# ANOMALOUS THERMODYNAMICS OF ENTROPIC PHASE TRANSITIONS IN DENSE NON-IDEAL PLASMAS

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Poorly known and recognized thermodynamic objects – Anomalous Thermodynamics Regions (ATR) are under discussion as combination of *entropic phase transition* [1] and conjugated region with regular but anomalous thermodynamics [2]. Main feature of the ATR is simultaneous negativity of great number (usually positive) second cross derivatives of thermodynamic potential, e.g. Gruneisen parameter, thermal expansion coefficient etc. The main consequence of this negativity is violated order and mutual crossing of great number of isolines e.g. isotherms, isentropes, Hugoniots etc. It is the forced delocalization of some kinds of bound complexes (e. g. pressure ionization, pressure dissociation *etc*) that is the main "driver" of all physical transformations in both parts of ATR. And it is multilayered structure of thermodynamic surfaces $T(P, V)$, $S(P, V)$, $U(P, V)$, $H(P, V)$ (temperature, entropy, energy and enthalpy) that is the unique "geometric" feature of these thermodynamic transformations in both parts of ATR. The main sequence of this multilayered structure of the surfaces $T(P, V)$, $S(P, V)$, $U(P, V)$, $H(P, V)$ is anomalous ("returnable") type of crossing of the ATR-zone by dynamic trajectories of shock and isentropic compression and expansion. The main sequence in turn of such type of crossing is anomalous Z-shaped ("*zigzag*") form of dynamic $P, V$-trajectories mentioned above. That leads in turn to violation within ATR of global concavity property for isentropes and hence to possibility of *hydrodynamic instability* of the simple (single-wave) form of the shock and isentropic compression and expansion. Two examples of discussed ATR are following: – Two entropic fluid-fluid phase transitions in high T-P nitrogen and hydrogen are under discussions and illustrations. Effect of so-called "shock cooling" is discussed as example of mentioned above anomalies on the base of our calculations with the use of First-Principle Equation of State (FPEOS) of Driver & Militzer [3]. There is enough reason to expect appearance of similar "shock cooling" effect in ATR region, which could be achieved in quasi-isentropic compression experiments on dense hydrogen, hydrogen-helium mixture and some other important fluid planetary substances.

## References

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