Ground states of a novel AlAs quantum wire

TRINANJAN DATTA, ERICA W. CARLSON, Department of Physics, Purdue University — Using abelian bosonization and renormalization group, we analyze the ground states of a recently fabricated novel AlAs quantum wire [Moser et al, Appl. Phys. Lett. (2005)]. There are two degenerate lowest energy bands, separated by half an umklapp vector. This bandstructure arrangement leads to four Fermi points and umklapp-induced pair processes, independent of filling. The ground states are different from those of a conventional quantum wire, where acquiring four Fermi points requires occupying two successive bands, leading to a CDW instability via density reorganization. Such an instability is forbidden in the AlAs wire, which may help stabilize other exotic gapped ground states.