Design of a high-precision $\beta$-telescope$^1$ R.H. TERBEEK, REU student from Hillsdale College, Hillsdale, MI, USA, S. BEHLING, D. MELCONIAN, Cyclotron Institute, Texas A&M University, College Station, TX, USA — The question is raised of whether or not parity is maximally violated in the weak interaction, focusing on $\beta$ decay. Efforts to measure the neutrino asymmetry parameter, $B_\nu$, and how it will provide limits on the existence of a new right-handed $W$ boson are described. In this experiment, a magneto-optical trap is used to laser-cool and confine $^{37}$K atoms, which are then polarized using optical pumping techniques. A $\beta$-telescope will be used to detect the energy and direction of the $e^+$s emitted from the decay. This detector will be used in coincidence with a microchannel plate which observes the momentum of the recoiling $^{37}$Ar nucleus. The kinematics of the decay allow us to deduce the neutrino’s momentum event-by-event, and so by correlating the neutrino’s momentum with the initial nuclear spin, we will be able to make a precision measurement of $B_\nu$. The physics of positron detection and constraints on $\beta$-telescope design are covered in detail, as well as research into computer simulation methods for the analysis of response functions and the optimization of certain parameters of a $\beta$-telescope.

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