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Magnetic Schrödinger operators on zigzag nanotubes

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We consider the Schrödinger operator with a periodic potential on a quasi 1D continuous periodic model of zigzag nanotubes in a uniform magnetic field (with amplitude B), which is parallel to the axis of the nanotube. The spectrum of this operator consists of an absolutely continuous part (spectral bands separated by gaps) plus an infinite number of eigenvalues with infinite multiplicity. We describe all compactly supported eigenfunctions with the same eigenvalue. We define a Lyapunov function, which is analytic on some Riemann surface. On each sheet, the Lyapunov function has the same properties as in the scalar
case, but it has branch points, which we call resonances. We prove that all resonances are real. We determine the asymptotics of the periodic and anti-periodic spectrum and of the resonances at high energy. We show that endpoints of the gaps are periodic or anti-periodic eigenvalues or resonances (real branch points of the Lyapunov function). We describe the spectrum as a function of B and obtain a priori estimates for gap lengths and effective masses. Moreover, we determine the asymptotics of spectral gaps and effective masses for small B.

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