

FUSTIPEN Report

The purpose of this visit was to establish a collaborative effort to study the effects of a particle-hole interaction on the low-lying excited state spectrum of a system of neutrons and protons subject to pairing forces. The hope is to find a system for which exact solutions can be constructed in special cases and to use those exact solutions as a test of approximate methods that can be used in more general cases.

We decided to use a Lipkin type of particle-hole interaction. An analysis of this nature is known for a two-level system of *identical* particles with a particle-hole term and a pairing interaction [NPA **116** (1968) 49]. Our aim was thus to generalize this study to a two-level system consisting of neutrons and protons. The algebraic structure of this problem was identified to be $Sp(8)$ for $T=1$ pairing and $SO(16)$ if both $T=0$ and $T=1$ pairing are included. These are large algebras of which little is known and an entirely analytic treatment thus seems difficult. We are currently exploring the feasibility of an exact numerical diagonalization which exploits simplifications due to group theory akin to our study in PLB **685** (2010) 55.