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Fractional quantum Hall effect in higher Landau levels MICHAEL R. PETERSON, S. DAS SARMA, University of Maryland — The fractional quantum Hall effect in the second Landau level (LL), particularly at filling factor 5/2, has seen a resurgence of research activity since its possible use in fault tolerant topological quantum computation was pointed out[1]. We do not, however, have a complete understanding of the FQHE in the second LL(SLL) compared with the corresponding lowest LL situation. For instance, while the Moore-Read Pfaffian state is the leading candidate for the 5/2 FQHE, it has only a moderate overlap ($\sim$0.9) with the exact wavefunction for finite size systems of electrons interacting through the Coulomb interaction. In this work we consider the finite thickness of the electrically polarized quasi-2D quantum confinement in three models: Zhang-Das Sarma, infinite square-well, and Fang-Howard potentials, respectively. We calculate overlap between the Laughlin(fillings 1/3 and 1/5) or Pfaffian(filling 1/2) and the corresponding exact state, obtained by exact diagonalization, in the lowest, second, and third LLs as a function of the layer thickness. We find that the Pfaffian state becomes a nearly exact description of the physics at filling factor 1/2 in the SLL for a finite value of thickness. We also show the comparative trends in the ground state energy and the excitation gap as a function of layer thickness, comparing among the first, second, and the third LLs. We acknowledge support from Microsoft Q Project.
[1] Das Sarma et al. PRL 94, 166802(2005)

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