Fermi-edge singularity and related interaction induced phenomena in multilevel quantum dots.

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Abstract

We study the manifestation of the non-perturbative effects of interaction in sequential tunnelling between a quasi-one dimensional system of chiral quantum Hall edge channels and a multilevel quantum dot (QD). We use the formal scattering theory approach to the bosonization technique to present an alternative derivation of the Fermi-edge singularity (FES) effect and demonstrate the origin of its universality. This approach allows us to address, within the same framework, plasmon assisted sequential tunnelling to relatively large dots and investigate the interaction induced level broadening. The results are generalised by taking into account the dispersion in the spectrum of plasmons in the QD. We then discuss their modification in the presence of neutral modes, which can be realised either in a QD with two chiral strongly interacting edge channels or in a three dimensional QD in the Coulomb blockade regime. In the former case a universal behaviour of the tunnelling rate is discovered.

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