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Sub-Kelvin Neutron Powder Diffraction Studies of Magnetic Ordering in $Er_3Cu_4X_4$ (X=Si,Ge,Sn).
D.H. Ryan, Physics Dept., McGill Univ., Montreal, QC, H3A 2T8, Canada, J.M. Cadogan, School of Physics, The Univ. of New South Wales, Sydney, NSW 2052, Australia.

$Er_3Cu_4X_4$ alloys adopt the orthorhombic $Gd_3Cu_4Ge_4$—type *Immm* structure with two crystallographically distinct Er sites (2*d* and 4*e*). Initial neutron diffraction studies revealed that Er moments on the two sites exhibit different magnetic ordering temperatures, with those on the 2*d* site ordering first at 14K (X=Si) to 6K (X=Sn), followed by those on the 4*e* site at about 3.5K (for all X). These studies also indicated that even at 1.5K the moments were very different, with the Er-2*d* moments being about three times the size of the anomalously small Er-4*e* moments. By contrast, our ^{166}Er Mössbauer study revealed that the two moments were very similar, and were close to the $9\mu_B$ expected for erbium.

In order to understand the origins of this clear contradiction, we modified an Oxford Instruments 'Heliox' ^{3}He cold stage to fit into an 'Orange' cryostat that could be mounted on the C2 powder diffractometer at Chalk River. The system cooled the sample to 350mK and gave hold times in excess of 24 hours. We found that while the Er-2*d* ordering remains unchanged, the Er-4*e* moments undergo two further ordering events *below* 2K and that the final, fully ordered, moments are consistent with our ^{166}Er Mössbauer values.