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Clathrate Hydrates as Novel Moderator Material for Sources of Very Cold Neutrons

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Clathrate hydrates [1] are water-based solids with large unit cells which show promise as moderators for use in the development of new and more intense sources of very cold neutrons (VCN). Such sources have the potential to enhance existing neutron scattering techniques as well as to increase the reach of particle physics experiments employing beams of slow neutrons

The moderation potential of clathrate hydrates lies in their low energy modes, which are a consequence of the ability of these so-called inclusion compounds to host guest molecules in cages that are formed by networks of hydrogen-bonded water molecules. Of particular interest is a binary clathrate hosting oxygen and tetrahydrofuran (THF) as guest molecules. The molecular oxygen provides an additional path for neutron slowdown [2].

We present here, the results of an extensive experimental campaign with the aim of characterizing all relevant properties of deuterated clathrate hydrates for moderator applications. This includes, measurements of the temperature-dependent dynamical structure factor $S(q, \omega)$ in absolute units, neutron diffraction measurements and time-of-flight transmission experiments. These data serve as a baseline for NCrystal [4] scattering kernels, within the HighNESS project [5].

References

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