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Magnetic structure of the chiral triangular magnet MnSb2O6

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Incommensurate helical (or cycloidal) magnetic structure may have left- and right-wound states (helicity), which are in principle equally populated in a magnet with inversion symmetry. In addition, for a Heisenberg triangular antiferromagnet, clockwise and counter-clockwise rotations of the 120 degree spin structure provide another intriguing degree of freedom. Hence, a triangular magnet that has incommensurate helical ordering along the stacking direction will show intriguing interplay of the helicity (of the helical structure) and chirality (in the triangular plane). Such phenomenon is, however, rarely studied in the past since only one example, the Ba3NbFe3Si2O14 langathite, has been known to date [1]. In this work, we study MnSb2O6, which consists of distorted triangular lattice stacking along the c-axis [2,3]. MnSb2O6 belongs to the space group P321, and hence lacks inversion symmetry. Due to this fact, unique selection of the helicity and chirality may be expected. However, the earlier studies were carried out using unpolarized neutron diffraction with mostly the powder sample, and thus helicity and chirality selection cannot be concluded. Here, we have performed single-crystal diffraction experiment using polarized neutrons in addition to the unpolarized ones, and have succeeded in determination of the magnetic structure of MnSb2O6. The resulting magnetic structure is nearly cycloidal with the magnetic modulation vector q = (0, 0, 0.182) (see figure below). The spin rotation plane is, however, inclined from the ac-plane toward the b-axis for approximately 30 degrees. Polarization analysis indicates that both the helicity of the (nearly-) cycloidal structure and chirality of the in-plane 120 degree structure are uniquely selected. The 30 degree inclination from the ac-plane is a key finding of this work, allowing new kind of multiferroicity in this material.

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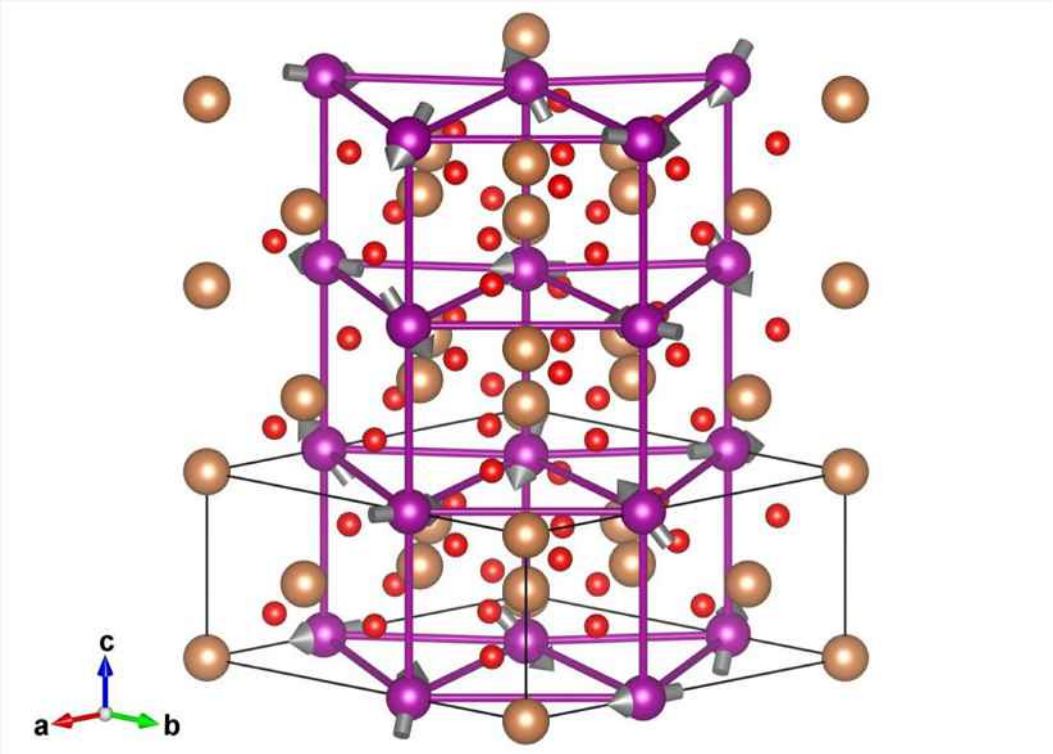

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