

Cryogenics Parallel Sessions

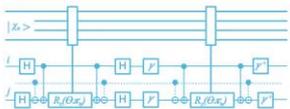
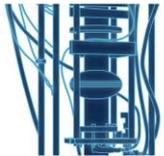
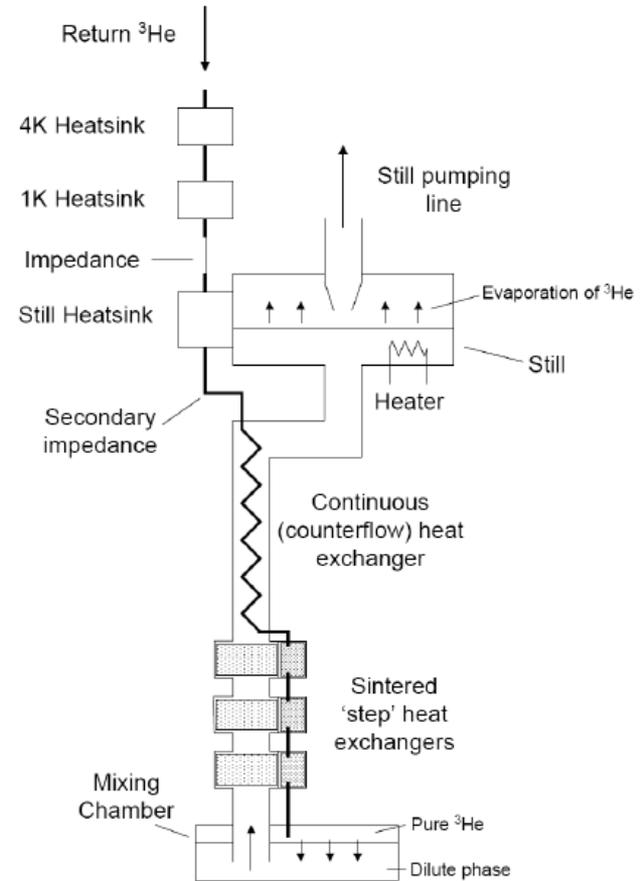
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USQIS Summer School

August 8, 2023

General refrigerator layout

- Major components of a generalized dilution refrigerator shown in the diagram.
- ^3He from the room temperature pump system is cooled and liquified above (or at) the still.
- Cooled further on the way to the mixing chamber.
- ^3He is pumped away from the still.

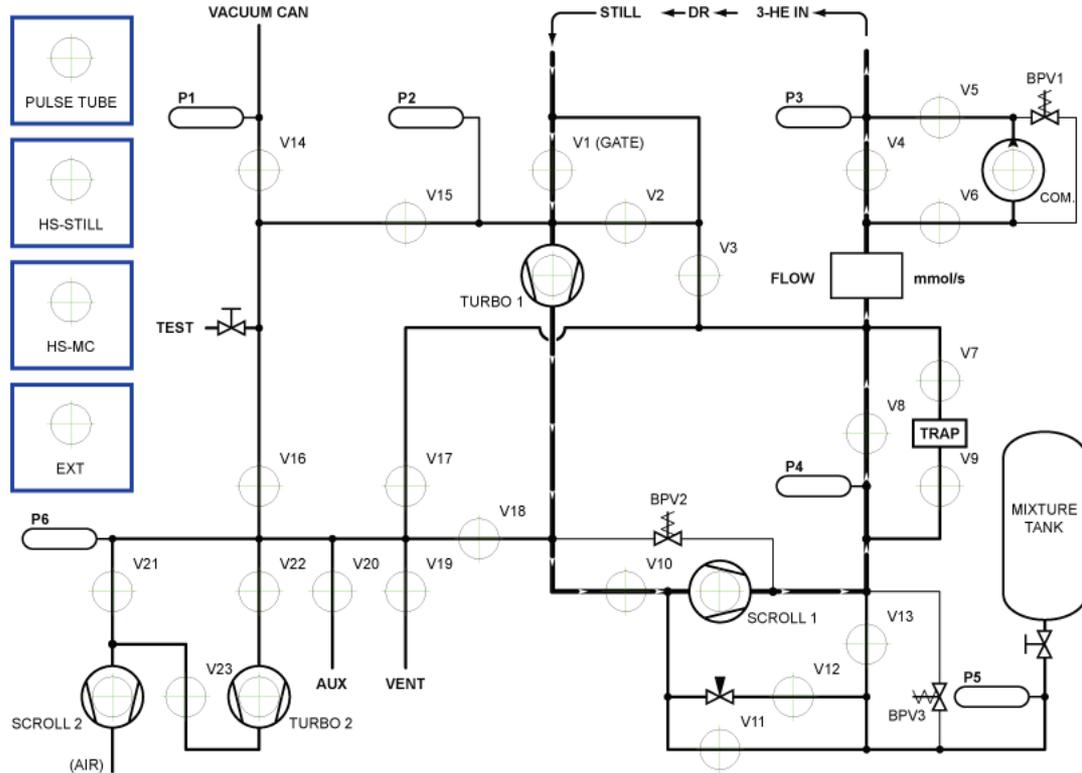


Circulation System

BlueFors

CRYOGENICS

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Circulation System

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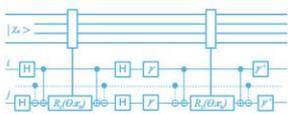
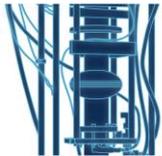
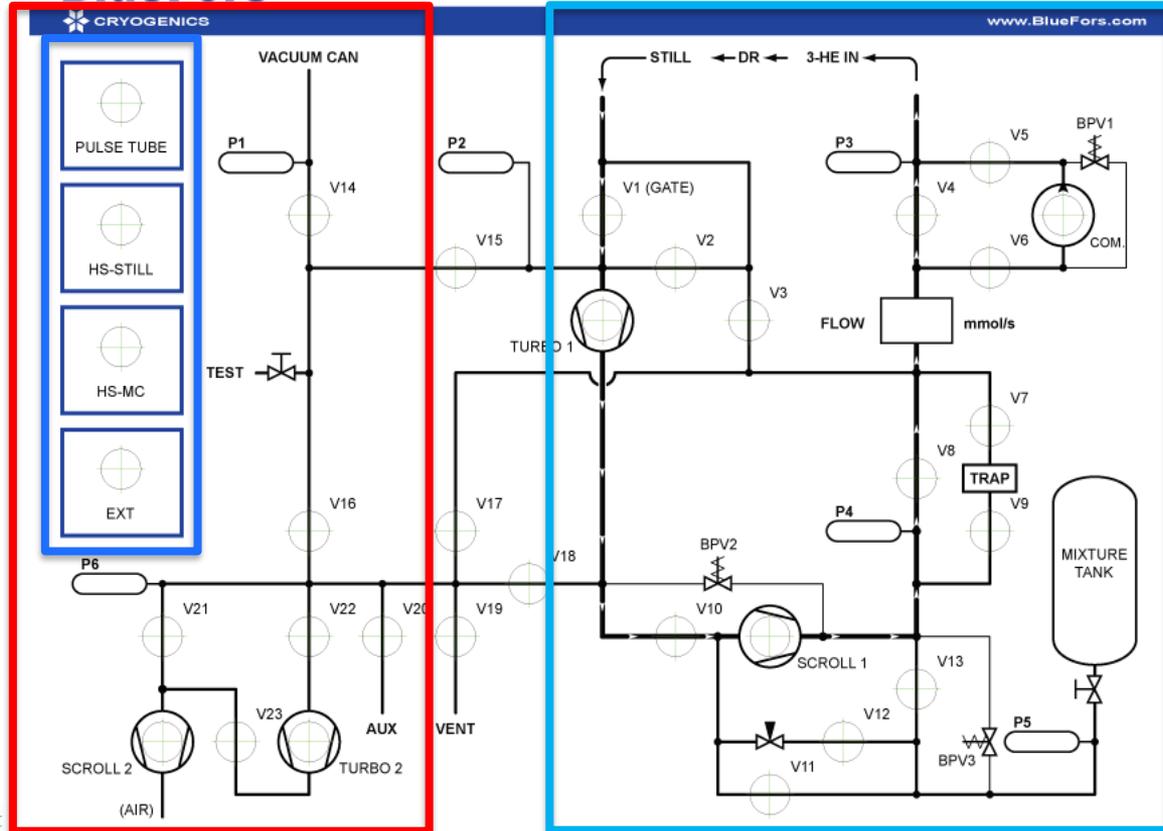
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Controls

Vacuum System

Helium-3 System



Modern refrigerator layout

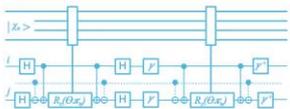
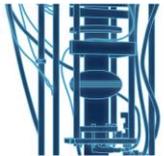
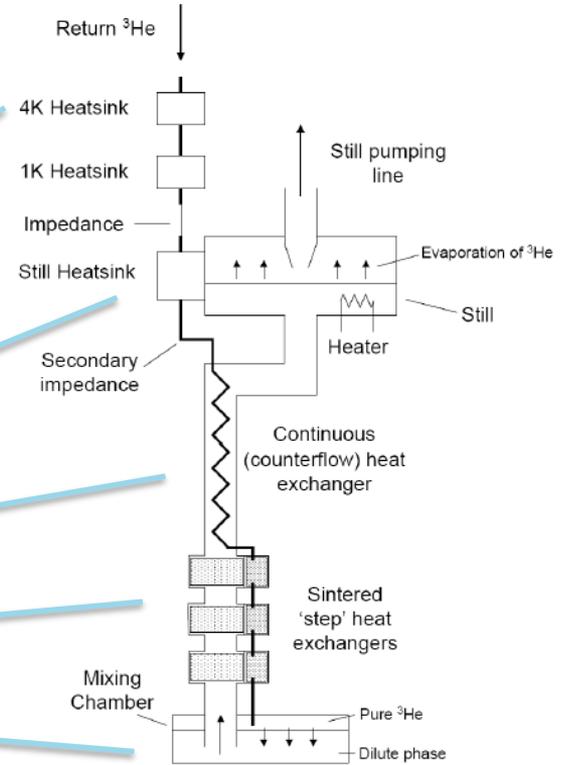
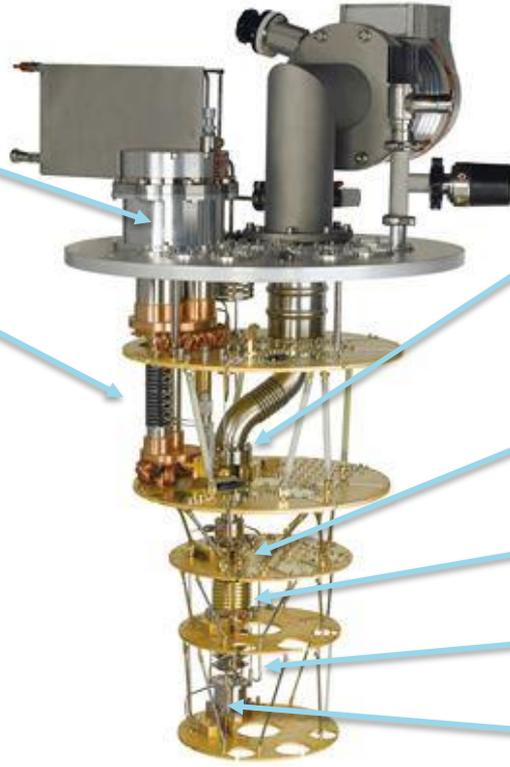
Image: Oxford Instruments

2 stage pulse tube cooler

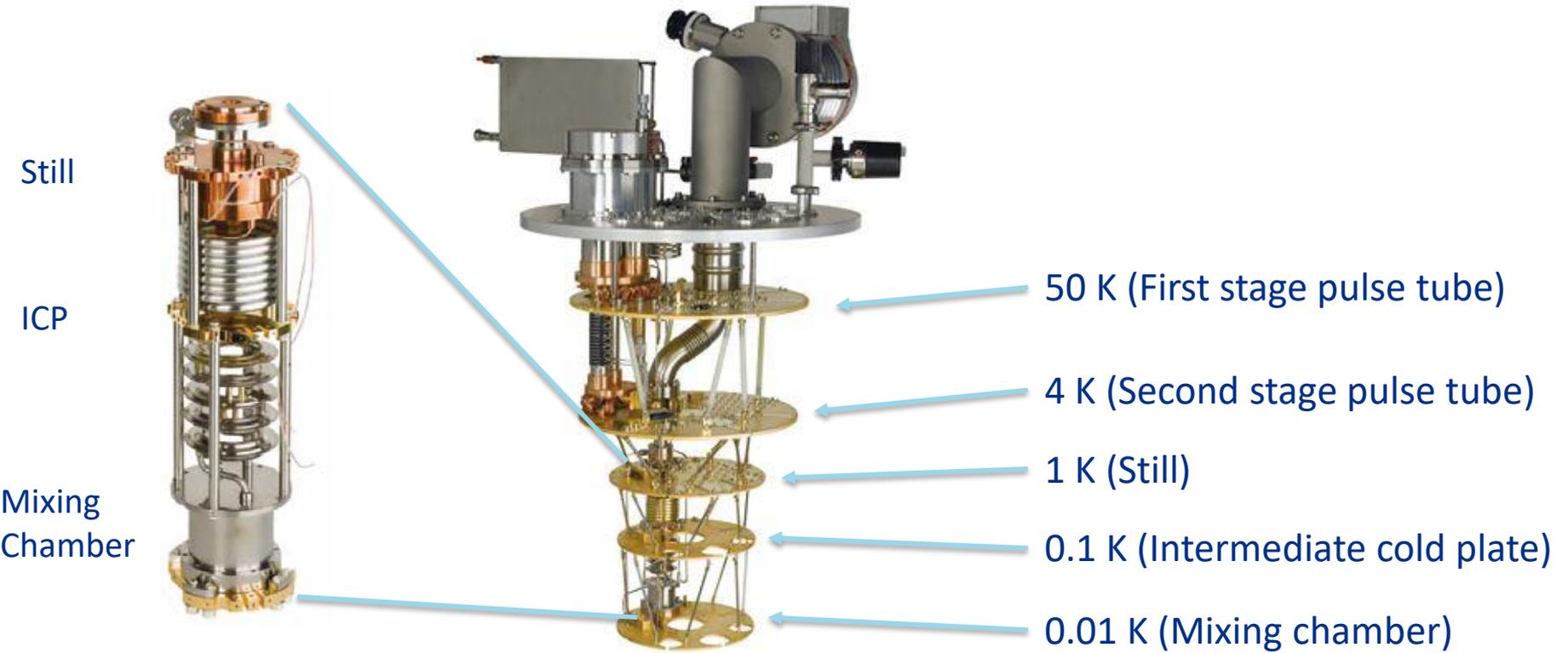
Additional heat exchanger



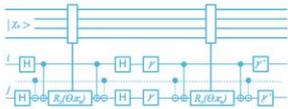
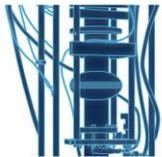
Additional heat exchanger (Uhlig, personal communication)



Modern refrigerator layout – temperature stages and dilution unit



Images: Oxford Instruments

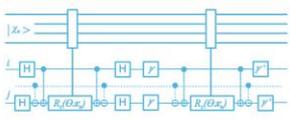


Commercial fridge examples – Small Fridges

Image: Oxford Instruments



Small fridges
Mixing chamber diameter ~150mm
Minimum temperature ~25 mK

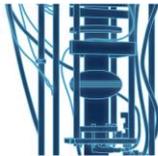


Commercial fridge examples – Standard Fridges

Image: Oxford Instruments



Standard fridges
Mixing chamber diameter ~300mm
Minimum temperature ~10 mK

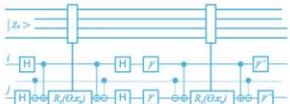
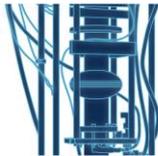


Commercial fridge examples – Large Frame Fridges

Image: BlueFors



Large frame fridges
Mixing chamber diameter ~500mm
Minimum temperature ~10 mK



Commercial fridge examples – XXL Fridges

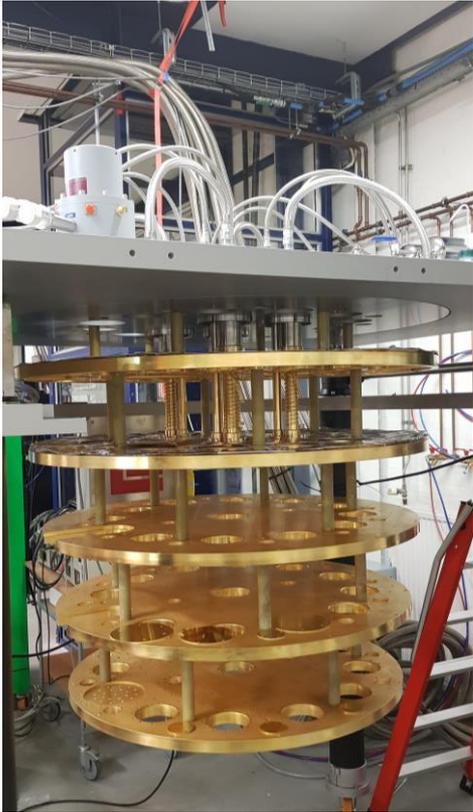
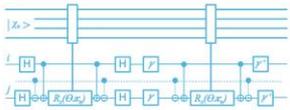
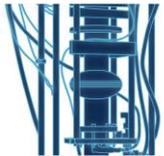


Image: Leiden Cryogenics

“XXL” fridges
Mixing chamber diameter ~1000mm
Minimum temperature ~10 mK

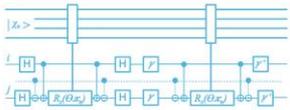


Commercial fridge examples – XXL Fridges

Image: BlueFors

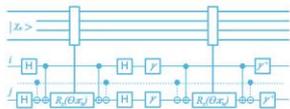


“Kide” fridge
Mixing chamber diameter ~1500mm
Minimum temperature ~10 mK



Colossus

- SQMS is constructing a large fridge for hosting quantum processors and sensing experiments.
- 2-meter diameter mixing chamber plate.
- Does not use cryomechanical coolers – instead, using a liquid helium refrigeration plant.



Acknowledgement

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