As a particular case, let us take for $q$, a non-equilibrium normalized distribution $\rho(x)$:

$$\int f(x) \rho(T_0 x) \, d\sigma \underset{t \to \infty}{\longrightarrow} \int f(x) \, d\sigma,$$

which means that, in average, the distribution $\rho(x)$ tends to a uniform equilibrium probability density.

We shall not discuss the subtle relations of mixing with irreversibility. Let us only emphasize in this respect that the equations of motion allow to recover any point $x(t = 0)$ knowing $x(t > 0)$; however, all memory of the initial state is lost as time tends to infinity, and it is only in this limit that one can speak of irreversibility.

**K-systems**

Without no further assumption than mixing, one cannot give any quantitative information about the separation of orbits with time.

The so-called K-systems are mixing systems which possess so strong instability that most orbits starting from close points separate, in the average, exponentially with time. For such systems, the knowledge of $\chi(t)$ for all discrete times $\{t_i\} = \{-\infty, \ldots, t_{n-1}, t_n\}$ does not provide any useful information on the behaviour of the system for times $t > t_n$. Such a strange feature means that, though the system is completely deterministic -i.e. is governed by causal equations of motion-, the evolution of a generic point in phase space is very irregular, and exhibits some kind of random behaviour; this is why one associates with K-systems, for which the motion does not depend on their distant past history, the idea of unpredictability.

The mathematical definition of a K-system would go beyond the scope of our "qualitative" introduction to chaotic phenomena (see for instance Refs.[AA-67,Sh-73,Or-74] for a rigorous approach). Let us only give the main ideas of characterization of K-systems, and try to understand roughly in which sense one can say that the past does not determine the future. All the concepts used are borrowed from information theory [SW-49,Bi-78,ME-81]. First, one introduces any finite ordered partition $P$ of the energy surface $S_E$ into cells (atoms), in order to define a measurement: the result of the measurement of the system associated with $P$ at time $t_0$ is the $n^o$ of the cell of $P$ which is crossed by the orbit at time $t$; then, an experiment associated with $P$ is a sequence of measurements for equally spaced times going from $t_0$ to $\infty$. Now, one can define the entropy $h(T,P)$ of the hamiltonian flow $T$ relative to the partition $P$, which represents the mean rate (averaged over the whole sequence of measurements