

Paper Evaluation and Summary

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Paper: Odom et al. and Wu et al. (Parity violation, 1957)

- Motivation (Lee and Yang)

Lee and Yang discuss the question whether parity is conserved in certain processes or not. They find that existing experiments only probe for P-violation in strong interactions but not in weak interactions. They propose several types of experiments: the conservation in parity in the β -decay can only be tested if the experiment measures a pseudoscalar “formed out of the experimentally measured quantities” because only the interference term carries information about the parity. To test this they suggest an experiment where the angular distribution and polarity of the decay products of oriented ^{60}Co is measured. If parity is conserved the observed gamma rays should be unpolarized. They also propose other experimental tests in the meson and hyperon sector.

- Main finding and importance By performing the proposed experiment by Wu et al. the collaboration finds that the angular distribution for emitted electrons from the β -decay of ^{60}Co indeed is asymmetric in angles ϑ and $180^\circ - \vartheta$ and therefore confirms that parity is violated in this weak process for the very first time.

- Experimental setup.

- The ^{60}Co -specimen was prepared by growing a single crystal of cerium magnesium nitrate and then depositing an additional layer of ^{60}Co (0.002 inch, several microcuries)
- The specimen is placed in a vacuum chamber and is cooled by liquid nitrogen and helium to roughly one Kelvin. After adiabatic demagnetization the horizontal magnet is shut off and a vertical solenoid is lowered to provide the external magnetic field. This lowers the temperature to sub-Kelvin regions.
- The anthracene crystal is located two centimeters above the source to count the emitted electrons. The light is guided through a light guide to a photomultiplier tube.
- Two additional NaI crystals count the emission of the gamma-rays to monitor the polarization and the temperature. Compton scattering effects are discriminated by pulseshaping.
- The counting procedure is as follows: After shutting off the large magnets and turning on the solenoid the specimen warms up within roughly six minutes. While this warming period the count rate for the emitted electrons and

gamma rays is measured in an interval of 60 seconds. After the asymmetry disappears the counting is then stopped.

- Systematics

- For providing good light transmission and to avoid loss the light guide is shaped in a certain way (logarithmic spiral)
- The stability of the β -counter was tested to avoid dependencies such like temperature or external fields.
- Test for intrinsic magnetic field of the nitrite cooling salt:
 1. Drop-specimen ($CoCl_2$) to test for asymmetry if no intrinsic orientation is given (was found to be negative)
 2. Test for influence of the travel path of the electron through the specimen by magnetic field by testing a thin layered sample (also negative)

- Where did you get lost? Was there anything you did not understand?:

- Shape of light guide?
- What exactly is changed to create the mirrored experimental setup?
- How does measuring the gamma-ray anisotropy help understanding the parity violation?
- Same experiment with 4π coverage?