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RAFAEL MÉNDEZ: Artificial Mechanical Molecules

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We show that it is possible emulate the pz orbitals of aromatic molecules using mechanical vibrations. This is done from the theoretical, numerical and experimental points of view. When connecting resonators through locally periodic structures, the resonances can be trapped thanks to the bandgaps of the locally periodic connectors [1,2]. This trapping yields a similar phenomenology to what happens with tightly bound electrons in quantum systems: the resonators take the role of the atoms, the connectors the role of the chemical bonds and the trapped vibrations the role of the orbitals. As a first system, a 1D chain of mechanical atoms is studied. In this case the spectrum and wave amplitudes agree with those obtained by
a quantum tight-binding model, in which the frequency takes the role of the energy. With the same ideas the pz orbitals of some aromatic molecules are emulated.

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[1] F. Ramírez-Ramírez, R. A. Méndez-Sánchez, G. Báez, A. Morales, L. Gutierrez, and J. Flores, Emulating Tunneling with Elastic Vibrating Beams, 2018 Progress in Electromagnetic Research Symposium (PIERS-Toyama), 10-23919/PIERS.2018.8597751.

[2] F. Ramírez-Ramírez, E. Flores-Olmedo, G. Báez, E. Sadurní, and R. A. Méndez-Sánchez. Emulating tightly bound electrons in crystalline solids using mechanical waves. ArXiv: 1922.11272.

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