

Physics 252 – Reading Exercise #1

(due Tuesday, April 12)

Read the paper:

D. W. Gidley, A. Rich, E. Sweetman, and D. West, “New Precision Measurements of the Decay Rates of Singlet and Triplet Positronium”, *Phys. Rev. Lett.* **49**, 525 (1982)

Write a brief summary of this paper. Include answers to the following questions:

1. What is the goal of the experiment? The title claims a precision measurement. What relative accuracy was required?
2. How were the positrons produced in this experiment? What medium was used to create positronium? How did the experimenters control for the effects of the medium is perturbing the decay rate from its value in vacuum?
3. The role of the magnetic field in this experiment is to mix one of the three $S = 1$ states of positronium with the $S = 0$ state. Why was this done? Why do both rates $\lambda_{T'}$ and λ_T appear in the formula (4)? Why is there no λ_S in this formula?
4. At the end of p. 526, there is a reference to an “inverted time spectrum”. What is this, and why was it used?
5. The paper finds a discrepancy between theory and experiment for λ_T . This discrepancy eventually grew to over 9σ and then later was removed by an improvement in the experimental technique. See Vallery, Zitzewitz, and Gidley, *Phys. Rev. Lett.* **90**, 203402 (2003). What was the problem, and how was it resolved?