Generalized nonlinear sigma models and path integral approach to polymer dynamics

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In this contribution a model describing the dynamics of a freely jointed chain fluctuating in a thermal bath is considered. The standard approach to problems of this kind consists in considering the fluctuations of the chain as a stochastic process, which is usually described with the help of the Langevin equations. This approach leads to the well known models of Rouse and Zimm. One major drawback of these coarse grained models is that they do not take into account rigid constraints as those which are needed in the case of a freely jointed chain in order to keep constant the length of the links connecting the beads.

The strategy presented here to treat the problem of the freely jointed chain is to regard the motion of the beads as the motion of a system of small brownian particles with rigid constraints. One ends up in this way with a field theory which is a generalized non-linear sigma model (GNLSM). While the Zimm and Rouse models describe the fluctuations of a polymer chain in a solvent, the GNLSM may be applied to the case of an isolated cold chain or of a hot polymer in the vapor phase. The explicit calculation of the partition function of the GNLSM in the semi-classical approximation for a closed chains in two dimensions will be presented.