Paper Evaluation and Summary

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Paper: Nico et al. (Measurement of neutron lifetime using beam method)

- What is the main finding of this paper and why is it important?
  The mean neutron lifetime was found to be $\tau_n = 886.3 \pm 1.2(\text{stat}) \pm 3.2(\text{sys})s$
  and therefore is the most precise measurement utilizing the beam method. It still
  disagrees with the magnetic trap method.

- Describe at a high level the basic technique used. Try a series of "steps" here if
  necessary, if there is a sequence to be followed (like a recipe).

  1. Generate cold neutrons, guide into the proton trap
  2. Start the trapping cycle:
     - Trapping: trap protons produced by neutron decay for $10ms$.
     - Counting: Door gets grounded and a ramped potential "flushes" out the
       produced protons which are guided to the silicon detector (enabled for
       $21\mu s$).
     - Clearing: ramp potential gets maintained for another $33\mu s$ to clear the
       trap from all charged particles
  3. Measure resulting protons with silicon surface barrier detector (must be
     aligned precisely with proton beam).

- Choose an interesting technical aspect of the experiment and describe its relation
  and importance to the measurement.
  The alignment of the proton detector to measure the proton beam is quite sophis-
  ticated to avoid loss of counts due to exceeding the active area of the silicon. To
  do so, optical measurements were performed first to get a "rough" alignment. Fur-
  thermore, an electron beam from a ^{210}Pb-^{210}Bi-^{210}Po source was used to monitor
  the the beam position on the detector. Last, the same procedure was performed
  with decay protons. All measurements agreed, according to the paper, better
  than $1mm$.

- Pick one systematic uncertainty issue that you find interesting and describe its
  importance and the author's method of addressing it.

- Fascinating aspect:
  The experiment is described much more sophisticated than the Pattie et al. paper.
  The method also necessitates the application of much more systematic corrections
  to the data then the magnetic trap method.