NOV 30 1967

C00-818-103

TECHNICAL REPORT

FOR

HIGH ENERGY MACHINE PHYSICS

MASTER

CONTRACT AT(11-1)-818

1 OCTOBER 1966 TO 30 SEPTEMBER 1967

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

F. Reines

F. Reines, Principal Investigator
Professor of Physics (On Leave)
Case Institute of Technology and
Professor of Physics, Dean of
Physical Sciences, University
of California, Irvine

T. L. Jenkins

T. L. Jenkins, Investigator
Associate Professor of Physics
Case Institute of Technology

Case Western Reserve University
10900 Euclid Avenue
Cleveland 6, Ohio

June, 1967

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

1. D₂O Solar Neutrino Experiment and Baryon Stability Experiment

This experiment has been described in detail in the request for loan of D₂O submitted in May 1965 (C00-818-62). The detector described in that proposal has been located in the Morton Salt Mine in Fairport Harbor since Feb. of 1966. In the 15 months since the installation of that detector we have studied sources of background and have reduced the background more than an order of magnitude. The present background in the detector is of the order of 200 per day. This is one order of magnitude too great to permit us to set a limit on the solar neutrino flux from the B⁸ decay better than has been achieved to date. It is two orders of magnitude too great to permit us to observe the theoretically expected flux. We have good evidence that most of the background is due to accidental coincidences between noise pulses from the photomultiplier banks.

The tank is presently filled with D₂O and we have been operating it since April 15, for the purposes of obtaining data for the proton stability problem described in our technical report of July 1966 (C00-818-96). It is anticipated that the present runs will be continued and sufficient data will be accumulated by the end of the summer, 1967. At our present background rate we estimate that a lower limit of $>10^{25}$ years can be set by this method. As pointed out in our previous reports, the method employed here is independent of assumptions regarding the mode of proton decay.

II. Double Beta Decay.

We have experienced some unanticipated difficulties in assembling and operating this apparatus. The apparatus (described in our renewal proposal of September 1965) is constructed and will be operated in our ground level laboratory during the summer of 1967. We anticipate that the apparatus will be ready for shipment to the Salt Mine by September 1967.

III. High Energy Physics at Accelerators.

The group described in our previous technical report has been augmented by one Research Associate, Dr. Charles R. Sullivan, who joined the group in April, 1967. There are presently three graduate students associated with the group. Two members of the group have continued with collaborations in which they had been involved prior to coming to Case. Professor Blanpied has been collaborating with a group made up of physicists from Harvard, Stanford, Cornell and McGill on spark chamber experiment studying muon pair production by high energy negative π -mesons.¹ Professor Frisken, during the fall of 1966, continued his collaboration with the Cornell Brookhaven Users Group in a run at the AGS studying π -p elastic scattering in the backward hemisphere.²

K^+ Experiments.

The High Energy Physics group has designed an experiment for the purpose of measuring the transverse polarization of the muon in $K_{\mu 3}$ decay. The proposal for this experiment has been submitted to the ZGS Program Committee at Argonne National Laboratory. This proposal was submitted on January 10, 1967. No final decision as to the disposition of this proposal has been made by that committee as of this writing. Detailed plans have been developed for a simpler experiment which would utilize the stopped K^+ beam which we have designed. This experiment is the study of the radiative $K_{\pi 2}$ mode ($K^+ \rightarrow \pi^+ + \pi^0 + \gamma$) on which very little data exist. Providing we obtain approval^{from} the ZGS to do so, it is our intention, this summer to construct this stopping K^+ beam from a target placed in the external proton beam of the ZGS. Details of this proposed experiment are contained in our proposal for support from the AEC. We submitted a letter of intent to perform this experiment to the ZGS Program Committee on 3 May 1967.

Construction of the γ -ray spark chambers has begun. It is anticipated that these will be completed by September 1967 and it is our intention to study their properties by means of a tagged photon beam.

Flying Spot Scanner

The computer control flying spot scanner, described in our technical report for 1966 (COO-818-96), is in the final stages of assembly. The IBM 1800 system which will control the machine was delivered on May 1, 1967 and the interface hardware between the computer and the machine has been tested and found satisfactory. All components of the machine are on hand and have been individually tested. Final assembly of the machine is being made as of this writing. It is anticipated that the first useful measurements from spark chamber film analyzed on the machine will be that obtained this summer in the collaborative effort at the AGS between Professors E. Engles, and R. Wilson of Harvard, L. Hand at Cornell, and W.A. Blanpied at Case. The spark chamber pictures so obtained will be relatively simple in format and topology and therefore suitable for the initial application of this machine.

-
1. Wehmann, et al, Phys. Rev. Letters 17, 1113 (1966 and Wehmann, et al, Phys. Rev. Letters 18, 929 (1967)
 2. Damerell, et al, Bulletin of the Amer. Phys. Society, 12, 469, (1967)
 3. Cline, Phys. Rev. Letters, 16, 367 (1966)
Cline and Frye, Phys. Rev. Letters, 13, 101 (1964)
 4. Costa and Kabir, Phys. Rev. Letters, 18, 429 (1967)

Publications List: High Energy Accelerator Physics

1. "Muon-Pair Decay Modes of the Vector Mesons", A. Wehmann, E. Engels, Jr., C. Hoffman, P. Innocenti, R. Wilson, W. Blanpied, D. Drickey, L. Hand, D. Stairs; Phys. Rev. Letters, 18, 929 (1967)
2. "Observation of Muon Pairs Produced by High Energy Negative π -Mesons". A. Wehmann, E. Engels, Jr., L. Hand, C. Hoffman, P. Innocenti, R. Wilson, W. Blanpied, D. Drickey, D. Stairs; Phys. Rev. Letters 17, 1113 (1966)
3. "Large-Angle Pion-Proton Elastic Scattering at High Energies"; R. Rubinstein, D.B. Scarl, D.H. White, A.D. Krisch, W.R. Frisken, A.L. Read, H. Ruderman"; Phys. Rev. 152, 1162 (1966)
4. " π -p Elastic Scattering in the Backward Region from 6 to 17.5 GeV/c"; C. Damerell, A. Ashmore, W.R. Frisken, R. Rubenstein, J. Orear, D.P. Owen, F. Peterson, A.L. Read, D.G. Ryan, D.H. White; Bull. Am. Phys. Soc. 12, (4), 46a (1967) (Paper AF⁴ - Washington A.P.S. Meeting)
5. "Observation of Muon Pairs Produced by High Energy π and K Mesons"; A. Wehmann, E. Engels, Jr., L.N. Hand, C.M. Hoffman, P. Innocenti, R. Wilson, W. Blanpied, D. Drickey, D. Stairs; Bull. Am. Phys. Soc. 12 (4) 569 (1967) (Washington Meeting (JC13))