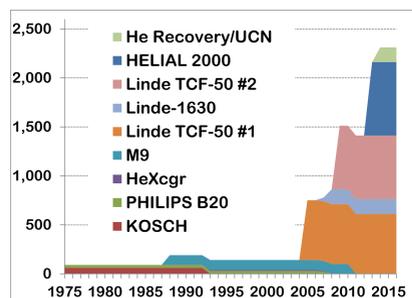


# Cryogenic Infrastructure at TRIUMF: Overview of Upgrades

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## Helium Cryogenics in TRIUMF



Over 40 years of operation, TRIUMF's capacity of helium cryogenics significantly increased.

Starting from 100W of cooling at 4K in 1970s it grew ~25 times up to almost 2.5 kW with new helium coldboxes installed for Cyclotron cryopumping, ISAC SC linac, helium recovery and ARIEL electron SRF linac.

## TRIUMF's Cyclotron Cryopumping System



Cyclotron tank, Linde 1630 helium refrigerator, operational and spare compressors

In TRIUMF, 500 MeV cyclotron is used as a proton beam source for most of the experimental facilities. Cyclotron utilizes cryogenic pumping to achieve high vacuum inside of the tank. Upgrade of the LN2 circuit is considered as a future upgrade to conserve on LN2 budget. Spare RSX compressor was purchased.

ISAC cryogenic system is based on two TCF50 coldboxes. In 2013-2015 oils removal skids of both compressors were upgraded. Additional third coalescer was installed to eliminate oil migration issues that caused few interruptions of operation.



Linde TCF50 helium refrigerator, main compressor, storage tanks, upgraded ORS

## ISAC Cryogenic System

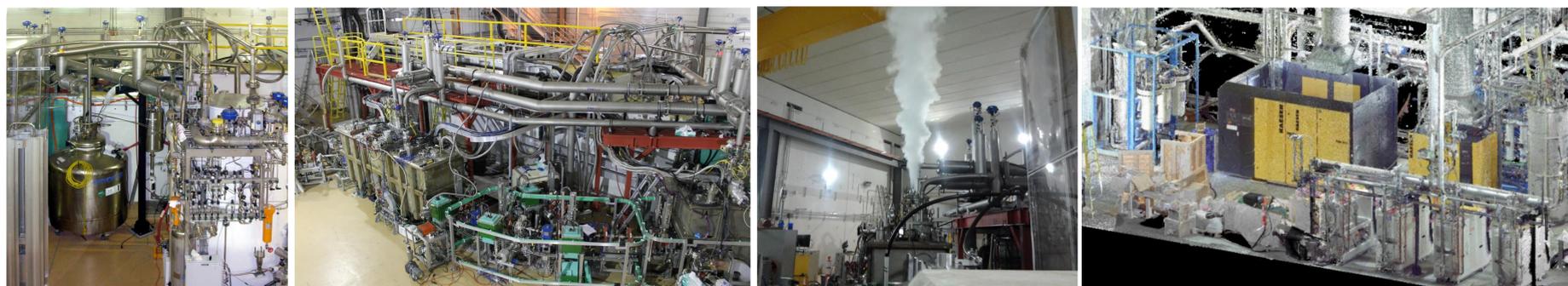
## Helium Recovery System / UCN Liquefier



Helium storage bag, high-pressure compressors, high-pressure cylinders, Linde 1610 compressor and liquefier

TRIUMF used to purchase 500,000 CAD worth of liquid helium for its experimental facilities. None if this was recovered. In 2013, helium recovery facility was installed, conserving operational budgets.

ARIEL cryogenic system is based on Air Liquide HELIAL LL coldbox. The project caused many minor and major upgrades of cryogenic infrastructure, including upgrades of TRIUMF's LN2 system in 2012-2015.



Air Liquide coldbox with dewar, e-linac cryomodules, burst disk event, compressor building (image from 3D scan)

## ARIEL Cryogenic System