Cooling ^{3}He superfluid by demagnetising solid ^{3}He in aerogel

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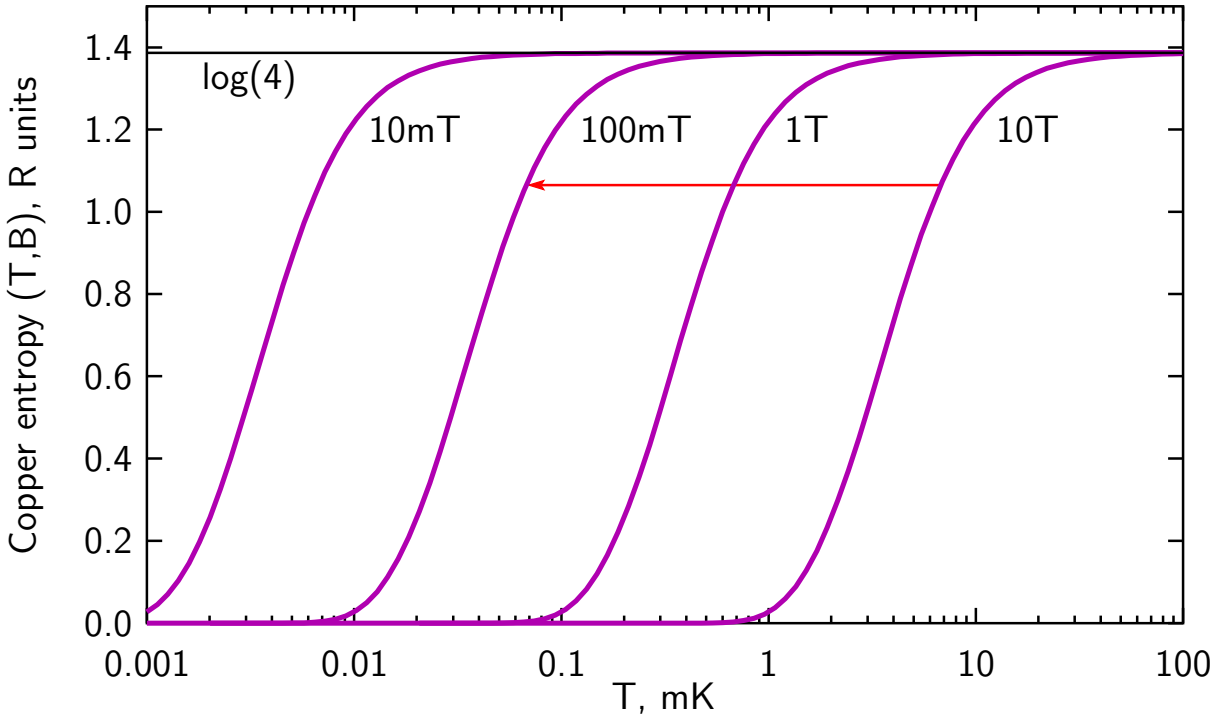
Lancaster, 22.1.2021

Adiabatic demagnetisation



Cooling of copper nuclei: 20 nK

Cooling He^3: 100 μK
- Kapitza boundary resistance
- Ballistic regime

Aerogel:
- acts as a uniform impurity
- does not break superfluidity
- surface covered with solid ^{3}He
- solid ^{3}He is paramagnetic

Experiment in Lancaster, 2006

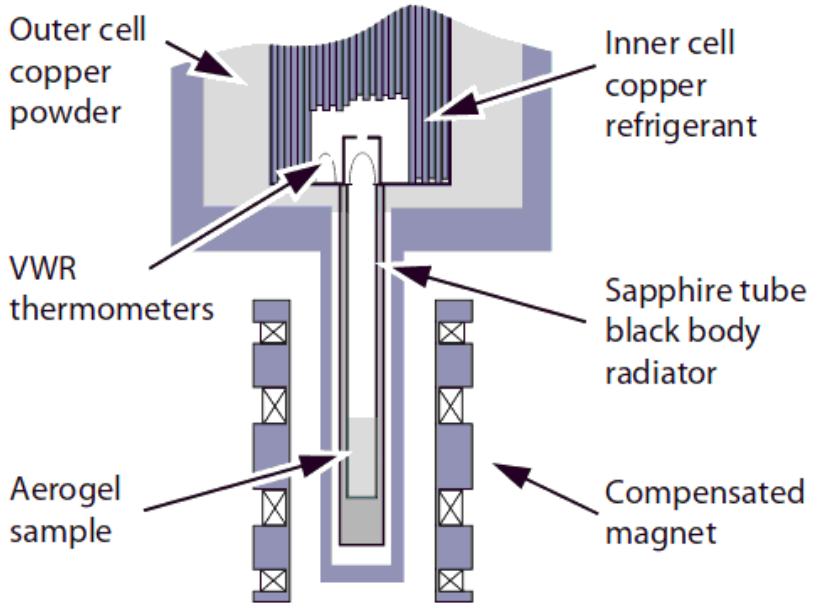


FIGURE 1. Schematic of the experimental cell showing the sapphire blackbody radiator containing the aerogel sample. The copper demagnetization final field magnet is not shown.

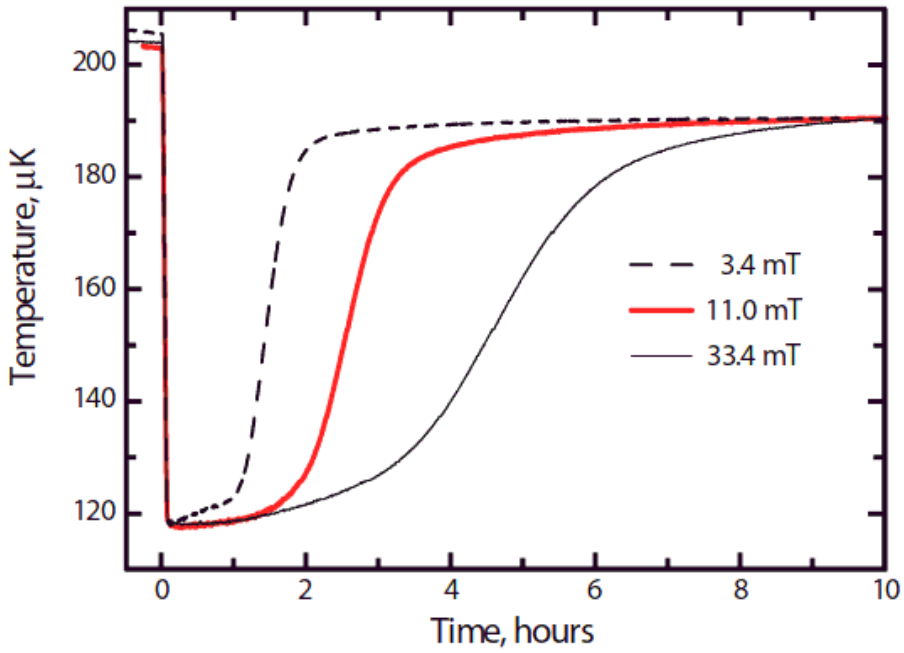
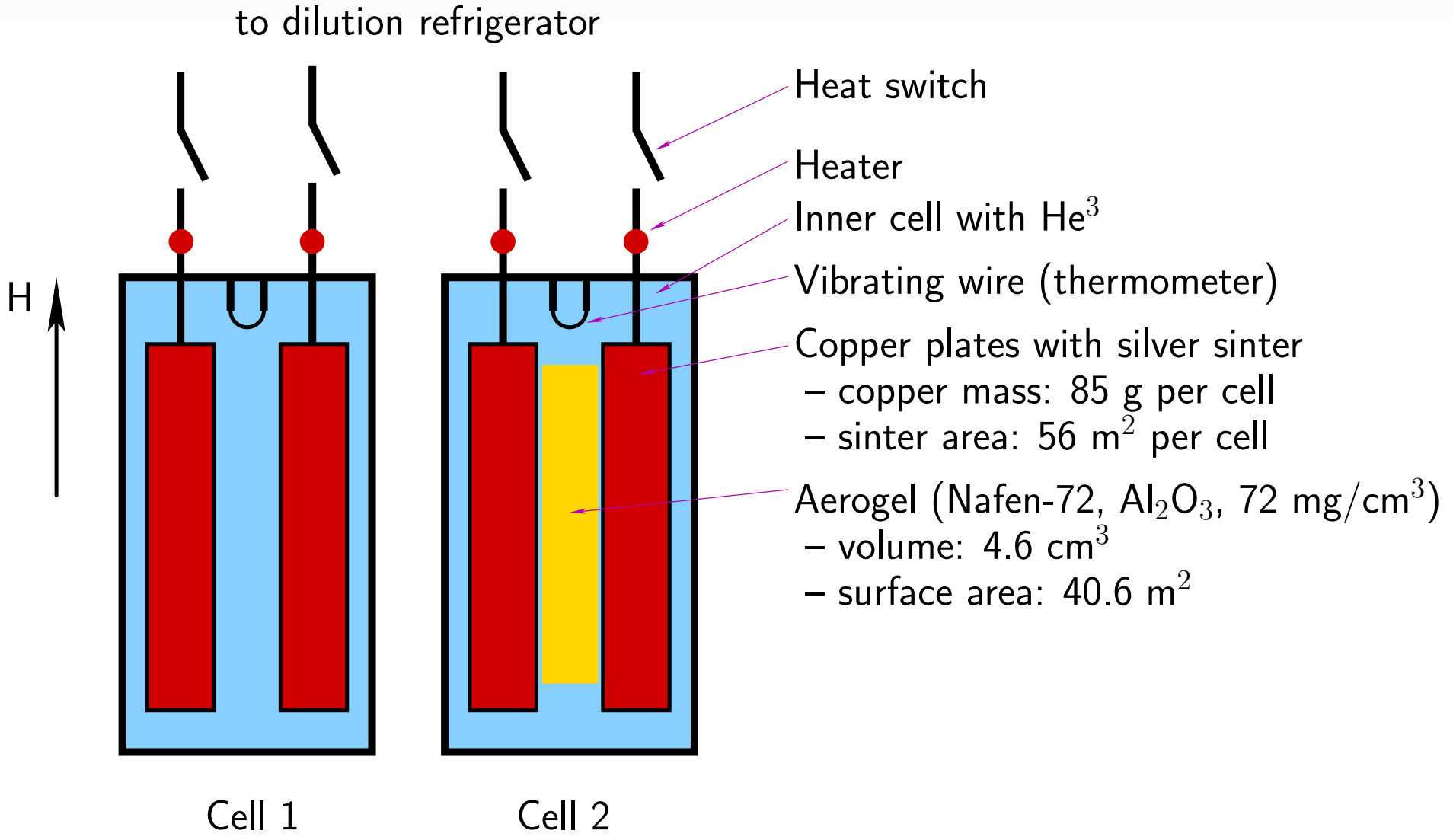


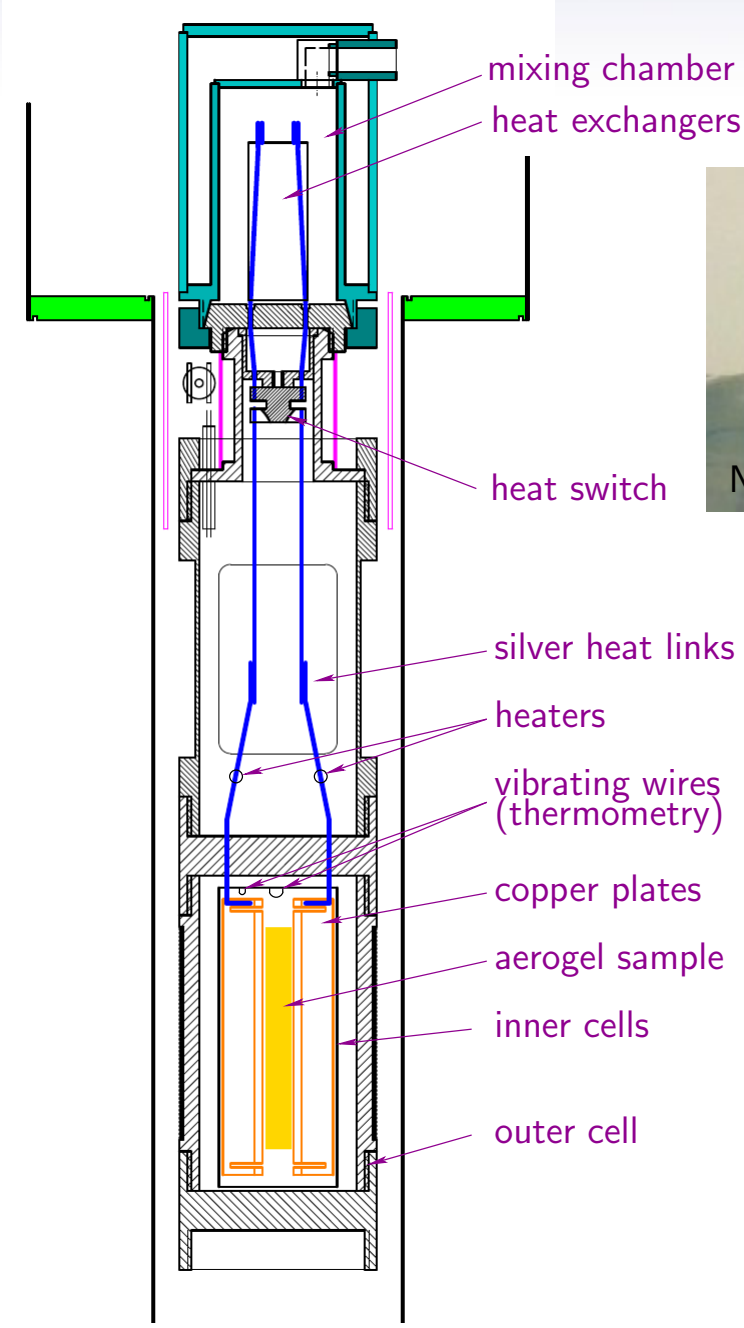
FIGURE 2. Temperature evolution of the ^{3}He-B in the blackbody radiator following three demagnetizations from an initial field of 124 mT to the final fields indicated.

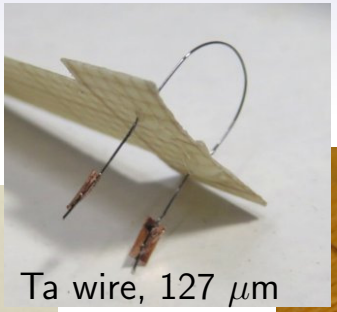
D. I. Bradley et al., AIP Conference Proceedings 850, 243 (2006),
https://doi.org/10.1063/1.2354684

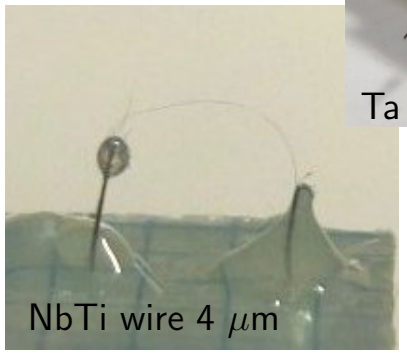
New experiment

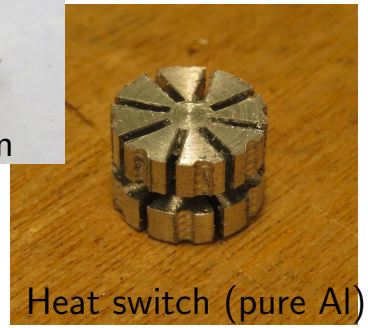


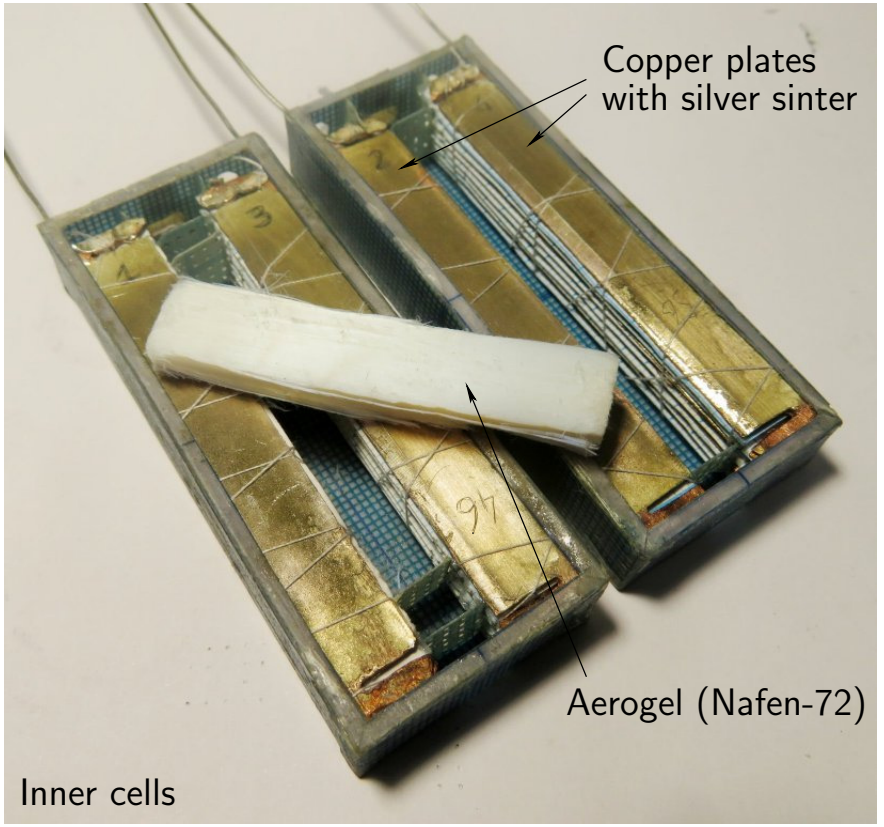
Building the experimental cell




Ta wire, 127 μm


NbTi wire 4 μm


Heat switch (pure Al)




Outer cell