

# THEORETICAL AND CONDENSED MATTER PHYSICS

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## Negative partial density of states in mesoscopic systems

Scattering phase shift of an electron in quasi-one-dimensional systems can now be experimentally measured. The experiment has accentuated many theoretical problems. In this study we have addressed these problems using the concept of burgers circuit. In case of scattering in quasi one dimension, the contour PDABQCRS in the first Riemann surface can have subloops like ABQC in fig. Such a sub-loop is very new and novel to quasi one dimension and does not occur in one, two or three dimensions. Observation of such a subloop helps us to prove some results. Whether partial density of states (PDOS) can be negative is still an open problem. On applying the concept of burgers circuit on a closed subloop we can prove its negativity. The proof does not depend on explicit calculations for specific models but uses the topological properties of subloops and is general. Realistic potentials have been shown to generate such subloops and also the fact that such subloops are consistent with the burgers circuit which suggests that such subloops can occur in a large class of mesoscopic systems. It has been also argued that such negative PDOS can have several physical consequences including a mechanism for electron-electron attraction. We can also prove that semiclassical Friedel sum rule can become exact in a purely quantum regime. This can help us to experimentally determine the density of states and hence mesoscopic thermodynamic and transport properties without knowing the exact potential or impurity configuration inside the sample.

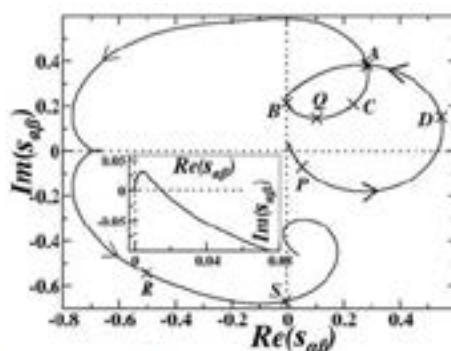


Figure.1: Contour plot of  $Im(S_{\alpha\beta})$  versus  $Re(S_{\alpha\beta})$  (Argand diagram), where  $S_{\alpha\beta}$  is the scattering matrix element for a certain realistic potential.

## Biography

P Singha Deo did his PhD in 1996 and has remained associated with research and teaching in physics in premier institutions and universities of abroad and in India. He has published more than 50 papers in international journals. He is a Professor at S N Bose Centre, Kolkata since 1999 and successfully guided several PhD theses. He has worked on various issues and problems in mesoscopic physics and correlated systems. Some of his current research topics include quantum devices, quantum capacitance, bosonization in higher dimensions, quantum mechanical scattering phase shift in low dimensions, etc.

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