MAR10-2009-001028

Abstract for an Invited Paper
for the MAR10 Meeting of
the American Physical Society

Field-effects and fractionalization in nanotubes and nanorings

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Magnetic and electric fields are a valuable means of probing the underlying physics of strongly correlated low dimensional systems. Here, the effect of fields is discussed in two instances of interacting electronic one- dimensional systems, both exhibiting "fractionalization" of the constituent electron degrees of freedom - i) The dramatic effects of transverse electric and magnetic fields on conduction properties of nanotubes is discussed.[1] It is shown that fields can yield controlled tuning of low-energy band structure properties such as inducing gaps in the spectrum, breaking various symmetries and altering Fermi velocities. Fields can strongly affect electron- electron interaction, yielding tunable Luttinger liquid physics, a means of accessing individual bands and the possibility of spin- charge-band separation. ii) The magnetic field profile around a nanoscale conducting ring is explored. The geometry is geared to investigate coherence properties of fractionalized electrons reported to have been recently observed in quantum wires.[2] It is shown that the magnetic landscape provides a non-invasive probe for mapping the manner in which an electron injected into the ring splinters into two parts.

[1]DeGottardi et al., Phys. Rev. B 79, 205421 (2009)
[2]Steinberg et al., Nature Physics 4, 116 (2008)