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Embedded solitons in the double sine-Gordon lattice with next-neighbor interaction

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Topological solitons under certain conditions can freely propagate without radiation in the discrete systems of Josephson junctions [1]. These solutions are known as embedded solitons [2]. The dynamics of soliton in the array of the small Josephson junctions which contain a ferromagnet (SFS, SFIS) in their structure and where the intercell inductance is taken into account is investigating. For such junctions the current-phase relation is complicated and the second harmonic must be considered. The possibility of embedded solitons existence in the array, where the inductive coupling between cells occurs not only between the nearest neighbors, but also with the subsequent ones is demonstrated [3]. These interactions can be either destructive or favorable for the embedded solitons creation. The equation of soliton motion in the array with long-range interaction is analytically obtained, the dispersion law for Josephson plasmons which essentially depends on the inductive interaction between the adjacent cells of the array is found. The simulation of soliton dynamics in such system performed, the range of system parameters and the set of velocities at which the embedded solitons existence is possible are obtained. The existence area is inversely proportional to the spectrum width of the linear waves that producing due to the soliton motion across the array. The influence of the array cells interaction parameters on the mode of the soliton free propagation is analyzed and the dependence of its velocity on these parameters is found. The current-voltage characteristics of the array with the signs of embedded solitons existence are constructed. The inaccessible voltage interval is formed on it, the upper edge of this interval is proportional to the sliding velocity of the embedded soliton and its size depends on the dissipation in the system.

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