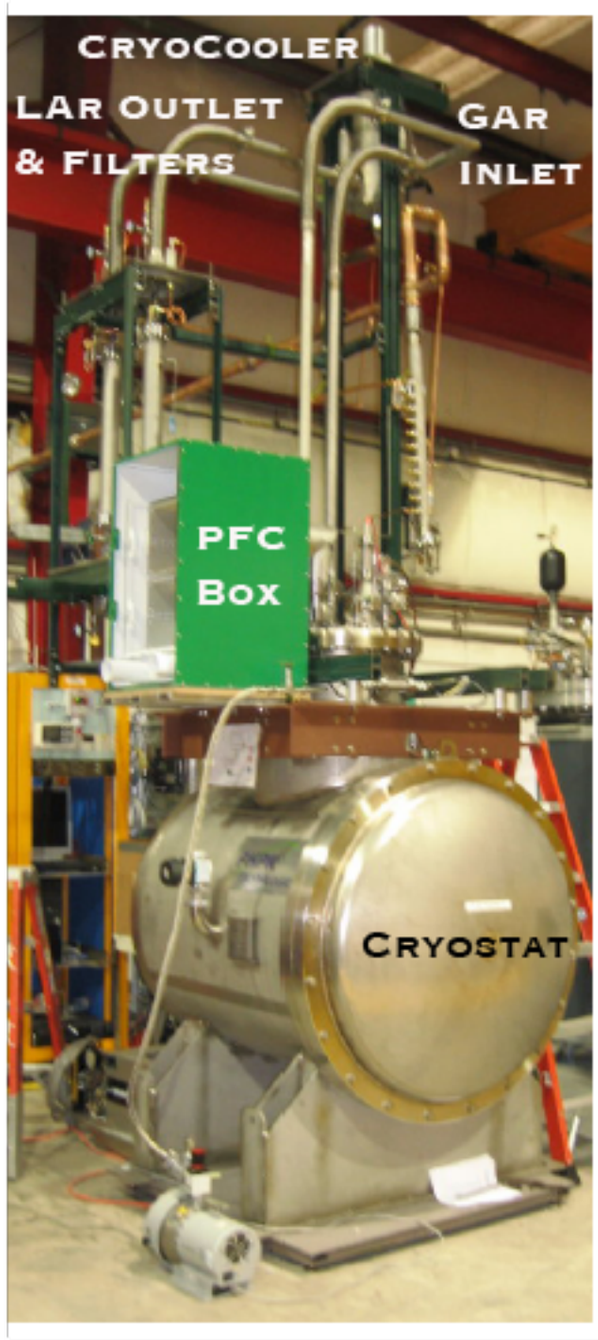


LArTPC R&D Workshop

20-21 March 2013

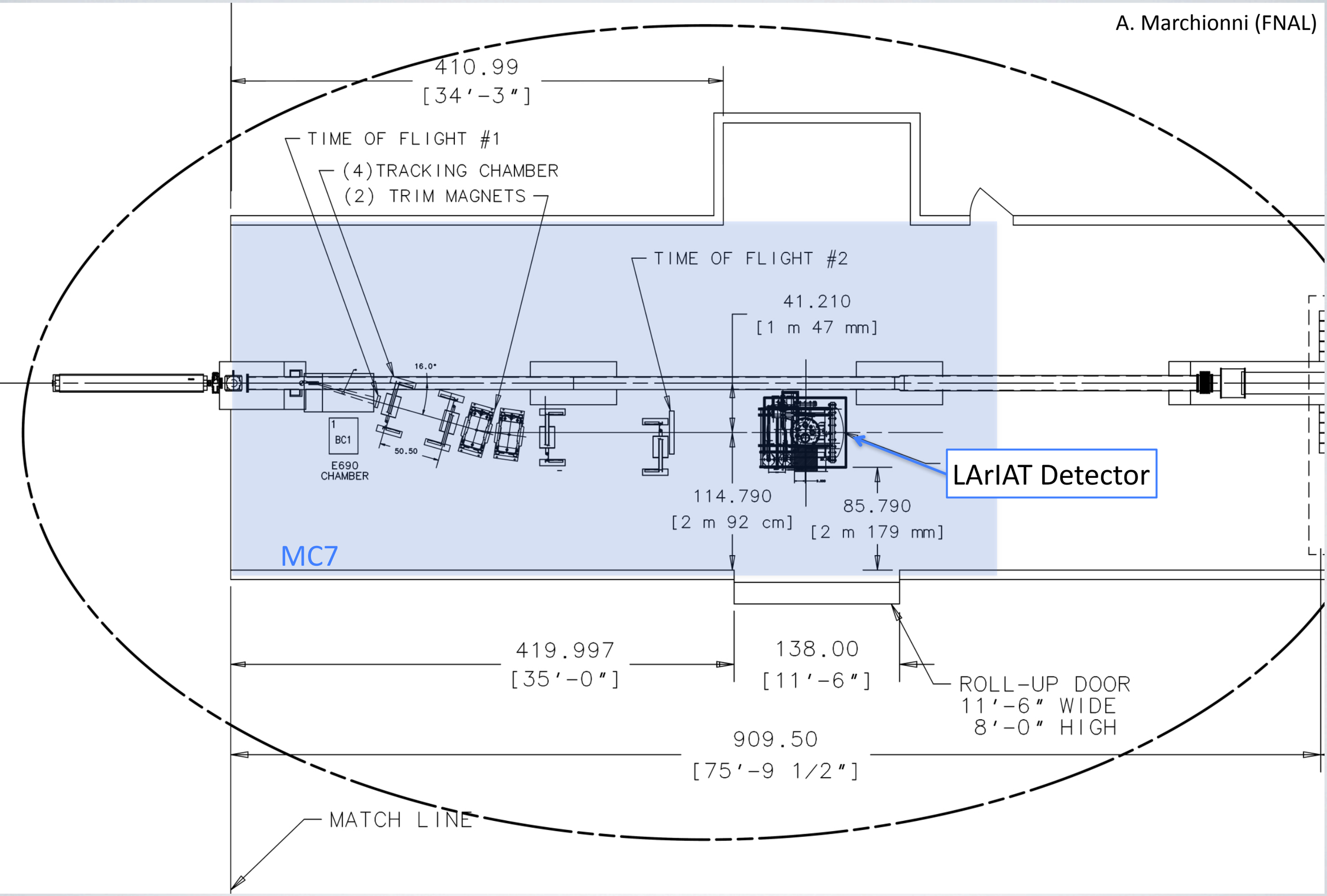
Fermi National Accelerator Laboratory

From ArgoNeuT to LArIAT: development of the cooling/purification system

Flavio Cavanna
Yale University
& L'Aquila U. (IT)

LArIAT in the FTBF M-Central Tertiary Beam (Top View, at MC7)

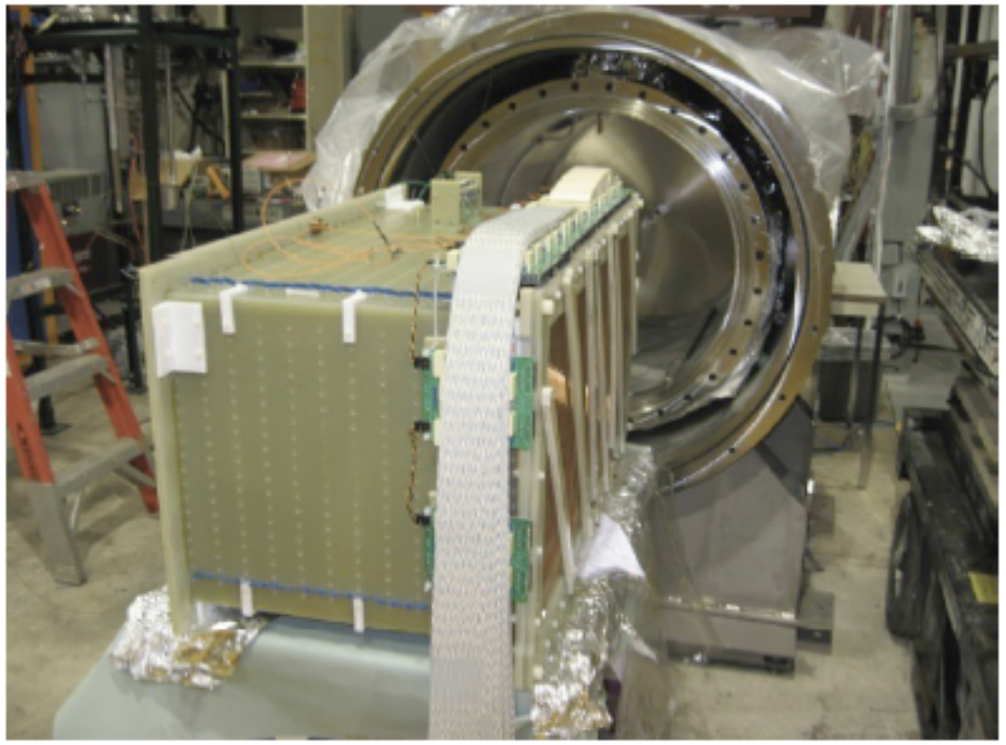
A. Marchionni (FNAL)



ARGONEUT ➡ LARIAT

The experimental program at FTBF capitalizes on the availability of the existing hardware (from ArgoNeuT experiment).
The detector set-up consists of a cryostat housing the Inner Detector TPCs and the relative R/O electronics.

A number of modifications on the existing hardware components are necessary however, to cope with the specific experimental needs and the running conditions/ requirements at FTBF.



The main of these modifications consist in the upgrade of the Argon Cooling&Purification System

The Cryostat:

a traditional double-wall,
vacuum jacketed + SuperInsulation solution (550 lt)

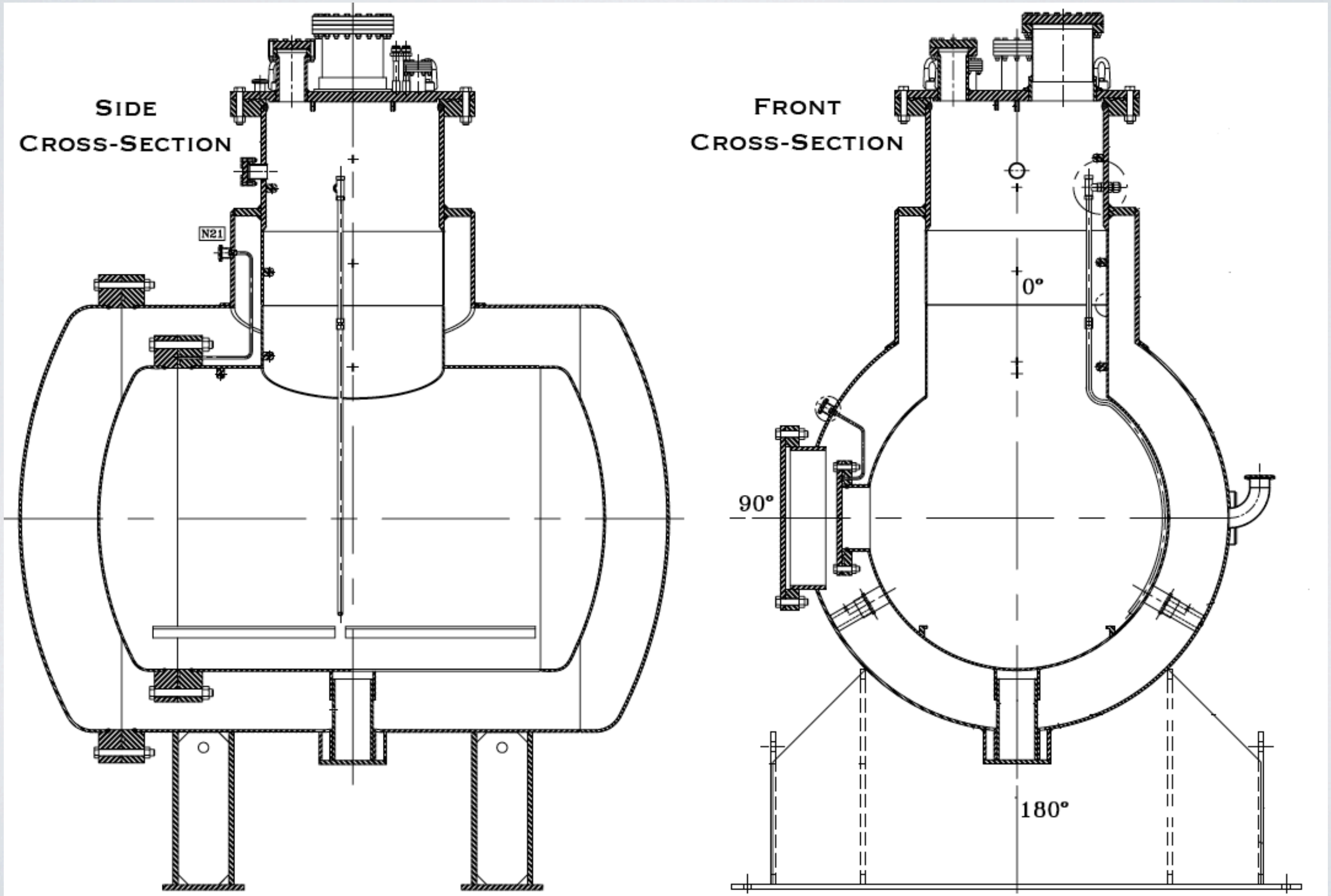


Table 1. ArgoNeuT cryostat and cryogenic system main specifications.

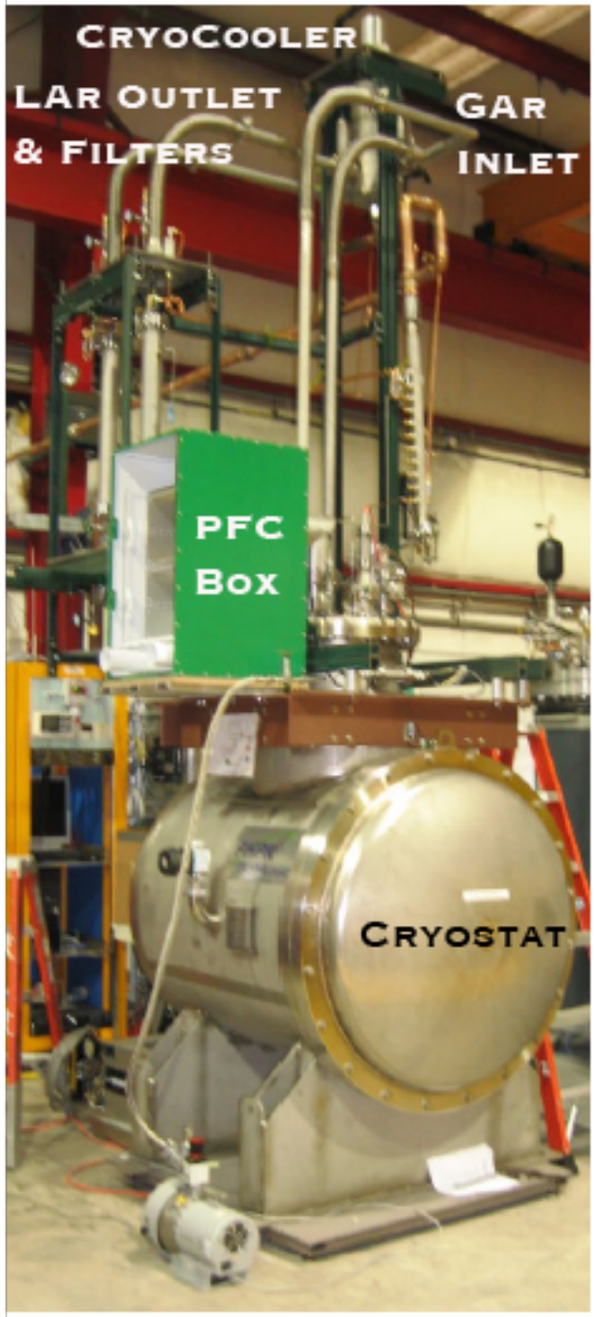
Liquid Argon volume (mass)	550 liters (0.77 t)
Inner Vessel Dimensions	=30", *l*=130 cm
Outer Vessel Dimensions	=42", *l*=163 cm
Insulation	Vacuum Jacket (10^{-4} mbar) with SuperInsulation
Total Heat Load	$\approx$ 120 W
Cooling	CryoCooler (330 W cooling capacity)
Ar Recondensation	LAr Flow Rate: $\approx$ 3 lt/hr
P, T (set point)	GAr P=2 psig, LAr T=88.4 K

Access to the internal volume, e.g. for detector installation, is possible by opening the end-caps (inner and outer vessels) at one end of the cryostat. These are 32-bolt flanged end-caps with a double Helicoflex sealing with guard vacuum.

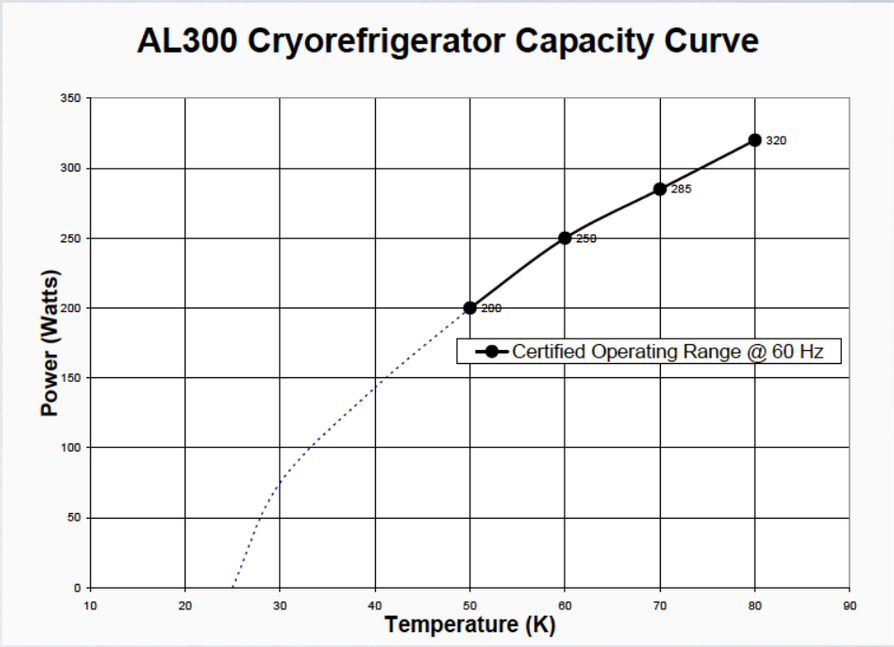
A chimney is located on the top of the cryostat at its mid length and serves as access path for signal cables from the TPC and from the internal instrumentation, as well as for the outlet/inlet pipes for the gas/liquid Ar recirculation and for the high voltage (HV) feed-through.

Inside the chimney Ar in gas phase (GAr) is at equilibrium pressure with the liquid inside the cryostat main body.

COOLING&PURIFICATION SYSTEM



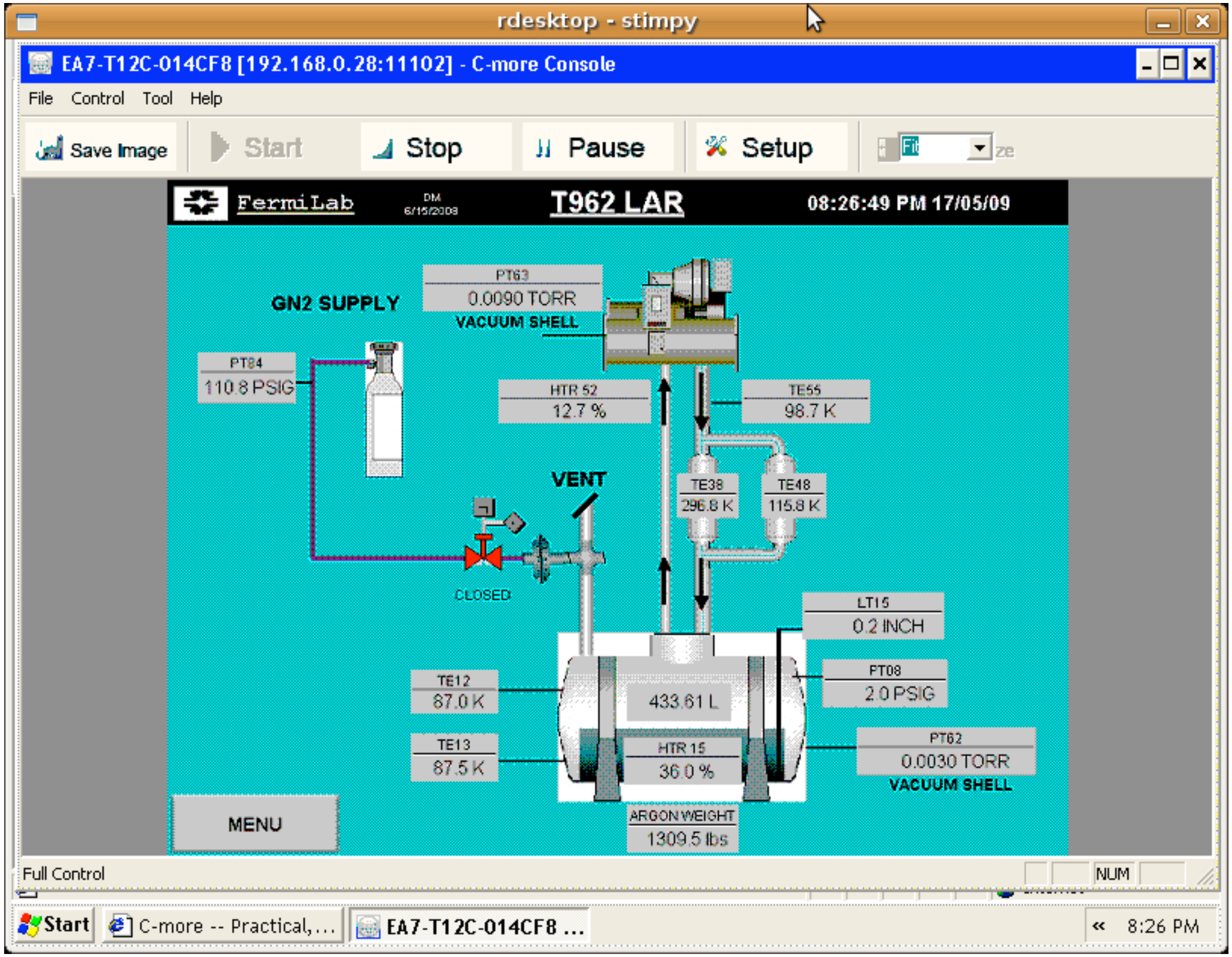
ARGONEUT



To keep the argon inside the cryostat in liquid phase at constant temperature (around 88 K), the cryogenic system is based on a commercial single stage cryocooler with high cooling capacity, in excess of 330 W at LAr temperature.

Boil-off argon gas from the surface of the liquid volume travels vertically through one pipe (the GAr inlet) and is re-condensed inside the heat exchanger vessel.
The resulting liquid is then forced through one of the other three pipes (LAr outlet) on its return
trip back to the liquid volume at the bottom of the cryostat.
Two of these three passes are through
argon filters and one is through a bypass pipe.

Purification in Gas Phase Only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PT84
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VACUUM SHELL
HTR 52
12.7 %
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CLOSED
TE38
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TE48
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PT08
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TE12
87.0 K
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TE13
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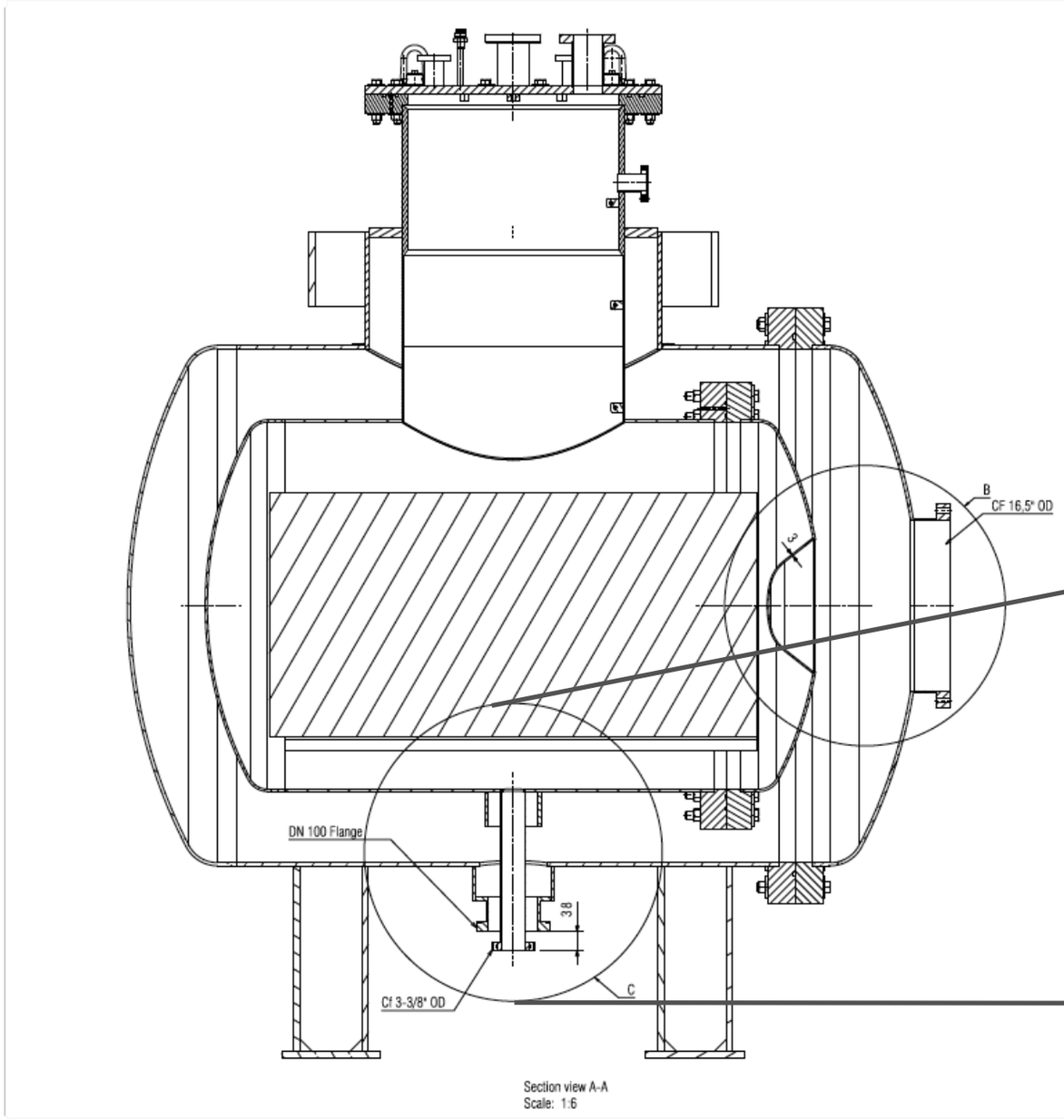
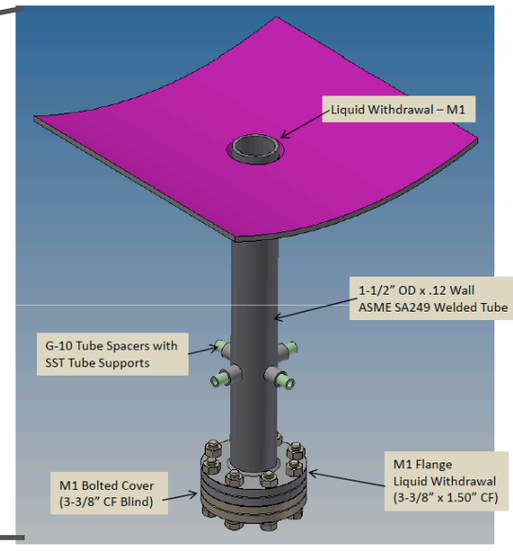
LArIAT PURIFICATION system:
from GAr Recirculation
to combined GAr & LAr forced recirculation



Cryostat Modification at PHPK-Technologies

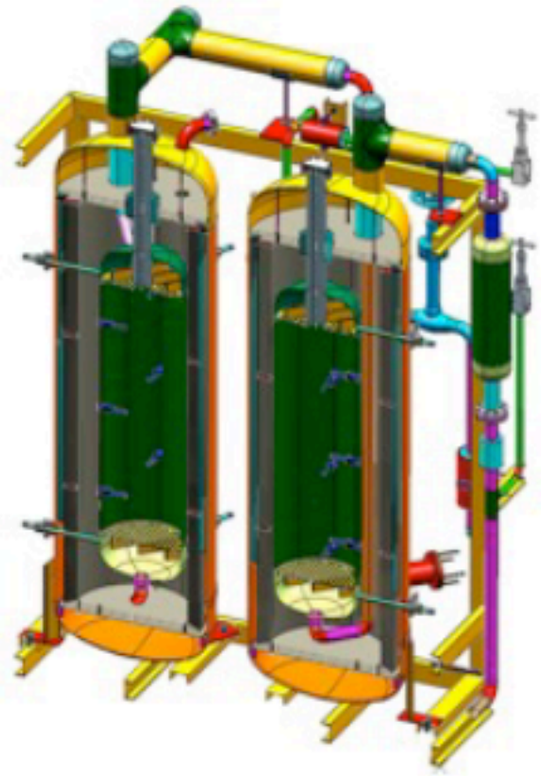
"LAr Withdrawal"

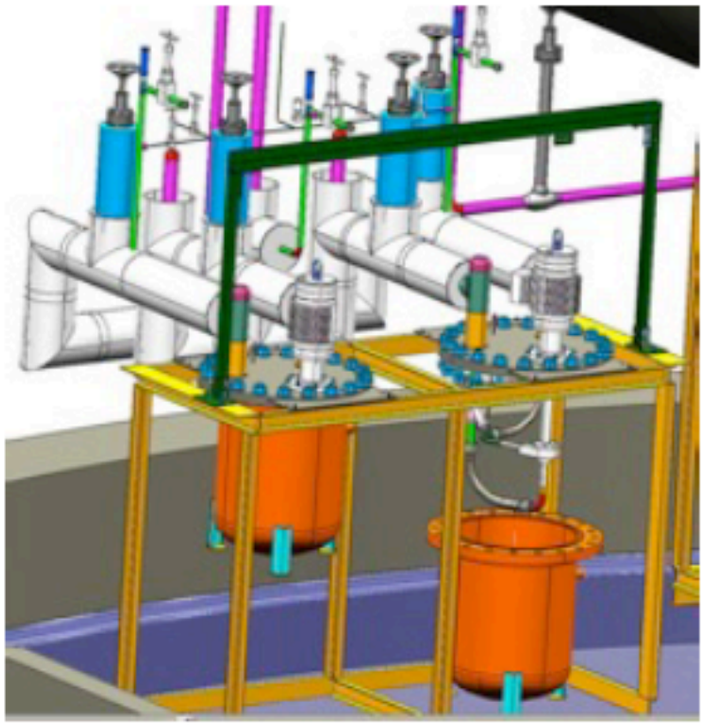


MODIFICATION 01

Add new 1-1/2" OD Nozzle for Liquid Withdrawal

MicroBooNE
Filter Skid





MicroBooNE
Pump Skid

Existing Components:
Large Filter Skid (1 unit)
LAr Pump Skid (1 unit)

Cryostat will be delivered on March 25th at FNAL

Summary

A new cryogenic&purification system is being designed and constructed for LArIAT (Phase1&Phase2)

It will provide adjustable LAr flow-rate (100 lt/hr =1 vol. cycle in 6 hrs for Phase1)

Filter skid and Pump skid are ready
Cryostat Modification for LAr withdraw done

Delivery and assembly of new cryogenic system and commissioning to be defined (goal: fall '13)