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Elementary electronic excitations in quantum wires made up of vertically stacked quantum dots M.S. KUSHWAHA, Rice University — We report on the theoretical investigation of the elementary electronic excitations in a quantum wires made up of vertically stacked self-assembled InAs/GaAs quantum dots. The resultant quantum wire is characterized by a two-dimensional harmonic confining potential in the x-y plane and a periodic (Kronig-Penney) potential along the z (or the growth) direction within the tight-binding approximation. Since the wells and barriers are formed from two different materials, we employ the Bastard's boundary conditions in order to determine the eigenfunctions along the z direction. These wave functions are then used to generate the Wannier functions, which, in turn, constitute the legitimate Bloch functions that govern the electron dynamics along the direction of periodicity. Thus the Bloch functions and the Hermite functions together characterize the whole system. We discuss the behavior of the eigenfunctions, band-widths, density of states, Fermi energy, single-particle and collective excitations, and finally size up the importance of studying the inverse dielectric function in relation with the quantum transport phenomena. It is remarkable to notice how the variation in the barrier- and well-widths can allow us to tailor the excitation spectrum in the desired energy range...

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