Doctoral Thesis

Investigations on the odd-odd isotopes Ga-64, Ga-66, Ga-68 and the odd-even isotope Ga-67

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THESIS

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by

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Investigations on the odd-odd isotopes Ga$^{64}$, Ga$^{66}$, Ga$^{68}$ and the odd-even isotope Ga$^{67}$

by Ambuj Mukerji.

Summary. Disintegrations of the odd-odd isotopes Ga$^{64}$, Ga$^{66}$ and Ga$^{68}$ have been investigated by spectrometer and coincidence measurements. The positron activity assigned in literature to Ga$^{64}$ has to be attributed to some impurities. Disintegration schemes for Ga$^{66}$ and Ga$^{68}$ have been established. Spin assignments to ground states of Ga$^{66}$ and Ga$^{68}$ have been compared to those predicted by Nordheim’s rules regarding odd-odd nuclei.

Some new $\gamma$-radiations observed during the course of disintegration of Ga$^{67}$ are reported in the supplement and a disintegration scheme proposed. The findings are difficult to reconcile with the predictions from shell model in its simplest form.

1. Introduction.

It is well known that all the odd-odd nuclei with the exception of $^1$H$^2$, $^3$Li$^6$, $^5$B$^{10}$ and $^7$N$^{14}$ are unstable. They, therefore, disintegrate into the corresponding stable even-even isobars. The nuclear spins of the nuclei with odd mass numbers can be predicted with the help of the nuclear shell model$^{1-4}$ in its simplest form of single particle picture. For the odd-odd nuclei Nordheim$^5$ has formulated an empirical rule about the manner in which the odd proton and the odd neutron combine together to give the total spin of a nucleus of this type in its ground state. But till now only relatively few instances are known to verify the validity of this rule and it seems to be too premature to draw conclusions from it. Otherwise also, it seems important to know more about the combinations of spins of the odd-odd nuclei, as it is hoped that valuable informations about the properties of bound states of nuclei may be obtained from such studies. The precise investigation of the disintegration schemes of radioactive isotopes is a good method for assigning spins of the nuclear energy levels.

The work reported here is a part of a bigger programme of investigations that is being carried out in this laboratory to study the modes of decay of odd-odd nuclei and consequently, the excited states of the even-even nuclei.