

Flat bands in quasi-one-dimensional Josephson junction arrays

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We study quasi-one-dimensional arrays of inductively coupled Josephson junctions with only self-inductance of a cell taken into account. A 2-row anisotropic Josephson junction ladder (JJL) has a flat band in the linear electromagnetic wave spectrum [1]. We derive the equations of motion for a 3-row anisotropic JJL and generalise them for a ladder with an arbitrary number of rows $\kappa \geq 3$. In the case of weak damping we obtain the spectrum of linear electromagnetic waves in these arrays. A κ -row JJL has 3 bands in the spectrum, two of them are dispersive: the upper band consists of $(\kappa - 1)$ branches, the lower one of 2 branches, the band in the middle of the spectrum is dispersionless (flat) and is $(\kappa - 2)$ -fold degenerate. At zero external dc bias current the two lower branches become flat, resulting in κ -fold degeneracy of the flat band.

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1. A. E. Miroshnichenko, S. Flach, M.V. Fistul, Y. Zolotaryuk, J. B. Page. Breathers in Josephson junction ladders: Resonances and electromagnetic wave spectroscopy. – PHYSICAL REVIEW E, VOLUME 64, 066601. – 2001.

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