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A-2 NEUTRON INELASTIC SCATTERING FROM SATURATED AND SUPERHEATED WATER VAPOR MOLECULES

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ABSTRACT: To study the effect of potential interactions between molecules, cold neutrons were scattered from saturated and superheated water vapors both at a constant temperature of 455K. The neutron spectra were taken by the time-of-flight facility at scattering angles of 15,40,65.3, and 120 degrees for comparison.

This experiment was performed to investigate the effect of molecular interaction on translational motions of the molecules. As the vapor pressure is increased, one expects the increased collision frequency to affect the spectral distribution of the scattered neutrons.

The measurements were made with the cold neutron time-of-flight facility at PIR reactor.[1] The cold neutron source was a black-body radiator shaped block of alcohol coried with a Be-filter both cooled to liquid nitrogen temperature. The vapors were kept in a leak-tight sample holder made of aluminium cylinder 51mm I.D. and 3.5mm thick incorporating a CONSEAL joint and a safety valve. The section exposed to the neutrons were thined down to 2mm in order to reduce the background neutrons scattered from the sample holder. The water vapor on the path of neutrons were equivalent to 0.2mm of liquid water. The temperature for both experiments was 182C and the density of superheated vapor was 75% of that for the saturated vapor. The temperatures were automatically controlled within 1C. Background runs with empty sample holder gave at most 30% of total signal. The spectra were accumulated in 256 channels of a multi-channel time analyzer at scattering angles of 15,40, 65.3, and 120 degrees.

The figures show the cross sections as a function of the velocity of the scattered neutrons for saturated and superheated water vapors at 182C with the calculated point to point ratios. At 15 degees a quasi-elastic peak is observed which decreases in intensity for higher scattering angles and completely disappears at 65.3 and 120 degrees. Also an energy gain peak at about 600 μsec/m was obtained which increases in intensity with increasing angles. This peak is the envelope of the rotational levels of water molecules. The point to point ratios of intensities due to saturated and superheated vapors are taken but from them no definite conclusions can be made.

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REFERENCE: 1.E.Tunkelo, and A.Palmgren, Nucl.Inst.Methods 46 (1966)260.

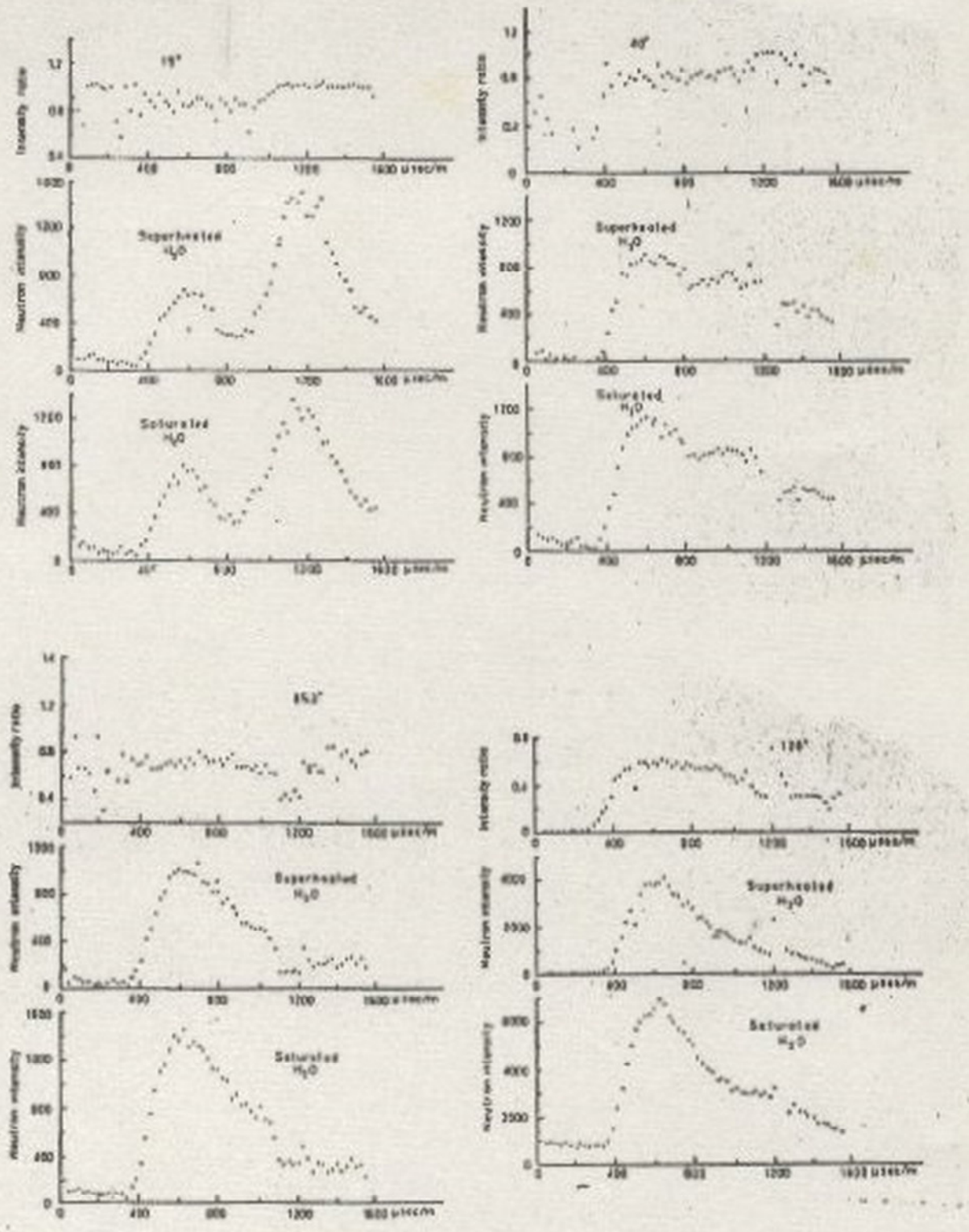

Fig.1. Time-of-flight spectra of cold neutrons scattered by saturated and superheated water vapor molecules at 455K at scattering angles of 15,40,65.3,and 120 degrees.