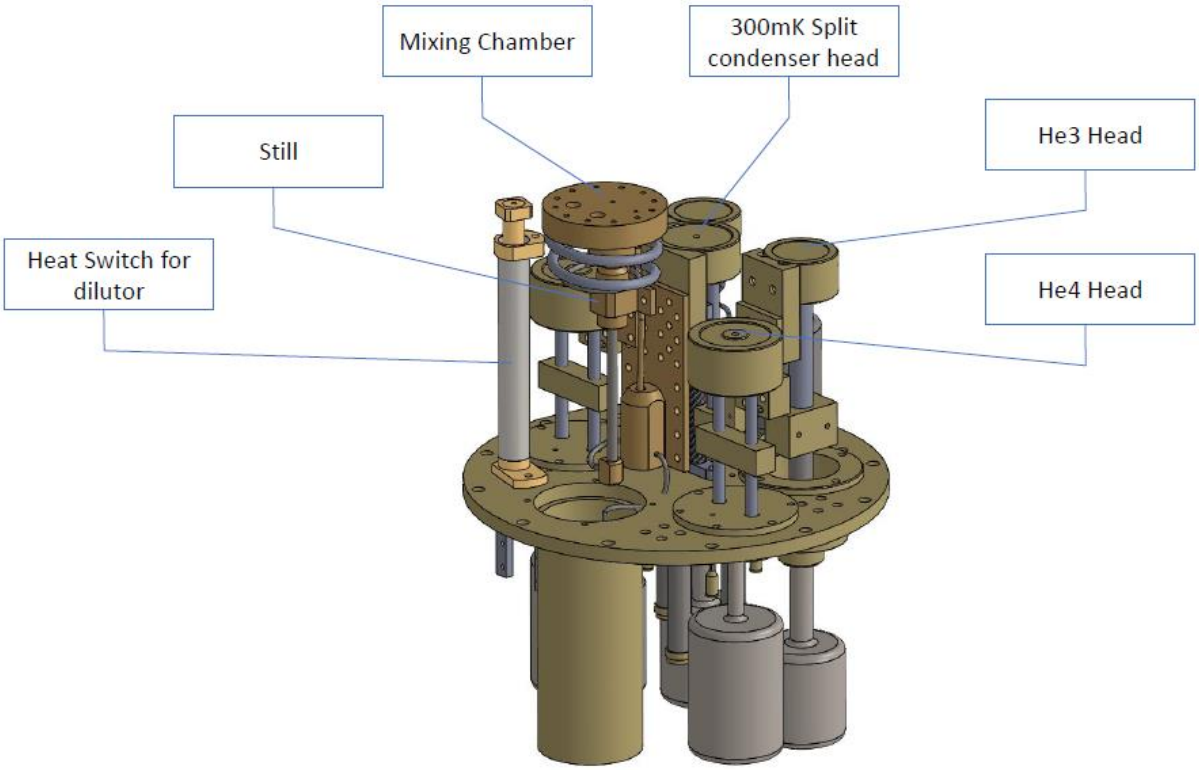
Chase Research Cryogenics

World leaders in sub-Kelvin cryogenics

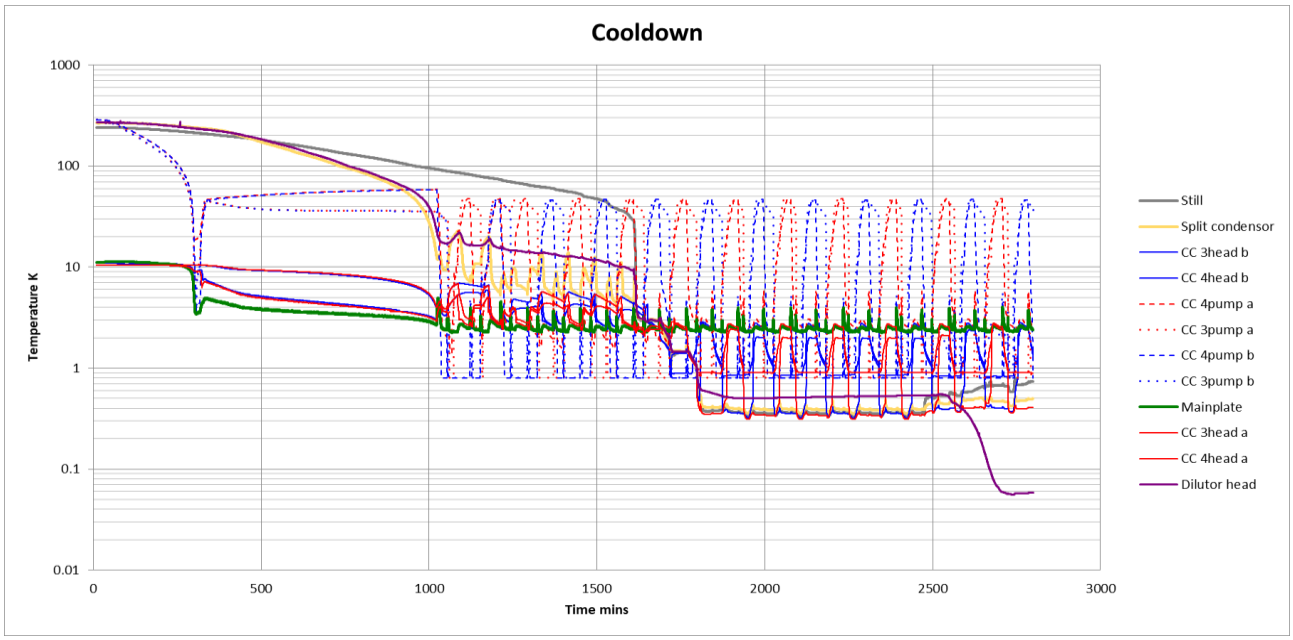
PERFORMANCE NOTES FOR THE CMD (Continuous MiniDilutor) sorption cooler

The CMD is a small, low-power dilution system that consists of a sealed dilution module that is pre-cooled by CRC's continuous CC7 system, interfaced to a low-power GM cryocooler. The CC7 has two sets of (helium 3 + helium 4) modules, which are cycled alternately to keep the central 300 mK split condenser permanently cold. The split condenser then cools the condenser of the dilution module. The dilution module Mixing Chamber is the cold head of the CMD system. In use, the head of the mixing chamber is in the downward orientation, not upwards as shown in the diagram below.

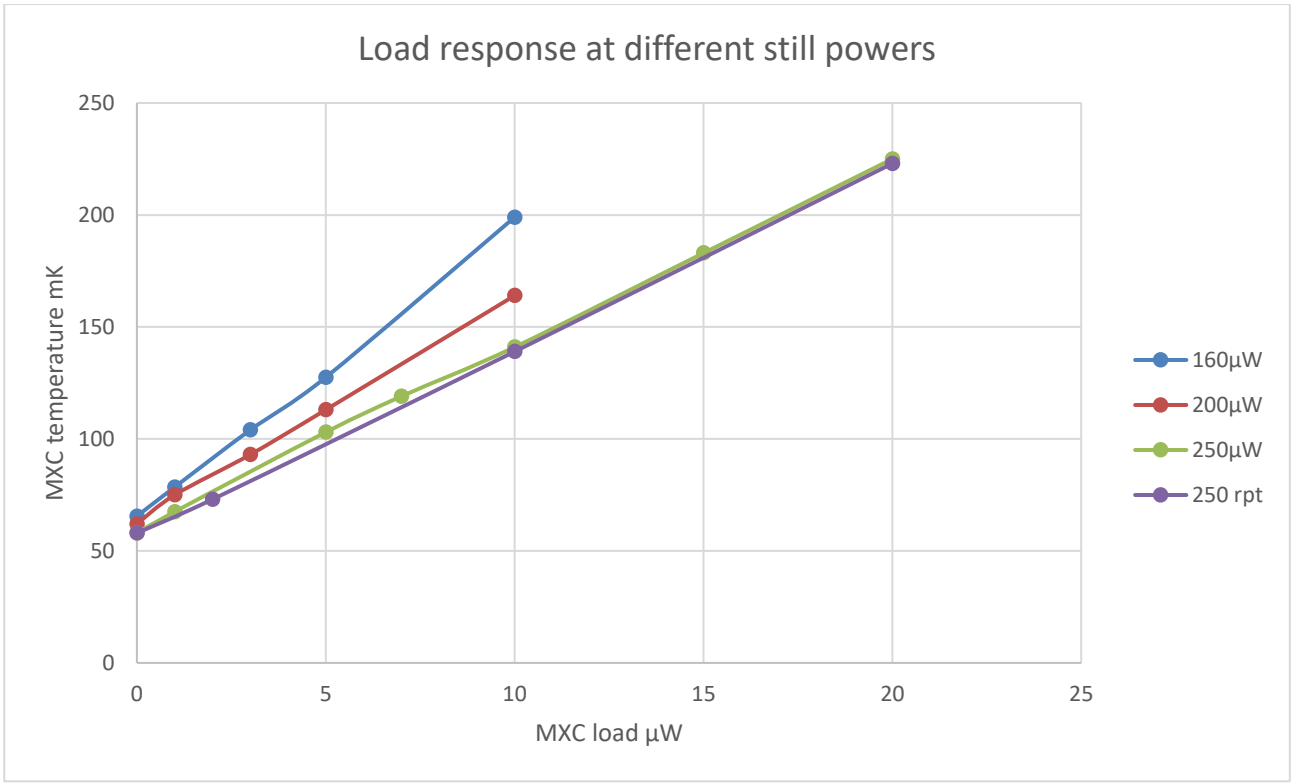


Unlike a conventional dilution cooler the CMD has no external gas handling or pumped gas circulation. This makes it very small and compact, however it also means that the circulation rate, and hence the cooling power, is very low. In such a system it is important to manage thermal loads carefully and to sink as much load as possible at higher temperature stages. A thermal sink point is provided at the dilution module's still (at ~800mK), but there is little scope for sinking at 300mK as nearly all of the cooling power of the CC7 is needed to operate the dilution module.

Here (overleaf) are some typical run data for the CMD. In this run the CMD is pre-cooled using a Sumitomo RDK408 GM cryocooler, which has 1W cooling power at 4K. We have successfully run the CMD with cryocoolers having cooling powers lower than 200 mW, but obviously initial cooldown times can be very long in that case. Once the CMD is cold it can be run for extended periods under automated software control. In the first figure we show the CMD's cooldown sequence, from room temperature. You can see that the dilution module begins to run after around 2700 minutes using the large RDK408 cryocooler.



Our data indicate a base temperature (unloaded) for the CMD of ~60mK HOWEVER please note that the temperature data presented are subject to uncertainty at the lower end of the range. We are currently working to improve our low-temperature thermometry and will report updated figures in due course. The measured load response of the CMD is given in the figure below. This too is subject to uncertainty at the lower end of the temperature range, <100mK.



Finally we would like to make it clear that this is currently an early-stage product and it requires very careful attention to radiation loading etc to secure the best performance from it. We are actively working to improve its usability and functionality.