

A D.S.A. STUDY OF ^{28}Si LIFETIMES IN SOME SELECTED MATERIALS

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ABSTRACT

The Doppler-shift attenuation method is used to obtain a comprehensive panorama of the theoretical stopping power predictions at very low ion energies.

INTRODUCTION

A programme of systematic D.S.A. measurements of well known nuclear lifetimes has been started at the L.F.E.N., in order to build up a picture of theoretical stopping power predictions, in terms of recoiling-ion/backing-material combinations at very low recoil energies, where the nuclear stopping is dominant. Studies of this kind have already been done for ion energies where the electronic stopping is dominant (^{1,2,3}), showing the effect of the so-called Z_2 -oscillations and conducing to the appearance of more refined treatments, apparently capable of predicting these oscillations (⁴). For low recoil energies, however, very few studies have been devoted, *e.g.* ref. 5 and 6. (But see also ref. 7)

FIRST RESULTS

The first step of this project consisted on the measurement of the lifetimes of the first and second excited states of ^{28}Si populated by proton capture from ^{27}Al , the stopping being made in either aluminium and tantalum (⁸). The Lindhard, Scharff and Schiøtt theory (⁹), using the Thomas-Fermi screening potential, was unable to reproduce the known lifetimes, except when the nuclear stopping power was multiplied by a constant factor $f_n=0.7$. This is in excellent agreement with the work by Bister and co-workers (⁶). The use of the Lenz-Jensen screening potential (⁹) also failed to give acceptable values for the lifetimes (¹⁰).

Alternatively, we suggested (¹⁰) an energy-dependent correction to the LSS-TF theory,

$$f_s(\epsilon) = \frac{(\epsilon + \epsilon_0/2)}{\epsilon + \epsilon_0}$$

ϵ being the reduced energy, conducting, for $\epsilon_0=1$ and relatively to our experiments at least, to results as good as those for the constant correction, but being more acceptable, and therefore more interesting, from the physical point of view.

FUTURE WORK

For the immediate future, experiments are planned concerning the lifetimes of the two lower levels of ^{28}Si , excited via the proton capture resonances at $E_p = 1800$ and 767 keV. Backing materials will be C, Ti, Ni, Cu, Zr, Ag, Ta, Pb and U, initial ion energies covering therefore the range $\epsilon \sim 2$ to $\epsilon \sim 0.1$.

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