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AbstractAbstract

[en] These notes are concerned with the formulation of a new conceptual framework for classical field theories. Although the formulation is based on fairly advanced concepts of symplectic geometry these notes cannot be viewed as a reformulation of known structures in more rigorous and elegant terms. Our intention is rather to communicate to theoretical physicists a set of new physical ideas. We have chosen for this purpose the language of local coordinates which is more elementary and more widely known than the abstract language of modern differential geometry. Our emphasis is directed more to physical intentions than to mathematical vigour. We start with a symplectic analysis of states. Both discrete and continuous systems are considered on a largely intuitive level. The notion of reciprocity and potentiality of the theory is discussed. Chapter II is a presentation of particle dynamics together with more rigorous definitions of the geometric structure. Lagrangian-Submanifolds and their generating function \mathcal{H} are defined and the time evolution of particle states is studied. Chapter II form the main part of these notes. Here we describe the construction of canonical momenta and discuss the field dynamics in finite domains of space-time. We also establish the relation between our symplectic framework and the geometric formulation of the calculus of variations of multiple integrals. In the following chapter we give a few examples of field theories selected to illustrate various features of the new approach. A new formulation of the theory

of gravity consists of using the affine connection in space-time as the field configuration. In the past section we present an analysis of hydrodynamics within our framework which reveals a formal analogy with electrodynamics. The discovery of potentials for hydrodynamics and the subsequent formulation of a variational principle provides an excellent example for the fruitfulness of the new approach to field theory. A short review of several geometric concepts frequently used throughout these notes is given in the appendices. (orig.)

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