ABSTRACT NO.: 524

TITLE: **Interacting Electrons in One-Dimension: The Luttinger Liquid**

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This project involved the introduction, analysis and applications of the Luttinger model. Firstly, the concept of the Luttinger liquid is introduced using the ideas of Fermi gases and Fermi liquids. The basic assumptions of the Fermi gas model and Landau's Fermi liquid theory are discussed and it is shown that individual particle excitations occur in each case. The language of second quantization and the technique of bosonization are mentioned as these are the mathematical tools used to analyse the Luttinger model.

The Luttinger model is introduced by showing that it is impossible for individual excitations to occur but instead, only collective excitations exist. Bosonization is then used to write the Hamiltonian of the spin-less Luttinger model in terms of boson operators (b^{+}_{p} and b_{p}) and the single-particle operator $\psi(x)$ for the system is derived. The importance of the model is highlighted by showing that it can be used to derive the Hamiltonian for any one-dimensional system, in terms of the parameters u and K. The properties of specific heat and compressibility are discussed for Luttinger liquids. The spin model is then analysed for the case of electrons and it is shown that the Hamiltonian of spin model separates into a charge Hamiltonian and a spin one. This is an important feature of Luttinger liquids called spin-charge separation. Lastly, some applications of the model are discussed, particularly with respect to carbon nanotubes.