ESRF	**Experiment title:** High-pressure X-ray investigation of phase transitions in model quantum spin system $SrCu_2(BO_3)_2$	**Experiment number**: HS-3692
Beamline: ID9A	**Date of experiment**: from: 18 February 2009 to: 24 February 2009	**Date of report**:
Shifts: 18	**Local contact(s)**: M. Hanfland, M. Merlini	*Received at ESRF:*

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Report:

We performed synchrotron X-ray single crystal and powder diffraction measurements as a function of pressure and temperature in order to determine the structural phase diagram of the Shastry-Sutherland quantum magnet $SrCu_2(BO_3)_2$.

Hydrostatic pressure ranging from ambient to 19 GPa was applied to the samples by mean of a diamond anvil cell (DAC), with helium as pressure transmitting medium. Pressure calibration was performed using the ruby luminescence method. Temperature was varied from ambient to 25 K using a helium cooled cryostat.
The single crystal samples (~30 x 30 x 5 μm^3) were placed in the DAC with c-axis parallel to the X-ray beam and rotated by ± 10° during exposure while the powder samples were rotated by ± 3°.

We could observe the distortion from the ambient tetragonal to the monoclinic phase [1] and follow this transition as a function of temperature down to 30 K. The transition essentially remained confined in the 4 – 5 GPa range [2]. A higher pressure first order transition around 15 GPa was also observed.

A full refinement of the powder diffraction data was not possible due to the presence of impurities in the sample.

Figure 1 shows a typical peak splitting observed on ID9A with $SrCu_2(BO_3)_2$ in the DAC for both a powder and a single crystal sample.

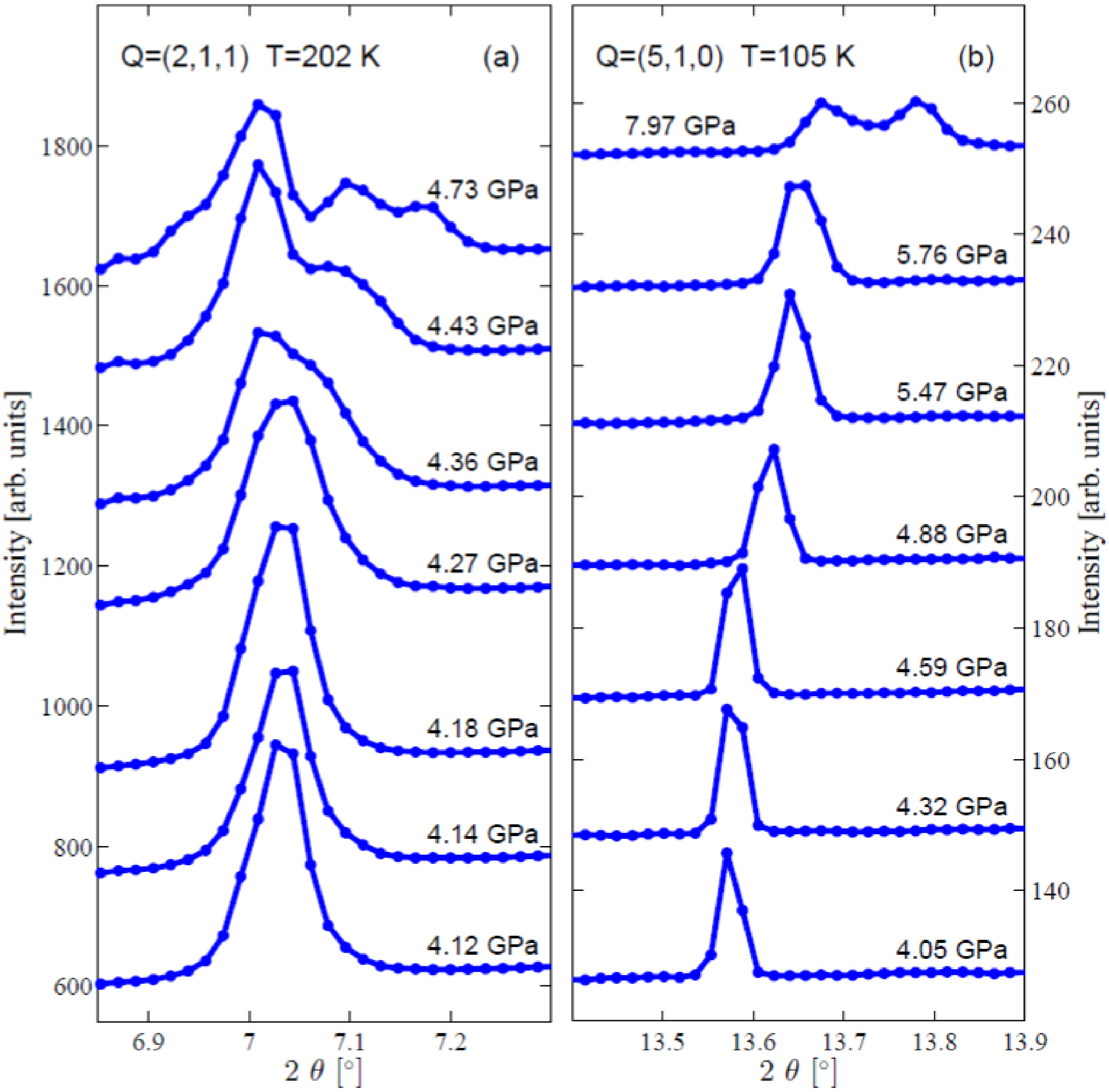

Figure 1: Pressure dependence of Bragg reflections in $SrCu_2(BO_3)_2$. (a) Powder sample, T=202 K. The (2,1,1) tetragonal reflection splits into several non equivalent monoclinic reflections. (b) Single crystal. The original (5,1,0) tetragonal reflection abruptly changes position above 4.59 GPa. Above this pressure, the reflection broadens and can be fully resolved as two non-equivalent peaks around 8 GPa. Peaks are shifted vertically for clarity.

References:

[1] I. Loa, F.X.Zhang, K.Syassen, P.Lemmens,W.Crichton, H.Kageyama,Y.Ueda, Physica B 359–361, 980 (2005).

[2] M. E. Zayed, Ch. Rüegg, E. Pomjakushina, M. Stingaciu, K. Conder, M. Hanfland, M. Merlini, and H. M. Rønnow, Solid State Commun. 186, 13 (2014).