Summary: A Mountain-Altitude Search for X^-p Dark Matter Candidates

Patrick McGuire, Theodore Bowen, Burt Pifer, Peter Halverson, Delmar Barker

1 December 1989

DeRujula, Glashow, et al have hypothesized the existence of dark matter in the form of X^-, a stable, singly- charged particle with mass $\approx 10^{15}eV$, velocity $\leq 10^{-3}$ c, and flux $\approx 1cm^{-2}-sec$. In order to begin an exploratory search for the hypothesized X^- in the form of X^-p cosmic rays, we plan to place a mountain altitude three-counter cosmic ray telescope into full operation during the term of this grant. We wish to search for a reaction cycle: $X^-p \rightarrow X^-d, X^-d + {}^{12}C \rightarrow {}^{13}C + p + X^-, X^- \rightarrow X^-p$, all within the liquid scintillator of the counters of our telescope. Each ${}^{12}C(d,p){}^{13}C$ reaction will cause a small (relative to charged particles, $E \ll 1MeV$) scintillation in our counter. We will use coincidence and anticoincidence techniques to veto large charged-particle pulses and PM tube noise pulses in our telescope's counters. These techniques will allow us to look for a series of small scintillations within each counter, which might be a signature of a slow massive particle moving through our telescope, catalyzing nuclear reactions.We will also use a shift register built by a collaborator, two waveform digitizers, and PC-based data acquisition, so that we may examine possible events in detail. At the end of the term of this grant, we should be able to decide which directions to pursue, such as deuterium-enriched counters, more counters, more electronics, or long data runs.