Anomalous thermodynamics and entropic phase transition problem in hot dense hydrogen (deuterium)

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Nonstandard properties for dense adiabatically compressed hydrogen (deuterium) in Megabar pressure range, are investigated for a long time experimentally in VNIIEF, (Sarov), as well as theoretically in frames of the first-principle and simplified model approaches. These nonstandard properties may be explained selfconsistantly [1] due to existence of extended *anomalous thermodynamics region* (ATR) in this region of hydrogen phase diagram. This ATR region accompany, as a rule, hypothetical 1st-order *entropic phase transition* driven by dissociation and/or ionization of highly compressed hydrogen. The main point of the ATR anomaly is *negativity* of great number of (usually positive) second cross derivatives of thermodynamic potential, such as Grunaizen parameter, thermal expansion coefficient etc (Iosilevskiy-2015). One of the main manifestation of discussed anomalies is entanglement and mutual crossing of many types of isolines, such as isotherms, isentropes, shock adiabats etc. This feature could in turn be considered as direct consequence of *multilayered structure* of thermodynamic surfaces such as *U(P,V), S(P,V), T(P,V)*. Just this anomaly results in coincidence of the boundary for phase transition predicted by the QMD-calculations with original *P-V* discontinuity in quasi-isentropic paths in pioneering VNIIEF experiments of Kormer et al (1972), as well as in recent experiments of Fortov, Mochalov et al (2007).