

# HgMn<sub>7</sub>O<sub>12</sub>, a novel improper ferroelectric, under pressure

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Perovskites have long been regarded as a playground for solid-state chemistry due to the wide variety of properties that can be achieved. However, despite their very rich chemistry, ferroelectricity, the switchability of a spontaneous electric polarisation by an external electric field, has been restricted to a narrow range of compositions.

Designing materials in which ferroelectric polarisation is coupled to other parameters such as magnetic, electronic and lattice instabilities is of great interest for solid-state scientists and in recent years, extensive work has been undertaken to further our understanding of these so called ‘improper ferroelectric mechanisms’.

Although coupling between ferroelectricity and electronic ordering seems to be quite rare, we recently reported such coupling in the 134-perovskite HgMn<sub>7</sub>O<sub>12</sub>. [1] In this work we show that in HgMn<sub>7</sub>O<sub>12</sub> a polar ground state arises from a relatively simple charge and orbital ordering pattern (driven by an intersite transfer) *via* an improper ferroelectric mechanism. This mechanism is not well understood yet, and is at odds with the chemically similar compound, CaMn<sub>7</sub>O<sub>12</sub>. [2]

Since electronic ordering is expected to be very sensitive to hydrostatic pressure, it should be possible to manipulate the polar ground state and gain further

understanding of the improper mechanism that occurs. Here we present the results of a high pressure neutron diffraction experiment, carried out at PEARL, ISIS to investigate the effects of pressure on the charge transfer process that gives rise to this unusual ground state.

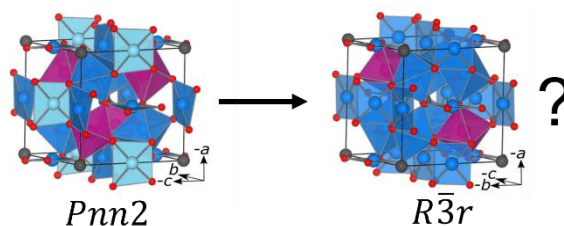


Figure 1. The expected crystallographic phase change with increasing pressure.

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[1] W. T. Chen, C. W. Wang, H. C. Wu, F. C. Chou, H. D. Yang, A. Simonov and M. S. Senn, *Phys. Rev. B.*, 2018, **97**, 144102.

[2] G. Zhang, S. Dong, Z. Yan, Y. Guo, Q. Zhang, S. Yunoki, E. Dagotto, and J. M. Liu, *Phys. Rev. B.*, 2011, **84**, 174413.