The t-J model in a strong magnetic field

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The normal-state energy spectrum of the two-dimensional t-J model in a homogeneous perpendicular magnetic field is investigated using the Mori projection operator technique. The density of states (DOS) at the Fermi level as a function of the inverse magnetic field $\frac{1}{B}$ reveals oscillations in the range of hole concentrations $0.08 \lesssim x \lesssim 0.18$. The oscillations have both high- and low-frequency components. The former components are connected with large Fermi surfaces, while the latter with van Hove singularities in the Landau subbands, which traverse the Fermi level with changing B. The singularities are related to bending the Landau subbands due to strong electron correlations. Frequencies of the low-frequency components are of the same order of magnitude as those observed in underdoped cuprates. These components become dominant if smoothing processes are accounted for. It is shown that the pseudogap affects only slightly the frequency of DOS oscillations, however it increases significantly the distance between Landau subbands.