Chapter 6

Summary

The work reported here is a result of experiments performed at the Laboratori Nazionali di Legnaro in Italy. Gamma-particle coincidence events were collected using the GASP germanium array in conjunction with the ISIS charged-particle detector. This combination enables discrimination between the different reaction channels by selecting the proper number of evaporated light charged-particles detected in the silicon telescopes.

Many new results have been obtained including properties of cluster emission and γ-ray spectroscopy of molecular states. In particular, several of the specific results are:

1) The γ-ray decay properties of neutron-rich isotopes of beryllium, close to the particle emission thresholds, have been studied. The γ-ray decay scheme has been extended for the levels up to the neutron decay threshold in ^{10}Be. A new γ-ray transition from the isomeric 0_2^+ state in ^{10}Be was found and the population of the bandheads of the proposed rotational bands was measured.

2) The γ-ray decay of states populated in the ^{16}O(^{7}Li,2n), ^{16}O(^{7}Li,np) and ^{18}O(^{13}C,xn) reactions has been studied. The spectroscopy of ^{21}Ne has been extended and interpreted following the concept of reflection asymmetric shapes due to octupole deformation. Two parity doublets with $K = 3/2$ and $1/2$ have been established and the corresponding quadrupole transitions between members of the

inversion doublets have been observed. The mirror nucleus to ^{21}Ne, namely ^{21}Na, was investigated and the behaviour of the Coulomb Energy Difference (CED) was interpreted.

Furthermore, the γ-ray decay properties of the neon isotopes ^{21,22,23}Ne, populated in the ^{18}O(^{13}C,xn) reaction, where x=0,1,2, have been studied. New γ-ray transitions in ^{22}Ne and ^{23}Ne have been identified and the level schemes have been extended to higher spins. Possible spin assignments for the new transitions have been suggested. The decay scheme for the $K = 3/2$ band in ^{21}Ne suggests a 'pure' compound nucleus reaction in which mainly yrast states are populated.

3) The emission of clusters, from the compound nucleus, and their energy spectra have been studied. The experimentally deduced ratio of uncorrelated α-particles hitting the same silicon detector compared to multiple α-particles from clusters is observed to be an order of magnitude smaller than expected. Moreover, the cluster fragments, ^{8}Be or ^{12}C, carry away less energy from the compound nucleus than 2 or 3 sequentially emitted α-particles. Thus, the emission of another light particle from the residual nucleus after cluster emission is enhanced and a possible explanation is given.

These results will also enable future spectroscopic studies to be optimally designed for studying cluster states in light nuclei. Investigations are likely to continue to yield results on this interesting phenomenon of nuclear molecular states and cluster emission.