



**Experiment title:** **Magnetoelectric coupling in incommensurately modulated materials**

**Experiment number:**  
**HE- 3094**

**Beamline:**  
ID31

**Date of experiment:**  
from: 19/02/09 to: 23/02/09

**Date of report:**  
01/09/09

**Shifts:**12

**Local contact(s):** Irene Margiolaki

*Received at ESRF:*

**Names and affiliations of applicants (\* indicates experimentalists):**

**Matthew Rosseinsky (Liverpool University)**

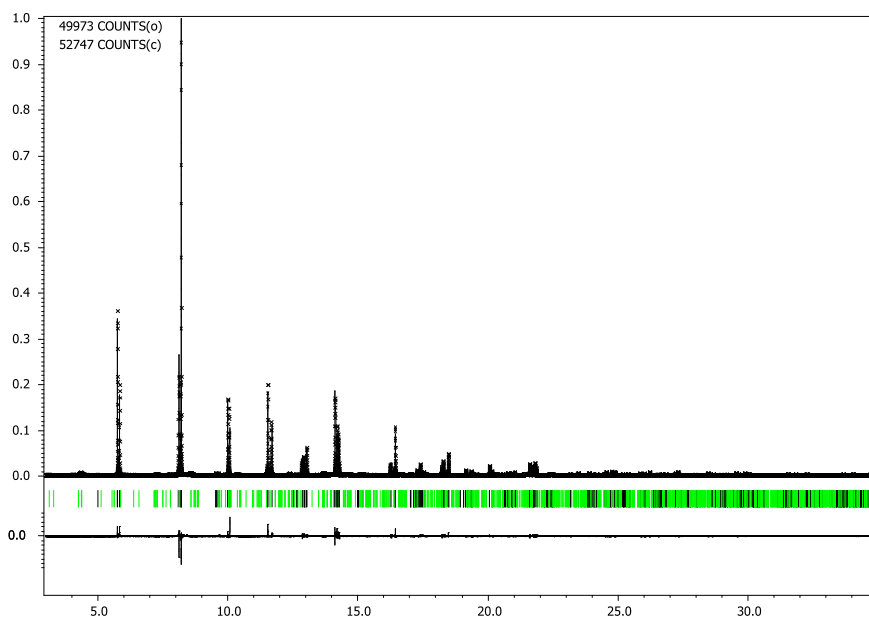
**John Claridge (Liverpool University)\***

**Sam Chong (Liverpool University)\***

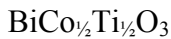
**Joanna Clark (Liverpool University)\***

## Report:

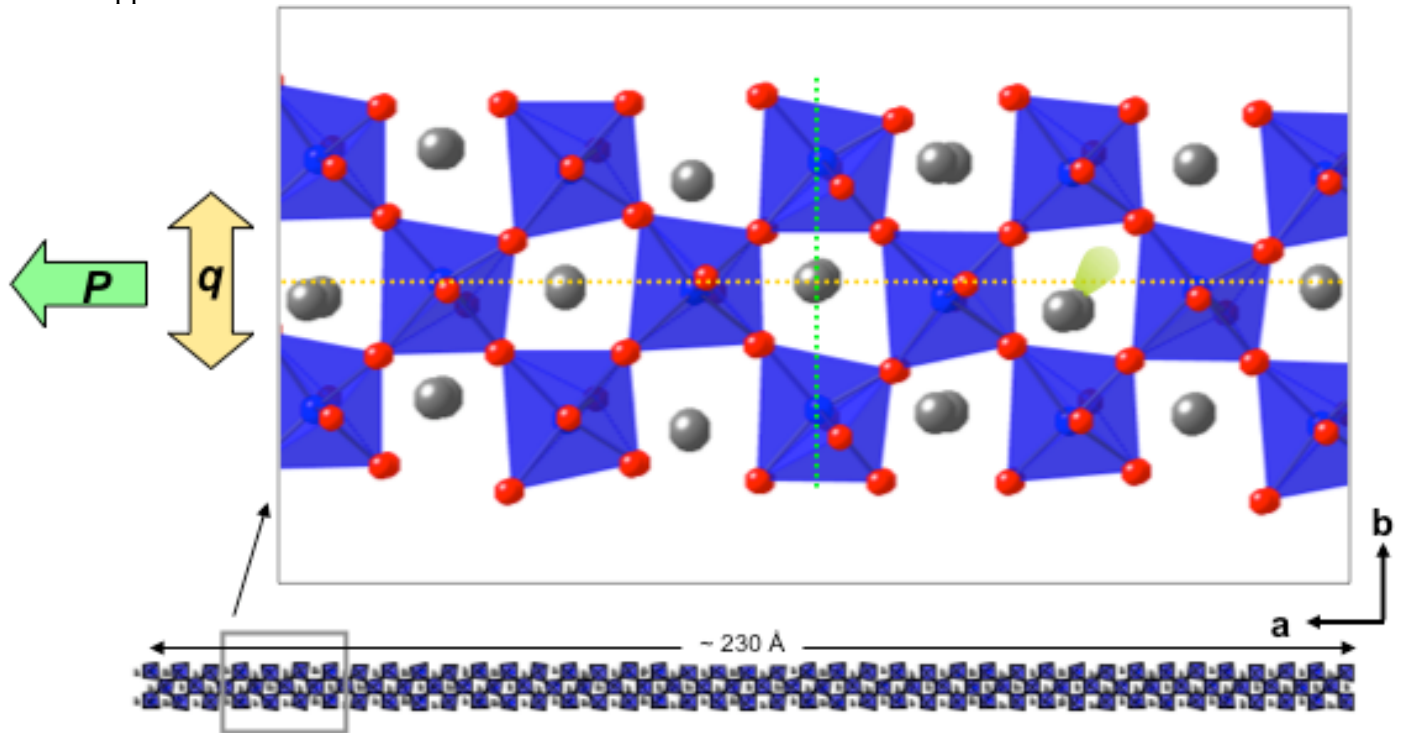
Data were collected on four different compositions  $\text{BiCo}_{1/2}\text{Ti}_{1/2}\text{O}_3$ ,  $\text{Bi}_2\text{Mn}_{4/3}\text{Ni}_{2/3}\text{O}_6$  (ceramic sample and single crystal sample) and  $\text{Bi}_{1.9}\text{La}_{0.1}\text{Mn}_{4/3}\text{Ni}_{2/3}\text{O}_6$  from 10K to 295K with longer scans at 10K, 50K and 295K these data were collected at  $\lambda = 0.40005 \text{ \AA}$  using the liquid helium cryostat.



*Rietveld refinement of the modulated phase  $\text{BiCo}_{1/2}\text{Ti}_{1/2}\text{O}_3$*

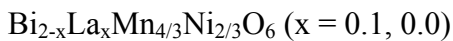


This phase was synthesised at 1100°C and 6 GPa. In conjunction with TEM and neutron diffraction we have shown that it crystallises in a  $Ic2m(0\beta0)s00$  and is thus polar whilst magnetometry and muon spin resonance shows that it is ferromagnetically ordered at 30K. The room temperature rietveld refinement is shown above and an approximant to the structure below:

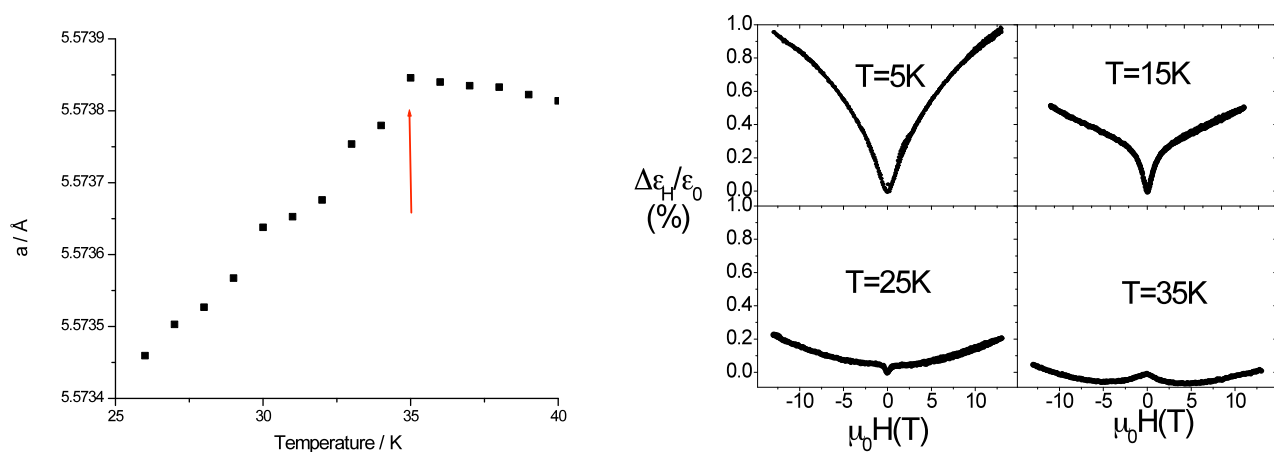


#### *Rational approximant of $\text{BiCo}_{1/2}\text{Ti}_{1/2}\text{O}_3$*

Ongoing refinements are being carried out to understand how the modulation and structure are affected by temperature particularly around the magnetic ordering temperature.



All three phases crystallise in  $Ibmm(0-\beta0)(\alpha00)mm.ss$  and all show interesting and unexplained magnetocapacitance behaviour around the spin glass freezing temperature. Here the structural information derived from ID31 data will be used to help determine any structural effects causing these effects.



*Variation in  $a$  (left) and magnetocapacitance (right) for  $\text{Bi}_2\text{Mn}_{4/3}\text{Ni}_{2/3}\text{O}_6$*