The Pomeranchuk Effect and Broken Symmetry Phase (BSP) Transitions in Solid Hydrogens under Pressure

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It is shown that there is a very close analogy between the BSP transition in solid hydrogens under pressure and melting of solid ^{3}He. The theory of the BSP transitions is developed taking into account the Pomeranchuk effect. The same entropy-based considerations which are characteristic for the Pomeranchuk effect may be applied to the BSP transition lines in solid HD and in thermodynamically equilibrium ortho-para (even-J - odd-J, J being the rotational quantum number) mixtures. We found that the phase transition lines in these species display a minimum, indicating that the disordered phase is reentrant. Two limiting cases are considered: mixtures at thermodynamic equilibrium and frozen mixtures when the conversion time is large compared with the thermalization time. Experimentally, conditions to find the reentrant BSP transition line are most favorable for H_2 mixtures whereas the frozen monotonic phase line should be the case for D_2 ortho-para mixtures. Phase diagrams and thermodynamics of the systems have been calculated including the pressure behavior of the hcp lattice distortion parameter.