

q -breathers: solving the FPU problem and going beyondS. Flach^{1*}, M. V. Ivanchenko², O. I. Kanakov², K. G. Mishagin²¹ Max-Planck-Institut für Physik Komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden, Germany² Department of Radiophysics, University of Nizhny Novgorod, Gagarin Avenue 23, 603950 Nizhny Novgorod, Russia* Electronic Address: flach@pks.mpg.de

I will start with the famous Fermi-Pasta-Ulam problem and show that the corresponding FPU model allows for exact time-periodic solutions which are exponentially localized in the space of normal modes [1, 2]. These periodic orbits are called q -breathers. The trajectory initially computed by FPU is a slight perturbation away from an exact q -breather orbit. Consequently most of the key observations related to the FPU problem (localization of energy in normal mode space for long times, recurrence on relatively short times, system size and energy thresholds) are captured by the properties of q -breathers and the phase space flow nearby. I will present analytical characteristics of these features. The underlying concept of q -breathers is much more general than the original setting with the frame of the FPU model. I will present results for two- and three-dimensional finite lattices [3], and discuss scaling relations which allow to obtain these orbits and analyze their properties in the limit of infinite system sizes.

-
- [1] S. Flach, M. V. Ivanchenko and O. I. Kanakov, Phys. Rev. Lett. **95**, 064102 (2005).
 - [2] S. Flach, M. V. Ivanchenko and O. I. Kanakov, Phys. Rev. E **73**, 036618 (2006).
 - [3] M. V. Ivanchenko, O. I. Kanakov, K. G. Mishagin and S. Flach, Phys. Rev. Lett., in press (2006); nlin.PS/0604075.