Implicit erasure: A universal paradigm of irreversibility

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Irreversibility is manifest in phenomena throughout physics – a fact not accounted for in the reversible dynamics at a microscopic level: Standard Gibbs-Shannon-von-Neumann Entropy is a constant of motion. In order to bring dynamics into contact with thermodynamics, this constraint must be lifted, allowing entropy to increase [1]. Some established approximations to dynamical laws lead to entropy "production" as a by-product, which is typically diagnosed a posteriori. I will argue that entropy production can alternatively be viewed as *implicit erasure* of information [2,3] – information which is not pertinent to a limited set of (typically macroscopic) observables under study. This concept will be formalized, allowing great flexibility to find erasure-modified equations of motion compatible with given sets of observables. Boltzmann's program of irreversibility is thus generalized far beyond gas particles in the weak interaction limit, using information theory instead of scattering theory as its basis. Numerical simulations in both classical and quantum regimes illustrate the approach.

[1] E. T. Jaynes, Am. J. Phys. 33 (1965), 391.

[2] R. Landauer, IBM J. Res. Dev. 5 (1961), 183.

[3] L. del Rio, J. Åberg, R. Renner, O. Dahlsten and V. Vedral, Nature 474 (2011), 61.