

Abstract Submitted
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Some Implications of a Scale-Invariant Model of Statistical Mechanics to Classical and Black Hole Thermodynamics. SIAVASH SOHRAB, Northwestern University — A scale-invariant model of statistical mechanics is applied to described modified forms of four laws of classical thermodynamics. Following de Broglie formula $\lambda_{rk} = h/m_k v_{rk}$, frequency of matter waves is defined as $\nu_{rk} = k/m_k v_{rk}$ leading to stochastic definitions of (Planck, Boltzmann) universal constants ($h = m_k < \lambda_{rk} > c$, $k = m_k < \nu_{rk} > c$), $\lambda_{rk} \nu_{rk} = c$, relating to spatiotemporal *Casimir* vacuum fluctuations. Invariant Mach number $Ma_\beta = v/v_{r\beta}$ is introduced leading to hierarchy of “supersonic” flow separated by shock front, viewed as “event-horizon” EH_β , from subsonic flow that terminates at surface of stagnant condensate of “atoms” defined as “black-hole” BH_β at scale β thus resulting in hierarchy of embedded “black holes” at molecular- atomic-, electron-, photon-, tachyon-. . . scales, ad infinitum. Classical black hole will correspond to solid phase photon or *solid-light*. It is argued that Bardeen-Carter-Hawking (1973) first law of black hole mechanics $\delta M = (\kappa/8\pi)\delta A + \Omega_H \delta J + \Phi_H \delta Q$, instead of $dE = TdS - PdV$ suggested by Bekenstein (1973), is analogous to first law of thermodynamics expressed as $TdS = PdV + dE$ such that entropy of black hole, rather than to its horizon surface area, will be related to its total energy hence enthalpy $H = TS$ leading to $S_{BH} = 4kN$ in exact agreement with prediction of Major and Setter, *Class. Quant. Grav.* **18**(2-3), 5125 (2001).

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