

The Hamiltonian Structure of Classical Electromagnetism

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We present the use of the constructions of global analysis in classical electromagnetism. We first discuss the subject of global analysis from the standpoint of functional analytical techniques, nonlinear partial differential equations, symplectic geometry, infinite dimensional Hamiltonian and Lagrangian systems, and then proceed to its general appearance in mathematical physics. From here the Maxwell equations are discussed from the global perspective: we present them as simultaneously as infinite dimensional Hamiltonian and Lagrangian systems and verify that the momentum map is a constant of the motion. We are currently working on an outline of this analysis for the Einstein-Maxwell system and obtain a covariant Poisson bracket for it in spirit of the work of Arms, Fischer, Marsden, and Montgomery. Additionally, we comment on the power and versatility of reduction theory in the general setting of classical field theory.

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