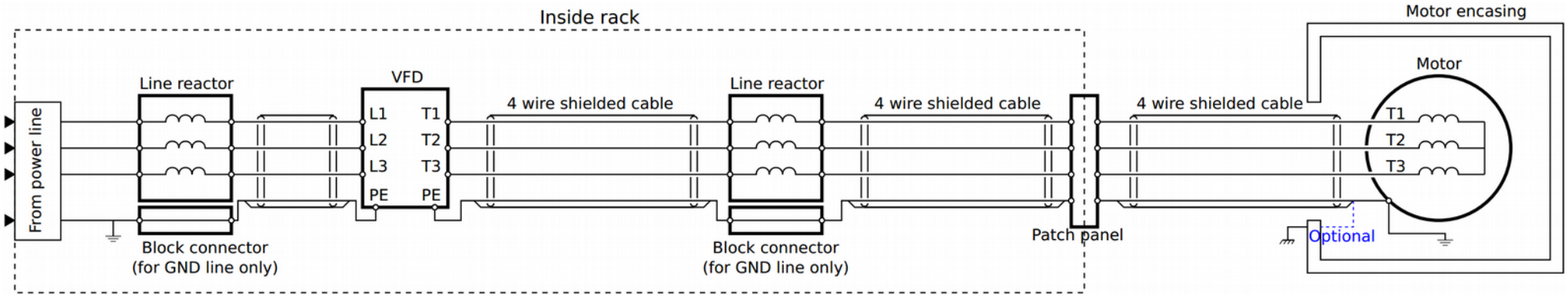
Sump pump





Recirculation pump

Electrical Isolation of Pump

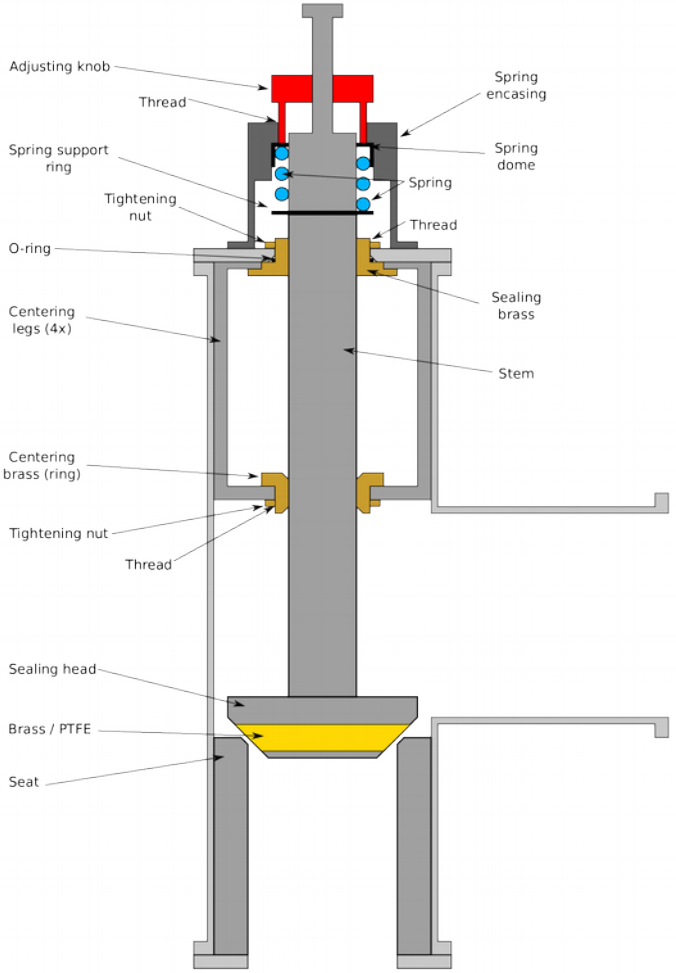


Grounding scheme by T. Nichols

- VFD in between line reactors → reduce voltage spikes
- Power GND, motor and cable shield on same potential
- Minimise length of unshielded phase wires

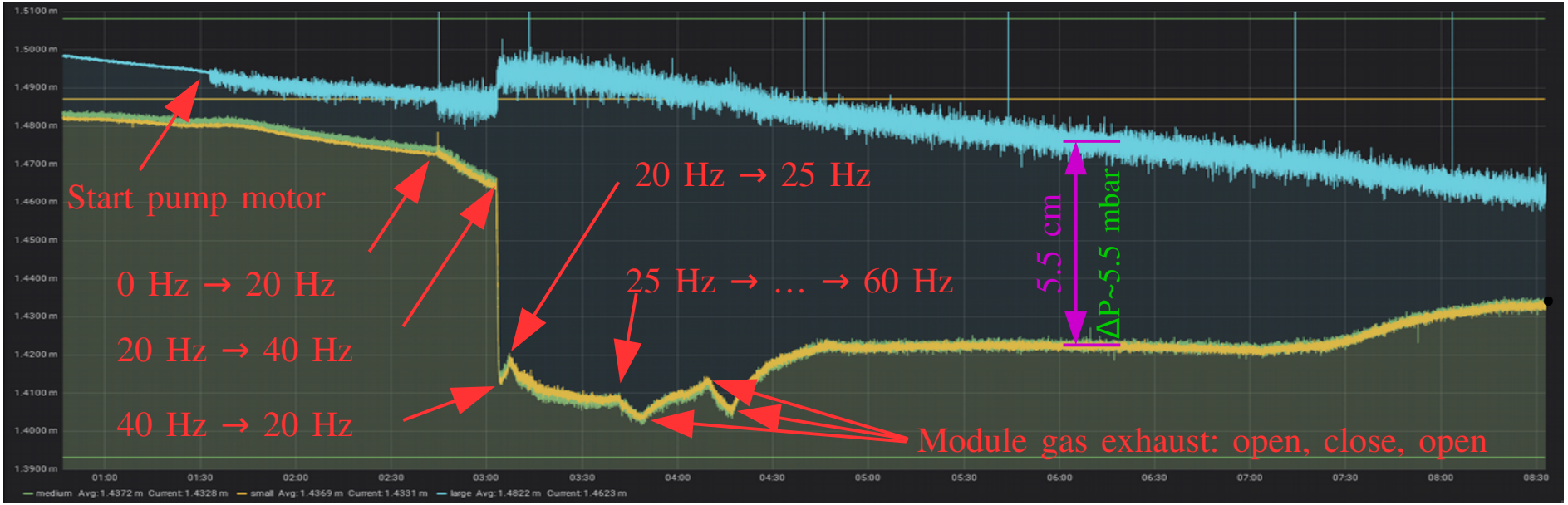
Cryostat Gas Exhaust-Valve

Custom designed valve with steel shaft and brass guide



Sketch by F. Piastra

Liquid Check-Valves



LAr purification increased module pressure up to ~11 mbar (w.r.t. cryostat)

→ liquid check-valves opened

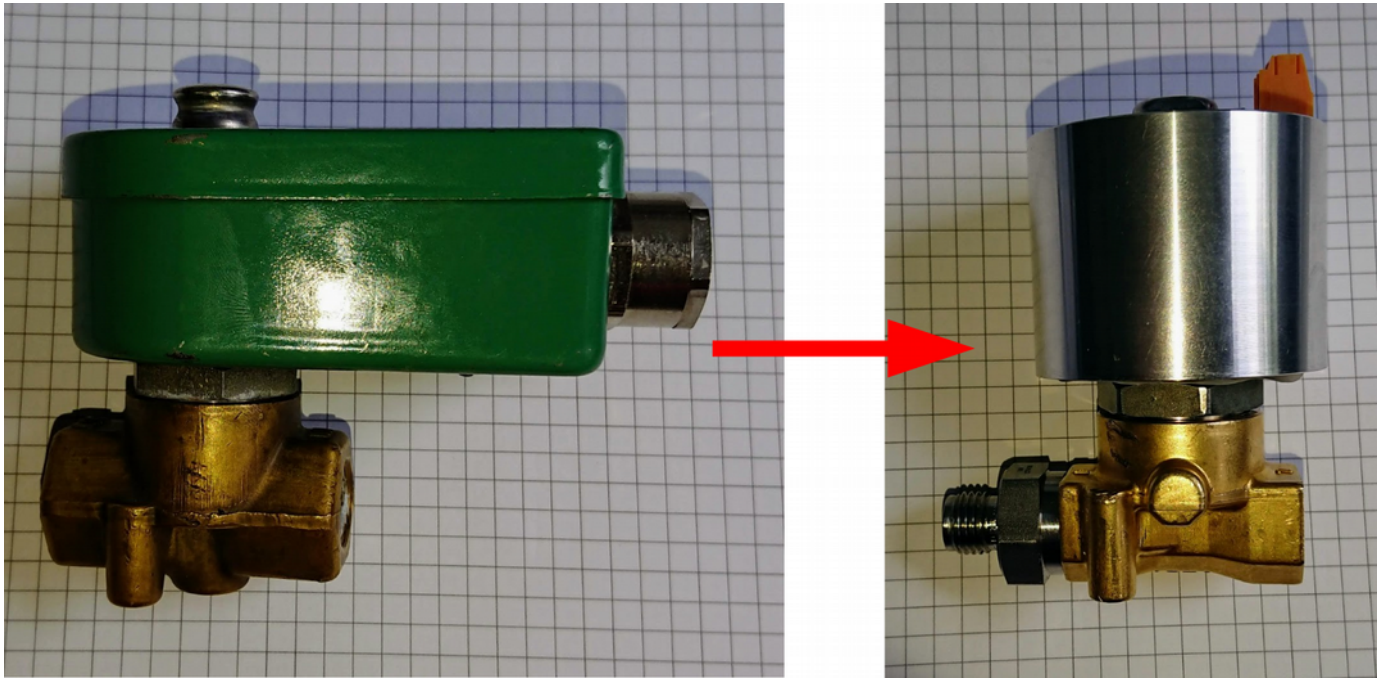
→ LAr level in module decreased by ~10 cm (w.r.t. cryostat)

→ **Problem:** Suck in dirty Argon when stopping recirculation

➞ **developed manually controllable cryogenic control-valves**

Liquid Control-Valves

Developed liquid control-valve in order to control the LAr level in the module



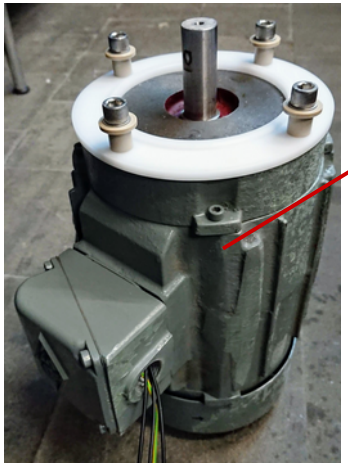
Designed by I. Kreslo

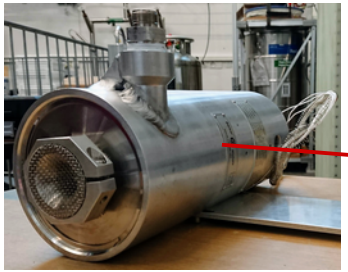
EM controlled, bi-stable check-valve: Either fully open or close (no intermediate state)

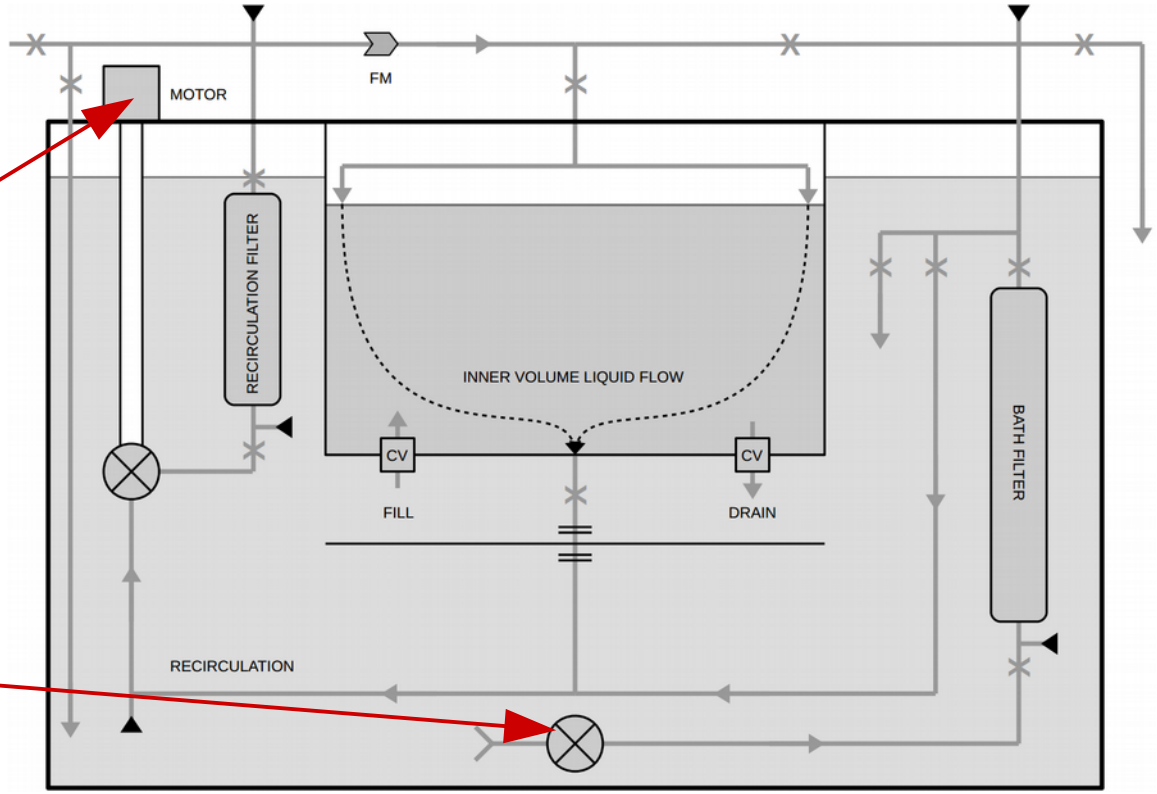
→ valves enable more complex cryogenics scheme

Cryogenics Scheme for 2x2

Cryogenics Scheme for 2x2







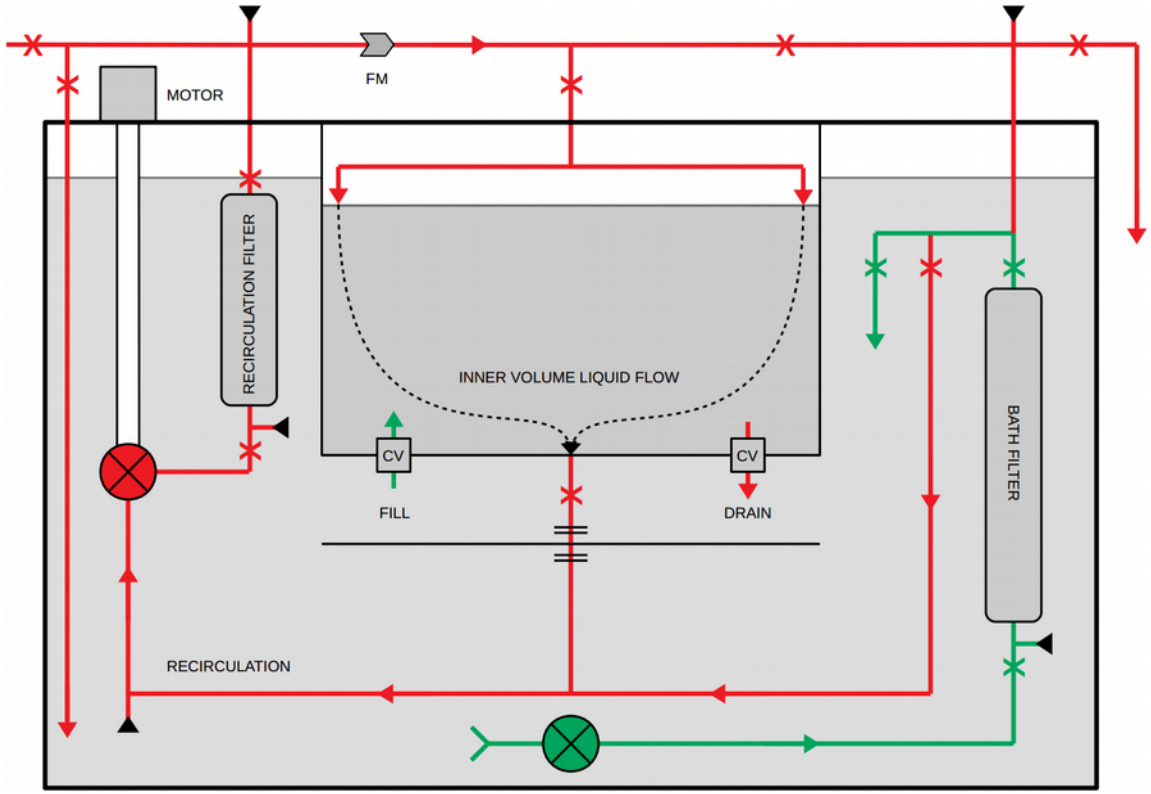
X control-valve

CV check-valve

FM flow meter

Connections below dummy flange: coiled flexible steel lines

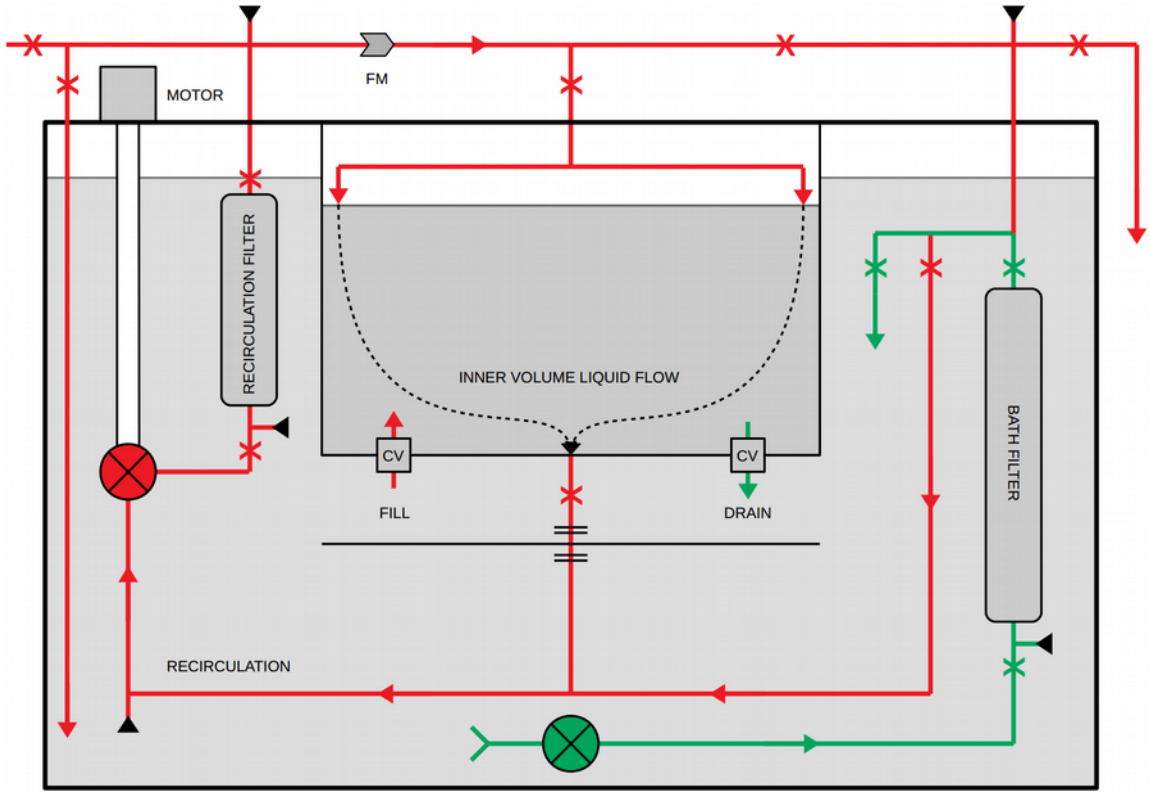
Cryogenics Scheme for 2x2 – Module Insertion



– active line
– inactive line
X control-valve
CV check-valve
FM flow meter

Connections below dummy flange: coiled flexible steel lines

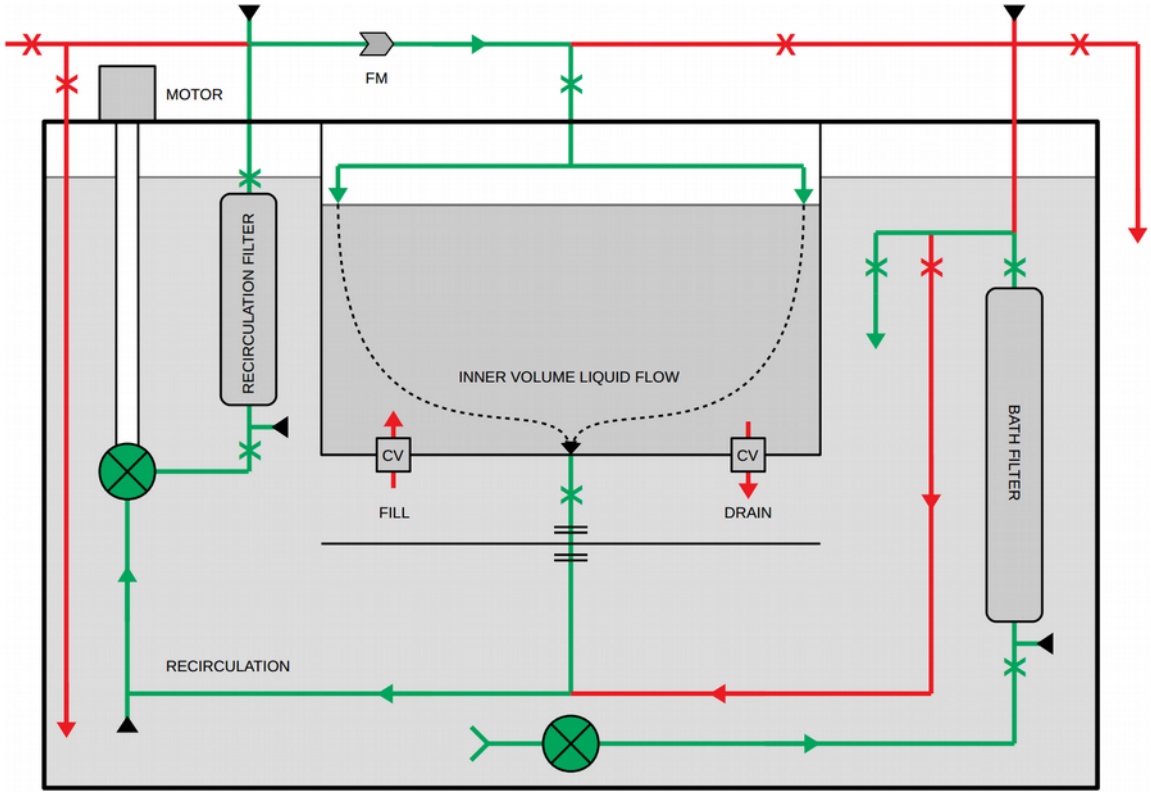
Cryogenics Scheme for 2x2 – Module Extraction



– active line
– inactive line
X control-valve
CV check-valve
FM flow meter

Connections below dummy flange: coiled flexible steel lines

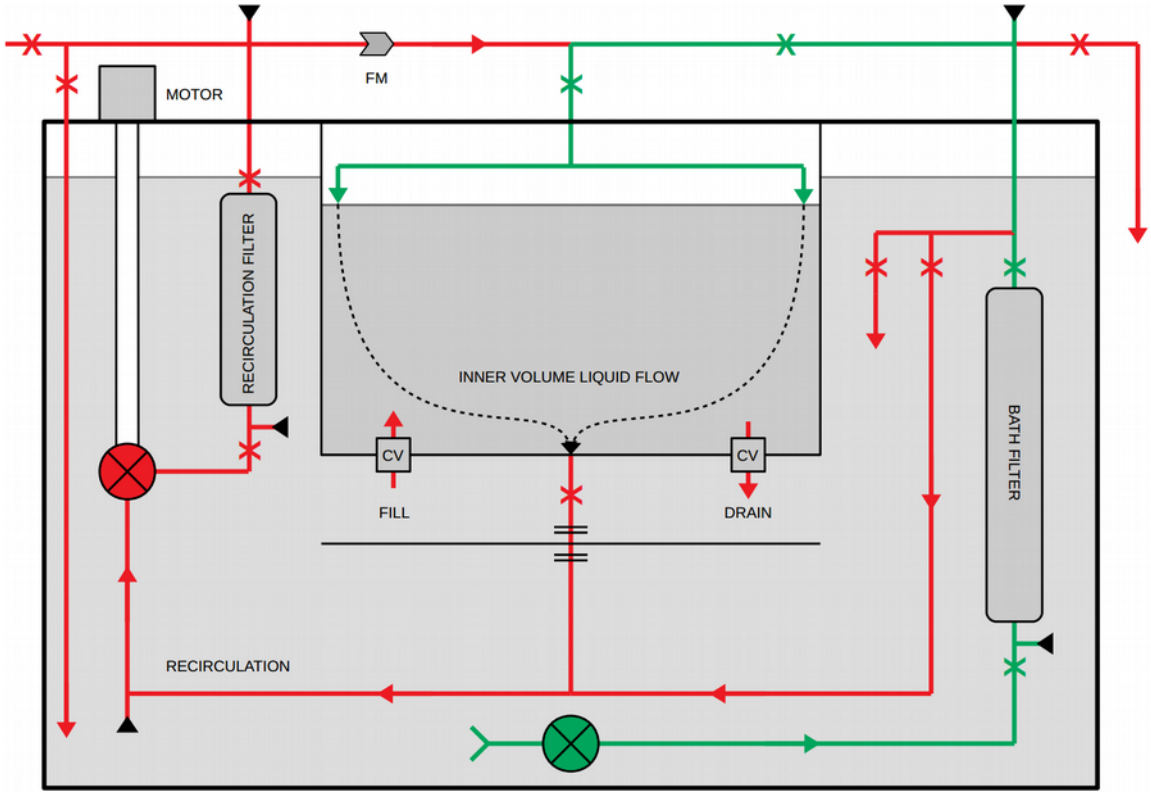
Cryogenics Scheme for 2x2 – Recirculation



– active line
– inactive line
X control-valve
CV check-valve
FM flow meter

Connections below dummy flange: coiled flexible steel lines

Cryogenics Scheme for 2x2 – Refilling



– active line
– inactive line
X control-valve
CV check-valve
FM flow meter

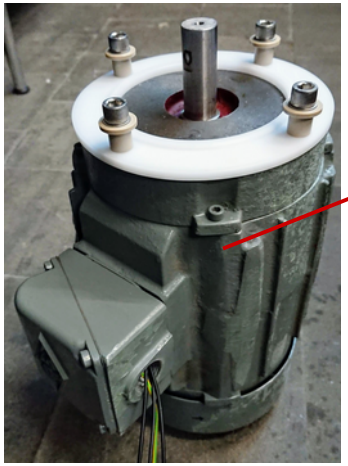
Connections below dummy flange: coiled flexible steel lines

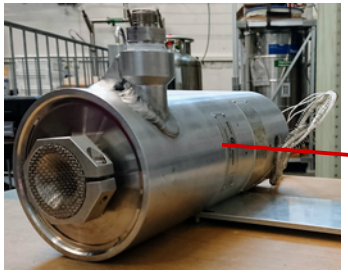
Cryogenics Scheme for Experiment in July

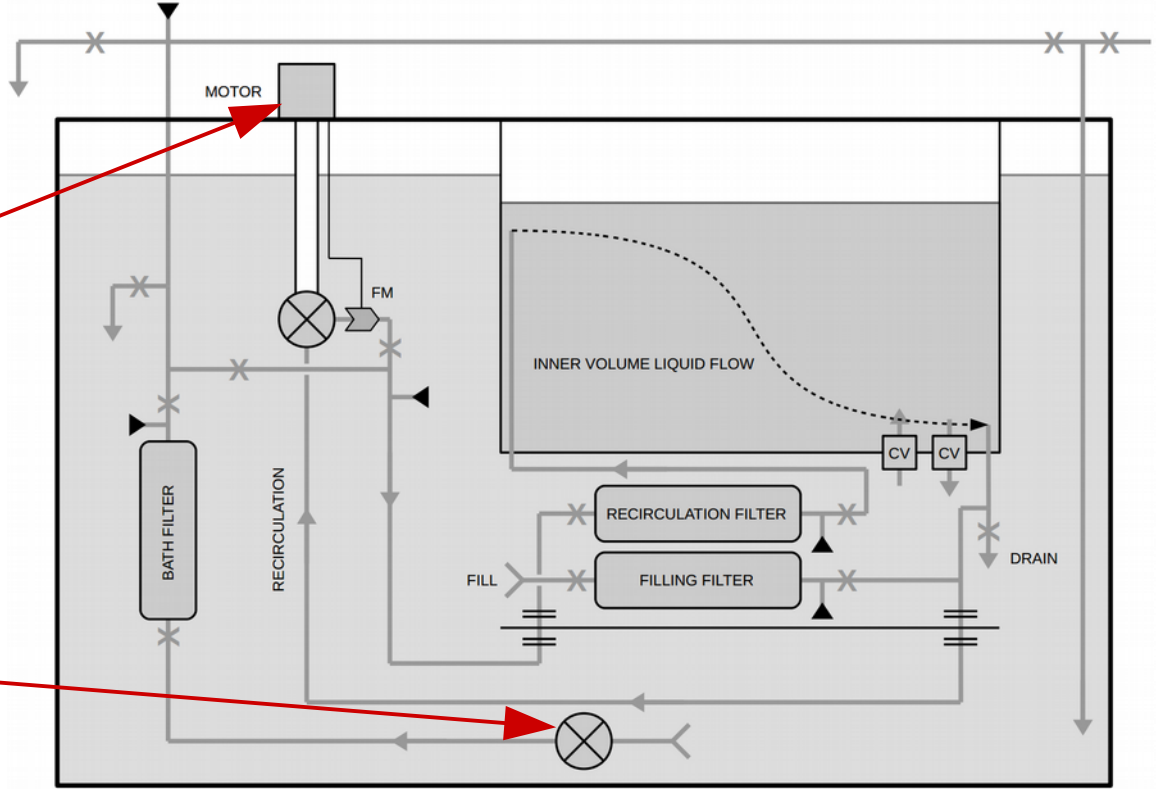
Looks different. Want to test:

- Coiled flexible steel lines below dummy flange
- Module filling through filter
- Pressure control through filter
- New filters
- New PLC
- New cryostat gas exhaust valve

Cryogenics Scheme – For Run in July







X control-valve

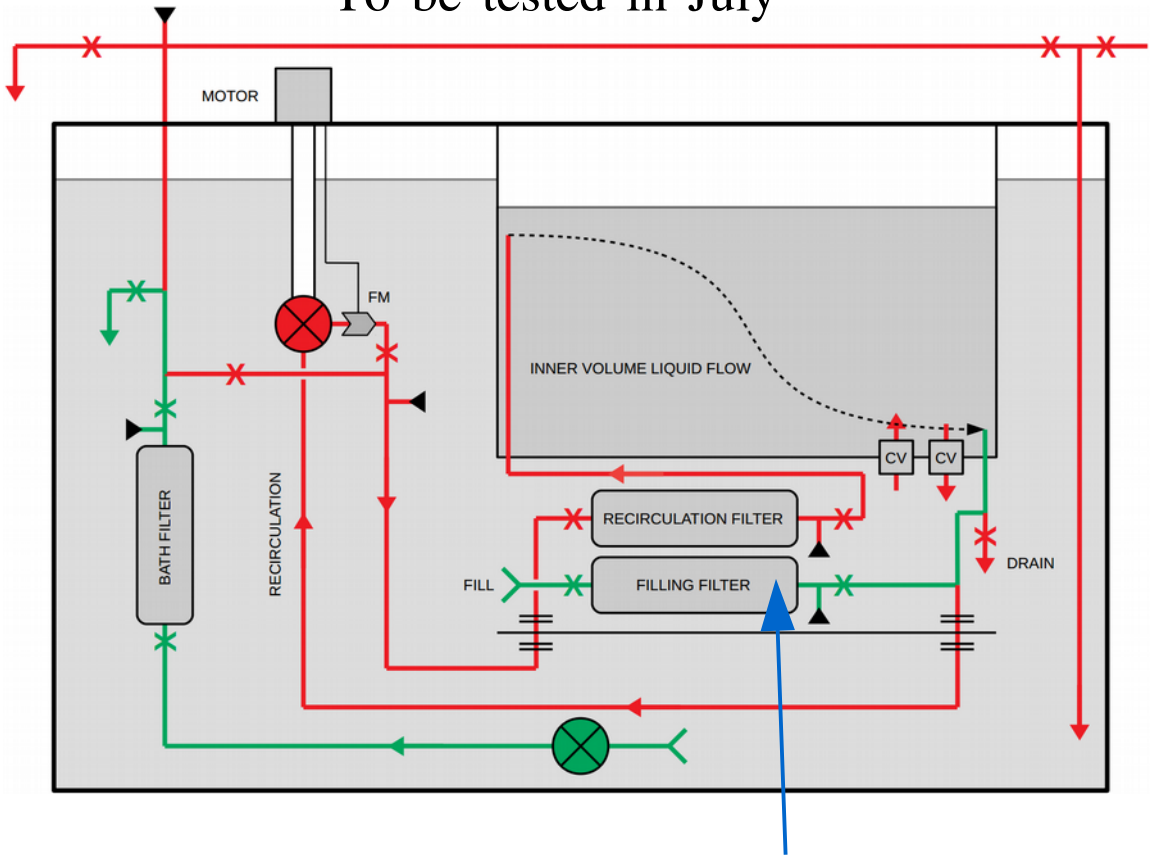
CV check-valve

FM flow meter

Connections below dummy flange: coiled flexible steel lines

Cryogenics Scheme – Module Insertion

To be tested in July

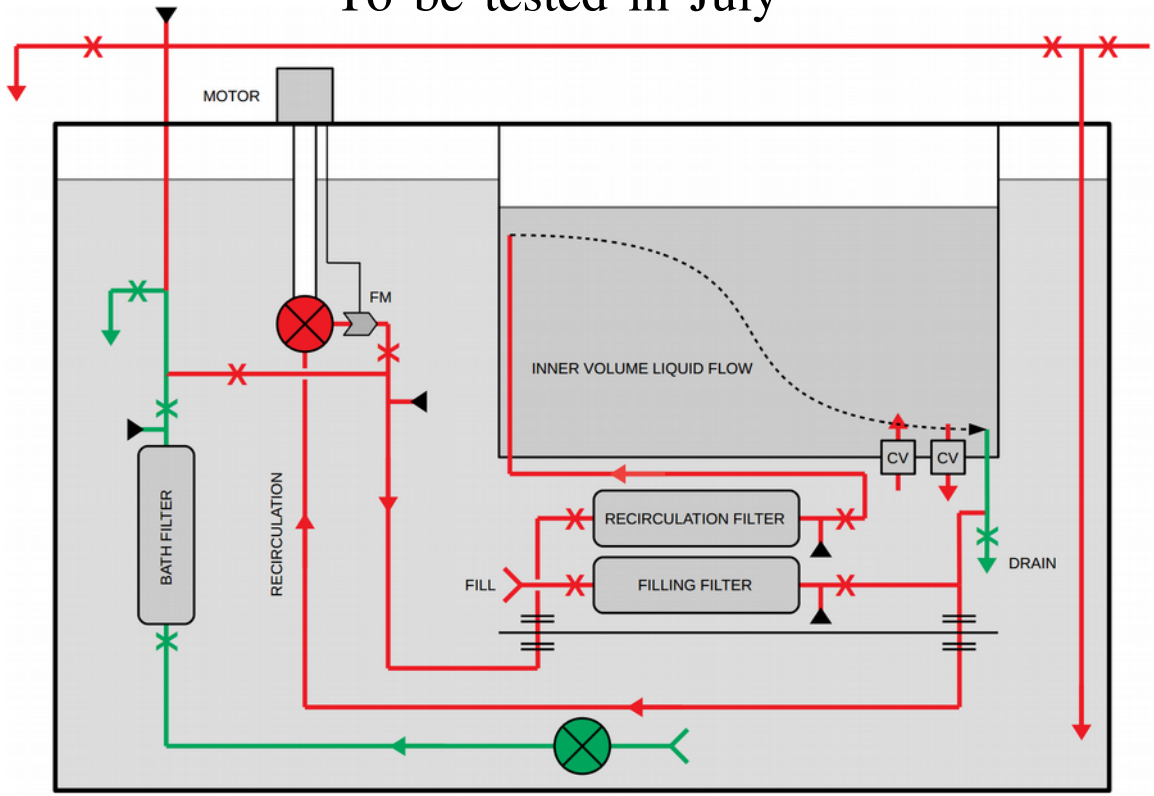


– active line
– inactive line
X control-valve
CV check-valve
FM flow meter

To be tested: Using this line for pressure / level control between cryostat & module (see p. 26)

Cryogenics Scheme – Module Extraction

To be tested in July



– **active** line

– **inactive** line

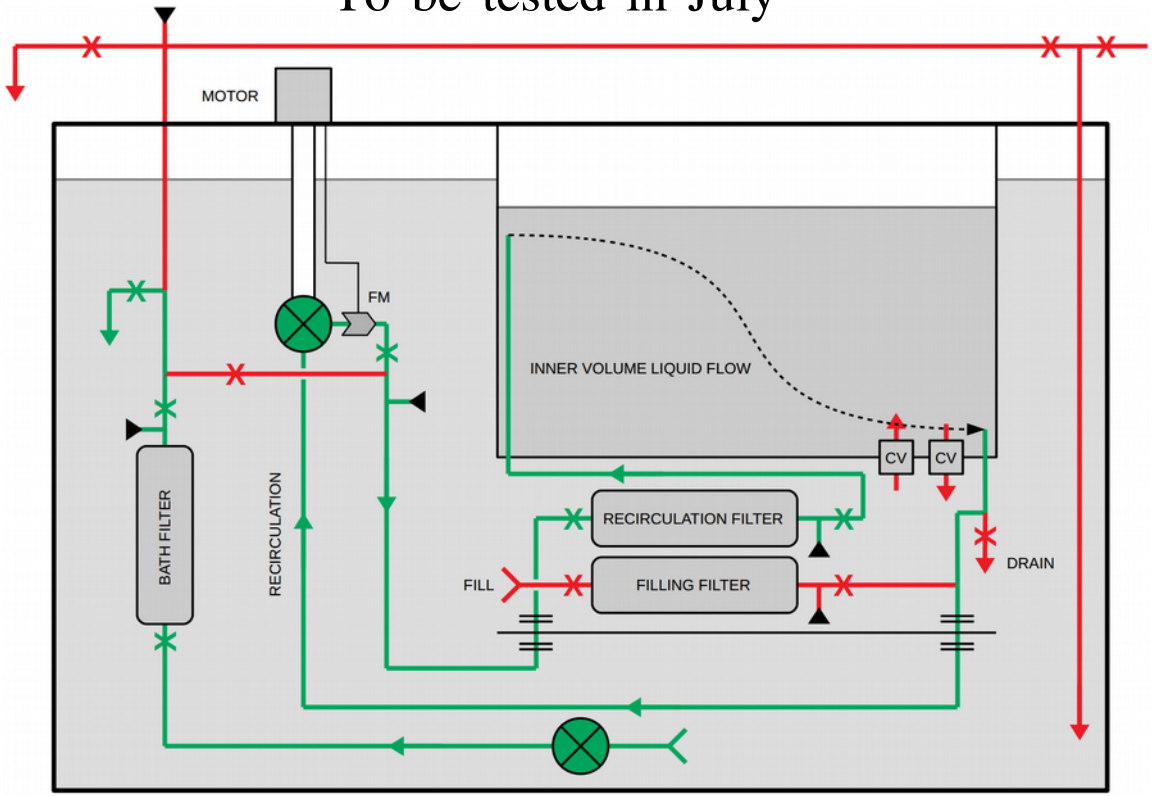
X control-valve

CV check-valve

FM flow meter

Cryogenics Scheme – Recirculation

To be tested in July



– active line

– inactive line

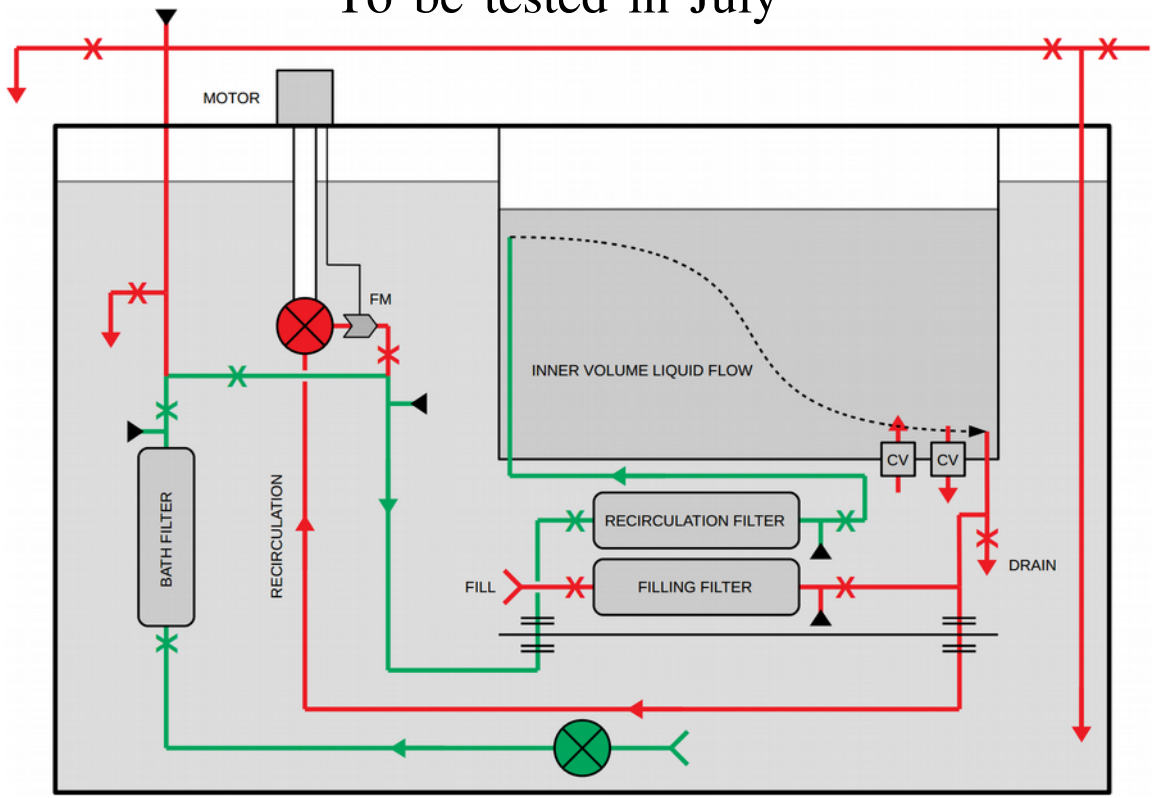
X control-valve

CV check-valve

FM flow meter

Cryogenics Scheme – Refilling

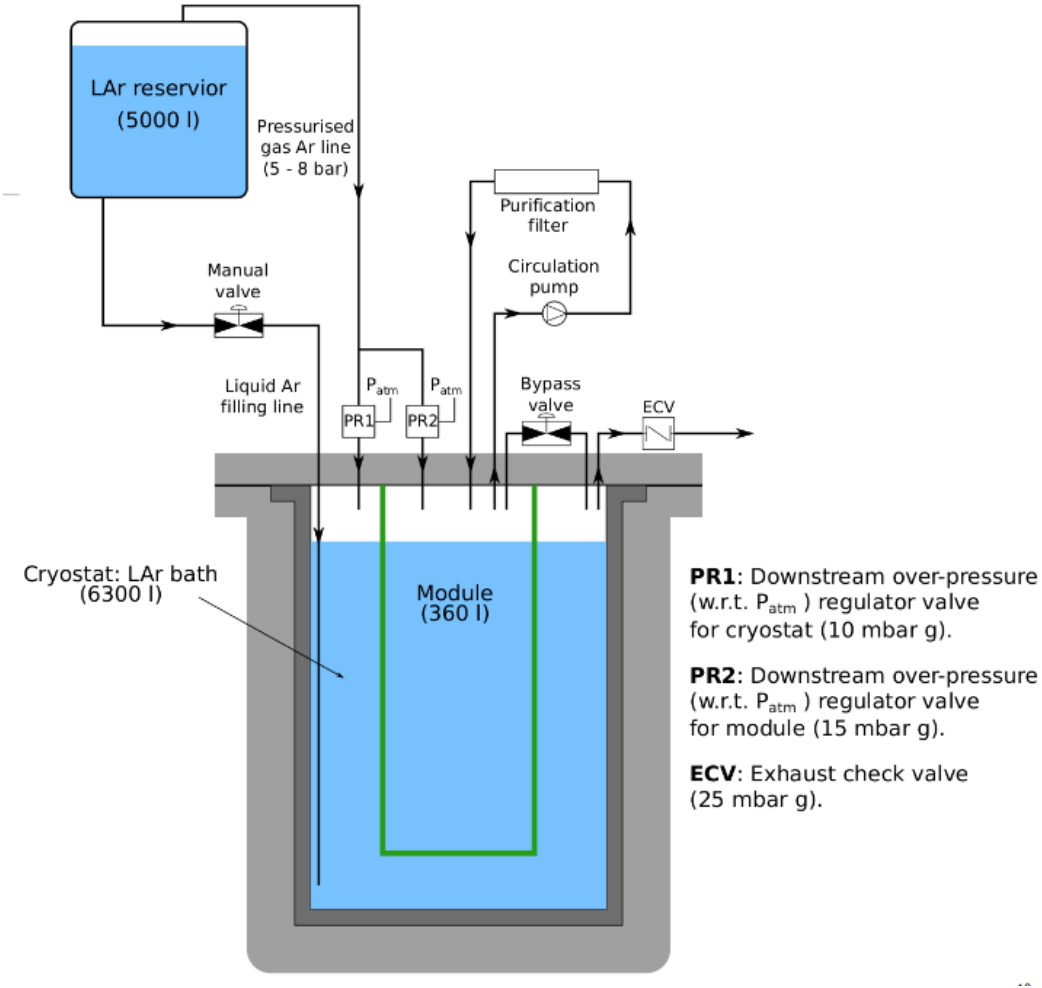
To be tested in July



– active line
– inactive line
X control-valve
CV check-valve
FM flow meter

Filling module through filters

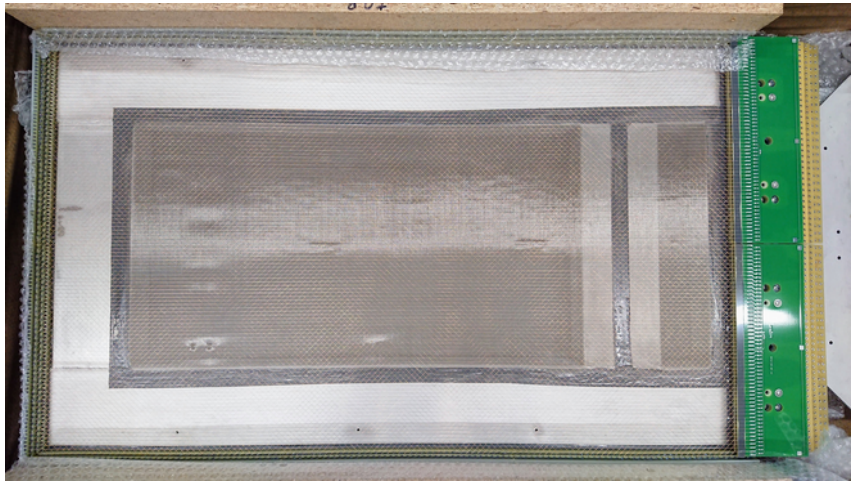
Module Pressure Control



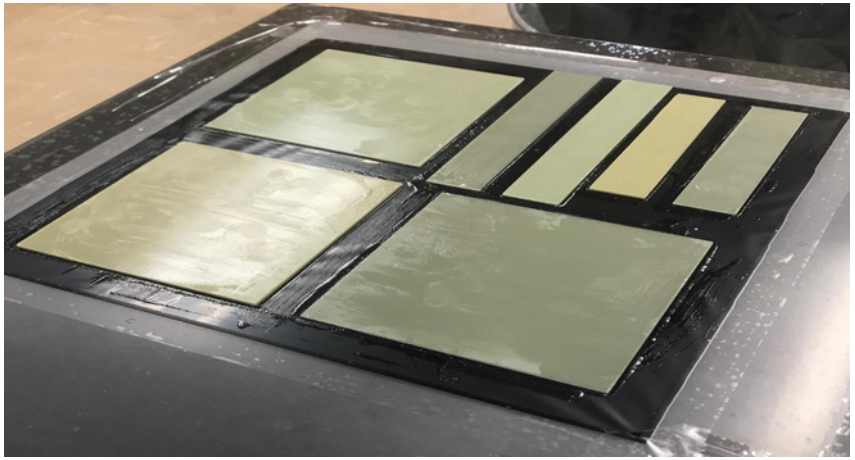
- LAr level in cryostat controlled by reservoir above cryostat
- Refilling module with LAr from cryostat (through filter, see previous slide)
- Module and cryostat pressure control via PR1 and PR2
  (possibly also through filter – see p. 23)

Bern Experiment in July

Sheffield wire plane



SLAC lamination



- Test charge R/O:
  - → Sheffield wire plane with latest BNL ASICS
  - → DAQ from ArgonTube

- Ideally test field-shell produced by SLAC (schedule might be too tough though)

Bern Experiment in July

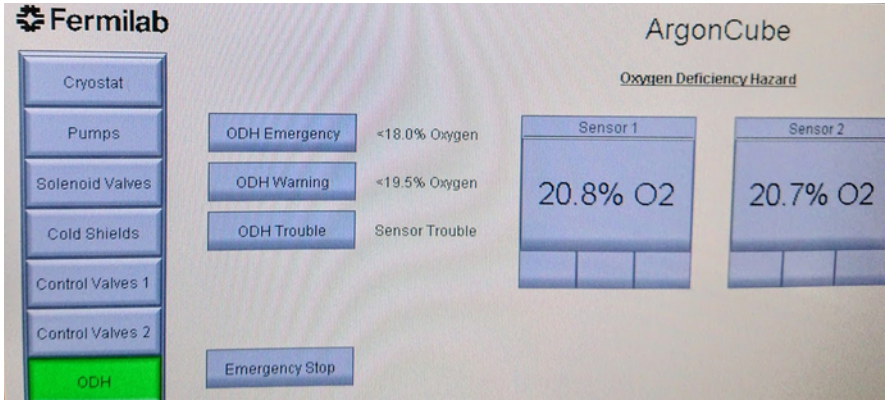
FNAL PLC rack

New PLC (from FNAL)

→ simplifies 2x2 integration at FNAL

Installation in Bern done by Trevor Nichols in May

→ simplified integration when 2x2 is shipped to FNAL



PLC rack touchscreen

Timeline

July:

- New cryostat gas phase exhaust valve
- New designed LAr purification filters
- Test new designed liquid control-valves and new cryogenics scheme
- Test module pressure regulation in gas phase as well as through filter
- Test new installed FNAL PLC
- Test Sheffield wire plane with latest BNL ASICS
  and ideally test field shell produced by SLAC

August / September:

- Cryostat and associated infrastructure ready for 2x2
  (modifications on top flange for recirculation pump are required)

Afterwards:

- Module assembly for 2x2 to be sent to FNAL