Scientific Spokesman:

K. Lande
Department of Physics
University of Pennsylvania
Philadelphia, PA 19174

Proposal for a Measurement of the Transition Rate for CL(37) to Ar(37) Induced by Muons at Fermilab Energies

August 8,1976

4pgs.

UNIVERSITY of PENNSYLVANIA

PHILADELPHIA 19174

The Faculty of Arts and Sciences

August 5, 1976

For the past several years the Brookhaven Solar Neutrino Group (R. Davis, J. Evans) has been engaged in a search for neutrinos emitted by proton fusion reactions in the Sun. The present upper limit to the detected signal in the ^{37}Cl (perchlorethylene) detector is $\approx$ 1.4 S.N.U. (solar neutrino units). Of this it is estimated that 0.5 SNU is due to (p,n) reactions initiated by the cosmic ray remnant that penetrates to the depth of the Solar Neutrino Observatory (4850 ft. underground).

The signal contributed by the cosmic ray muons ($E_\mu \approx 300$ GeV) was estimated by extrapolating cross sections from low energies assuming $\sigma \sim E_\mu^{0.7}$. The availability of muons at Fermilab with energies similar to the above cosmic ray muons makes it possible to directly measure the relevant transition rate, $^{37}Cl \rightarrow {}^{37}Ar$ due to μ interactions. This measurement combined with our recent measurement of the muon flux at the Solar Neutrino Observatory will permit an absolute measure of the μ induced contribution to the above signal.

The determination of the solar neutrino signal is critically dependent on the cosmic ray muon correction and thus on the proposed Fermilab measurement.

Specifically, we propose to expose an 18" cube stainless steel tank of perchlorethylene to the Fermilab muon beam and measure the rate of μ induced $^{37}Cl \rightarrow {}^{37}Ar$ transitions in this target. We estimate that we will require an integrated flux of $\sim 5 \times 10^9 \times (E_\mu/300\ \text{GeV})^{0.7} \mu$.

In order to establish the energy dependence of the above process we would like to carry out these measurements for $E_\mu \sim 75$, 150, 250 GeV. We expect that the 250 GeV exposure can be carried out parasitically with exp. 398 and that the 75 GeV run could possibly be done while exp. 319 is running. From our present knowledge of the muon schedule it appears that 150 GeV will require 1-2 days of prime time.

In parallel with the above measurements we would also like to expose the two candidates for a new solar neutrino detector, Ga and Li. The Ga is mounted on the same stand as the Cl and so is automatically exposed simultaneously

with the Cl. Within the space limitations that apply during August and September the Li target must alternate with the Cl, Ga target set. During August we would place our stand behind the apparatus of exp. 319 and after the completion of their experiment would move to a location downstream of exp. 398.

We have no demands on the muon beam that are not met by the requirements of the presently scheduled prime experiments and do not anticipate any problem in utilizing the beam as it exists.

The experimental procedure consists of exposing each target to a given integrated flux of muons, separating the reaction products from the target material in a cold trap and transporting the reaction products to Brookhaven for analysis.

We expect the demands on Fermilab, other than the delivery of muons, to be quite modest. We have requested 6 discriminators, 6 coincidence circuits, 6 scalers, 2 Rustracks and 1 or 2 HV power supplies from PREP. Bob Shafer told us that all of these circuits are available. If the situation demands, we are prepared to supply all the circuitry other than Rustracks from Brookhaven (see rack of circuitry in attached photograph). However, we felt logistics would be simplified and costs reduced if we could utilize PREP circuitry. We also anticipate buying 50-100 liters of liquid nitrogen and 2 cylinders of helium per run from your stockroom. At this point we anticipate no other demands on Fermilab services.

We have discussed our experiment with Wendell Chen (exp. 319) and he has agreed to our acquiring a 2 day or so exposure early in the August running period. This early August exposure (Cl and Ga only) is critical in permitting us to make a calm evaluation of the experimental situation and to fully utilize the parasitically muon beam this fall. It requires 1-2 half lives to analyse the reaction products and in the case of Cl this implies that an August test run is necessary in order to have results by early October.

We all look forward to working at Fermilab.

Sincerely yours,

Kenneth Lande

KL/cat
Enclosures
XC: T. Groves

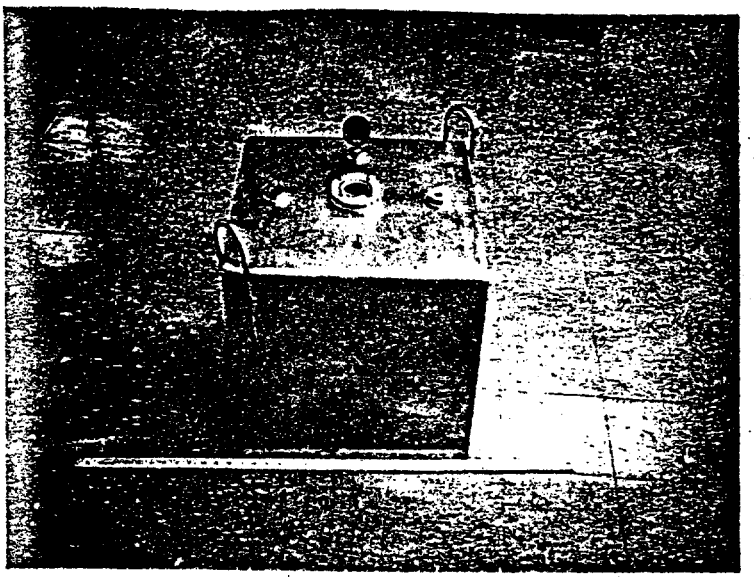

Fig. 1 Perchlorethylene target

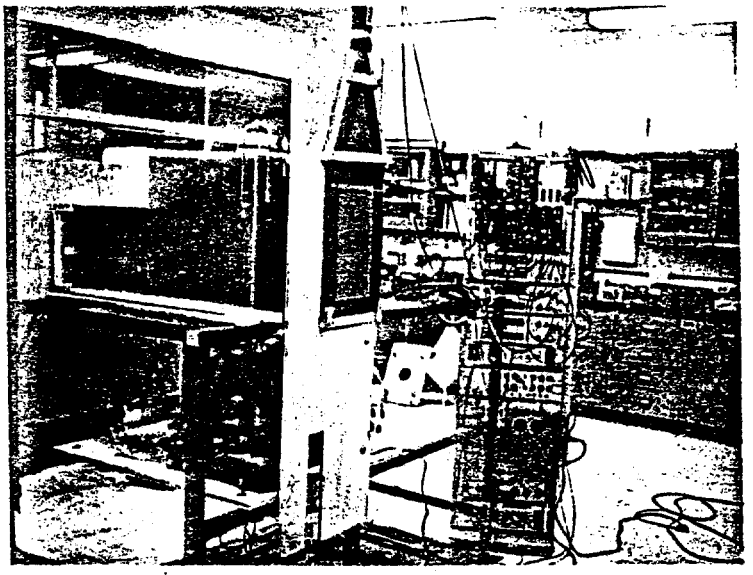

Fig. 2 Target stand, perchlorethylene target, muon counter array and circuitry. This is the complete Fermilab solar neutrino calibration experiment system.