Spectral-statistics analysis of the light meson spectrum

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Quantum chaos is currently a well established discipline with outreach to many fields of physics. The most important signature of quantum chaos is the statistical analysis of the energy spectrum, which distinguishes between systems with integrable and chaotic classical analogues. The spectral statistical techniques inherited from quantum chaos have been applied to the baryon spectrum revealing its likely chaotic behavior in the low energy regime [1,2]. We present a robust analysis of the spectral fluctuations exhibited by the light meson spectrum. With this analysis we can obtain information about the degree of chaos in the spectrum getting insight on the properties of the underlying interactions. Our analysis unveils that the statistical properties of the light meson spectrum are close, but not exactly equal, to those of chaotic systems [3]. Besides the experimental spectrum, we have analyzed several theoretical spectra [4,5,6,7] including the latest lattice QCD calculation [8] finding out that, with the single exception of [5], their statistical properties are close to those of a generic integrable system, and thus incompatible with the experimental result.

[1] V. Pascalutsa, Eur. Phys. J. A 16 (2003) 149.

[2] C. Fernández-Ramírez, A. Relaño, Phys. Rev. Lett. 98 (2007) 062001.

[3] L. Muñoz, C. Fernández-Ramírez, A. Relaño, J. Retamosa, Phys. Lett. B 710 (2012) 139.

[4] M. Koll, R. Ricken, D. Merten, B. C. Metsch, H. R. Petry, Eur. Phys. J. A 9 (2000) 73.

[5] J. Vijande, F. Fernández, A. Valcarce, J. Phys. G 31 (2005) 481.

[6] D. Ebert, R. N. Faustov, V. O. Galkin, Phys. Rev. D 79 (2009) 114029.

[7] S. Godfrey, N. Isgur, Phys. Rev. D 32 (1985) 189.

[8] J. J. Dudek, R. G. Edwards, B. Joó, M. J. Peardon, D. G. Richards, C. E. Thomas, Phys. Rev. D 83 (2011) 111502.

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