SELECTION OF MOLECULAR CHIRALITY BY EXTREMELY WEAK CHIRAL INTERACTIONS

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The origin of Earth's overwhelmingly chiral biochemistry has been a long standing problem (Mason, 1984). In several model chemical reactions it has been shown that, under thermodynamically far-from-equilibrium conditions, chemical systems can spontaneously evolve to a state dominated by either the L or the D enantiomer (Franck, 1953; Seelig, 1971; Decker, 1974). On such systems, systematic chiral influences, as those that could arise due to the parity non-conservation in β-decay or that attributable to weak-neutral-current interactions (WNC) in molecules are generally thought to be too small to have any significant influence on the emergent chirality (Kezthelyi, 1984; Morozov, et. al., 1984). Other conceivable systematic influences are generally even weaker (Mead and Moscowitz, 1980). In this paper we show that there is a simple and extremely sensitive mechanism by which a minute but systematic chiral interaction, no stronger than the WNC interaction in amino acids, can, over a period of about 15,000 years, determine with about 98% probabilty which enantiomer will dominate (Kondepudi and Nelson, 1985). This mechanism is independent of the particularities of the reaction scheme and becomes especially relevant to biochemical evolution in the light of the recent work of Mason and Tranter (1984), Tranter (1985) and Hegstrom (1985).

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