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THE HYPERFINE FIELD AT Na IN Fe

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In this note the results of TDPAD measurements for ^{22}Na nuclei recoil implanted into magnetized iron are reported.

The 583-keV, $J^{\pi} = 1^+$ isomeric level was populated by means of the $^{12}C(^{14}N,\alpha)^{22}Na^*$ reaction at the incident energy of 32 MeV. The half-life of this level was known[1] to be 243 ± 2 ns. Perturbed angular correlation measurements[1,2] of the $0^+ \xrightarrow{73.9\gamma} 1^+ \xrightarrow{583\gamma} 3^+$ cascade had yielded for the g-factor of this level a value of +0.529 ± 0.008. The target used in the present experiment consisted of 1 mg/cm^2 aquadag deposited on a 0.5 mil thick natural iron foil mounted in the gap of a C-magnet which produced a field of about 300 gauss to saturate the Fe foil. The ^{14}N beam was pulsed with a repetition period of 800 ns. The delayed time spectrum of the 583-keV gamma rays was measured with two NaI(Tℓ) scintillation detectors placed at ± 45° to the beam direction using conventional fast-slow electronics with a time resolution of ∿ 5 ns. The Ratio R(t) obtained with the normalized difference in counting rates for the two field directions was fitted to the function A sin 2 $\omega_L t$. As the amplitude of the observed oscillations did not exceed ∿ 1.5%, data were obtained for a total of 70 hours with an average beam current of 3 nA of pulsed beam. A typical R(t) curve obtained is shown in figure 1. The period of Larmor precession obtained as an average over all the runs was found to be (383 ± 14) ns. The effective hyperfine field is then determined from the relation $H_{eff} = H_{obs} - H_{ext} + H_{DM}$ where H_{ext} is the external field (0.3 kG) and H_{DM} the demagnetizing field, the latter assumed negligible for the geometry used.

We obtain a value of 6.5 ± 0.3 kG for the effective magnetic field acting on Na nuclei in Fe. Taking into account the Lorentz field value in Fe of 7.2 kg at room temperature the hyperfine field at Na in Fe is estimated to be -1.5 ± 0.3 kG.

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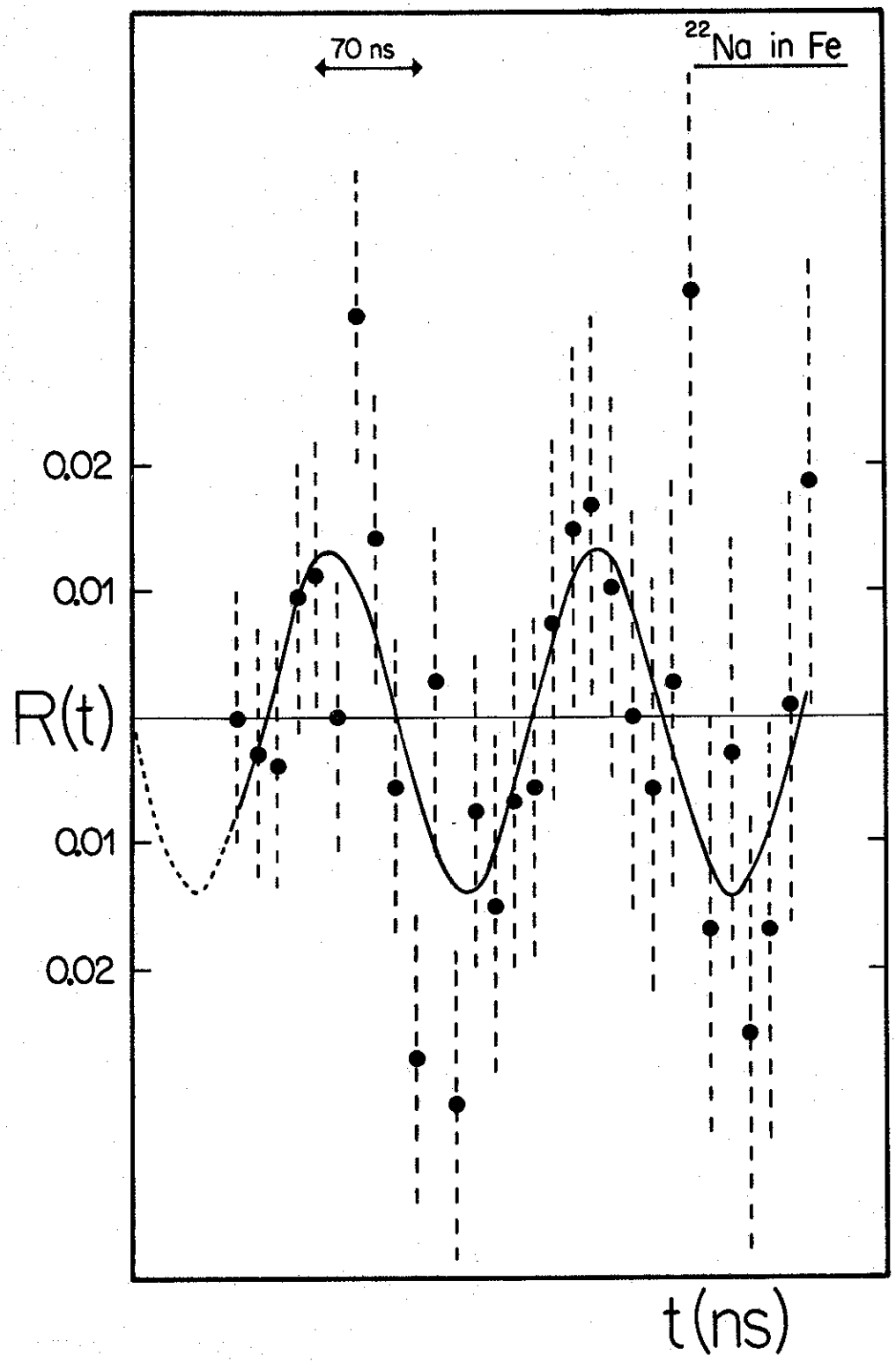
70 ns
^{22}Na in Fe
0.02
0.01
R(t)
0.01
0.02
t(ns)