Systems for Neutron Scattering

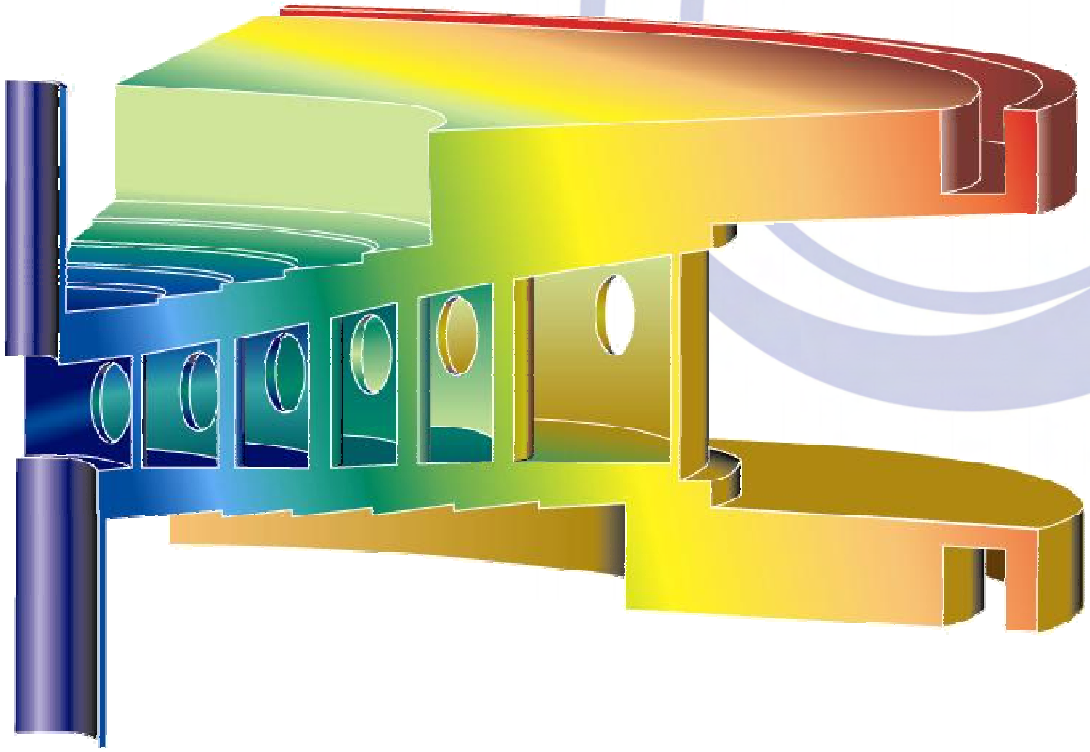
User Meeting May 2008

Overview

- State of the art magnet technology for Neutron Scattering
- Low temperature sample environments for Neutron Scattering
- Remove or reduce dependency on supply of liquid helium

The Design Process

- Finite Element Analysis
- Former Design
- Wire
- Quench Management
- Coil Structure



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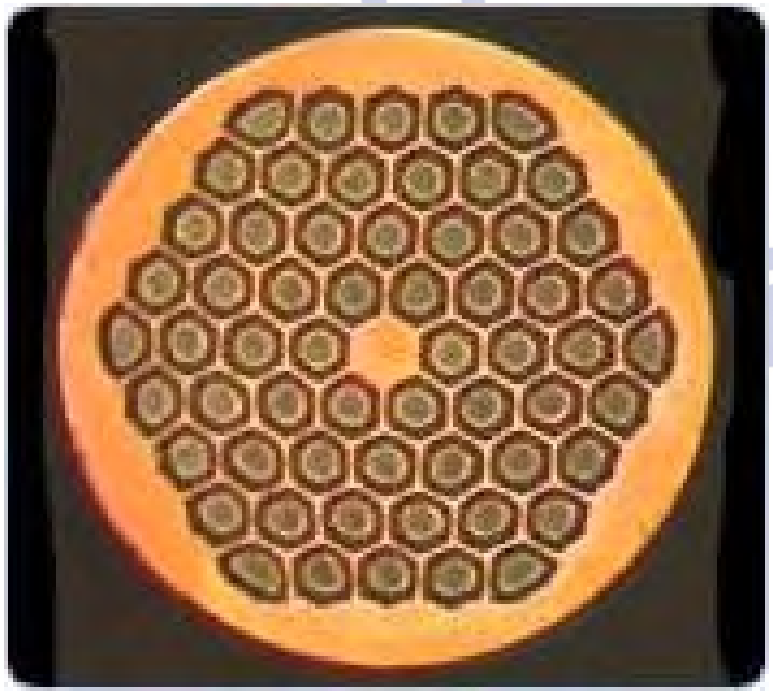

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Latest developments

- 6th 15T system supplied
  - Delivered within 6M of order (as per system 4 and 5)
- New horizontal field magnet design (6.5T field), with large 45 degree access
- Cryostat design improvements following consultation with users, in particular Eddy Lelievre of ILL
- 2 magnet systems to LLB, Saclay in 2008
  - 10T magnet for SANS
  - 10T asymmetric magnet (new technique for cadmium coating)
- Magnets under design/construction
  - 3 x unique designs, all with recondensing cryostats
  - 14T at 4K

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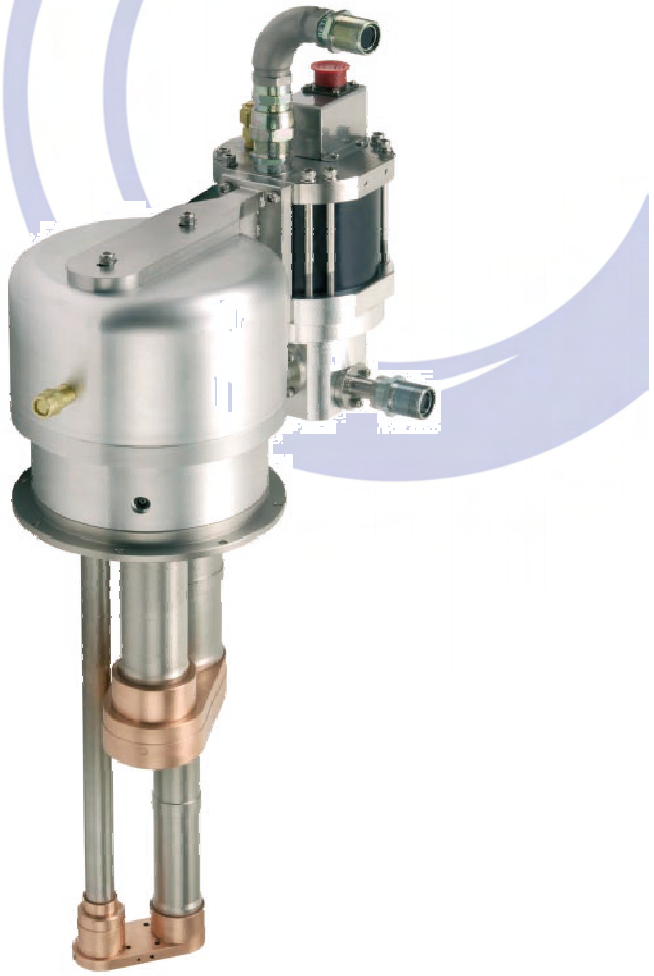
Pulse Tube Refrigerators

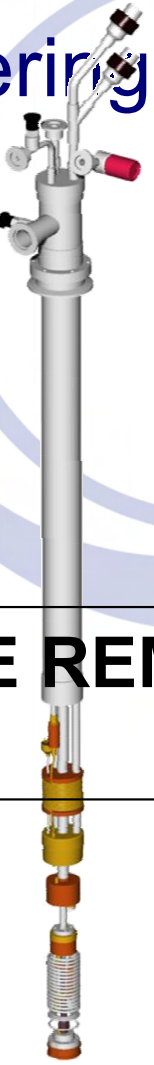
- PTR advantages over GM cryocooler designs
  - no moving parts in the low temperature region
  - significantly reduced vibration
  - The low temperature sections have no need for maintenance in normal use



Recondensing Systems for Neutron Scattering

- ActivelyCooled™ magnet technology is a helium recondensing technology that reduces dependency on liquid cryogens.

- Why recondensing and not Cryofree?
  - Stability of liquid bath for large complex coil structures
  - Improved vibration performance
  - System hold time during power failure
  - Integrated sample environments
  - Cool down before moving to beamline
  - Use conventional ULT inserts



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Cryofree™ sample environments – **VeriCold** VC4-Tn

- In close collaboration with the new neutron source FRM-2 in Garching, VeriCold Technologies GmbH has developed a pulse tube based 4K Closed Cycle Refrigerator for Neutron Scattering
  - Completely automatic
  - Initial cool down time of < 4 hours
  - Sample cool down time of < 2 hours from room temperature
  - Magnetic fields up to 9T can be applied
  - Windows for direct sample characterisation

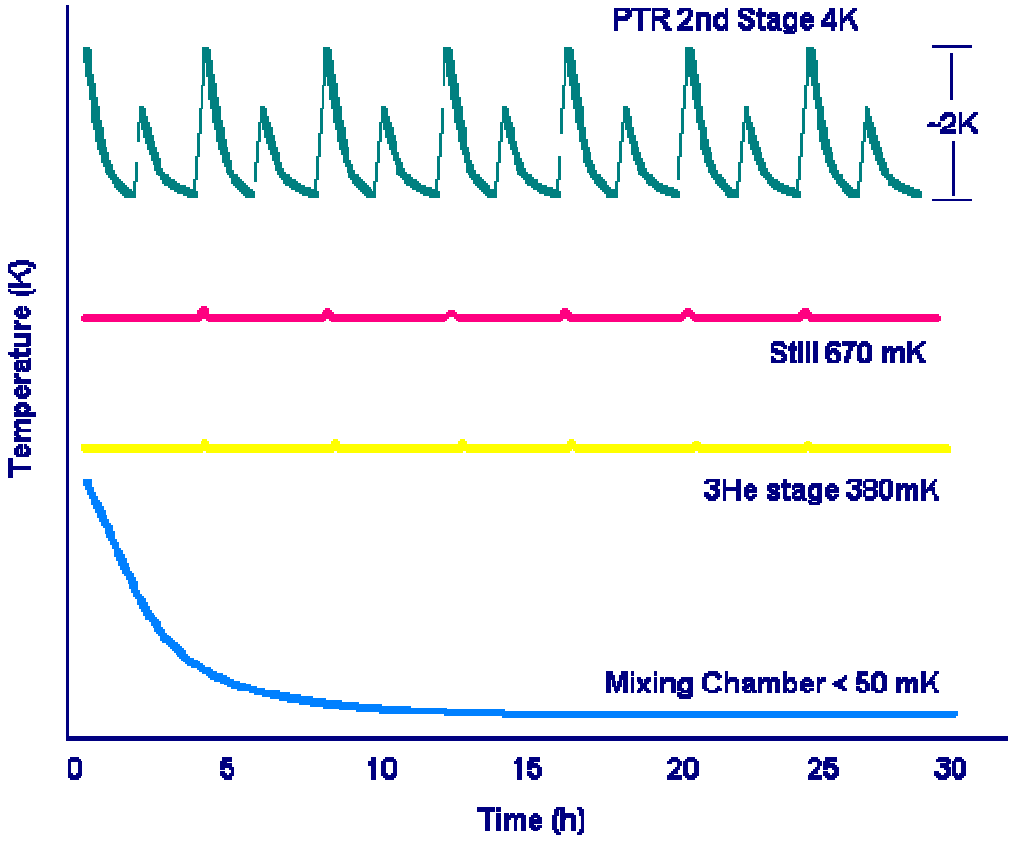
Cryofree™ sample environments – **Heliox**™AC-V

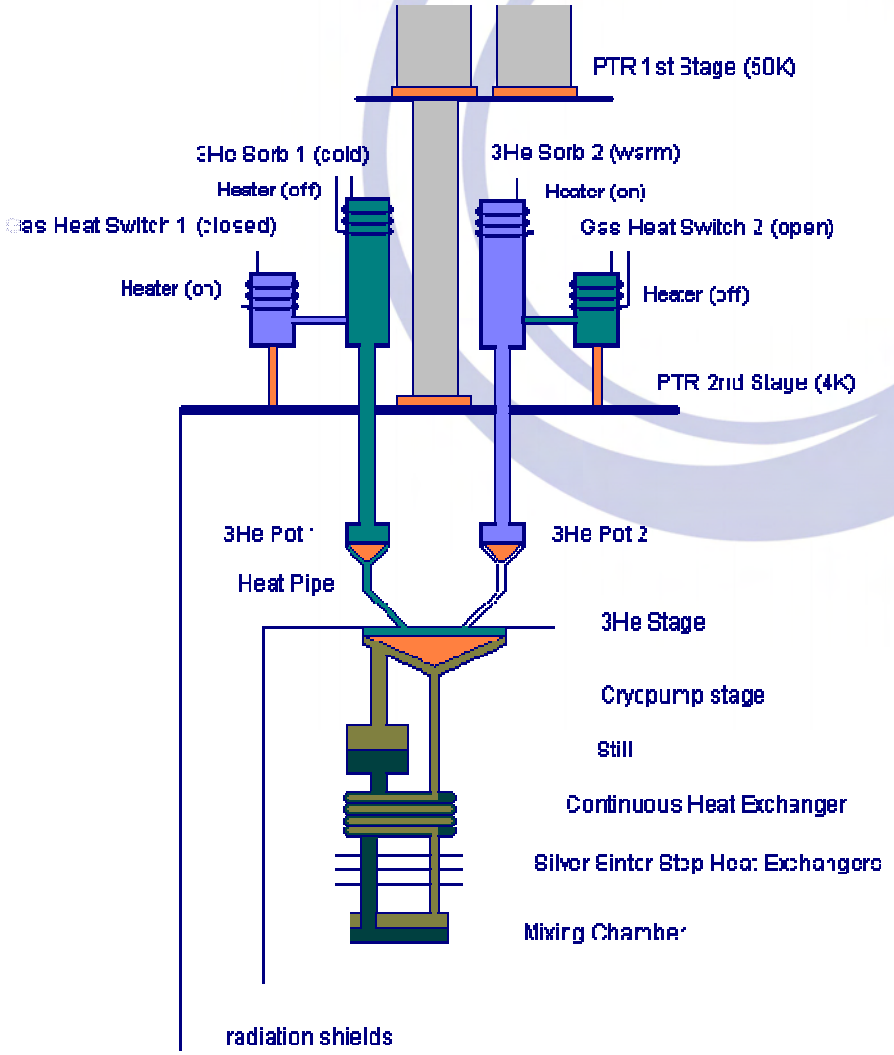
- For wider temperature ranges down to 300 mK the **Heliox**™AC-V offers Cryofree® operation at the touch a button.
  - Base temperatures < 300 mK
  - hold times > 50 h
  - High temperature operation up to 300 K
  - Thin wall Aluminum tails available
  - Seamless tails also available. Smooth high temperature
- This patented 3He technology developed on **Heliox**™AC-V has led Oxford Instruments to develop our latest low temperature system **Triton**™DR.

Triton™ DR

- 50 (20) mK cryofree® base temperature, 10 μW at 100 mK cooling power
- 300K operation
- High cooling power intermediate stage at 400 mK
- Low vibration pulse tube refrigerator technology
- No pumps or gas handling system
- Patented self-contained cryogenic cycle for leak-free reliable operation
- No needle valves or impedances

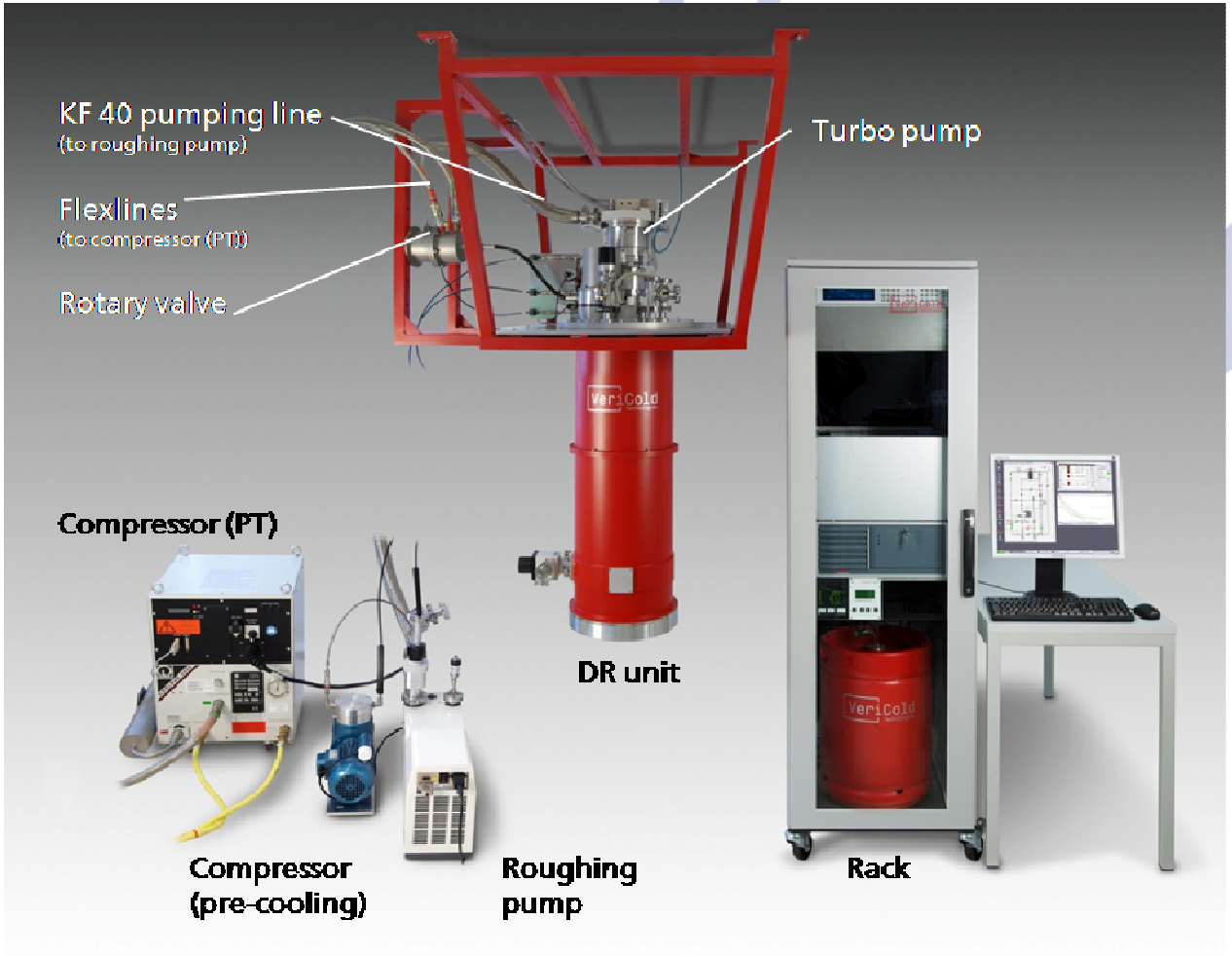
Triton™ DR Operation





VeriCold DR 200-10

- 10 mK cryofree® base temperature,
- 200 μW at 100 mK cooling power
- JT stage provides cooling of the returning 3He mixture from 4K to below 1K.
- Oil free operation
- Single vacuum (No IVC, no indium seal)



Summary

- For large complex superconducting magnets Actively Cooled™ recondensing technology offers stable magnet operation with minimum He consumption.
- Large split pair magnets are poor candidates for Cryofree® technology
- Low temperature sample environments are now available Cryofree®
- Triton DR Cryofree Dilution Refrigerators for Neutron Scattering