Contribution ID: **340** Type: **Poster Presentation (120m)**

Ultra low temperature noise thermometry and its applications at ISIS Neutron and Muon Source

Tuesday 23 July 2024 14:00 (2 hours)

The ISIS Neutron and Muon Source undertakes approximately 100 experiments per year at temperatures below 1K. At these temperatures there is a clear need for accurate, precise, and well-calibrated thermometry, which is resilient to the challenging sample environments found in large science facilities. Commonly used resistive thermometers, whilst offering convenience and operational simplicity, struggle under conditions involving radiation flux and magnetic fields. Additionally, they can be prone to self-heating and have a relatively high cost when bought fully calibrated.

The magnetic field fluctuation noise thermometer (MFFT-1) from Magnicon can be utilised to overcome these difficulties. It operates through the Johnson-Nyquist noise theorem to link thermodynamic temperature to thermal fluctuations of voltage in a metal, allowing it to function as a primary thermometer. Through the use of a superconducting quantum interference device (SQUID), it can read precise temperatures in the mK range.

In this work we look to improve the use of low temperature resistive sensors in the high-throughput environment of an operational large-scale facility. Firstly, by installing the MFFT-1 into a dilution refrigerator we were able to create a methodology and mounting solution for the rapid calibration of cheap commercial resistors, thus enabling the creation of our own low-cost resistive thermometers able to measure down to mK temperatures. Secondly, this provision enables us to characterise the behaviour of both SQUID and resistance based thermometers in the extreme environments found at neutron and muon sources. This incorporates the behaviour of our sensors under radiation, whilst also including a scheme to operate the MFFT-1 in moderate magnetic fields, allowing calibration of the magnetoresistance effect in our resistive sensors. Lastly, we use these tools to understand the effect of 'beam heating'upon samples placed in our neutron instruments. This has been historically enigmatic due to the poor understanding of radiation on resistive sensors, coupled with the large variety of potential materials and neutron energies that are used.

We wish to share our experiences implementing ultra-low temperature noise thermometry at a large-scale facility and discuss possibilities for further developments.

Submitters Country

United Kingdom

Primary author: BAIN, Lucy (ISIS Neutron and Muon Source)

Co-authors: JONES, Alex (ISIS Neutron and Muon Source); LAWSON, Christopher (ISIS Neutron and Muon Source); Mr PRICE, Ross (ISIS Neutron and Muon Source); KIRICHEK, Oleg (ISIS Neutron and Muon Source)

Presenter: BAIN, Lucy (ISIS Neutron and Muon Source)

Session Classification: Tue-Po-1.3

Track Classification: Tracks ICEC 29 Geneva 2024: ICEC 14: New devices and novel concepts