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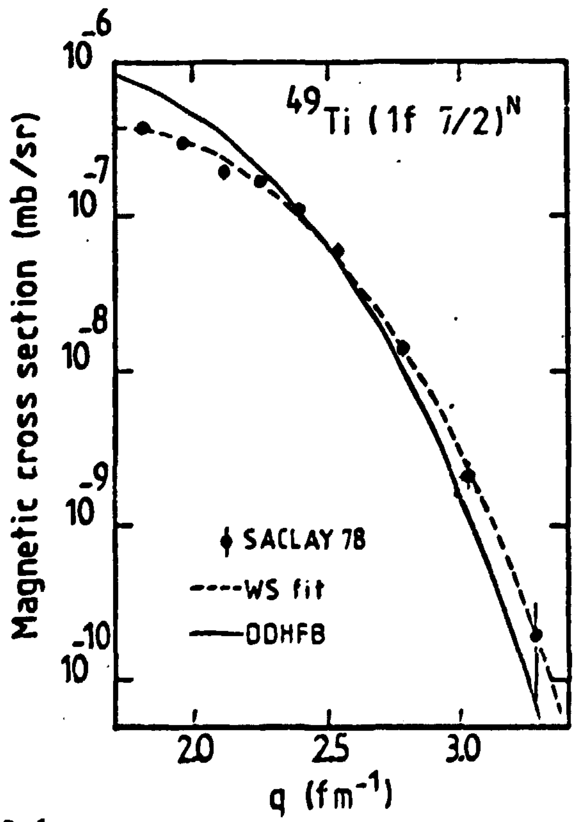
Results for the $1f_{7/2}$ neutron orbit have been obtained via elastic electron scattering from the ^{49}Ti magnetization distribution. The experiment was performed at the Saclay 500 MeV linear accelerator. ^{49}Ti and ^{48}Ti cross-sections were measured at 155° and 9 incident energies between 175 and 325 MeV and at the same momentum transfer at 500 MeV. The cross-sections were fitted using neutron wave functions computed in a Woods-Saxon well. The best fit is shown in figure 1 together with a Hartree-Fock-Bogolyubov prediction[1]. The r.m.s. radius for the $1f_{7/2}$ neutron wave function is 4.006 ± 0.040 fm. From a similar experiment on ^{51}V[2] extended to higher momentum transfer, we find 4.011 ± 0.040 fm for the r.m.s. radius of the $1f_{7/2}$ proton wave function.

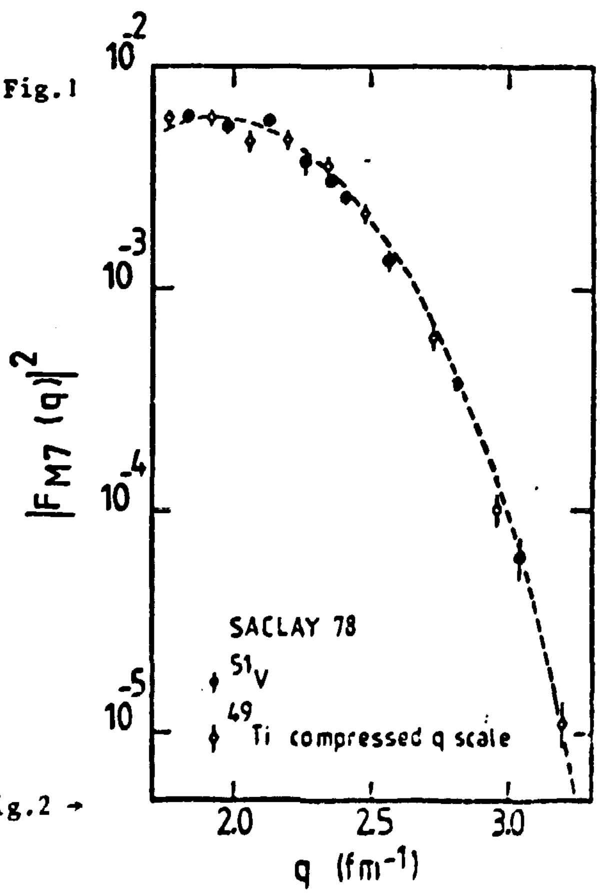
Both the neutron and proton orbits are smaller than the theoretical prediction by 3.6 ± 1 % and 2.5 ± 1 % respectively. Core polarisation and meson exchange effects have been evaluated[3] and are not sufficient to explain this disagreement.

Given the similarity in shape between proton and neutron wave functions[4] the ^{49}Ti neutron form factor can be related directly to the proton one by compression[4] in the q scale (figure 2). The compression factor found is 0.996 ∓ 0.008 and represents the ratio of neutron to proton radii free of model assumption. Compared with the theoretical ratio (r_n/r_p = 1.013) it also shows that theory predicts valence neutrons with a too large r.m.s. radius.



← Fig.1

Fig.2 →



References

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