

Final Progress Report for Research Projects Funded by Health Research Grants

Instructions: Please complete all of the items as instructed. Do not delete instructions. Do not leave any items blank; responses must be provided for all items. If your response to an item is “None”, please specify “None” as your response. “Not applicable” is not an acceptable response for any of the items. There is no limit to the length of your response to any question. Responses should be single-spaced, no smaller than 12-point type. The report **must be completed using MS Word**. Submitted reports must be Word documents; they should not be converted to pdf format. Questions? Contact Health Research Program staff at 717-783-2548.

1. **Grantee Institution:** Carnegie Mellon University
2. **Reporting Period (start and end date of grant award period):** 1/1/09-12/31/11
3. **Grant Contact Person (First Name, M.I., Last Name, Degrees):** Jim Osborn, MS
4. **Grant Contact Person’s Telephone Number:** 412-268-6553
5. **Grant SAP Number:** 4100047627
6. **Project Number and Title of Research Project:** 1: Mellon Institute Vivarium - Research Infrastructure
7. **Start and End Date of Research Project:** 1/1/09-12/31/11
8. **Name of Principal Investigator for the Research Project:** Frederick Gilman
9. **Research Project Expenses.**

9(A) Please provide the amount of health research grant funds spent on this project for the entire duration of the grant, including any interest earned that was spent:

\$ 369,887

9(B) Provide the last names (include first initial if multiple individuals with the same last name are listed) of **all** persons who worked on this research project and were supported with health research funds. Include position titles (Principal Investigator, Graduate Assistant, Post-doctoral Fellow, etc.), percent of effort on project and total health research funds expended for the position. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name	Position Title	% of Effort on Project	Cost
Jennifer Dry-Henich	Manager of MICV	0% Yr 1-2; 52% Yr 3	\$31,535

9(C) Provide the names of **all** persons who worked on this research project, but who *were not* supported with health research funds. Include position titles (Research Assistant, Administrative Assistant, etc.) and percent of effort on project. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name	Position Title	% of Effort on Project
None		

9(D) Provide a list of **all** scientific equipment purchased as part of this research grant, a short description of the value (benefit) derived by the institution from this equipment, and the cost of the equipment.

Type of Scientific Equipment	Value Derived	Cost
None		

10. Co-funding of Research Project during Health Research Grant Award Period. Did this research project receive funding from any other source during the project period when it was supported by the health research grant?

Yes _____ X _____ No _____

If yes, please indicate the source and amount of other funds:

Pittsburgh Life Sciences Greenhouse \$ 467,711

Carnegie Mellon University \$ 7,352,597

11. Leveraging of Additional Funds

11(A) As a result of the health research funds provided for this research project, were you able to apply for and/or obtain funding from other sources to continue or expand the research?

Yes _____ No X _____

If yes, please list the applications submitted (column A), the funding agency (National Institutes of Health—NIH, or other source in column B), the month and year when the application was submitted (column C), and the amount of funds requested (column D). If you have received a notice that the grant will be funded, please indicate the amount of funds to be awarded (column E). If the grant was not funded, insert “not funded” in column E.

Do not include funding from your own institution or from CURE (tobacco settlement funds). Do not include grants submitted prior to the start date of the grant as shown in Question 2. If you list grants submitted within 1-6 months of the start date of this grant, add a statement below the table indicating how the data/results from this project were used to secure that grant.

A. Title of research project on grant application	B. Funding agency (check those that apply)	C. Month and Year Submitted	D. Amount of funds requested:	E. Amount of funds to be awarded:
	<input type="checkbox"/> NIH <input type="checkbox"/> Other federal (specify: _____) <input type="checkbox"/> Nonfederal source (specify: _____)		\$	\$
	<input type="checkbox"/> NIH <input type="checkbox"/> Other federal (specify: _____) <input type="checkbox"/> Nonfederal source (specify: _____)		\$	\$
	<input type="checkbox"/> NIH <input type="checkbox"/> Other federal (specify: _____) <input type="checkbox"/> Nonfederal source (specify: _____)		\$	\$

11(B) Are you planning to apply for additional funding in the future to continue or expand the research?

Yes _____ No _____

If yes, please describe your plans:

12. Future of Research Project. What are the future plans for this research project?

This infrastructure grant was used to fund the construction of a new centralized rodent vivarium for use by researchers at CMU.

This construction project was completed in July of 2011 and the facility then underwent extensive cleaning, sterilization, testing and commissioning of all systems. In addition, small numbers of sentinel animals were kept in the facility for 8 weeks to determine whether any pathogens were introduced into the facility during construction.

Research animals were introduced into the facility in October 2011. Since that time, the facility has been in continuous use by approximately 8 investigators. Several groups are still in the process of ramping up their use of the facility as equipment is moved into the facility and additional transgenic mouse lines are purchased or brought through quarantine.

The vivarium has proven very important for recruiting new faculty to the Biological Sciences Department and for facilitating research of existing faculty. For example, among the first users of the facility were students and postdocs from the lab of Dr. Adam Linstedt of CMU Biological Sciences. Their work led to the development and validation of a possible novel treatment for shigella toxicity, a condition which results from infection by pathogenic strains of *e-coli*. These experiments, which have already been published in the journal *Science* could not have been performed without this facility. The Linstedt lab's future work in this area is also highly dependent on this facility.

13. New Investigator Training and Development. Did students participate in project supported internships or graduate or post-graduate training for at least one semester or one summer?

Yes _____ No _____

If yes, how many students? Please specify in the tables below:

	Undergraduate	Masters	Pre-doc	Post-doc
Male				
Female				
Unknown				
Total				

	Undergraduate	Masters	Pre-doc	Post-doc
Hispanic				
Non-Hispanic				
Unknown				
Total				

	Undergraduate	Masters	Pre-doc	Post-doc
White				
Black				
Asian				
Other				
Unknown				
Total				

14. Recruitment of Out-of-State Researchers. Did you bring researchers into Pennsylvania to carry out this research project?

Yes _____ No _____

If yes, please list the name and degree of each researcher and his/her previous affiliation:

15. Impact on Research Capacity and Quality. Did the health research project enhance the quality and/or capacity of research at your institution?

Yes _____ No _____

If yes, describe how improvements in infrastructure, the addition of new investigators, and other resources have led to more and better research.

This project represents an enormous upgrade in the capacity of CMU researchers to perform work on rodent model systems, and also has led to improved infrastructure for scientific research overall.

1. The capacity for housing rats and mice has been increased several fold. This will allow the University to hire faculty doing more medically oriented research that involves rodent disease models. We are recruiting two such faculty right now.
2. The ability to bring in novel genetically modified animals has been hugely improved through the upgrade of space for quarantining animals. Also, this process can be done much more safely in the new facility than was possible previously.
3. Existing research can be performed in a way that is much improved because this modern facility allows better protection of animals from possible exposure to

pathogens that may alter research results. This will allow preservation of genetically unique strains and better animal welfare.

4. Moreover, because of the provision of specialized rooms for animals that have undergone experimental manipulations, the new facility dramatically reduces the likelihood of cross contamination from different labs.
5. The new facility has space for behavioral and other experiments that previously could not be performed in any existing CMU facility. This will make CMU researchers more competitive for federal grants, facilitate their involvement with biotechnology and pharmaceutical companies and promote collaborations with other researchers at institutions in Pennsylvania and across the world.

16. Collaboration, business and community involvement.

16(A) Did the health research funds lead to collaboration with research partners outside of your institution (e.g., entire university, entire hospital system)?

Yes _____ No X

If yes, please describe the collaborations:

16(B) Did the research project result in commercial development of any research products?

Yes _____ No X

If yes, please describe commercial development activities that resulted from the research project:

16(C) Did the research lead to new involvement with the community?

Yes _____ No X

If yes, please describe involvement with community groups that resulted from the research project:

17. Progress in Achieving Research Goals, Objectives and Aims.

List the project goals, objectives and specific aims (as contained in the grant application’s strategic plan). Summarize the progress made in achieving these goals, objectives and aims for the period that the project was funded (i.e., from project start date through end date).

Indicate whether or not each goal/objective/aim was achieved; if something was not achieved, note the reasons why. Describe the methods used. If changes were made to the research goals/objectives/aims, methods, design or timeline since the original grant application was submitted, please describe the changes. Provide detailed results of the project. Include evidence of the data that was generated and analyzed, and provide tables,

graphs, and figures of the data. List published abstracts, poster presentations and scientific meeting presentations at the end of the summary of progress; peer-reviewed publications should be listed under item 20.

This response should be a DETAILED report of the methods and findings. It is not sufficient to state that the work was completed. Insufficient information may result in an unfavorable performance review, which may jeopardize future funding. If research findings are pending publication you must still include enough detail for the expert peer reviewers to evaluate the progress during the course of the project.

Health research grants funded under the Tobacco Settlement Act will be evaluated via a performance review by an expert panel of researchers and clinicians who will assess project work using this Final Progress Report, all project Annual Reports and the project's strategic plan. After the final performance review of each project is complete, approximately 12-16 months after the end of the grant, this Final Progress Report, as well as the Final Performance Review Report containing the comments of the expert review panel, and the grantee's written response to the Final Performance Review Report, will be posted on the CURE Web site.

There is no limit to the length of your response. Responses must be single-spaced below, no smaller than 12-point type. If you cut and paste text from a publication, be sure symbols print properly, e.g., the Greek symbol for alpha (α) and beta (β) should not print as boxes (\square) and include the appropriate citation(s). DO NOT DELETE THESE INSTRUCTIONS.

This was an infrastructure grant the goal of which was to build a new centralized rodent vivarium. This was achieved when the new facility was opened in October. The new facility consists of almost 9,000 sq ft of usable space which can hold >2,500 research animals, improved space for quarantine and behavioral testing. The space also improves our ability to work with biosafety level 2 animals and reagents, allows the development of research projects that require longitudinal analysis or work in aged animals.

18. Extent of Clinical Activities Initiated and Completed. Items 18(A) and 18(B) should be completed for all research projects. If the project was restricted to secondary analysis of clinical data or data analysis of clinical research, then responses to 18(A) and 18(B) should be "No."

18(A) Did you initiate a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

Yes
 No

18(B) Did you complete a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

Yes
 No

If “Yes” to either 18(A) or 18(B), items 18(C) – (F) must also be completed. (Do NOT complete 18(C-F) if 18(A) and 18(B) are both “No.”)

18(C) How many hospital and health care professionals were involved in the research project?

Number of hospital and health care professionals involved in the research project

18(D) How many subjects were included in the study compared to targeted goals?

Number of subjects originally targeted to be included in the study
 Number of subjects enrolled in the study

Note: Studies that fall dramatically short on recruitment are encouraged to provide the details of their recruitment efforts in Item 17, Progress in Achieving Research Goals, Objectives and Aims. For example, the number of eligible subjects approached, the number that refused to participate and the reasons for refusal. Without this information it is difficult to discern whether eligibility criteria were too restrictive or the study simply did not appeal to subjects.

18(E) How many subjects were enrolled in the study by gender, ethnicity and race?

Gender:

Males
 Females
 Unknown

Ethnicity:

Latinos or Hispanics
 Not Latinos or Hispanics
 Unknown

Race:

American Indian or Alaska Native
 Asian
 Blacks or African American
 Native Hawaiian or Other Pacific Islander
 White
 Other, specify: _____
 Unknown

18(F) Where was the research study conducted? (List the county where the research study was conducted. If the treatment, prevention and diagnostic tests were offered in more than one county, list all of the counties where the research study was conducted.)

19. Human Embryonic Stem Cell Research. Item 19(A) should be completed for all research projects. If the research project involved human embryonic stem cells, items 19(B) and 19(C) must also be completed.

19(A) Did this project involve, in any capacity, human embryonic stem cells?

Yes
 No

19(B) Were these stem cell lines NIH-approved lines that were derived outside of Pennsylvania?

Yes
 No

19(C) Please describe how this project involved human embryonic stem cells:

20. Articles Submitted to Peer-Reviewed Publications.

20(A) Identify all publications that resulted from the research performed during the funding period and that have been submitted to peer-reviewed publications. Do not list journal abstracts or presentations at professional meetings; abstract and meeting presentations should be listed at the end of item 17. **Include only those publications that acknowledge the Pennsylvania Department of Health as a funding source** (as required in the grant agreement). List the title of the journal article, the authors, the name of the peer-reviewed publication, the month and year when it was submitted, and the status of publication (submitted for publication, accepted for publication or published.). Submit an electronic copy of each publication or paper submitted for publication, listed in the table, in a PDF version 5.0.5 (or greater) format, 1,200 dpi. Filenames for each publication should include the number of the research project, the last name of the PI, the number of the publication and an abbreviated research project title. For example, if you submit two publications for PI Smith for the “Cognition and MRI in Older Adults” research project (Project 1), and two publications for PI Zhang for the “Lung Cancer” research project (Project 3), the filenames should be:

- Project 1 – Smith – Publication 1 – Cognition and MRI
- Project 1 – Smith – Publication 2 – Cognition and MRI
- Project 3 – Zhang – Publication 1 – Lung Cancer
- Project 3 – Zhang – Publication 2 – Lung Cancer

If the publication is not available electronically, provide 5 paper copies of the publication.

Note: The grant agreement requires that recipients acknowledge the Pennsylvania Department of Health funding in all publications. Please ensure that all publications listed acknowledge the Department of Health funding. If a publication does not acknowledge the funding from the Commonwealth, do not list the publication.

Because infrastructure funding is not typically acknowledged in publications, we have no qualifying publications.

Title of Journal Article:	Authors:	Name of Peer-reviewed Publication:	Month and Year Submitted:	Publication Status (check appropriate box below):
1.				<input type="checkbox"/> Submitted <input type="checkbox"/> Accepted <input type="checkbox"/> Published
2.				<input type="checkbox"/> Submitted <input type="checkbox"/> Accepted <input type="checkbox"/> Published
3.				<input type="checkbox"/> Submitted <input type="checkbox"/> Accepted <input type="checkbox"/> Published

20(B) Based on this project, are you planning to submit articles to peer-reviewed publications in the future?

Yes No

If yes, please describe your plans:

As indicated above, we anticipate that many articles will be published, but because this was an infrastructure grant, these publications will not acknowledge this funding.

21. Changes in Outcome, Impact and Effectiveness Attributable to the Research Project.

Describe the outcome, impact, and effectiveness of the research project by summarizing its impact on the incidence of disease, death from disease, stage of disease at time of diagnosis, or other relevant measures of outcome, impact or effectiveness of the research project. If there were no changes, insert “None”; do not use “Not applicable.” Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

Because the vivarium was just opened a few months ago, only one project using this facility has been completed and published. This study demonstrated that manganese is a potentially effective treatment for kidney failure that results from *shigella* or *e. coli* infection

Manganese blocks intracellular trafficking of Shiga toxin and protects against Shiga toxicosis.

Mukhopadhyay S, Linstedt AD.
Science. 2012 Jan 20;335(6066):332-5..

22. Major Discoveries, New Drugs, and New Approaches for Prevention Diagnosis and Treatment. Describe major discoveries, new drugs, and new approaches for prevention, diagnosis and treatment that are attributable to the completed research project. If there were no major discoveries, drugs or approaches, insert “None”; do not use “Not applicable.” Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

The paper mentioned above describes a potential new treatment for complications that result from *shigella* or *e. coli* infection.

This work is summarized in the abstract below. All the mouse work in this paper was performed in the new vivarium.

Infections with Shiga toxin (STx)-producing bacteria cause more than a million deaths each year and have no definitive treatment. To exert its cytotoxic effect, STx invades cells through retrograde membrane trafficking, escaping the lysosomal degradative pathway. We found that the widely available metal manganese (Mn(2+)) blocked endosome-to-Golgi trafficking of STx and caused its degradation in lysosomes. Mn(2+) targeted the cycling Golgi protein GPP130, which STx bound in control cells during sorting into Golgi-directed endosomal tubules that bypass lysosomes. In tissue culture cells, treatment with Mn(2+) yielded a protection factor of 3800 against STx-induced cell death. Furthermore, mice injected with nontoxic doses of Mn(2+) were completely resistant to a lethal STx challenge. Thus, Mn(2+) may represent a low-cost therapeutic agent for the treatment of STx infections.

23. Inventions, Patents and Commercial Development Opportunities.

23(A) Were any inventions, which may be patentable or otherwise protectable under Title 35 of the United States Code, conceived or first actually reduced to practice in the performance of work under this health research grant? Yes _____ No X

If “Yes” to 23(A), complete items a – g below for each invention. (Do NOT complete items a - g if 23(A) is “No.”)

- a. Title of Invention:
- b. Name of Inventor(s):
- c. Technical Description of Invention (describe nature, purpose, operation and physical, chemical, biological or electrical characteristics of the invention):
- d. Was a patent filed for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?

Yes _____ No _____

If yes, indicate date patent was filed:

- e. Was a patent issued for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?

Yes _____ No _____

If yes, indicate number of patent, title and date issued:

Patent number:

Title of patent:

Date issued:

- f. Were any licenses granted for the patent obtained as a result of work performed under this health research grant? Yes _____ No _____

If yes, how many licenses were granted? _____

- g. Were any commercial development activities taken to develop the invention into a commercial product or service for manufacture or sale? Yes _____ No _____

If yes, describe the commercial development activities:

23(B) Based on the results of this project, are you planning to file for any licenses or patents, or undertake any commercial development opportunities in the future?

Yes _____ No _____ X _____

If yes, please describe your plans:

24. Key Investigator Qualifications. Briefly describe the education, research interests and experience and professional commitments of the Principal Investigator and all other key investigators. In place of narrative you may insert the NIH biosketch form here; however, please limit each biosketch to 1-2 pages. *For Nonformula grants only – include information for only those key investigators whose biosketches were not included in the original grant application.*

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2. Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME		POSITION TITLE	
Frederick J. Gilman		Dean, Mellon College of Science	
eRA COMMONS USER NAME		Professor of Theoretical Physics	
EDUCATION/TRAINING (<i>Begin with baccalaureate or other initial professional education, such as nursing, and</i>			
INSTITUTION AND LOCATION	DEGREE (<i>if applicable</i>)	YEAR(s)	FIELD OF STUDY
Michigan State University	B.S.	1958-62	Physics
Princeton University	Ph.D.	1962-65	Physics
California Institute of Technology	Postdoctoral Fellow	1965-67	Theoretical Physics

A. Positions and Honors:**Carnegie Mellon University, Pittsburgh, PA (1995-present)**

Dean, Mellon College of Science, Carnegie Mellon University, April 2008-present

Acting Dean, Mellon College of Science, Carnegie Mellon, September 2007-April 2008

Head, Department of Physics, Carnegie Mellon, December 1999-April 2008

Superconducting Super Collider Laboratory, Dallas, Texas (1990-1995)

Deputy Director, 1994-95

Associate Director and Head of the Physics Research Division, 1990-94

Stanford University, Stanford, CA – Stanford Linear Accelerator Center (1967-1990)

Professor, 1973-90; Associate Professor, 1969-73; Research Associate, 1967-69

Institute for Advanced Study (1974) - Visiting Professor**California Institute of Technology (1973) - Visiting Professor****Fermilab (1972) - Visiting Professor****Honors:**

Fellow of the American Physics Society

National Science Foundation Postdoctoral Fellow, 1965-66

National Science Foundation Predoctoral Fellow, 1962-65

Invited talks (selected):

F. J. Gilman, "Roadmap to the Future", invited summary talk at the 2004 SLAC Summer Institute in Particle Physics, *Nature's Greatest Puzzles*, August 2-13, 2004, Stanford, California; published in eConf: <http://www.slac.stanford.edu/econf/C040802/>.

F. J. Gilman, "The Particle Physics Roadmap," invited summary talk at the Aspen Winter Conference on Particle Physics, February 7, 2004, Aspen, Colorado.

F. J. Gilman, "The future of B Physics at Hadron Machines", invited talk given at Beauty 2002, Santiago de Compostella, Spain, June 17-21, 2002. Published in Nucl. Phys. Proc. Suppl. 120, 338 (2003).

F. J. Gilman, "Workshop Summary", invited talk at the Fourth International conference on B Physics and CP Violation, Ise-Shima, Japan, February 19 - 23, 2001, in *B Physics and CP Violation*, edited by T. Oshima and A. Sanda (World Scientific, Singapore, 2001), p. 235.

B. Selected Peer-Reviewed Publications

C.-W. Chiang and F. J. Gilman, "K(L,S) \rightarrow pi pi neutrino antineutrino Decays Within and Beyond the Standard Model," *Phys. Rev. D* **62**, 094026 (2000).

STANDARD MODEL PREDICTIONS FOR CP VIOLATION IN B0 MESON DECAY. By Claudio Dib, Isard Dunietz, Frederick J. Gilman, Yosef Nir (SLAC), SLAC-PUB-5109, Oct 1989. 34pp. Published in *Phys. Rev. D* **41**:1522, 1990.

K(L) \rightarrow PI0 LEPTON+ LEPTON- DECAYS FOR LARGE M(T). By Claudio Dib, Isard Dunietz, Frederick J. Gilman (SLAC), SLAC-PUB-4818, Dec 1988. 41pp. Published in *Phys. Rev. D* **39**:2639, 1989.

CALCULATION OF EXCLUSIVE DECAY MODES OF THE TAU. By Frederick J. Gilman, Sun Hong Rhie (SLAC), SLAC-PUB-3444, Sep 1984. 28pp. Published in *Phys. Rev. D* **31**:1066, 1985.

K0 ANTI-K0 MIXING IN THE SIX QUARK MODEL. By Frederick J. Gilman (SLAC), Mark B. Wise (Harvard U.), SLAC-PUB-2940, Jun 1982. 33pp. Published in *Phys. Rev. D* **27**:1128, 1983.

STRONG INTERACTION CORRECTIONS TO K0 ANTI-K0 MIXING IN THE SIX QUARKMODEL. By Frederick J. Gilman, Mark B. Wise (SLAC), SLAC-PUB-2473, Feb 1980. 15pp. Published in *Phys. Lett.* **93B**:129, 1980.

K \rightarrow PI E+ E- IN THE SIX QUARK MODEL. By Frederick J. Gilman, Mark B. Wise (SLAC), SLAC-PUB-2437, Nov 1979. 45pp. Published in *Phys. Rev. D* **21**:3150, 1980.

EFFECTIVE HAMILTONIAN FOR DELTA S = 1 WEAK NONLEPTONIC DECAYS IN THE SIX QUARK MODEL. By Frederick J. Gilman, Mark B. Wise (SLAC), SLAC-PUB-2341, May 1979. 49pp. Published in *Phys. Rev. D* **20**:2392, 1979.

THE DELTA I = 1/2 RULE AND VIOLATION OF CP IN THE SIX QUARK MODEL. By Frederick J. Gilman, Mark B. Wise (SLAC), SLAC-PUB-2243, Nov 1978. 13pp. Published in *Phys. Lett.* **83B**:83, 1979.

THE TRANSFORMATION BETWEEN CURRENT AND CONSTITUENT QUARKS AND TRANSITIONS BETWEEN HADRONS. By Frederick J. Gilman (Cal Tech & SLAC), M. Kugler (SLAC), Sydney Meshkov (Cal Tech & NIST, Wash., D.C.), SLAC-PUB-1286, Aug 1973. 69pp. Published in *Phys. Rev. D* **9**:715, 1974.

PIONIC TRANSITIONS AS TESTS OF THE CONNECTION BETWEEN CURRENT AND CONSTITUENT QUARKS. By Frederick J. Gilman (Cal Tech & SLAC), M. Kugler (SLAC), Sydney Meshkov (Cal Tech & NIST, Wash., D.C.), SLAC-PUB-1235, Apr 1973. 14pp. Published in *Phys. Lett.* **45B**:481, 1973.

SCALING AND THE BEHAVIOR OF NUCLEON RESONANCES IN INELASTIC ELECTRON -NUCLEON SCATTERING. By E.D. Bloom, Frederick J. Gilman (SLAC), SLAC-PUB-0942, Aug 1971. 51pp. Published in *Phys. Rev. D* **4**:2901, 1971.

SCALING, DUALITY, AND THE BEHAVIOR OF RESONANCES IN INELASTIC ELECTRON- PROTON SCATTERING. By E.D. Bloom, Frederick J. Gilman (SLAC), SLAC-PUB-0779, Jun 1970. 11pp. Published in *Phys. Rev. Lett.* **25**:1140, 1970.

THE SIGN OF THE PI0 \rightarrow GAMMA GAMMA DECAY AMPLITUDE. By Frederick J. Gilman (SLAC), SLAC-PUB-0594, Apr 1969. 7pp. Published in *Phys. Rev.* **184**:1964-5, 1969.

STRONG INTERACTION SUM RULES FOR PION - HADRON SCATTERING. By Frederick J. Gilman, Haim Harari (SLAC), SLAC-PUB-0345, Sep 1967. 100pp. Published in *Phys. Rev.* **165**:1803-29, 1968.

C. Research Support (current)

DOE	High Energy Physics	1/01/2007-10/31/2008	\$1,430,000.00
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(1 of 9 faculty supported by this grant, renewed in 2006 for three years)