**Meeting:** 1000, Albuquerque, New Mexico, SS 5A, Special Session on Categories and Operads in Topology, Geometry, Physics and Other Applications

1000-80-31

**R. M. Kiehn***, 69 Saint Donat, 84380 Mazan, France. *NonEquilibrium Systems and Irreversible Processes - from the perspective of Continuous Topological Evolution.*

To within a factor, many physical systems can be encoded as a 1-form of Action, A, and many physical processes can be encoded as a vector field, V. For such objects, Cartan's magic formula L(V)A=i(V)dA+d(i(V)A)= W+dU=Q is equivalent to the First Law of Thermodynamics. The Pfaff Topological Dimension(s) of A, Work, W, and Heat, Q, define topological equivalence classes. Non Equilibrium systems have PTD(A) more than 2 and Isolated Equilibrium systems have PTD(A)less than 3. Thermodynamic reversible processes are such that the PTD(Q)is less than 3 and Qˆ dQ=0. It follows (Frobenius) that Q=TdS, defining temperature and entropy for such systems, even though A is not isolated. All Hamiltonian, and Helmholtz (preserving vorticity) processes are thermodynamically reversible. But if PTD(A)=2n+2, there exists (to within a factor)a unique process, T(A), such that PTD(Q) is larger than 2. Evolution in the direction of T (the Topological Torsion vector) defines an irreversible process. Evolution can start with PTD(A)=2n+2, irreversibly decaying to a long lived state far from equilibrium with PTD(A)=2n+1. Similarity invariants of the Jacobian matrix of A can be used to define a universal thermodynamic phase function deformably equivalent to van der Waals gas. (Received July 27, 2004)