High energy resolution has been a goal of microcalorimeter x-ray detectors that has been successfully achieved. However, drifts in energy scale over extended counting times have set limits on both the long-term resolution and the calibration. The successful operation of a microcalorimeter as an x-ray detector puts considerable constraints on the stability of all the electrical and thermal inputs to the instrument. We have reexamined the factors that lead to drift in the energy scale of the NIST-designed detector with superconducting readout and report here on improvements that we have been able to implement.

Operating conditions are maintained by employing a stabilized electrical bias to the low-temperature components of the microcalorimeter electrical circuitry and two feedback loops which respectively maintain the short-term temperature of the calorimeter and long-term temperature of the substrate (T=70 mK). The long-term feedback control circuit was based on the temperature readings from a RuO thermometer that regulates heat flow into an adiabatically demagnetized salt reservoir cooled to around 50 mK. The heat flow is actually controlled by the field of a large superconducting magnet surrounding the salt reservoir.

Studies conducted on the sensitivity of the energy scale indicated that an arbitrarily selected stability of ±1 eV/h requires maintaining the substrate to within ±23 μK. Our measurements of component performance over time pointed to excellent stability in the temperature-sensing circuitry, but variable performance of the magnet control circuit. We have modified the magnet control circuitry to compensate for long-term drift and unexpected changes in response time of the magnet with operating current. The energy scale of spectra is now observed to be stable to within about 1 eV/h over a period of hours, under bias conditions in which a linewidth of 11-12 eV is readily obtained. We present representative spectra including a Cu and Zn Lα spectrum from NIST SRM Brass (Cu_{0.768}Zn_{0.232}). The spectrum was taken over a single continuous live time of 10,000 s, representing a total counting time of approximately 4 h.