Robnik M., Dobnikar J., Rapisarda A., Prosen T. and Petkovšek M. **New universal aspects of diffusion in strongly chaotic systems** J.Phys. A: Math. Gen., **30** L803-L813 (1997)

We study some new universal aspects of diffusion in strongly chaotic systems, such having very large Lyapunov coefficients on the chaotic (indecomposable, topologically transitive) component. We do this by discretizing the chaotic component on the Surface-of-Section in a (large) number N of simplectically equally big cells (in the sense of equal relative invariant ergodic measure, normalized such that the total measure of the chaotic component is unity). By iterating the transition of the chaotic orbit through SOS, where j counts the number of iteration (discrete time), and assuming complete lack of correlations even between consecutive crossings (which can be justified due to the very large Lyapunov exponents), we show the universal approach of the relative measure of the occupied cells, denoted by $\rho(j)$, to the asymptotic value of unity, in the following way: $\rho(j) = 1 - (1 - \frac{1}{N})^j$, so that in the limit of big N, $N \to \infty$, we have the exponential law $\rho(j) \approx 1 - \exp(-j/N)$. This analytic result is verified numerically in a variety of specific systems: For a plane billiard (Robnik 1983, $\lambda = 0.375$), for a 3-D billiard (Prosen 1997, a=-1/5, b=-12/5) and for Hydrogen atom in strong magnetic field ($\epsilon = -0.05$) the agreement is almost perfect (except, in the latter system, for some long-time deviations on very small scale), for Henon-Heiles system ($E = 1/6$) the disagreement can be seen, whilst for the standard map ($k = 3, 400$) and for the logistic tent map ($\lambda = 4$) the deviations are big. We have tested the random number generators, and surprisingly found that for 1-D the agreement is perfect, whilst for 2-D and 3-D the deviations are clearly visible, showing that the generators are really not completely random, and in this sense some of the above mentioned physical systems (2-D billiard) are better in producing randomness. We give an outline of an improved analytical theoretical model (the so-called two and many component model), where deviations from the exponential law can be captured in a statistical way.