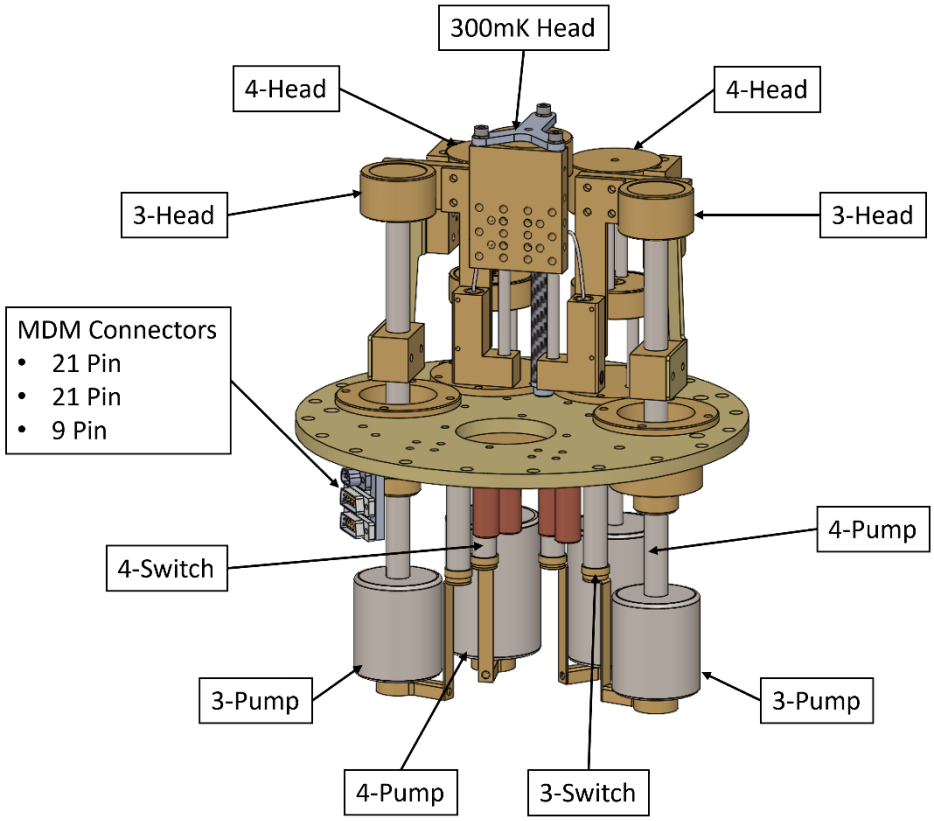
Chase Research Cryogenics

World leaders in sub-Kelvin cryogenics

PERFORMANCE NOTES FOR THE CC7 SORPTION COOLER

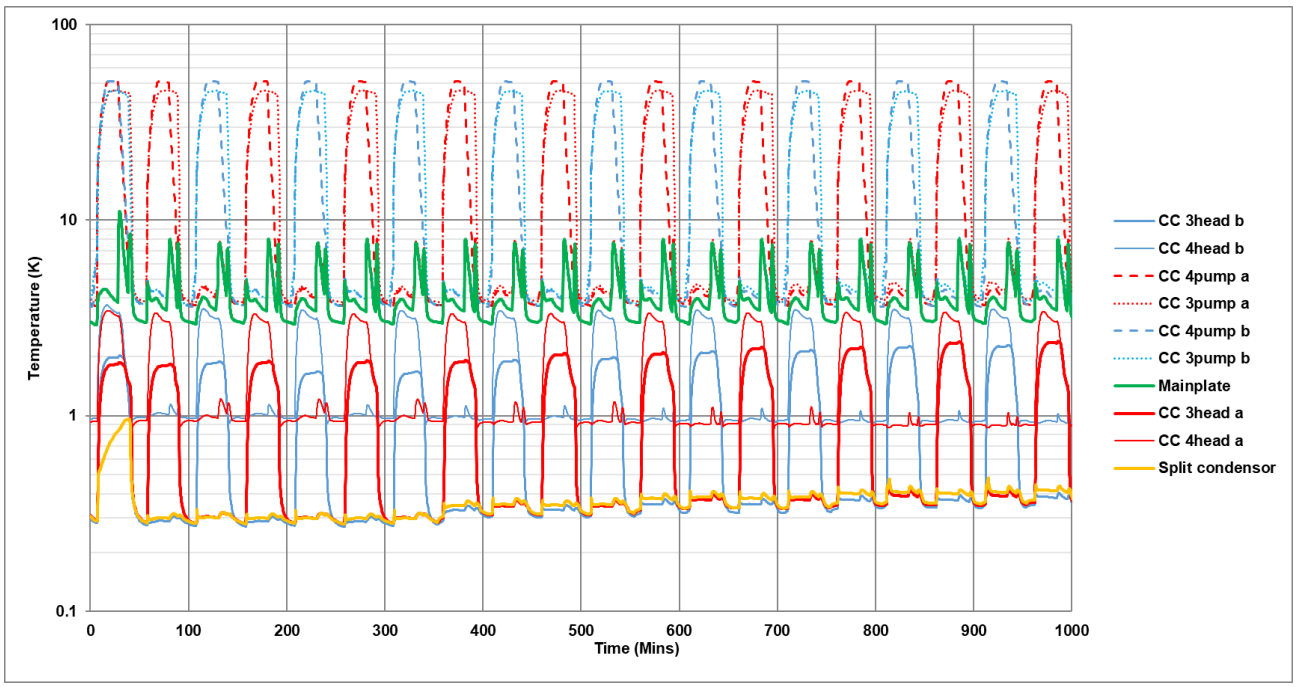
The CC7 is a continuous ~300mK sorption cooler that is designed to interface to a GM cryocooler. A CC7 has two helium 3 and two helium 4 modules. Each 3-4 module set works like a conventional two-stage sorption cooler. The two 'sides' of the CC7 are cycled alternately to keep the central split condenser permanently cold. The split condenser incorporates the 300mK cold head of the CC7. Once a CC7 is running it can be kept going for as long as needed, even for several months if required.



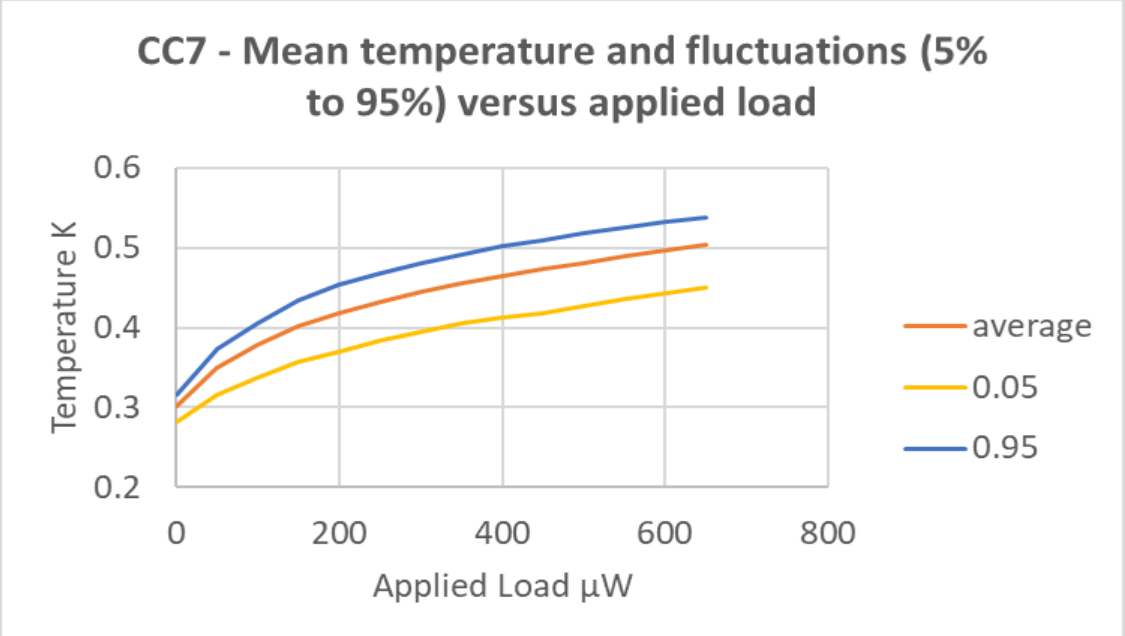
There are many ways to optimise the CC7 to meet differing operational requirements. For applications where the objects to be cooled impose a low heat load (e.g. ~100µW) the CC7 can be cycled slowly, cycle interval >2 hours, which results in a low average running temperature with small temperature fluctuations when each cycle initiates. For applications requiring higher cooling power the CC7 must be cycled more frequently. The minimum cycle interval of ~1 hour allows heat loads of ~500µW to be managed. Fast cycling will give higher average temperatures and larger temperature fluctuations, however it is possible to dampen fluctuations by adding a PID stabilisation loop to a load resistor sunk to the split condenser. A PID imposes an additional load on the CC7, which again raises the average running temperature while reducing the variability.

Overleaf we present some run data obtained with a CC7 pre-cooled using a Sumitomo RDK408 GM cryocooler, cooling power 1W at 4.2K. With this precooler the initial cool down time of the CC7 was approx. 12-15 hours, but this could be significantly reduced by adding an optional heat switch. In the example shown the CC7 was cycled every 50 minutes, allowing loads up to 700µW to be applied.

There was no PID stabilisation used. The data segment shown (~17 hours, during which time applied loading is increased) illustrates the operational sequencing used to run the CC7.



The CC7 (without PID) requires 8 DC power channels to operate the heat switches and pumps and has 10 housekeeping temperature sensors fitted, though not all of these need to be monitored. The graph below shows the load response of the CC7 run with 50 minute cycling. The average head temperature is plotted against applied load, along with 5% and 95% centiles of head temperature readings taken every ~10 seconds.



Note that in the above example the CC7 was optimised for high loads by using the short cycling interval of 50 minutes. Lengthening the cycling interval to 120 minutes would reduce the average temperature to ~360 ± 25mK for an applied load of 100µW.