Detection of spin entanglement via spin-charge separation in crossed Tomonaga-Luttinger liquids

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We investigate tunneling between two spinful Tomonaga-Luttinger liquids (TLL) realized, *e.g.* as two crossed nanowires or quantum Hall edge states. When injecting into each TLL one electron of an opposite spin pair, the dc-current measured after the crossing differs for singlet, triplet or product states. This is a striking new non-Fermi liquid feature because the (mean) current in a non-interacting beam splitter is insensitive to spin-entanglement. It can be understood in terms of collective excitations subject to spin-charge separation. This behavior may offer an easier alternative to traditional entanglement detection schemes based on current noise, which we show to be suppressed by the interactions.