

11.2: Following Many Systems- a “Gas” in Phase Space

We’ve looked at four paths in phase space, corresponding to four falling bodies, all beginning at $t = 0$, but with different initial coordinates in (p, x) . Suppose now we have many falling bodies, so that at $t=0$ a region of phase space can be imagined as filled with a “gas” of points, each representing one falling body, initially at (p_i, x_i) , $i = 1, \dots, N$.

The argument above about the phase space path of a point within the square at $t=0$ staying inside the square as time goes on and the square distorts to a parallelogram must also be true for any dynamical system, and any closed volume in phase space, since it depends on phase space paths never intersecting: that is,

if at $t = 0$ some closed surface in phase space contains a number of points of the gas, those same points remain inside the surface as it develops in time -- none exit or enter.

For the number of points N sufficiently large, the phase space time development looks like the flow of a fluid.

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