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Thermal expansion and phase changes of methane and nitrogen at Pluto temperatures

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Some of the most striking images from the New Horizons fly-by of Pluto were of the towering mountains surrounded by seemingly flowing glacial terrain [1]. The explanation for this terrain has its basis in crystallography, where at 44 K the strength of the hydrogen bond endows water ice with the resilience to build such mountains, while the rotational disorder in the solid structures of methane [2] and nitrogen [3] allow these materials to flow plastically even at 44K. These interpretations have been strengthened by the spectral observations that correlate these materials to the respective terrains [4].
In order to undertake accurate modelling of the geological features on Pluto the physical properties of the constituent materials must be well constrained. Although water-ice has been the subject of intensive laboratory studies, the same cannot be said of methane and nitrogen. The thermal expansions of these materials have been investigated [5], but only to a lowest temperature of 40 K and using techniques which were largely insensitive to, in particular, the hydrogen positions within methane. Thus, the aim of the experiments reported here is to investigate the structures and determine the thermal expansion of methane and nitrogen over temperatures relevant to Plutonian processes using neutron diffraction.

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Topic

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