NEGATIVE MUON SPIN ROTATION IN THIS PAPER

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Negative muons were stopped herein at the μE2 channel of S.I.N. These muons exhibit relaxation when precessed in a transverse magnetic field. A puzzling signal is also revealed whose unknown origin still is concealed. Despite my desire for confirmation of this inexplicable observation, as well as my natural inclination to share my results through publication (and thus prevent damage to my reputation), I'm logically led to the integration of sample and text, or this could've been the first work made false by a Xerox machine. Which it is, if not autographed here in green:

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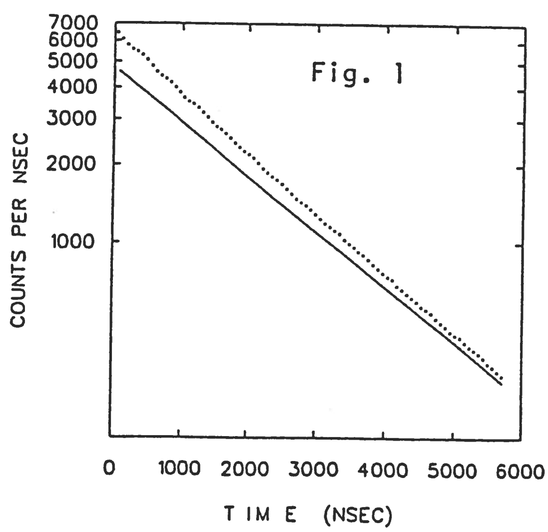
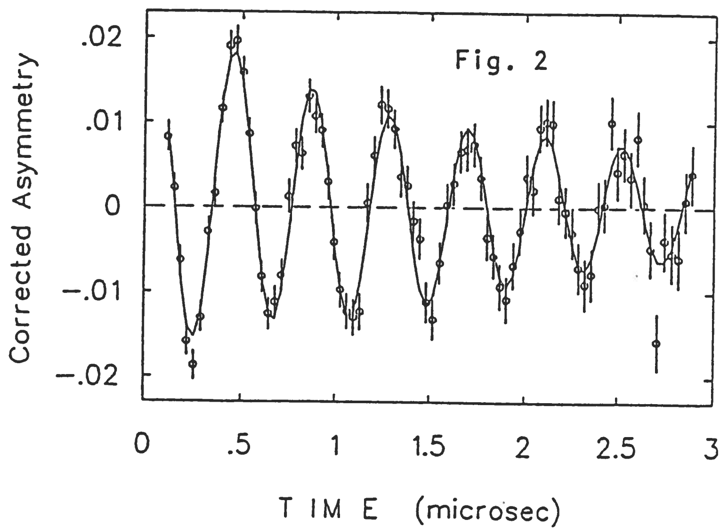
Polarized negative muons from the μE2 muon channel of S.I.N. were stopped in the paper upon which this abstract is written,[1] which was at that time situated in the S.I.N. general purpose TD-μSR apparatus "Löwe."[2] All measurements were made at room temperature. A magnetic field of 179 Oe was applied transverse to the muon polarization, and conventional "Forward" [F(t)] and "Backward" [B(t)] TF-μSR time spectra [3] were acquired with approximately 10^7 counts each. The F(t) data are shown in Fig. 1, along with a line fitted to a spectrum from μ^- in graphite for "lifetime calibration." A good fit to this spectrum (χ^2 = 179 for 182 degrees of freedom) was obtained using a main [68(2)%] component with a lifetime of 2.028 μs, representing μ^-C, and an "X" component [32(2)%] with a lifetime of 1.46(3) μs, probably due to a combination of μ^-O and traces of heavier elements. The fit is insensitive to finer details of the lifetimes.

Fig. 2 shows a fit to the μ^- precession "signal" A(t) extracted from F(t) and B(t) by the algorithm A = (F−B)/(F+B) after background subtraction. The initial amplitude is 1.1(1) times that measured in C (graphite), but the relaxation rate [0.38(3) μs^{-1}] is remarkably high for a nonmagnetic sample. One possible explanation of this result is the "spur" model: as the μ^- comes to rest it creates numerous ions which may be (or react to form) stable





paramagnetic molecules (radicals), whose nearby electronic moments generate random local magnetic fields which relax the muon. This model has been proposed by Balandin et al.[4] to explain similar results in solutions; it is certainly more applicable to μ^- than to μ^+, since the latter remains a light species which can diffuse away from its "spur", while the former is immediately captured in a muonic atom, and emits Auger electrons to add to the local disruption.

The discerning reader will also notice a small [0.40(4)% asymmetry] fast-relaxing [1.1(2) μs^{-1}] signal at low frequency [0.54(14) MHz] underlying the normal μ^- precession signal [1.95(3)% asymmetry at 2.43(1) MHz]. This "anomalous μ^- precession" signal must be included to obtain a good fit to A(t), but its nature is unknown. The frequency and relaxation rate are reminiscent of the F^+ hyperfine state of $\mu^{-11}B$ undergoing transitions to the F^- state [5] but this seems unlikely, as it would require that nearly 50% of the muons encounter a boron nucleus in this paper. Another remote possibility is that the muonic atom neutralizes with a paramagnetic electronic configuration, forming a system analogous to muonium, whose precession frequencies pass through zero at certain fields [6]. However, it would be a remarkable coincidence if I had randomly chosen the correct field to give near-perfect stopping of the precession. This signal could possibly be some sort of distortion due to different lifetime components in the different counters, but similar data on other samples show no such effect. Anomalous μ^- precession thus remains a mystery.

Although it would be desirable to repeat this measurement at other magnetic fields, this is strictly impossible, as the target is now scattered around the world and contaminated with ink, carbon and toner chemicals, as the reader can plainly see. We will have to content ourselves with "similar" studies of other paper in the future. Which raises the interesting question of whether this investigation, being intrinsically irreproducible, qualifies in principle as science. "Publishing" it myself in this fashion avoids arguments with editors over this issue (which is, in or out of turn, created by the method of publication). Can this be what Wheeler means by "self-reference cosmogony?"

The original idea for such an experiment as this came from Tony Fiory of Bell Labs in approximately 1978. Thanks, Tony.

[1] This paper, supplied by the Swiss paper company Biber Xerographie, is (or was in 1982) the standard paper used in the copy machines at S.I.N. Further details (composition, etc.) can presumably be obtained from the supplier.

[2] I am grateful to Alex Schenck and Fredy Gygax for lending me their apparatus and help, and to ETHZ and SIN for tolerating my somewhat frivolous use of an evening's unclaimed beam time during my visit to SIN.

[3] See for instance J.H. Brewer and K.M. Crowe, Ann. Rev. Nucl. Part. Sci. 28, 239 (1978).

[4] M.P. Balandin et al., Khimiya Vysokikh Energii 15, 552 (1981).

[5] D. Favart et al., Phys. Rev. Lett. 25, 1348 (1970).

[6] V.N. Gorelkin and V.P. Smilga, Sov. Phys. JETP 39, 586 (1974); V.N. Gorelkin and L.P. Kotova Sov. Phys. JETP 53, 865 (1981).

Tokyo, 6 April 1983