Theory of Caroli-de Gennes-Matricon analogs in full-shell hybrid nanowires

Carlos Payá[1]
Pablo San-Jose[1], Carlos Payá[1], C.M. Marcus[2], S. Vaitiek˙enas[2] and Elsa Prada[1]

[1]*Instituto de Ciencia de Materiales de Madrid, Consejo Superior de Investigaciones Científicas (ICMM-CSIC), Madrid, Spain.*
[2]*Center for Quantum Devices, Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark.*

carlos.paya@csic.es

We show that full-shell hybrid nanowires can host subgap states similar to teh Caroli-de Gennes- Matricon (CdGM) states in vortices, which are shell-induced Van Hove singularities in propagating core subbands.The CdGM analgos exhbit a characteritic skewness towards higher flux values inside non-zero Little-Parks (LP) lobes, resulting from the interplay of three ingredients: orbital copuling to the field, coalescence into degeneracy points, and the average radii of all CdGM analog wavefunctions inside the core. An approximation to realistic parameters is controlled by the electrostatic band bending at the core/shell interface. The analysis provides a transparent interpretation of the nanowire spectrum and allows for the extraction of microscopic information by measuring the number and skewness of CdGM analogs. Moreover, it allows for the derivation of an efficient Hamiltonian of the full-shell nanowire in terms of a modified hollow-core at the average radius of the CdGM wave functions.

References

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Figures

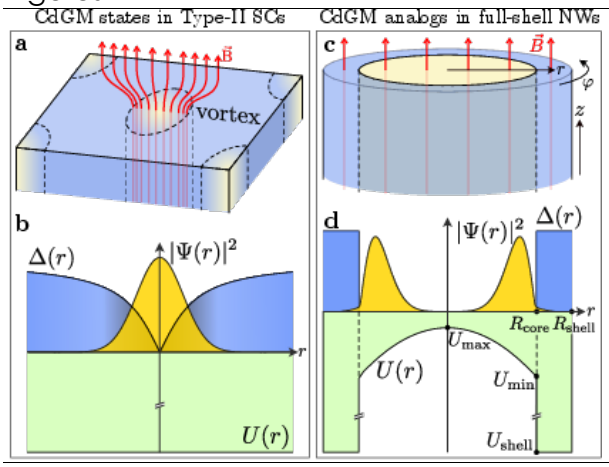

Figure 1: (a,c) Schematics of CdGM in Abrikosov vortices vs. full-shell hybrid nanowires. (b,d) Comparison of their radial wave functions.

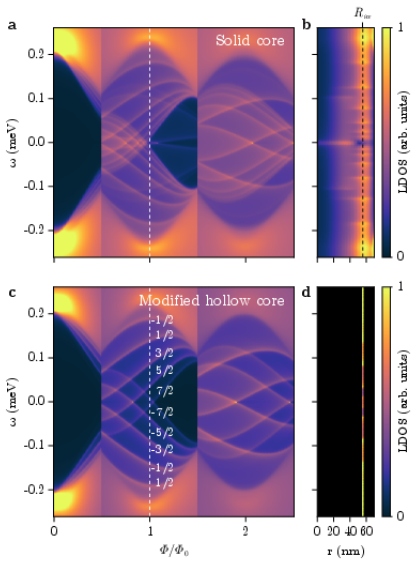

Figure 2: (a, b) Full microscopic simulation of the LDOS vs. magnetic flux and position at the end of the semi-infinite nanowire. (c,d) Same as (a,b) but using our effective 1D model.