NOISE-INDUCED HOMOCHIRALITY FROM AUTOCATALYSIS WITHOUT CHIRAL INHIBITION.

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Abstract: Autocatalysis has long been assumed to be the primary mechanism for homochirality in chemical and biological systems. The connection between autocatalysis and homochirality was originally established in a model by F. C. Frank [1], and refined or extended in subsequent work (for a recent review see [2]). A key feature of Frank's model is the inclusion of nonlinearity through an annihilation reaction. This extra reaction, which is not of the autocatalytic form, introduces fixed points in the dynamics at mean field level, which are identified as homochiral states through a mechanism known as chiral inhibition.

Here we remove this extra reaction, so that at the mean field level the only fixed point is the racemic state. Nevertheless, solving the full stochastic theory, we show that homochiral states can arise due to intrinsic noise from the autocatalytic reactions without a need for the chiral inhibition mechanism. The novelty of our mechanism is that homochiral states are not the minima of some potential function, but instead correspond to dynamical fixed points where the effects of noise are minimized. Finally, we show that under certain conditions, the spatial extension of our model exhibits stable global homochirality.

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