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PREAMBLE

This budget supports the continuing and new research in basic particle and nuclear physics of the UCLA Particle Physics Research Group presently operating under grant #DE-FG03-88-ER40420. It covers the following research:

Program I: Rare and Forbidden η and μ Decays to Test the Standard Model

I-1: "Rare and Forbidden Decays of Light Mesons." Our major new program for testing the Standard Model. Investigations include: search for longitudinal muon polarization in $\eta \rightarrow \mu^+ \mu^-$ and $\Gamma(\eta \rightarrow \pi^+ \pi^-)$, both are tests of CP; $\eta \rightarrow \mu e$ (test of lepton flavor conservation); $\eta \rightarrow e^+ e^-$, $\eta \rightarrow \mu^+ \mu^-$, and $\pi^0 \rightarrow e^+ e^-$ (search for new interactions). Saturne Exp. #198, B. Nefkens and B. Mayer, spokesmen. The feasibility of a tagged η beam at Saturne II using the reaction $d + p \rightarrow {}^3 He + \eta$ was explored in 1989 and 1990. Three weeks of beam time have been approved for measuring $\Gamma(\eta \rightarrow \mu^+ \mu^-)$ in late 1990.

I-2: "Search for the Rare Decay $\mu^+ \rightarrow e^+ \gamma$ (The MEGA Experiment)." LAMPF proposal #969, M. Cooper, spokesman. Approved with A⁺ priority for 4000 hours. This is a multi-year multi-million dollar project by 10 institutions to test lepton family conservation to the unprecedented level of 10^{-13} . Our prime responsibility currently is the development of the surface μ^+ beam of $3 \times 10^7 \mu^+/\text{sec}$. Several test runs in the muon channel have been made and we have developed unique beam diagnostic apparatus for the occasion.

Program II Tests of Charge Symmetry and Isospin Invariance

II-1: "The Superratio and the Simple Ratios of π^+ and π^- Elastic Scattering on ${}^3 H$ and ${}^3 He$ at 180 MeV to Investigate Charge Symmetry." LAMPF Exp. #546, B. Nefkens,

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spokesman. 250 hours have been used for taking data employing a 30,000 Ci tritium target. In this experiment we introduced the idea of the superratio. This resulted in the discovery of a new type of charge symmetry violation, namely, the inequality in the wavefunctions of the tri nucleon system. The final article has just been published in Phys. Rev C. This project is now completed.

II-2: "Angle and Energy Dependence of the Superratio of π^+ and π^- Elastic Scattering on ^3H and ^3He , Further Evidence for Charge-Symmetry Violation." LAMPF Exp. #905, B. Nefkens, spokesman. 300 hours have been used for data taking using a 180,000 Ci tritium target. The preliminary results on elastic scattering have been published in Phys. Lett. The final paper has been submitted to Phys. Rev. C..

II-3: " π^+ and π^- Scattering on Tritium and ^3He in the Region of the NSF-dip." LAMPF proposal #1032, B. Nefkens, B. Berman, W. Briscoe, co-spokesmen. The experiment ran for 280 hours. The data is being analyzed, preliminary results are available.

II-4: "Pion Scattering from ^3H and ^3He near 180° in the Region of the $\Delta(1232)$ Resonance." LAMPF proposal #1064, W. Briscoe, B. Berman, and B. Nefkens, co-spokesmen. Data taking took 480 hours. The analysis is in progress.

II-5: "Measurement of the Superratio in the Backward Hemisphere at $T_\pi = 180$ MeV." LAMPF Experiment #1155, K. Dhuga spokesman. The experiment ran recently for 200 hours and the analysis is in progress.

II-6: "Test of Charge Symmetry by the Comparison of the Cross Sections for $\pi^- d \rightarrow nn$ with $\pi^+ d \rightarrow pp$." TRIUMF Exp. #270, B. Nefkens, spokesman. 250 hours were used for data taking at 4 incident pion energies. The analysis is substantially done, and preliminary results have been submitted for publication.

II-7: "Charge Symmetry, Quarks and Mesons." This is a lengthy survey article to appear shortly in Physics Reports. This work was done in collaboration with G. Miller and I. Slaus.

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Program III Studies of Baryon Resonances: πN Scattering, Inverse Pion Photoproduction, Eta-Meson Photoproduction, and the Reaction $\pi^- p \rightarrow \eta n$

III-1: "Measurement of the Spin Rotation Parameters A and R in $\pi^+ p$ and $\pi^- p$ Elastic Scattering from 427 to 657 MeV/c." LAMPF proposal #806, B. Nefkens principal spokesman, D. Barlow, W. Briscoe, M. Sadler, spokesmen. The proposal has been approved with A rating and 1700 hours of beam time have been used. The setup included a longitudinal frozen-spin target and a spectrometer-polarimeter combination for processing the spin of the recoil proton. The data analysis is well under way, a Phys. Rev. Lett. has appeared recently, the full paper is in progress.

III-2: "Measurement of the Left-Right Asymmetry in $\pi^- p \uparrow \rightarrow \gamma n$ and $\pi^- p \uparrow \rightarrow \pi^0 n$ in the Region of the $\Delta(1232)$ and Roper Resonances and a Determination of $d\sigma/d\Omega(\gamma n \leftarrow \pi^- p)$." LAMPF proposal #804, B. Nefkens, spokesman. The experiment ran for 1200 hours, the data taking and analysis are finished. Thesis research by G.J. Kim. A Phys. Rev. Lett., Physics Letters, and a Phys. Rev. Brief Report have been published. One long paper is published in Phys. Rev. D, another one has been submitted.

III-3: "Photoproduction of Eta-Mesons." New research on the $S_{11}(1535)$ and other resonances via their photoproduction and decay through the $N\eta$ channel. Research is in progress at ELSA in Bonn.

III-4: "Measurement with a Polarized Target of the Cusp in $\pi^- p \rightarrow \pi^0 n$ and of the Asymmetry in $\pi^- p \rightarrow \eta n$." There is a dire need for good data in the region around the $P_{11}(1440)$ which is just outside the reach of LAMPF. Plans are being discussed to do an experiment at LNPI, Gatchina.

III-5: "Pion-Nucleon Partial Wave Analysis," and " πN Newsletter." The first is theoretical work in support of the above research. The second is a survey and appraisal of the field.

III-6: "Electroproduction of etas near Threshold." New research being considered

for MAMI.

Program IV: Exploratory Investigations in Support of the Previous Programs

IV-1: "Feasibility Study of Tagged Eta Meson Production in $p + {}^3 H \rightarrow {}^4 He + \eta$." LAMPF proposal #1135, C. Pillai, D. Barlow, and C. Mishra, spokesmen. An exploratory investigation of a novel way to produce tagged eta mesons at LAMPF. We propose to use the MRS or HRS near 0° to detect the ${}^4 He$'s and our 180,000 curies gaseous tritium target used in Program II. A test run has been approved, it awaits installation of the tritium safety systems.

IV-2: " ${}^6 Li + p \rightarrow {}^7 Be + \eta$ near Threshold." Saturne, B. Nefkens spokesman. A test run was made in July, another is planned when the ${}^6 Li$ beam at Saturne becomes available.

IV-3: Eta Production in Three-body Reactions " $p + p \rightarrow p + p + \eta$ near Threshold." Saturne #174, O. Bing spokesman. Some data were obtained in summer of 1989 using SPES III, preliminary results are available. " $p + d \rightarrow p + d + \eta$ far above Threshold" Saturne #186, Y. LeBornec spokesman. Data runs were made in spring 1989.

IV-4: "Particle Physics with PILAC." Physics options with a clean, intense monochromatic π^+ and π^- beam at $p_\pi = 0.7$ to 1.3 GeV/c.

IV-5: "Quark Physics with a Phi Meson Factory." Summary of quark physics options presented at the UCLA ϕ Factory Workshop.

IV-6: "A New Approach to Measuring the Neutron Electric Dipole Moment." Exploratory investigation for a new measurement of $\mu_E(n)$ at LANSCE.

The partition of the budget among the four programs for the next year is as follows:

Program I: 45%

Program II: 20%

Program III: 25%

Program IV: 10%

Alternatively, the budget can be divided into:

Analyzing data already acquired: 30%

Construction and testing of equipment and experiment preparation 40%

Running of experiments: 30%

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