

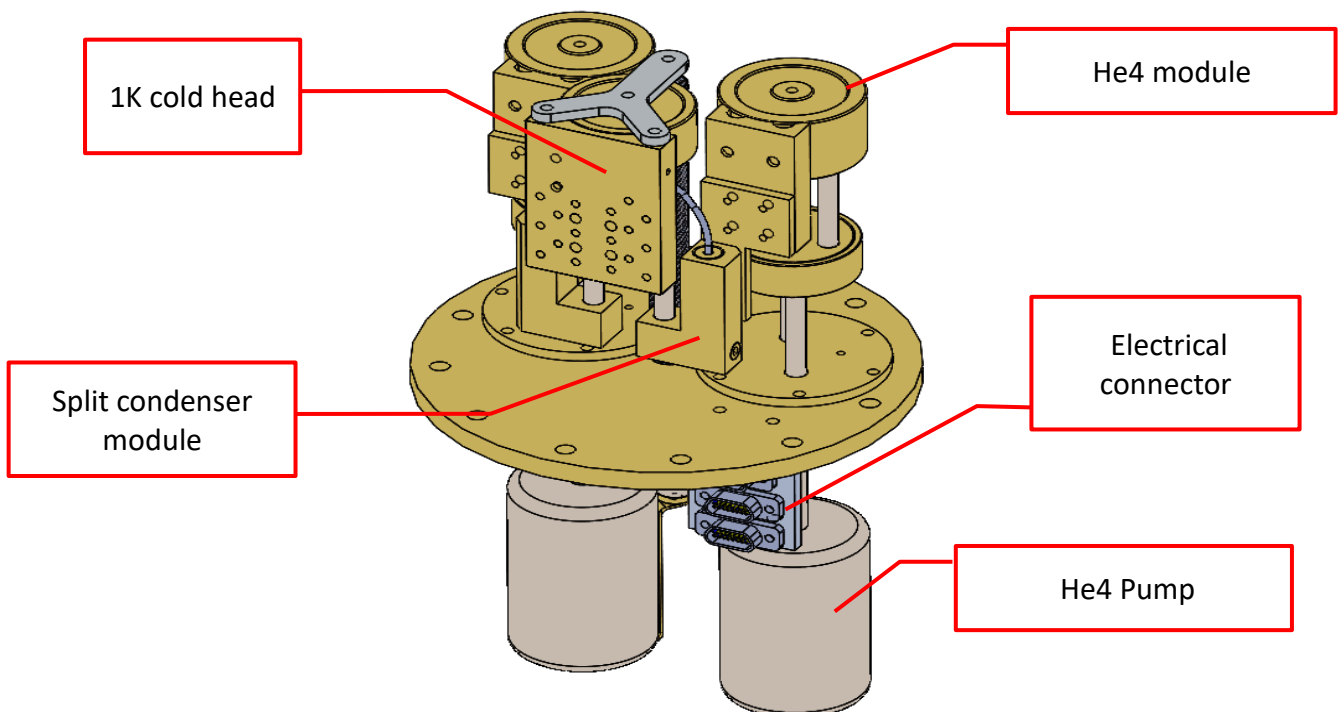


### PERFORMANCE NOTES FOR THE CC4 CONTINUOUS SORPTION COOLER

The CC4 is a compact sub-Kelvin system that has been designed to be interfaced to a low-power GM cryocooler. The initial cool down time is slow (approx. 24 hours) but this can be reduced by adding an optional heat switch or using a more powerful 4K cryocooler.

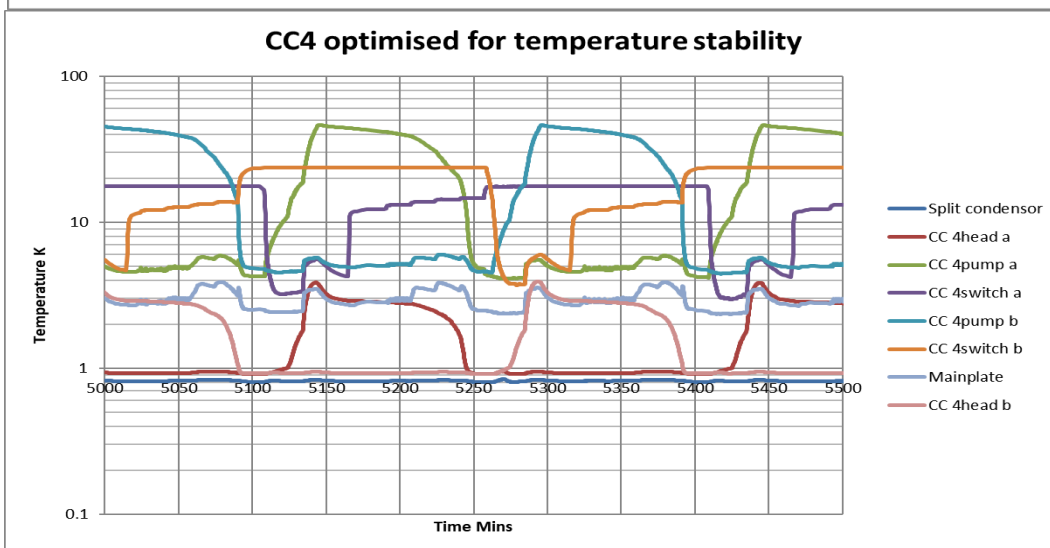
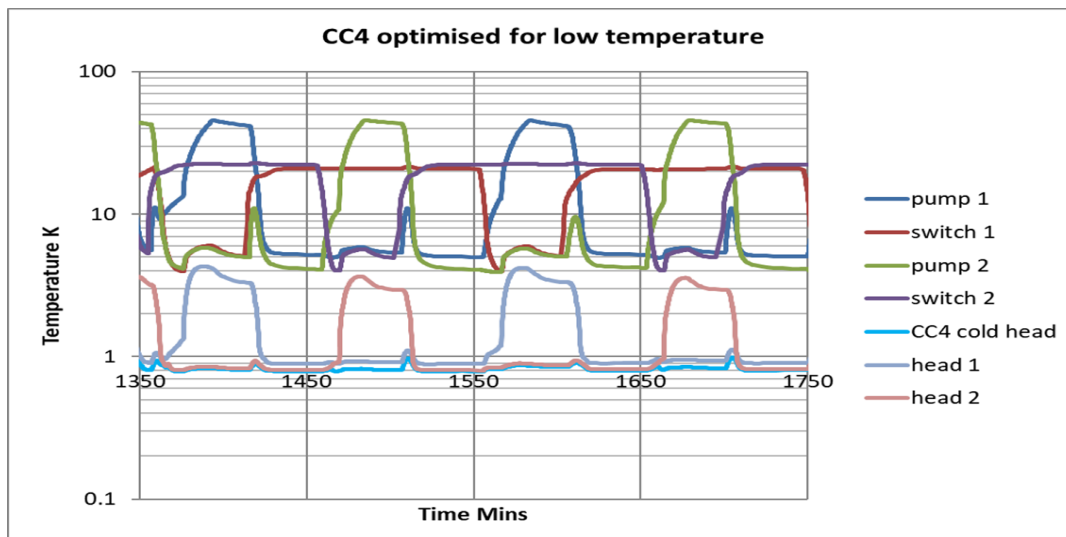
A CC4 has two helium 4 modules. Each 4 module works like a GL4 sorption cooler; the modules are cycled alternately to keep the central 1K-head permanently cold, i.e. run time is unlimited. When running, each module is cycled periodically, the total cycle time typically varying between 30 and 500 minutes, depending on the loads applied to the 1K-head.

The CC4 needs to be run under software control to switch the pump heaters and heat switches on



and off at regular intervals. If fixed voltages are used for these heaters the 1K-head temperature will have small fluctuations, particularly at the 'handover' between the two modules. However using programmable power supplies allows more sophisticated operational sequences to be implemented to smooth out the temperature fluctuations. As a general rule, there is a trade-off between low temperature and temperature stability, i.e. lower fluctuations come at the cost of slightly higher average temperature, however there are many possible optimisation schemes that the end user can employ to obtain the best possible performance for their own application.

Figure 1 shows the CC4 running with a very simple control programme that applies a fixed voltage to warm the pump heaters. The average temperature of the 1K-head is 0.83K with excursions ranging from 0.80K to 0.98K. With a more complex operational sequence to turn on the heat switches in stages (see Figure 2), the temperature fluctuations can be reduced significantly. In Figure 3 the CC4 is running under zero load at an average temperature of 0.82K, and excursions ranging from 0.81 to 0.83K.



Above: Figure 1. Below: Figure 2

The CC4 can tolerate significant loads of up to 500 $\mu$ W while remaining at an average temperature below 1K (Figure 3). If the load is fairly constant the control programme can be optimised to minimise the fluctuations at the required load. The data shown is optimised for zero load.

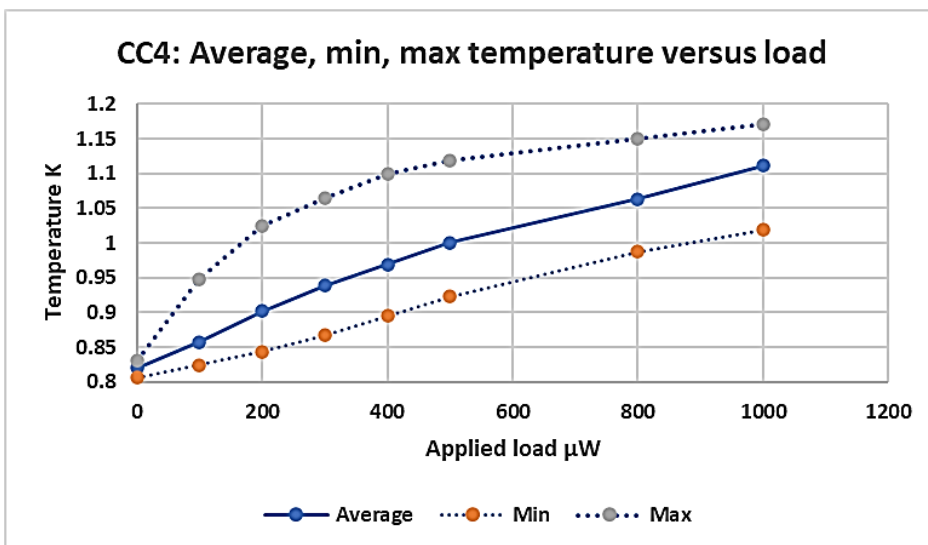


Figure 3: Load response of the CC4, showing average temperature, minimum and maximum temperature over two cycles.