GAMMA-RAY MULTIPLICITIES IN ^{6}Li INDUCED REACTIONS

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A multiplicity setup consisting of seven 2" x 3" NaI(Tl) detectors in conjunction with a Ge(Li) detector has been constructed and tested. A lead shield was designed to allow each detector to view the target with a minimum of 'cross talk' between them. The 2" x 3" NaI crystals mounted on SRC 50 B01/2 and SRC 52 B01/2 photomultiplier tubes were obtained from Bicron company and are observed to produce a typical energy resolution of 6-7% for 662 keV ^{137}Cs gamma-rays. The voltage divider was constructed locally and the operative voltage was optimized for gain stability at high count rates. In figure 1a the pulse height spectrum with a ^{22}Na source and in figure 1b that obtained during 95 MeV ^{6}Li bombardment of ^{165}Ho target in one of the NaI detectors are presented. The multifold coincidence gamma-ray spectra in the Ge(Li) detector were found to be of similar quality as obtained with the Washington University setup (see 1977-78 IUCF Annual Report).

During the experimental setting it is planned to record the energy spectra in Ge(Li) and 4 NaI detectors, coincident fold information of the NaI detectors, relative times of the NaI signals with respect to the beam and with respect to the Ge(Li) in an event mode. A general use computer program, MAKEAR[1] has been written to sort event data onto any number of multi-dimensioned arrays on the disk. Another program is being written to compute multiplicity with explicit account of the known portion of the cascade and with corrections for angular correlations in gamma radiation, accidental coincidences, electronic coincident efficiency, internal conversion, and coincident neutron events.

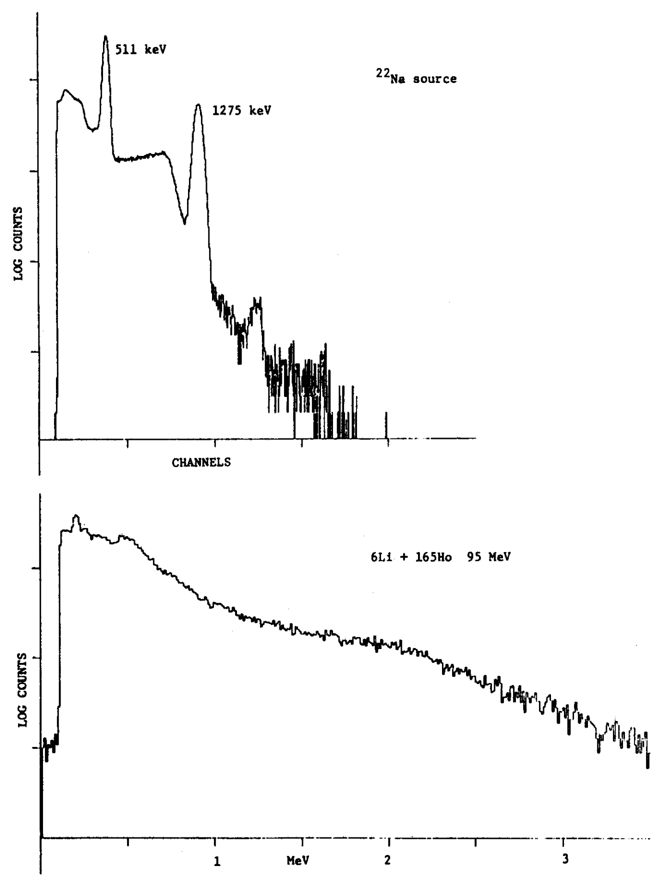

Figure 1.

The preliminary results from a test run with 95 MeV ^{6}Li on ^{165}Ho are plotted in figure 2 for the final nucleus ^{164}Yb. The interesting features of these results are (a) a change of 0.43 units in multiplicity per unit change in the spin of the emitting state beyond the $8^+\rightarrow 6^+$ transition and (b) a rather constant value of multiplicity below the $8^+\rightarrow 6^+$ transition. A change of 1/2 unit in multiplicity per unit spin is expected if it is assumed that the gamma-emitting cloud (see inset in figure 2) is parallel to the yrast line and that statistical transitions to the yrast line have the same multiplicity irrespective of the spin of the initial state of the cloud. In this picture, data are consistent with less than five statistical transitions and the plateau in multiplicity below a particular J^{π} (8^+ in this example) implies that for this final nucleus the entrance cloud has a lower limit in spin. In other words, states of spin lower than 8^+ are not populated significantly through direct feeding from states of higher excitation.

A similar increase in multiplicity with J was seen for ^{166}Yb produced in 66 MeV ^{6}Li bombardment of ^{165}Ho except that no plateau was observed for lower J values. This implies that at lower bombarding energies, and corresponding lower excitation of the compound nucleus, the gamma-emitting cloud extends over relatively lower spin values. Detailed studies of this and other phenomena using the gamma multiplicity filter and/or in

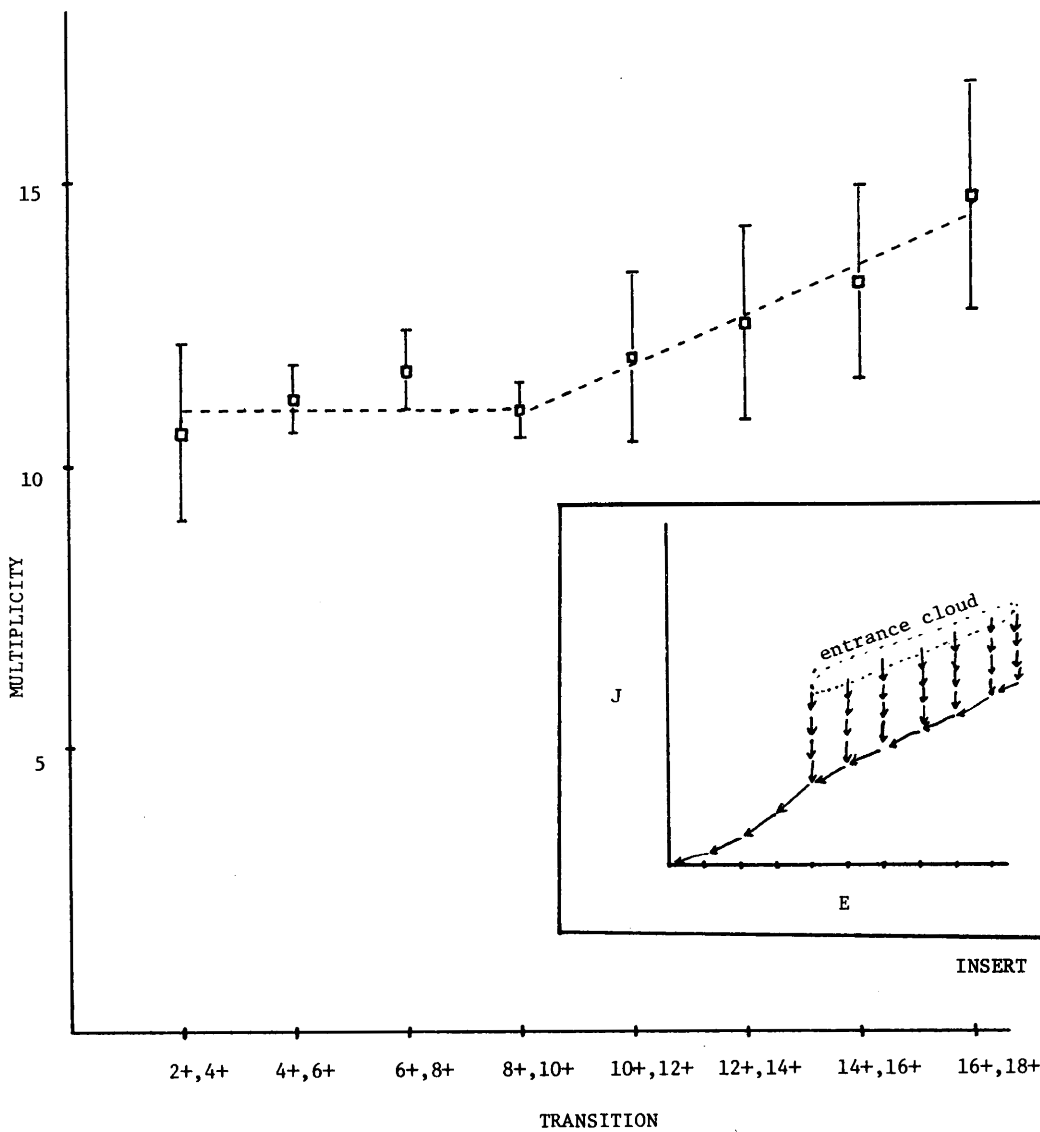

Figure 2.

conjuntion with X-ray multiplicity signatures are planned.

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1) J. Wiggins, IUCF Internal Report 79-01.