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Ngoc Do* (dothanh@math.tamu.edu), **Peter Kuchment** and **Frank Sottile**. *Some graph models in nano-science and solid state.*

Graph model is proven in many cases to be much simpler to study than other approaches and yet preserves all essential ingredients of the dispersion relation. We study some spectral problems for periodic operators originating from mathematical physics. Using quantum graph model, we analyze the dispersion relation, and thus spectra, of periodic Schrödinger operators on a particular graphyne structure and its nanotubes. We found highly directional Dirac cones, which makes graphynes fascinating. We also study a conjecture, which has been widely assumed in solid state physics, for a class of periodic differential operators on graphs. Namely, we prove that extrema of dispersion relations of generic periodic differential operators on a class of discrete graphs are non-degenerate. (Here by non-degeneracy we mean extrema having non-degenerate Hessian.) (Received September 10, 2015)