Cubism - Braque’s Bottle and Fishes, Paris c.1910-12

Cryo Discussion

DEEP UNDERGROUND NEUTRINO EXPERIMENT

FNAL, April 2019
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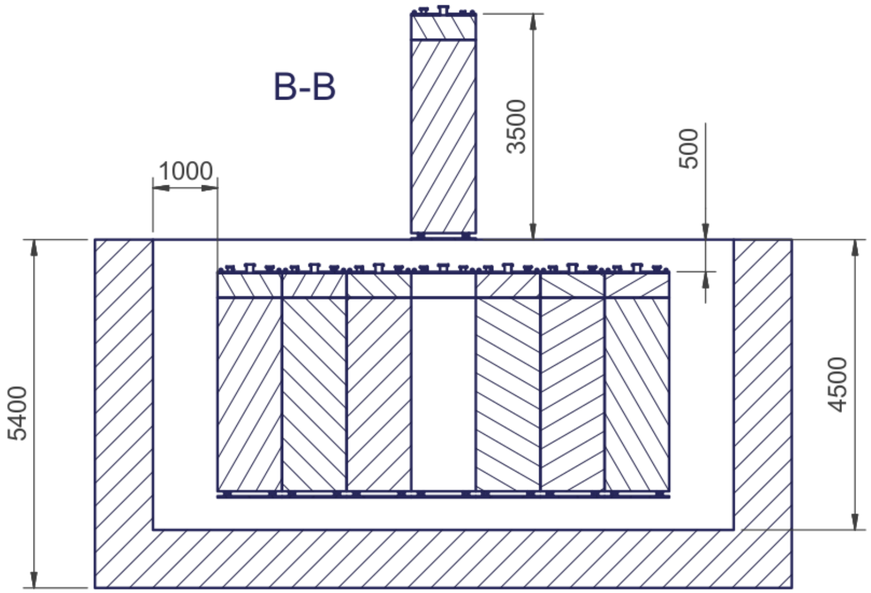
ND Dimensions

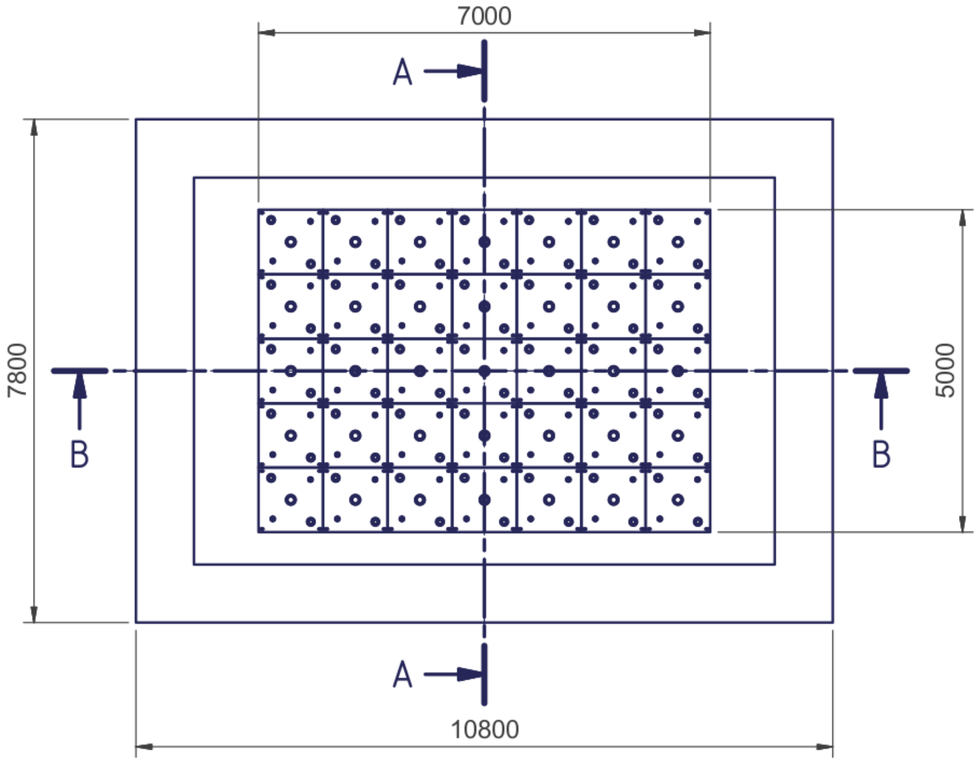
The results of the geological survey were not ideal. Therefore, we are again being asked to reduce the size of the detector.

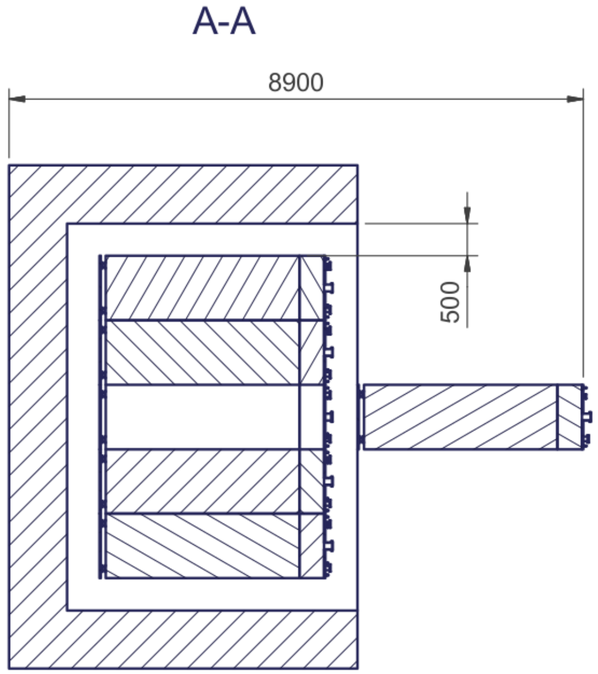
It is important to be able to finalize:

1 - Thickness of insulation.
2 - Depth of corrugations.
3 - The use of side penetrations.

All of this ultimately depends on the vendor used. Therefore, we cannot comment until a down-select has been made.







New 2x2 Module Design

We have adopted Knut's "bucket" module design.

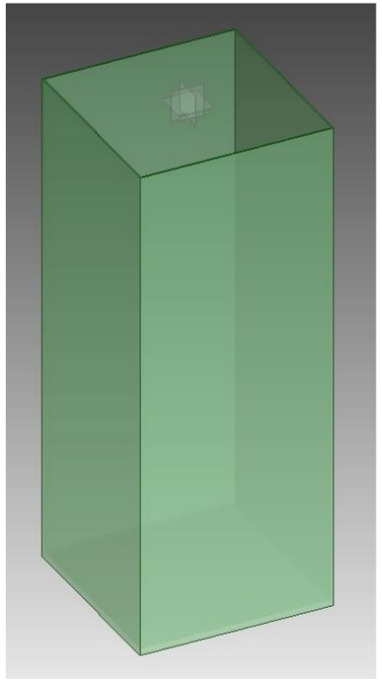
The top flange is a vacuum pocket.

Detector instrumentation & TPC is hung from the top flange.

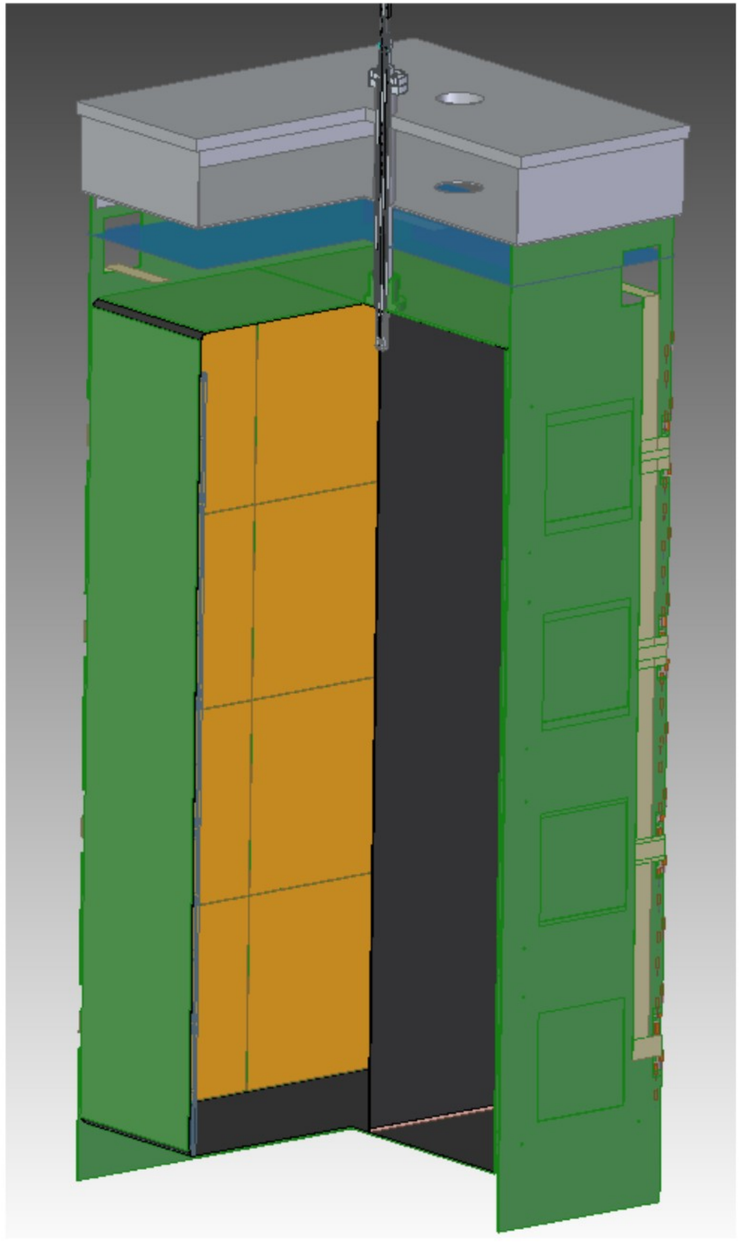
G10 bucket hermetically encases the module.

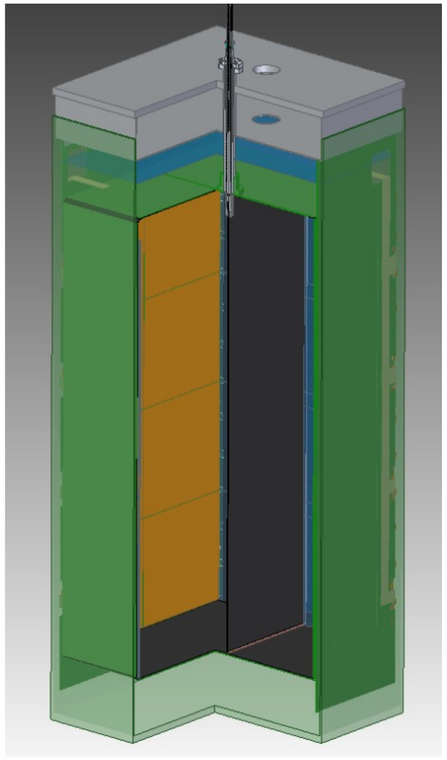
Many updates already implemented bus still must be tuned-

Fiberglass "bucket" is hermetic
(check valves on bottom)



Naked TPC hangs under insulating "pillow"





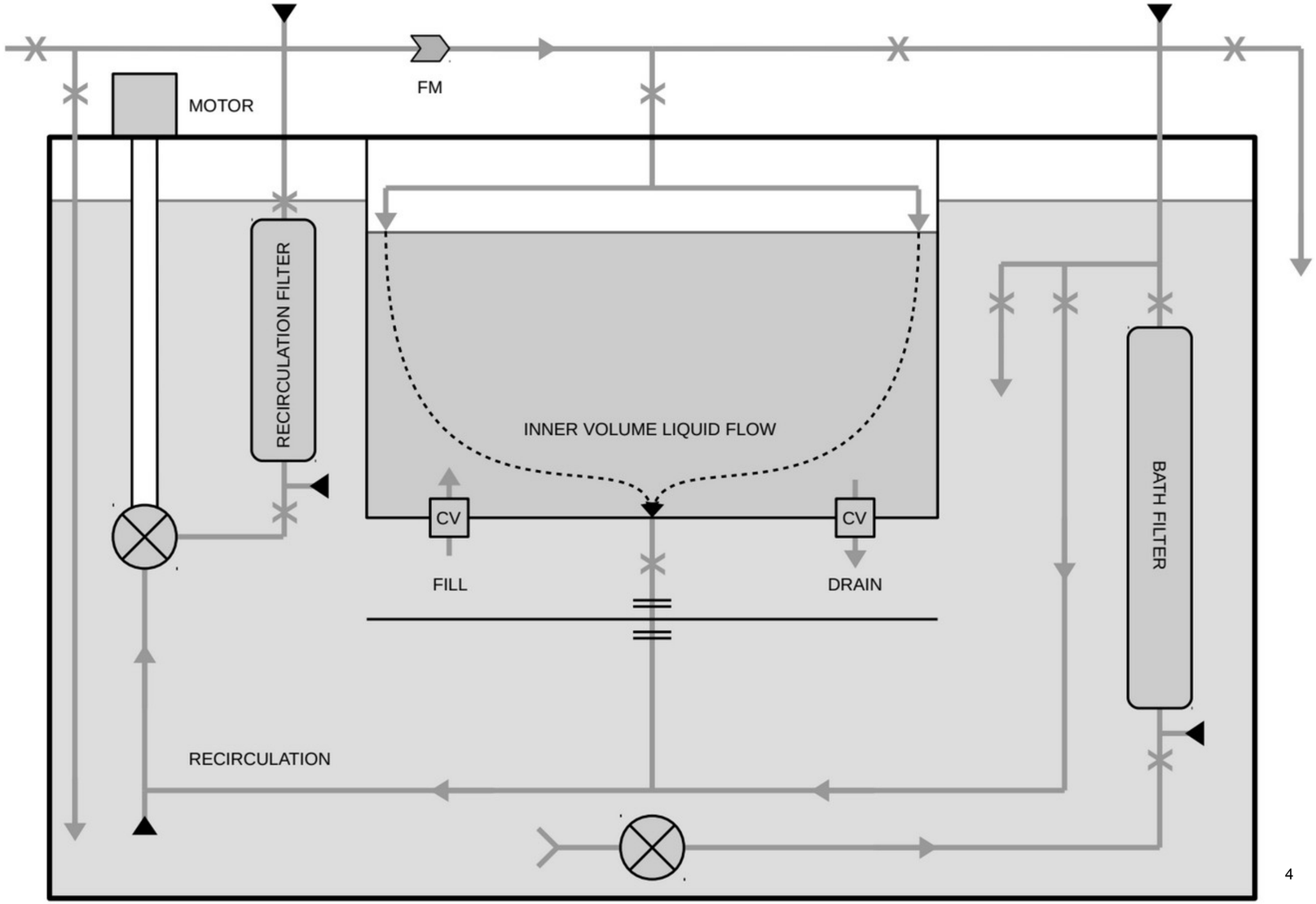
Fiberglass bucket bonds to pillow with shearable bond for removal

Cryo (liquid) Scheme for 2x2

Module recirculation:
Pump mounted at cryostat top flange used to extract argon from base of module, through filter and return to top of module.

Bath recirculation:
Pump in sump constantly recirculating bath through cold filters. Can also be used to drain bath and/or refill module. With appropriate valves closed the lines can be used for piston purge.

All cold lines are flexible steel pipe.



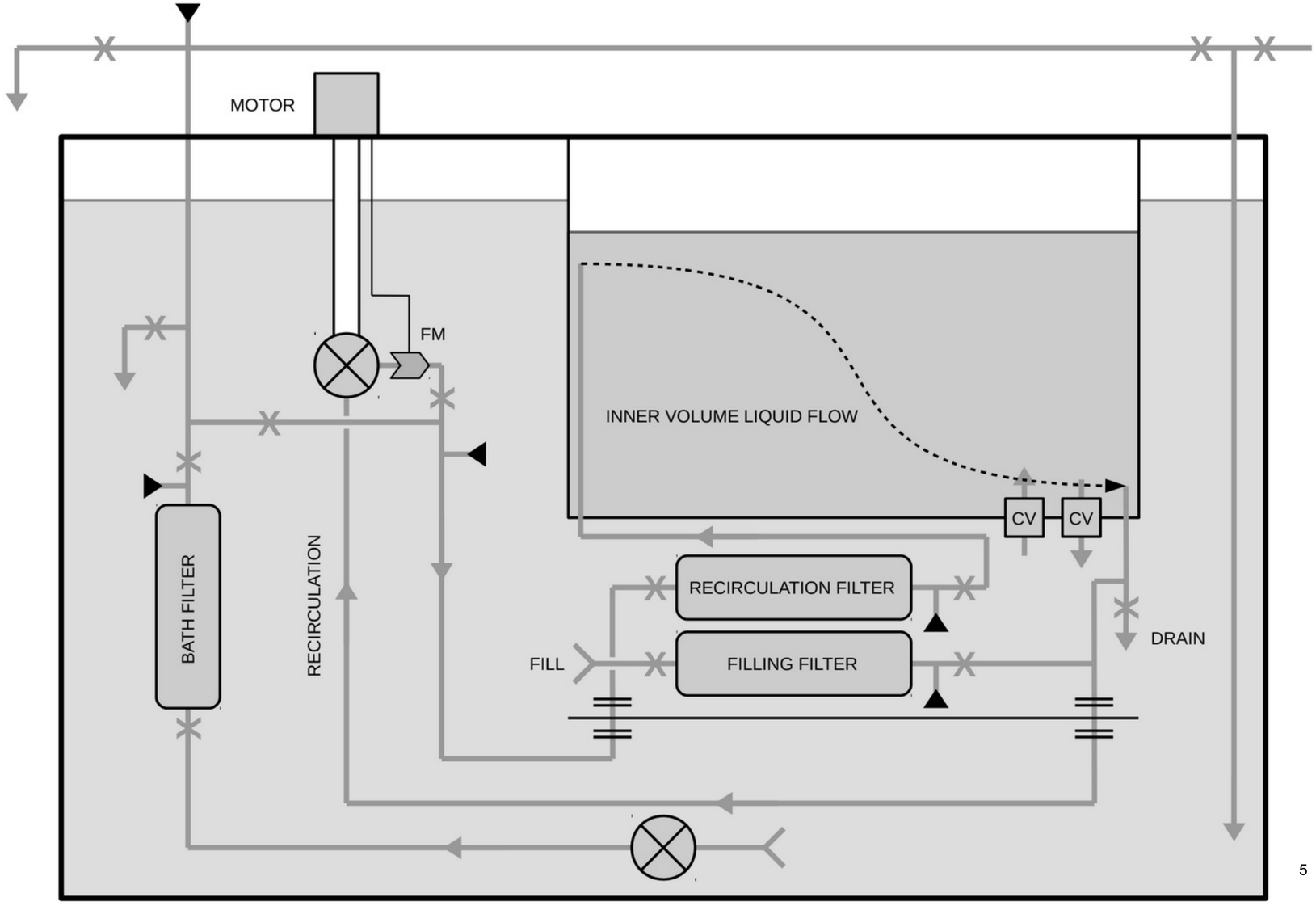
Cryo (liquid) Scheme for Next R&D Test in Bern

Adapting pre-existing components to demonstrate:

- Flexible steel lines below the dummy flange.

- Module recirculation with external (to module) pump

- Bath filtration, and module filling from bath system.



Cryogenic Control Valves

Cryogenic solenoid valves would mitigate the need for check valves.

Unfortunately, these are not yet commercially available.

Modify the actuator of existing solenoid valves (NOT THE VALVE MECHANISM), to create a bi-stable cryogenic valve.