Nonlinear Oscillations of a Spring Pendulum at the 1 : 1 : 2 Resonance by Normal Form Method

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Victor Edneral[1], **Alexander Petrov**[2]

Nonlinear spatial oscillations of a material point on a weightless elastic suspension are considered. The frequency of vertical oscillations is assumed to be equal to the doubled swinging frequency (the 1 : 1 : 2 resonance) [1]. In this case, vertical oscillations are unstable, which leads to the transfer of the energy of vertical oscillations to the swinging energy of the pendulum. Vertical oscillations of the material point cease, and, after a certain period of time, the pendulum starts swinging in a vertical plane. This swinging is also unstable, which leads to the back transfer of energy to the vertical oscillation mode, and again vertical oscillations occur. However, after the second transfer of the energy of vertical oscillations to the pendulum swinging energy, the apparent plane of swinging is rotated through a certain angle. These phenomena are described analytically by the normal form method[2].

Keywords: Pendulum, Resonance, Normal form method

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[1]Peoples' Friendship University of Russia (RUDN University)
 6 Miklukho-Maklaya st., Moscow, 117198, Russian Federation

 Skobeltsyn Institute of Nuclear Physics
 Lomonosov Moscow State University
 Leninskie Gory 1(2), Moscow, 119991, Russian Federation
 edneral_vf@pfur.ru

[2]Ishlinsky Institute for Problems in Mechanics of the Russian Academy of Sciences
 Prosp. Vernadskogo 101(1), Moscow, 119526, Russian Federation
 petrovipmech@gmail.com