DOE/ER-0028

Basic Research Projects

April 1979

U.S. Department of Energy
Office of High Energy and Nuclear Physics
and
Office of Basic Energy Sciences

DISCLAIMER

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U.S. Department of Energy
Office of High Energy and Nuclear Physics
and
Office of Basic Energy Sciences
Washington, D.C. 20545

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FOREWORD AND SUMMARY

The research programs under the cognizance of the Office of Energy Research (OER) consist primarily of fundamental theoretical and experimental investigations designed to support the objectives of the Department of Energy (DOE). These programs are directed toward discovery of natural laws and new knowledge, and to improved understanding of the physical and biological sciences as related to the development, use, and control of energy. The ultimate goal is to develop a scientific underlay for the overall DOE effort and the fundamental principles of natural phenomena so that these phenomena may be understood and new principles formulated.

The DOE-OER outlay activities include three major programs: High Energy Physics, Nuclear Physics, and Basic Energy Sciences.

The major objective of the High Energy Physics program is to explore and understand the properties and nature of energy and matter in their most basic forms. This involves the study of nature's basic forces and their relationships to the properties and nature of energy and matter. Incidental to this basic research is the development of new technologies required for advanced accelerator and detector facilities.

The objectives of the Nuclear Physics program are: to attain a deeper understanding of the structure and properties of atomic nuclei and the laws governing their motions and interactions through experimental medium energy and heavy ion research; to develop a unified theoretical understanding of nuclear phenomena and to interpret experimental results in terms of fundamental theory; and to identify practical applications resulting from medium energy and heavy ion research studies and to transfer the results to the appropriate scientific discipline or technology.

The objectives of the Basic Energy Sciences program are to expand the knowledge base in physical and biological science and engineering for all energy conversion and conservation technologies. The program produces knowledge which serves three general types of users: scientists and engineers who will be involved in the next generation of energy development efforts; scientists and engineers outside DOE interested in solving energy-related problems; and scientists and engineers in current applied research and development programs of the Department. Direct commercialization of results from basic research has occurred fairly often; however, more often the benefits accrue as the accumulated knowledge and understanding of detailed processes become an integral part of the body of data on which applied technologies rest. Basic Energy Sciences comprises six major activities; nuclear science; materials sciences; chemical sciences; engineering, mathematical and geosciences; advanced energy projects; and biological energy research.

Taken together, these programs represent some 30 percent of the Nation's Federal support of basic research in the energy sciences. The research activities of OER involve more than 6,000 scientists and engineers working in some 17 major Federal Research Centers and at more than 135 different universities and industrial firms throughout the United States.

The programs are managed by OER through its Offices of High Energy and Nuclear Physics (HENP) and Basic Energy Sciences (BES), and to a considerable extent represent significant expansion and redirection of research previously carried out under the cognizance of the Division of Physical Research of the Energy Research and Development Administration, which was incorporated into the new Department of Energy on October 1, 1977.

Approximately four-fifths of these program costs are associated with research conducted in DOE-owned, contractor (non-Federal)-operated, Federally Funded Research and Development Centers (FFRDC's). The major portion of the costs are spent at the well-known multi-program "national" laboratories at Argonne, Illinois; Berkeley, California; Brookhaven, New York; Los Alamos, New Mexico; and Oak Ridge, Tennessee; and at the high energy physics research centers at Batavia, Illinois; and Stanford, California.

About one-fifth of the costs are associated with the support of research conducted in other laboratories (designated "off-site"). Most of the off-site research is conducted at educational institutions and is based almost entirely on unsolicited proposals.

The following table summarizes the level of effort of the OER outlay programs managed by HENP and BES. Amounts listed represent estimated FY 1979 budget outlays for operations and equipment. Funding for construction and miscellaneous research-support activities, such as for other Federal agencies, National Academy of Sciences committees, special analyses, awards, exhibits, conferences, workshops, inventories, etc., are not included.

	FFRDC's	Off-Site Research	
	Amount (in millions)	No. of Projects	Amount (in millions)
High Energy Physics	$ 197.7	75	$ 35.5
Nuclear Physics	61.8	60	17.3
Basic Energy Sciences	130.7	395	43.7
TOTAL	$ 390.2	530	$ 96.5

There is no clear line of demarcation between National Laboratories, other Federally Funded Research and Development Centers, and off-site laboratories. The DOE investment in facilities ranges from zero for some contractors to tens of millions of dollars for others, and the annual level of DOE support ranges from a few thousand dollars for some contractors, to tens of millions of dollars for others--the spectrum is broad with no significant breaks.

At the multi-program national laboratories, the OER outlay programs provide, in varying degrees, some of the basic investigations underlying the more applied or developmental activities of such laboratories. Other FFRDC's include laboratories that are engaged in research in a single well-defined area. All FFRDC's have the following common characteristics:

1. They are operated for the Federal Government by universities, not-for-profit organizations for private industry;

2. They are treated as national facilities;

3. They represent large investments (several millions of dollars) in DOE-owned capital facilities; and

4. They have large annual levels (several millions of dollars) of DOE support.

The objective of the basic research program is to search for and discover new knowledge within the mission-oriented framework of DOE. It is from this expanding reservoir of knowledge that developmental accomplishments are ultimately achieved. The off-site program complements the FFRDC's in the advancement of science in those disciplines that are fundamental to DOE's programs.

FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS*

Name and Location of Laboratory	Operating Contractor
AMES LABORATORY Ames, Iowa	Iowa State University of Science and Technology
ARGONNE NATIONAL LABORATORY (ANL) Argonne (Lemont), Illinois	University of Chicago and Argonne Universities Association
BARTLESVILLE ENERGY TECHNOLOGY CENTER (BETC) Bartlesville, Oklahoma	DOE-Operated
BROOKHAVEN NATIONAL LABORATORY (BNL) Upton, Long Island, New York	Associated Universities, Inc.
FERMI NATIONAL ACCELERATOR LABORATORY Batavia, Illinois	Universities Research Association
IDAHO NATIONAL ENGINEERING LABORATORY (INEL) Idaho Falls, Idaho	Aerojet Nuclear Company
LAWRENCE BERKELEY LABORATORY (LBL) Berkeley, California	University of California
LAWRENCE LIVERMORE LABORATORY (LLL) Livermore, California	University of California
LOS ALAMOS SCIENTIFIC LABORATORY (LASL) Los Alamos, New Mexico	University of California
MORGANTOWN ENERGY TECHNOLOGY CENTER (METC) Morgantown, West Virginia	DOE-Operated
MOUND FACILITY Miamisburg, Ohio	Monsanto Research Corporation
OAK RIDGE ASSOCIATED UNIVERITIES (ORAU) Oak Ridge, Tennessee	Oak Ridge Associated Universities
OAK RIDGE NATIONAL LABORTORY (ORNL) Oak Ridge, Tennessee	Union Carbide Corporation
PACIFIC NORTHWEST LABORATORY (PNL) Richland, Washington	Battelle Memorial Institute
PITTSBURGH ENERGY TECHNOLOGY CENTER (PETC) Pittsburgh, Pennsylvania	DOE-Operated
SANDIA LABORATORIES Albuquerque, New Mexico and Livermore, California	Western Electric-Bell
STANFORD LINEAR ACCELERATOR CENTER (SLAC) Palo Alto, California	Stanford University

*FFRDC's receiving support from HENP and BES.

FFRDC's - Level of Support by Program
OFFICES OF HENP AND BES
FY 1979 Estimates - Operations and Equipment
($ in 1000's)

Laboratory	TOTAL	High Energy Physics	Nuclear Physics	Basic Energy Sciences
Ames	$ 10,935	$ 720	$ 125	$ 10,090
ANL	50,285	17,300	4,520	28,465
BETC	190	0	0	190
BNL	66,705	39,670	5,090	21,945
Fermilab	79,110	79,110	0	0
INEL	715	0	40	675
LBL	47,030	13,530	18,565	14,935
LLL	3,030	0	95	2,935
LASL	32,300	135	26,865	5,300
METC	140	0	0	140
Mound	1,210	0	0	1,210
ORAU	195	0	195	0
ORNL	43,200	475	6,285	36,440
PNL	4,040	0	0	4,040
PETC	75	0	0	75
Sandia	4,290	0	0	4,290
SLAC	46,790	46,790	0	0
TOTAL	$390,240	$197,730	$ 61,780	$130,730

OFF-SITE RESEARCH PROGRAM

Support of basic research at universities is typically arranged through execution of a special research contract. Under this type of contract, the DOE will contribute to the cost of performing the research, up to a specified amount (referred to as the "support ceiling"), in consideration for the performance of proposed research activities broadly defined in the contract and in accordance with the provisions of the contract.

Large projects (i.e., greater than $1 million) generally are financed by means of a cost-type contract which permits closer DOE surveillance of the work in accordance with appropriate contractual provisions not included in the special research contract. This type of contract is generally used for large-scale research programs performed in laboratories using equipment or facilities that are usually either partially or wholly DOE-owned or controlled and/or for projects that do not lend themselves to accurate cost estimates.

Research at an industrial firm is normally supported through regular fixed-price or cost-type contract arrangements.

Occasionally, no-fund agreements are used in the off-site research program when DOE loans property to an outside organization as DOE's support to the research project or when the organization wishes to enter into a study in a certain area of research before it actually undertakes the research. Also, agreements are frequently extended without additional funds being added when the research project is being completed or terminated and additional time is required to bring that project to an orderly close.

In most cases, the performer proposes to share in the cost of the work conducted under the contract. In order to support the maximum number of important and worthwhile projects within the limits of available funds and to have tangible evidence of the proposing institution's interest in the proposed research, OER encourages cost-sharing. Although sharing by the institution in the cost of the project is desirable, such sharing is not a prerequisite for DOE support, which in the final analysis is determined by the prospective quality of the proposed research, the relative interest of DOE and the institution in the research, and availability of funds on the part of both DOE and the performer. Thus, DOE will pay up to the full cost of a research project.

Most research contracts are written for terms of one year, renewable for additional annual terms. Sometimes terms may run somewhat more or less than one year (e.g., 9 or 15 months), usually for the purpose of establishing a different renewal date. There may also be cases where the project may be written for several years, but with the commitment for funding remaining on an annual basis. Occasionally, multi-year arrangements with full funding are executed, generally where procurement of a major piece of equipment is involved, or where the nature of the research project is such that a clearly defined, fixed term can be established within which the entire research can be carried out.

In practice, contracts tend to run for several years. Most research projects are not of the type that can be completed in one year, or in any specified longer time period that can be estimated in advance with reasonable accuracy. This is informally recognized by the parties concerned, whenever a new research project is approved for support and the customary one year arrangement is made.

An examination of the age at termination of projects that have terminated in recent years shows that about 15% had been in effect for less than 3 years, some 25% for 3 to 5 years, 30% for 5 to 10 years, and about 30% for 10 years or more, and that the average at termination was 7 1/2 years.

Proposals for research are usually initiated by the scientist interested in doing the work and are submitted through administrative channels of his institution to DOE Headquarters.

Those interested in submitting proposals for research support under this program may obtain a copy of a "Guide for the Submission of Unsolicited Proposals" from DOE Headquarters, Washington, D.C. 20545, or from a DOE field office.

Scientific reports on basic research investigations are usually published in the open literature. Special reporting of results in detail before they are ready for publication generally is not required of the performers. DOE supports open publication and wide dissemination as the normal and most desirable means for reporting the findings of fundamental research.

During Fiscal Year 1978 the Offices of High Energy and Nuclear Physics and Basic Energy Sciences received 507 formal unsolicited proposals for new research, representing requests for a total of $43.6 million. On hand at the beginning of FY 1978 pending reviews were 205 new proposals requesting $12.9 million, for a total of 712 proposals representing requests for $56.5 million ($ in millions):

	On Hand 9/30/77		Received in FY 1978		Total	
	No.	Amount	No.	Amount	No.	Amount
High Energy Physics	13	$ .7	40	$ 2.5	53	$ 3.2
Nuclear Physics	11	.5	36	7.8	47	8.3
Basic Energy Sciences	181	11.7	431	33.3	612	45.0
TOTAL	205	$ 12.9	507	$ 43.6	712	$ 56.5

Action Taken - New Proposals - FY 1978

	Approved in FY 1978		Declined, etc. in FY 1978		On Hand 9/30/78	
	No.	Amount	No.	Amount	No.	Amount
High Energy Physics	10	$ .6	31	$ 1.2	12	$ 1.4
Nuclear Physics	4	.2	25	6.8	18	1.3
Basic Energy Sciences	91	6.8	308	22.9	213	15.3
TOTAL	105	$ 7.6	364	$ 30.9	243	$ 18.0

The severity of the competition for available funds for new research projects can be seen if new award amounts are compared with the requests received during the past 10 years ($ in millions):

Fiscal Year	On Hand at Beginning of Year	Received During Year	Approved During Year	Declined, etc. During Year	On Hand at End of Year
1969	148	417 - $ 42.3	76 - $ 2.6	270 - $ 41.8	219
1970	219	412 - 46.6	31 - 1.5	421 - 68.7	179
1971	179	326 - 14.4	18 - .9	321 - 14.6	166
1972	166	200 - 8.7	21 - .7	205 - 11.5	140
1973	140	222 - 11.1	21 - .9	214 - 8.5	127
1974	127	301 - 15.1	20 - 1.0	226 - 11.9	182
1975	182	365 - 23.7	51 - 2.4	306 - 17.4	190
1976 (15 mos.)	190	518 - 44.2	54 - 3.0	407 - 26.2	247
1977	247	421 - 31.3	72 - 3.7	391 - 43.6	205
1978	205	507 - 43.6	105 - 7.6	364 - 30.9	243

Under OER's annual review and renewal system, the yearly turnover rate, i.e., numbers of new projects approved and existing ones terminated, during the 1960's tended to be in the 10-15% range, with an average of some 60 new projects started and a corresponding number of old ones terminated each year. In the early 1970's numbers of new projects started were sharply lower and terminations higher, resulting in a significant reduction in numbers of active projects. The broadened role of ERDA and DOE (as compared to AEC) has permitted some improvement in recent years.

New projects, for administrative reasons, sometimes are written as separate new tasks under an existing agreement; likewise, existing agreements ocasionally may be split into two or more separate ones, or several projects may be combined into one. The following table illustrates the situation in FY 1969-1978 ($ in millions):

Fiscal Year	New Projects	Project Terminations	No. of Projects at End of Year
1969	76 - $ 2.6	58 - $ 1.2	543 - $ 71.1
1970	31 - 1.5	59 - 2.1	515 - 68.5
1971	18 - .9	40 - 1.5	484 - 61.7
1972	21 - .7	142 - 9.8	368 - 50.2
1973	21 - .9	57 - 2.5	330 - 51.1
1974	20 - 1.0	30 - 1.5	315 - 52.2
1975	51 - 2.4	27 - 1.0	332 - 55.6
1976	54 - 3.0	25 - 1.6	356 - 62.1
1977	72 - 3.7	27 - 1.5	404 - 67.1
1978	105 - 7.6	41 - 2.3	468 - 83.2

Research projects in effect as of October 1, 1978 and supported by the DOE Headquarters Offices of HENP and BES are listed on pp. 8-35 by functional area and include the name and location of the contractor, the names(s) of the principal investigator(s), and a short descriptive title of the research and the level of DOE support (i.e., project amount authorized) during the most recent funding period. The amounts listed are for one year unless otherwise indicated.

HIGH ENERGY PHYSICS

Brandeis University, Waltham, Massachusetts. Lawrence E. Kirsch and Howard J. Schnitzer, Research in Elementary Particle Physics. $230,000.

Brown University, Providence, Rhode Island. David Feldman, Anatole M. Shapiro, and Robert E. Lanou, Jr., Experimental and Theoretical High Energy Physics. $470,000.

California Institute of Technology, Pasadena, California. Barry Barish, Experimental, Theoretical and Phenomenological Research. $1,750,000.

California, University of, Davis, California. Richard L. Lander and John F. Gunion, High Energy Particle Physics Research. $259,000.

California, University of, Irvine, California. Frederick Reines, Research Program in Neutrino Physics, Cosmic Rays and Elementary Particles. $490,000.

California, University of, Irvine, California. Jonas Schultz, High Energy Physics Studies. $159,000.

California, University of, Los Angeles, California. Harold K. Ticho and Donald H. Stork, Research in High Energy Physics. $582,000.

California, University of, Riverside, California. Robert T. Poe and Anne Kernan, High Energy Physics. $510,000 (13 months).

California, University of, San Diego, California. Oreste Piccioni and Norman Kroll, Experimental and Theoretical Particle Physics. $520,000.

California, University of, San Diego, California. George Masek, Initial Support of an Intercampus Institute for Research at Particle Accelerators. $202,000.

California, University of, Santa Barbara, California. David O. Caldwell, High Energy User Group. $345,000.

California, University of, Santa Cruz, California. Clemens A. Heusch, Experimental Research in High Energy Physics. $390,000.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Roger B. Sutton, High Energy Physics Users and Theoretical Research. $1,022,000.

Cincinnati, University of, Cincinnati, Ohio. Peter Suranyi, Inelastic Strong Interactions at High Energies. $16,000.

Colorado, University of, Boulder, Colorado. Uriel Nauenberg and David F. Bartlett, Elementary Particles and High Energy Phenomena. $292,000.

Columbia University, New York, New York. T. D. Lee, Theoretical High Energy Physics. $383,000.

Duke University, Durham, North Carolina. William D. Walker, Interactions Between Elementary Particles and Nuclei. $271,000.

Florida State University, Tallahassee, Florida. Joseph E. Lannutti, Elementary Particle Physics. $305,000.

HIGH ENERGY PHYSICS

The Franklin Institute, Philadelphia, Pennsylvania. Thomas K. Gaisser and Arthur Halprin, Particle Theory and Relativity. $115,000 (2 years).

Georgia, University of, Athens, Georgia. T. T. Chou, High Energy Hadron-Hadron Collisions. $19,800 (17 1/2 months).

Harvard University, Cambridge, Massachusetts. K. Strauch, High Energy Physics Research. $1,934,000.

Harvard University, Cambridge, Massachusetts. Tai Tsun Wu, High Energy Collision Processes. $41,500.

Harvard University, Cambridge, Massachusetts. Shlomo Sternberg, Integrability Conditions for the Existence of a Lagrangian in Newtonian Mechanics and Field Theory. $50,000 (15 months).

Hawaii, University of, Honolulu, Hawaii. Vincent Z. Peterson and San Fu Tuan, Research in High Energy Nuclear Physics. $539,000.

Illinois Institute of Technology, Chicago, Illinois. Thomas Erber, Experimental Study of Synchrotron-Cerenkov Radiation. $20,000 (15 months).

Illinois, Universty of, Urbana, Illinois. A. Wattenberg, High Energy Physics Users. $1,470,000.

Indiana University, Bloomington, Indiana. Richard M. Heinz, Homer A. Neal, Archibald W. Hendry and Don B. Lichtenberg, High Energy Physics Group and Theoretical Particle Physics. $530,000.

Institute for Advanced Study, Princeton, New Jersey. Roger F. Dashen and Stephen L. Adler, Problems in Particle Theory. $185,000.

Johns Hopkins University, Baltimore, Maryland. Gabor Domokos, Research in Theoretical Physics. $53,000.

Lehigh University, Bethlehem, Pennsylvania. Alvin Kanofsky, Study of Multiparticle Jet Production Using Calorimeters. $38,000.

Louisiana State University, Baton Rouge, Louisiana. Richard W. Haymaker and Lai-Him Chan, Interrelations Between Symmetry Breaking and Dynamics in Strong Interactions. $25,000.

Maryland, University of, College Park, Maryland. George A. Snow, High Energy Accelerator and Colliding Beam User Group. $950,000 (13 months).

Maryland, University of, College Park, Maryland. Martin P. Reiser, Study of Beam Transport Problems for Heavy Ion Fusion Accelerators. $45,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Martin Deutsch, High Energy Physics Research. $3,820,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Herman Feshbach, Study Group on the Very Big Accelerator. $28,000 (3 years).

HIGH ENERGY PHYSICS

Massachusetts, University of, Amherst, Massachusetts. Janice B. Shafer, Experimental High Energy Physics. $132,000.

Michigan State University, East Lansing, Michigan. Z. Ming Ma, Study of Production Mechanisms for Ideally Mixed $s\bar{s}$ Systems. $48,000.

Michigan, University of, Ann Arbor, Michigan. Richard H. Sands, High Energy Physics Users and Theoretical Research. $1,495,000.

Minnesota, University of, Minneapolis, Minnesota. Stephen Gasiorowicz and Hans W. J. Courant, Theoretical and High Energy Physics. $445,000.

Mount Holyoke College, South Hadley, Massachusetts. Howard W. Nicholson, Jr., Backward Elastic K^-p Scattering Below 1 BeV/c. $41,000.

New Hampshire, University of, Durham, New Hampshire. Asim Yildiz, Particles and Fields and Their Interactions. $20,000.

New York, State University of, Albany, New York. Walter M. Gibson and Chih-Ree Sun, Channeling Effect at Fermilab Energies. $46,000.

Northern Illinois University, DeKalb, Illinois. Frank E. Taylor, High Energy Physics Research. $45,000 (2 years).

Northwestern University, Evanston, Illinois. Jerome L. Rosen, Donald H. Miller, and Martin M. Block, High Energy Physics. $430,000.

Ohio State University, Columbus, Ohio. Thomas A. Romanowski, K. Tanaka and W. W. Wada, High Energy Physics Studies. $548,000.

Oklahoma State University, Stillwater, Oklahoma. Mark A. Samuel, Higher-Order Corrections to the Anomalous Magnetic Moment of the Muon. $20,000.

Oregon, University of, Eugene, Oregon. Paul L. Csonka, Rudolph C. Hwa, and Michael J. Moravcsik, Theory of Elementary Particles. $140,000.

Pennsylvania, University of, Philadelphia, Pennsylvania. Alfred K. Mann, High Energy Physics Research. $1,860,000.

Physical Dynamics, Inc., La Jolla, California. Robert H. G. Helleman and Elliott W. Montroll, Nonlinear Beam Dynamics of Accelerators and Storage Rings. $65,000.

Physics International Company, San Leandro, California. Sidney D. Putnam, Collective Ion Acceleration by Intense Electron Beams in Neutral Gases. $120,000 (14 months).

Princeton University, Princeton, New Jersey. Frank Shoemaker, High Energy Physics Research. $1,305,000.

Purdue University, Lafayette, Indiana. Robert L. Mieher, Fundamental Particle Physics. $1,741,300 (23 months).

Rice University, Houston, Texas. Gerald C. Phillips, Expand Studies of Interactions Among the Elementary Particles at High Energies. $177,700.

Rochester, University of, Rochester, New York. A. C. Melissinos and S. Okubo, High Energy Physics Users and Theoretical Research. $1,035,000.

Rockefeller University, New York, New York. Rodney L. Cool and N. N. Khuri, Studies of Elementary Particle Interactions at High Energies. $525,000.

Rutgers University, Piscataway, New Jersey. Douglas M. Potter, Research in Elementary Particle Physics. $25,000.

Stanford University, Stanford, California. Richard H. Pantell and Melvin A. Piestrup, Development of Laser Particle Acclerators. $85,000.

Stanford University, Stanford, California. Alan Litke, High Energy Physics Research. $95,000 (2 years).

Stanford University, Stanford, California. David M. Ritson, High Energy Physics. $185,000 (5 months).

Syracuse University, Syracuse, New York. K. C. Wali, Research Program in Elementary Particle Theory. $165,000.

Tennessee, University of, Knoxville, Tennessee. William M. Bugg, Bubble Chamber Studies of Hadron and Photon Interactions. $150,000.

Texas, University of, Austin, Texas. E. C. G. Sudarshan and Yuval Ne'eman, Research Program in Elementary Particle Theory. $182,000.

Tufts University, Medford, Massachusetts. J. Schneps and R. H. Milburn, Experimental High Energy Physics Research. $363,000.

Washington University, St. Louis, Missouri. Carl M. Bender and J. Ely Shrauner, Perturbation Methods in Quantum Field Theory. $45,000.

Washington, University of, Seattle, Washington. David G. Boulware, Theoretical Elementary Particle Physics and Quantum Field Theory. $200,000.

Washington, University of, Seattle, Washington. Jere J. Lord, High Energy Physics Studies of Particle Interactions and Search for New Particles. $97,000.

Wayne State University, Detroit, Michigan. Suraj N. Gupta, Quantum Theory of Fields. $36,000.

Wisconsin, University of, Madison, Wisconsin. Don D. Reeder, High Energy Physics Users and Theoretical Research. $1,840,000.

Yale University, New Haven, Connecticut. F. Gursey, V. W. Hughes and J. Sandweiss, High Energy Physics Users and Theoretical Research. $1,626,000.

NUCLEAR PHYSICS

Brown University, Providence, Rhode Island. Stavros Fallieros and Frank S. Levin, Nuclear Excitations and Reaction Mechanisms. $70,000.

California Institute of Technology, Pasadena, California. Felix Boehm, Research in Nuclear Physics at Low and Intermediate Energies. $387,000.

California, University of, Los Angeles, California. George J. Igo and C. A. Whitten, Jr., Intermediate Energy Nuclear Physics Users Group. $250,000.

California, University of, Los Angeles, California. Roy P. Haddock and B. M. K. Nefkens, Particle Physics. $269,245.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Peter D. Barnes and Robert A. Eisenstein, Experimental Nuclear Physics. $299,800.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Morton Kaplan, Nuclear Research with Heavy Ions. $103,500.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Paul J. Karol, Experimental Nuclear and Radiochemistry. $33,000.

Case Western Reserve University, Cleveland, Ohio. Harvey B. Willard, Medium Energy Nuclear Physics Research. $165,000.

Chicago, University of, Chicago, Illinois. Nathan Sugarman and Anthony Turkevich, Nuclear Chemistry Research. $195,000.

Colorado, University of, Boulder, Colorado. E. S. Rost, Study of Fundamental Nuclear Interactions. $180,000.

Connecticut, University of, Storrs, Connecticut. George H. Rawitscher, Theory of Deuteron-Nucleus Interactions. $20,000.

Georgia Institute of Technology, Atlanta, Georgia. Richard W. Fink, Nuclear and X-Ray Spectroscopy with Radioactive Sources. $72,428.

Houston, University of, Houston, Texas. John C. Allred, B. W. Mayes, II and Ed V. Hungerford, III, Pion Interactions at Medium Energies. $160,000.

Johns Hopkins University, Baltimore, Maryland. Leon Madansky and Y. K. Lee, Nuclear Moments and Nuclear Structure. $186,800.

Louisiana State University, Baton Rouge, Louisiana. R. W. Huggett and Paul N. Kirk, Two-Body Dissociation of Light Nuclei in Nuclear Fields. $66,500.

Louisiana State University, Baton Rouge, Louisiana. Edward F. Zganjar, Structure of Nuclei Far from Beta Stability. $30,000.

Maryland, University of, College Park, Maryland. W. M. MacDonald, James J. Griffin, and M. Banerjee, Theoretical Studies in Nuclear Reactions and Nuclear Structure. $345,000.

Maryland, University of, College Park, Maryland. Victor E. Viola, Studies of Heavy-Ion Induced Nuclear Reactions. $77,000.

NUCLEAR PHYSICS

Massachusetts Institute of Technology, Cambridge, Massachusetts. Martin Deutsch, Nuclear Physics Research. $6,925,000.

Massachusetts University of, Amherst, Massachusetts. Gerald A. Peterson, Nuclear Structure Studies by the Scattering of Medium Energy Electrons. $75,000.

Minnesota, University of, Minneapolis, Minnesota. Norton M. Hintz, Nuclear Structure Studies at Intermediate Energies. $80,000.

Montana, University of, Missoula, Montana. Mark J. Jakobson, Total Pion Cross Section Measurements. $16,704.

New Mexico State University, Las Cruces, New Mexico. George R. Burleson, Experimental Studies of Pion-Nucleus Interactions. $55,000.

New Mexico, University of, Albuquerque, New Mexico. Byron D. Dieterle, Christopher P. Leavitt and David M. Wolfe, Nucleon Physics Studies at Intermediate Energies. $199,968.

New York, State University of, Stony Brook, New York. Gerald E. Brown, Andrew D. Jackson, Jr., and Thomas T. S. Kuo, Research in Theoretical Nuclear Physics. $300,000.

New York, State University of, Stony Brook, New York. John M. Alexander, Nuclear Reaction Studies. $106,000.

Northwestern University, Evanston, Illinois. Kamal K. Seth, An Experimental Program in Medium Energy Physics. $85,000.

Oregon State University, Corvallis, Oregon. Walter D. Loveland, Radiochemical Studies of Heavy Ion Reactions. $8,147.

Pennsylvania, University of, Philadelphia, Pennsylvania. Sherman Frankel, Research in Very High-Energy Nuclear Physics. $29,300 (10 months).

Princeton University, Princeton, New Jersey. Robert A. Naumann, Nuclear Chemistry Project. $120,000.

Purdue University, Lafayette, Indiana. Norbert T. Porile, Deexcitation Processes in Nuclear Reactions. $90,000.

Purdue University, Lafayette, Indiana. Rolf M. Steffen, Study of Muonic Atoms. $50,000 (2 years).

Rensselaer Polytechnic Institute, Troy, New York. Daniel Sperber, Theory of Heavy Ion Collisions. $41,000.

Rice University, Houston, Texas. Gerald C. Phillips, Intermediate Energy Nuclear Physics Studies. $318,533.

Rochester, University of, Rochester, New York. J. Bruce French and Daniel S. Koltun, Nuclear Structure Theory. $135,338.

Rochester, University of, Rochester, New York. H. Marshall Blann, Nuclear Reaction Mechanisms. $102,264.

Rochester, University of, Rochester, New York. John R. Huizenga, Studies of Heavy Ion Reactions and Transuranic Nuclei. $164,167.

Temple University, Philadelphia, Pennsylvania. W. Kenneth McFarlane, L. B. Auerbach and V. L. Highland, Experimental Investigation in Particle Physics at Intermediate Energies. $140,000.

Tennessee, University of, Knoxville, Tennessee. Carrol R. Bingham and Leo L. Riedinger, Nuclear Spectroscopic Studies. $43,000.

Texas A & M University, College Station, Texas. Joseph B. Natowitz, Angular Momentum Effects in Nuclear Reactions. $77,000.

Texas A & M University, College Station, Texas. Thomas T. Sugihara, Nuclear Spectroscopy with Heavy Ions. $74,000.

Texas A & M University, College Station, Texas. L. C. Northcliffe, Study of Neutron-Proton Interactions in the 300-700 MeV Energy Region. $125,000.

Texas A & M University, College Station, Texas. Ronald A. Bryan, Intermediate Energy Nuclear Theory. $41,047.

Texas, University of, Austin, Texas. Taro Tamura and Peter J. Riley, Research in Nuclear Physics. $155,989.

Texas, University of, Austin, Texas. Wilfred J. Braithwaite, Gerald W. Hoffmann, and C. Fred Moore, Research in Experimental Nuclear Physics. $70,000.

Vanderbilt University, Nashville, Tennessee. Joseph H. Hamilton, Experimental Nuclear Structure Research. $100,000.

Vassar College, Poughkeepsie, New York. Robert L. Stearns, Hypernuclear Spectroscopy. $11,238.

Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Richard A. Arndt and L. David Roper, Partial Wave Analyses of Scattering Reactions Below 2 GeV. $80,000.

Virginia, University of, Charlottesville, Virginia. Ralph C. Minehart and Klaus O. H. Ziock, Experiments on Nuclear Interactions of Pions. $155,000.

Virginia, University of, Charlottesville, Virginia. James S. McCarthy, Electron Interactions with Nuclei. $110,000 (8 months).

Washington University, St. Louis, Missouri. Demetrios G. Sarantites, Investigation of Nuclear Structure and Nuclear Reactions Induced by Complex Projectiles. $80,000.

Washington, University of, Seattle, Washington. Eric Adelberger and Lowell Brown, Experimental and Theoretical Nuclear Physics. $910,000.

Wyoming, University of, Laramie, Wyoming. Glen A. Rebka, Jr., and Raymond Kunselman, Pion-Nucleon Interactions and Mesonic Atoms. $125,000.

Yale University, New Haven, Connecticut. D. Allan Bromley, MP Tandem Van de Graaff Research Program. $1,150,000.

Yale University, New Haven, Connecticut. Vernon W. Hughes, Studies in Nuclear Physics. $365,000.

NUCLEAR SCIENCE

Colorado, University of, Boulder, Colorado. J. J. Kraushaar, Study of Fundamental Nuclear Interactions. $475,000.

Columbia University, New York, New York. W. W. Havens, Jr., and Edward Melkonian, Nuclear Fission Studies. $100,000.

Denison University, Granville, Ohio. Ron R. Winters, Determination of Neutron Cross Sections and Resonance Parameters. $14,300.

Duke University, Durham, North Carolina. E. G. Bilpuch, Studies of Nuclear Structure using Neutrons and Charged Particles. $735,000.

Florida State University, Tallahassee, Florida. Gregory R. Choppin, Research in Nuclear Chemistry. $72,560.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Michael S. Feld, Laser-Induced Nuclear Orientation Effects. $65,200.

Michigan, University of, Ann Arbor, Michigan. Glenn F. Knoll, Absolute Fast-Neutron Cross Section Measurements. $110,000.

Michigan, University of, Ann Arbor, Michigan. W. C. Parkinson and R. S. Tickle, 83-Inch Cyclotron Research Program. $313,000 (42 months).

New York, State University of, Albany, New York. Jagadish B. Garg, Measurement and Analysis of Neutron Cross Sections. $27,587.

North Carolina State University, Raleigh, North Carolina. L. W. Seagondollar, Nuclear Structure Research. $100,000.

North Carolina, University of, Chapel Hill, North Carolina. Eugen Merzbacher, E. J. Ludwig, T. B. Clegg and S. M. Shafroth, Studies of Nuclear Processes. $135,000.

Ohio University, Athens, Ohio. Raymond O. Lane, Study of Structure of Light Nuclei with Neutrons and Nuclear Data Measurements for MFE. $103,000.

Oklahoma, University of, Norman, Oklahoma. M. Y. El-Ibiary, Optimization of Zero-Cross-Over Timing for Coaxial Germanium Detectors. $17,000 (9 months).

Pennsylvania, University of, Philadelphia, Pennsylvania. Fay Ajzenberg-Selove, Compilation of Information on the Energy Levels of the Light Nuclei. $36,000 (9 months).

Purdue University, Lafayette, Indiana. Patrick J. Daly, Radiochemical Investigations of Nuclear Properties. $62,457 (15 months).

Tennessee, University of, Knoxville, Tennessee. Joseph R. Peterson, Physical-Chemical Studies of Transuranium Elements. $53,500.

Washington, University of, Seattle, Washington. Eric Adelberger, Experimental Nuclear Physics. $600,000.

Washington, University of, Seattle, Washington. Gene L. Woodruff, Neutron Yield Measurements from (α, n) Reactions of Importance to Reactors. $26,000.

Wisconsin, University of, Madison, Wisconsin. H. T. Richards and L. W. Anderson, Research in Nuclear Physics and Atomic Collisions. $586,940.

NUCLEAR SCIENCE

Wisconsin, University of, Madison, Wisconsin. Henry H. Barschall, Charged Particle Production Induced by 14 MeV Neutrons. $42,200 (2 years).

Yale University, New Haven, Connecticut. D. Allan Bromley, MP Tandem Van de Graaff Research Program. $260,000.

Yale University, New Haven, Connecticut. Frank Firk, Studies in Nuclear Science. $165,000.

MATERIALS SCIENCES

Arizona State University, Tempe, Arizona. John M. Cowley, Imaging Surfaces and Defects in Crystals. $67,846.

Arizona, University of, Tucson, Arizona. Seppo O. Sari, Study of Inhomogeneous Solid Adlayers at Electrolyte-Solid Interfaces Using Differential Reflectance Spectroscopy. $147,310 (2 years).

Arizona, University of, Tucson, Arizona. B. O. Seraphin, Chemical Vapor Deposition of Amorphous Silicon for Photothermal Solar Energy Converters. $106,247.

Brown University, Providence, Rhode Island. Joseph Gurland and James R. Rice. A Combined Macroscopic and Microscopic Approach to the Fracture of Metals. $121,000.

California Institute of Technology, Pasadena, California. Pol Duwez, Studies of Alloy Structures and Properties. $140,000.

California Institute of Technology, Pasadena, California. Robert W. Vaughan, Metal Hydrides and Ionic Conductors with Nuclear Magnetic Resonance Techniques. $70,000.

California Institute of Technology, Pasadena, California. Nicholas W. Tschoegl, The Effect of Pressure on the Mechanical Properties of Polymers. $96,000 (16 months).

California, University of, Los Angeles, California. Alan J. Ardell, Irradiation Induced Precipitation in Palladium Base Alloys. $72,000.

California, University of, Los Angeles, California. Alfred S. Yue, Semiconductor Eutectics for Energy Conversion. $121,739 (27 months).

California, University of, Riverside, California. Eugen Simanek, Theoretical Aspects of Superconductor Behavior. $95,127 (2 years).

California, University of, San Diego, California. John C. Wheatley, Research on Thermophysical Properties of Materials. $225,393.

California, University of, San Diego, California. M. Brian Maple, The Response of Superconductors to Variations in Impurity Content and Applied Pressure. $154,356.

California, University of, Santa Barbara, California. Vincent Jaccarino, Resonance Studies of Superionic Conductors. $58,995.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Robert F. Sekerka, Kinetics, Morphology, and Thermodynamics of the Solid-Liquid Transition of Non-Metals. $44,740 (15 months).

Case Western Reserve University, Cleveland, Ohio. Ronald Gibala, Environmental Reactions and Their Effects on Mechanical Behavior of Metallic Materials. $60,000.

Case Western Reserve University, Cleveland, Ohio. Terence E. Mitchell, Experiments in High Voltage Electron Microscopy. $95,000.

Case Western Reserve University, Cleveland, Ohio. Alexander R. Troiano, Elastic and Plastic Strains and the Stress Corrosion Cracking of Austenitic Stainless Steels. $46,000.

Case Western Reserve University, Cleveland, Ohio. A. R. Cooper, Coupled Diffusion Phenomena in Multicomponent Glasses and Glass Forming Liquids. $97,650 (15 1/2 months).

MATERIALS SCIENCES

Case Western Reserve University, Cleveland, Ohio. A. H. Heuer, Plastic Deformation in Oxide Ceramics. $66,500.

Catholic University of America, Washington, D.C. C. T. Moynihan, Ionic Transport and Electrical Relaxation in Glass. $47,800.

Chicago, University of, Chicago, Illinois. Stuart A. Solin, The Study of Phonons and Electronic Processes in Ordered and Disordered Solids. $129,859 (2 years).

Cincinnati, University of, Cincinnati, Ohio. John Moteff, Radiation Effects to BCC Refractory Metals and Alloys. $42,000.

Cincinnati, University of, Cincinnati, Ohio. William C. H. Joiner, Flux Pinning and Flux Flow Studies in Superconductors Using Flux Flow Noise Techniques. $51,508.

Clarkson College of Technology, Potsdam, New York. Joseph L. Katz and Marc D. Donohue, Condensation Processes in Coal Combustion Products. $38,824.

Colorado Energy Research Institute, Golden, Colorado. Jerome G. Morse and Joel B. DuBow, Hydrogen and Methane Synthesis Through Radiation Catalysis. $161,990 (2 years).

Colorado School of Mines, Golden, Colorado. David L. Olson and David Matlock, Ferrous Alloy Metallurgy-Liquid Lithium Corrosion and Welding. $97,000.

Colorado, University of, Boulder, Colorado. Richard C. Mockler and William J. O'Sullivan, Critical Scattering of Laser Light by Bulk Fluids and Thin Fluid Films. $107,385.

Columbia University, New York, New York. Charles F. Bonilla, High Temperature Properties of Nuclear Reactor Coolants and Thermodynamic Power Cycle Working Fluids. $47,594.

Columbia University, New York, New York. Arthur S. Nowick, Defect Interactions at High Concentrations in Solid Oxide Electrolytes. $43,291.

Connecticut, University of, Storrs, Connecticut. James M. Galligan, Electron-Dislocation Interactions at Low Temperatures. $51,218.

Connecticut, University of, Storrs, Connecticut. John E. Morral, Cluster Carburizing. $32,500.

Connecticut, University of, Storrs, Connecticut. Owen F. Devereux, Electrode Polarization Studies in Hot Corrosion Systems. $42,200.

Cornell University, Ithaca, New York. Che-Yu Li and Edward W. Hart, Mechanical Properties of Crystalline Solids. $87,021.

Cornell University, Ithaca, New York. Richard H. Lance and Edward W. Hart, Mechanical Behavior of Materials and Structural Elements at Elevated Temperatures. $75,000.

Cornell University, Ithaca, New York. Dieter G. Ast, Influence of Grain Boundaries on the Electrical Transport Properties of Polycrystalline Si Films. $52,600.

Cornell University, Ithaca, New York. David N. Seidman, Defects in Metal Crystals. $211,948.

Cornell University, Ithaca, New York. H. H. Johnson, Environment and Fracture. $136,500 (2 years).

MATERIALS SCIENCES

Cornell University, Ithaca, New York. S. Leigh Phoenix, Probabilistic Models of the Stress-Rupture of Composite Materials. $132,600 (2 years).

Cornell University, Ithaca, New York. Rishi Raj, High Temperature Mechanical Behavior of Silicon Nitride. $56,824.

Cornell University, Ithaca, New York. David L. Kohlstedt, Inelastic Deformation in Non-Metallic Crystalline Solids. $48,600.

Dartmouth College, Hanover, New Hampshire. P. Bruce Pipes, Experimental Determination of the Temperature Dependence of Metallic Work Functions at Low Temperatures. $61,618 (2 years).

Dartmouth College, Hanover, New Hampshire. Walter E. Lawrence, Theory of Electron-Phonon Scattering Effects in Metals. $65,921 (2 years).

Dartmouth College, Hanover, New Hampshire. Mark P. Zaitlin, Superconductivity in Filamentary Eutectic Composites. $32,330.

Drexel University, Philadelphia, Pennsylvania. George Langford, Strain Hardening and Ductility of Iron: Axisymmetric vs. Plane Strain Elongation. $40,900.

Florida, University of, Gainesville, Florida. Robert E. Reed-Hill, Deformation Processes In Refractory Metals. $44,000.

Florida, University of, Gainesville, Florida. John J. Hren and Craig S. Hartley, Quantitative Analysis of Solute Segregation in Alloys by Transmission Electron Microscopy. $91,200 (2 years).

Florida, University of, Gainesville, Florida. George B. Butler and T. E. Hogen-Esch, Synthesis and Characterization of Novel Polymers from Non-Petroleum Sources. $70,000.

Georgia Institute of Technology, Atlanta, Georgia. Billy R. Livesay, Investigations of Intermetallic Alloy Hydriding Mechanisms. $82,000.

Georgia Institute of Technology, Atlanta, Georgia. Uzi Landman and Elliot W. Montroll, The Structure and Reactivity of Heterogeneous Surfaces and Studies of the Geometry of Surface Complexes. $84,025.

Hawaii, University of, Honolulu, Hawaii. William Pong, Photoelectric Emission from Thin Films in the Vacuum Ultraviolet Region. $68,723 (2 years).

Hawaii, University of, Honolulu, Hawaii. Murli H. Manghnani, Pressure Derivatives of Elastic Moduli in B.C.C. Transition Metals and Their Solid Solutions. $97,494 (2 years).

Houston, University of, Houston, Texas. Simon C. Moss, Microstructural Studies of Hydrogen and Other Interstitial Defects in B.C.C. Refractory Metals. $65,800.

Illinois Institute of Technology, Chicago, Illinois. Harold Weinstock, Thermal and Electrical Measurements on Solids at Low Temperatures. $279,316 (4 years).

Illinois Institute of Technology, Chicago, Illinois. Lawrence J. Broutman, Diffusion Mechanisms and Degradation of Environmentally Sensitive Composite Materials. $48,379.

Illinois Institute of Technology, Chicago, Illinois. J. R. Selman, Electrochemistry of Acetylides, Nitrides and Carbon Cathodes in Molten Halides. $42,000.

MATERIALS SCIENCES

Illinois, University of, Urbana, Illinois. Robert J. Maurer, The Science of Materials. $1,980,000.

Lehigh University, Bethlehem, Pennsylvania. Michael R. Notis, Pressure Sintering and Creep Deformation - A Joint Modeling Approach. $48,707.

Maryland, University of, College Park, Maryland. R. J. Arsenault, An Investigation of Irradiation Strengthening of BCC Metals and Solid Solutions. $50,500.

Maryland, University of, College Park, Maryland. M. J. Marcinkowski, Discrete Dislocation Analysis of Alloy Strength and Fracture. $53,600.

Massachusetts Institute of Technology, Cambridge, Massachusetts. W. D. Kingery and R. L. Coble, Basic Research in Crystalline and Noncrystalline Ceramic Systems. $585,000 (15 months).

Massachusetts Institute of Technology, Cambridge, Massachusetts. Harvey K. Bowen and Bernhardt J. Wuensch, High Temperature Properties and Processes in Ceramics. $124,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Clifford G. Shull, Low Temperature and Neutron Physics Studies. $291,063 (21 months).

Massachusetts Institute of Technology, Cambridge, Massachusetts. Harry L. Tuller, Electronic Conduction in Solid Oxide Electrolytes. $60,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Ali S. Argon and Frank A. McClintock, Micromechanical Modelling of Microstructural Damage at Elevated Temperature During Creep of Superalloys for Energy Applications. $122,700.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Nicholas J. Grant, Processing Studies of Oxide Dispersed Alloys for Service Above 1000°C. $46,800.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Julian Szekely and Thomas W. Eagar, A Basic Study of Electroslag Welding. $60,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Edward I. Solomon and F. R. McFeely, Spectroscopic Investigations of Small Molecule Interactions on Metal Oxide Surfaces. $54,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Robert W. Balluffi, Kinetic Processes at Grain Boundaries. $93,852.

Michigan Technological University, Houghton, Michigan. Dale F. Stein and Lloyd A. Heldt, A Study of Grain Boundary Segregation Using the Auger Electron Emission Technique. $55,383.

Minnesota, University of, Minneapolis, Minnesota. William Zimmermann, Jr., Walter V. Weyhmann, and Allen M. Goldman, Experimental Investigations in Solid-State and Low-Temperature Physics. $380,000 (2 years).

New Mexico Institute of Mining & Technology, Socorro, New Mexico. O. T. Inal and L. E. Murr, Microstructural and Mechanical Property Evaluation of Black Chrom-Coated Solar Collectors. $65,000.

New York, City University of/City College, New York, New York. Melvin Lax, Nonadiabatic Approach to Vibronically Assisted Radiation and Radiationless Transitions. $113,549 (2 years).

New York, State University of, Stony Brook, New York. Patrick J. Herley, Preparation, Characterization and Use of Metal Hydrides for Fuel Systems. $49,000.

New York, State University of, Stony Brook, New York. Jerry L. Whitten and Jimmie D. Doll, Theoretical Studies of Chemisorption on Transition Metal Surfaces: Interaction of Hydrogen with Titanium. $72,968.

New York, State University of, Albany, New York. Clifford E. Myers, Energies and Bonding in Manganese Phosphides. $22,000.

North Carolina, University of, Chapel Hill, North Carolina. James H. Crawford, Jr., The Structure of Neutron Damage in Ionic Refractory Oxides. $51,915.

Northeastern University, Boston, Massachusetts. Jeffrey B. Sokoloff, Studies of Dislocation Motion and Sliding Friction. $94,248 (2 years).

Northeastern University, Boston, Massachusetts. Arun Bansil and Petros N. Argyres, Equilibrium and Transport Properties of Disordered Transition and Nobel Metal Alloys. $37,639.

Northwestern University, Evanston, Illinois. M. Meshii, Effect of Point Defects on Mechanical Properties of Metals. $58,400.

Northwestern University, Evanston, Illinois. Donald H. Whitmore, Basic Research on Ceramic Materials for Energy Storage and Conversion Systems. $65,000.

Northwestern University, Evanston, Illinois. Yip-Wah Chung, Studies of Metal-Semiconductor Interfaces in Catalysis and Energy Conversion. $60,000.

Northwestern University, Evanston, Illinois. John B. Butt and Lyle H. Schwartz, Investigation of Dispersed Iron Alloy Catalysts in the Carbon Monoxide-Hydrogen Synthesis Reaction. $78,000.

Notre Dame, University of, Notre Dame, Indiana. George C. Kuczynski and Charles W. Allen, Pore Shrinkage and Ostwald Ripening in Metallic Systems. $54,000.

Ohio State University, Columbus, Ohio. Roger W. Staehle and Arun K. Agrawal, Corrosion, Stress Corrosion Cracking, and Electrochemistry of Iron and Nickel Base Alloys in Aqueous Caustic and Sulfide Environments. $61,400.

Ohio State University, Columbus, Ohio. Robert A. Rapp, Fundamental Studies of Metal Fluorination Reactions. $65,800.

Ohio State University, Columbus, Ohio. Paul G. Shewmon, Hydrogen Attack of Steel. $41,257.

Ohio State University, Columbus, Ohio. James C. Garland and David B. Tanner, Electrical Transport and Optical Properties of Random Small Particle Composites. $79,009.

Oklahoma State University, Stillwater, Oklahoma. Geoffrey P. Summers, Electronic Structure of Defects in Oxides. $21,100.

Pennsylvania State University, University Park, Pennsylvania. Peter A. Thrower, Studies of Mechanical Properties and Irradiation Damage Nucleation of HTGR Graphites. $72,700 (2 years).

MATERIALS SCIENCES

Pennsylvania State University, University Park, Pennsylvania. William B. White, Structure of Glasses Containing Transition Metal Ions. $72,000.

Pennsylvania State University, University Park, Pennsylvania. Richard C. Bradt and John H. Hoke, Superplasticity and Fracture of Ceramics. $40,000.

Pennsylvania State University, University Park, Pennsylvania. V. S. Stubican and J. W. Halloran, Grain Boundary Diffusion and Grain Boundary Chemistry of Cr-Doped Magnesium Oxide. $55,200 (2 years).

Pennsylvania, University of, Philadelphia, Pennsylvania. Wayne L. Worrell, Electrochemical Investigations of Novel Electrode Materials. $75,000.

Pittsburgh, University of, Pittsburgh, Pennsylvania. P. E. D. Morgan, Studies for the Production of Super-Pure Silicon Nitride. $45,000.

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Rensselaer Polytechnic Institute, Troy, New York. Norman S. Stoloff, Fatigue Behavior of BCC Metals. $43,600.

Rensselaer Polytechnic Institute, Troy, New York. John B. Hudson, Chemical Diffusion on Solid Surfaces. $24,600.

Rice University, Houston, Texas. John M. Roberts, The Effect of Tensile Bias Stress Upon the Ultrasonic Attenuation and Velocity of Ultra-High-Purity (undoped and doped) Tungsten, Molybdenum, Tantalum nd Niobium Single Crystals. $37,625.

Rochester, University of, Rochester, New York. James C. M. Li, Diffusional Creep of Multicomponent Systems. $70,190.

Rochester, University of, Rochester, New York. Stephen J. Burns, The Materials and Mechanics of Rate Effects in Brittle Fracture. $55,000.

Rockwell International Science Center, Thousand Oaks, California. F. F. Lange and David R. Clark, Sintering Phenomena of Non-Oxide Silicon Compounds. $69,998.

Rockwell International Science Center, Thousand Oaks, California. Otto Buck, Acoustic Emission Signature Analysis. $94,147.

SRI International, Menlo Park, Calfornia. Daniel Cubicciotti, Chemistry of Zirconium Related to the Behavior of Nuclear Reactor Fuel Cladding. $75,000.

Southern California, University of, Los Angeles, California. Terence G. Langdon, Grain Boundary Sliding and Deformation Mechanisms During High-Temperture Creep. $88,000.

Southern California, University of, Los Angeles, California. Ferdinand A. Kroger, Electrical and Mechanical Properties of Oxide Ceramics. $57,800.

MATERIALS SCIENCES

Southern California, University of, Los Angeles, California. James M. Whelan, Evaporation Driven Liquid Sintering. $53,900 (15 months).

Stanford University, Stanford, California. William D. Nix, Structure Dependence of High Temperature Deformation and Fracture of Metals. $74,800.

Stanford University, Stanford, California. David A. Stevenson, Diffusion of Oxygen in Liquid Metal Systems. $49,640.

Stanford University, Stanford, California. T. H. Geballe and M. R. Beasley, Superconducting Properties of Electron Beam Evaporated Materials. $86,400.

Stanford University, Stanford, California. Richard H. Bube, Photoelectronic Properties of II-VI Heterojunctions. $121,129.

Stanford University, Stanford, California. Alan K. Miller and Oleg D. Sherby, Modeling of Deformation and Fracture in High-Temperature Structural Materials. $98,000 (11 months).

Syracuse Univerity, Syracuse, New York. Richard W. Vook, Surface Characterization of Catalytically Active Metal, Alloy and Compound Films. $83,400.

Tennessee, University of, Knoxville, Tennessee. Charlie R. Brooks and Peter J. Meschter, A Combined Thermodynamic Study of Nickel-Base Alloys. $70,000.

Texas, University of, Austin, Texas. Richard J. Lagow, Synthesis of New Functionalized Fluorocarbon Polymers for Use as Battery Separators and Membranes. $83,000.

U.S. Steel Corporation, Monroeville, Pennsylvania. R. M. Fisher, Studies of Fundamental Factors Controlling Catalyzation of Reactions of Gases with Carbonaceous Solids. $67,940.

Utah, University of, Salt Lake City, Utah. Ronald S. Gordon, Impurity Effects on the Creep of Polycrystalline Magnesium and Aluminum Oxides at Elevated Temperatures. $43,000.

Utah, University of, Salt Lake City, Utah. Dinesh K. Shetty and Anil V. Virkar, Electrolytic Degradation of Lithia-Stabilized β"-Alumina. $63,000.

Varian Associates, Palo Alto, California. Ronald L. Bell, Research on Lattice-Mismatched Semiconductor Layers. $92,941.

Vermont, University of, Burlington, Vermont. John S. Brown, Thermodynamic and Transport Properties of Interstitial Hydrogen Isotopes in Metal Systems. $22,651 (25 months).

Virginia Polytechnic Institute and State University, Blacksburg, Virginia. M. R. Louthan, Jr., Hydrogen Embrittlement Testing. $64,500 (2 years).

Virginia, University of, Charlottesville, Virginia. Robert V. Coleman, Spectroscopy of Surface Adsorbed Molecules. $94,543.

Wisconsin, University of, Madison, Wisconsin. Gerald L. Kulcinski and P. Wilkes, Void Nucleation and Growth in Heavy Ion and Electron Bombarded Pure Metals. $75,000.

Wisconsin, University of, Madison, Wisconsin. M. G. Lagally, Local Electronic Properties of Semiconductor Surfaces and Interfaces. $71,660.

Wisconsin, University of, Madison, Wisconsin. Wilhelm G. Wolfer, Prediction of the Behavior of Structural Materials Under Irradiation Through Modelling of the Microstructure. $34,900.

CHEMICAL SCIENCES

AeroChem Research Laboratories, Inc., Princeton, New Jersey. Arthur Fontijn, High Temperature Photolysis Studies of Combustion Reactions. $78,000.

The Aerospace Corporation, Los Angeles, California. Paul F. Zittel, Two Photon Photodissociation of Polyatomics for Isotope Enrichment. $77,000.

The Aerospace Corporation, Los Angeles, California. Jerry A. Gelbwachs, Laser-Excited Nonresonant Fluorescence Spectroscopy. $37,990.

Alabama, University of, University, Alabana. Lowell D. Kispert, ELDOR Investigations of Radiation Processes. $43,386.

Amherst College, Amherst, Massachusetts. Bruce B. Benson, Solvent and Solute Isotope Effects of Non-Reactive Gases. $34,986.

Arizona, University of, Tucson, Arizona. Henry Freiser, Chelating Extractants of Improved Selectivity. $57,273 (13 months).

Arizona, University of, Tucson, Arizona. Gordon Tollin, Mechanisms of Photochemical Energy Conversion by Clorophyll. $45,000.

Bend Research, Inc., Bend, Oregon. Harold K. Lonsdale, Coupled Transport Membranes for Uranium Separations. $45,100 (15 1/2 months).

Boston University, Boston, Massachusetts. Richard H. Clarke, Investigation of the Triplet States of Chlorophylls. $58,928.

Boston University, Boston, Massachusetts. Norman N. Lichtin and Morton Z. Hoffman, Electron Transfer Reactions of Excited Dyes with Metal Complexes. $70,000.

Boston University, Boston, Massachusetts. Guilford Jones, II, Organic Photochemical Storage of Solar Energy. $57,235.

Brandeis University, Waltham, Massachusetts. Henry Linschitz, Photochemical Reactions of Complex Molecules in Condensed Phase. $92,782 (18 months).

Brandeis University, Waltham, Massachusetts. Saul G. Cohen, Hydrogen and Charge Transfer In Photochemical Reactions. $34,992.

Brigham Young University, Provo, Utah. James J. Christensen, Separation of Selected Cations by Liquid Membranes. $49,000.

Brown University, Providence, Rhode Island. Edward F. Greene, Interactions of Molecules with Surfaces. $55,000.

California Institute of Technology, Pasadena, California. Aron Kuppermann, Studies in Chemical Dynamics. $134,910.

California, University of, Berkeley, California. Earl L. Muetterties, Surface Chemistry and Catalytic Chemistry of Metallic Surfaces. $80,791.

California, University of, Davis, California. John W. Root, Nuclear Methods in Chemical Kinetics. $60,000.

California, University of, Irvine, California. Frank S. Rowland, Research in Chemical Kinetics. $130,000.

California, University of, Irvine, California. Max Wolfsberg, Studies of Isotopic Mass Effects in Chemistry. $59,700.

California, University of, Irvine, California. Edward K. C. Lee, Intermolecular Electronic Energy Transfer Processes. $59,900.

California, University of, Los Angeles, California. Donald J. Cram, Multiheteromacrocycles that Complex Metal Ions. $73,916.

California, University of, Los Angeles, California. M. A. El-Sayed, Time Resolved Raman and Energy Transfer Studies. $66,000.

California, University of, Los Angeles, California. John A. Gladysz, Ligand Intermediates in Metal-Catalyzed Fischer-Tropsch Syntheses. $48,700.

California, University of, San Diego, California. Hans Oesterreicher, Hydride Formation. $40,000.

California, University of, Santa Barbara, California. Robert G. Rinker, Transport and Reaction in Supported Liquids. $33,613.

California, University of, Santa Barbara, California. Richard M. Martin, Metastable Rare Gas Chemiluminescent Reaction Cross Sections. $42,287.

California, University of, Santa Barbara, California. Peter C. Ford, Homogeneous Catalysis of the Water Gas Shift Reaction. $60,150 (16 months).

California, University of, Santa Barbara, California. Richard J. Watts, Chemical Intermediates in the Photochemical Cleavage of Water. $24,438.

Chicago, University of, Chicago, Illinois. Ugo Fano, Basic Studies of Atomic Dynamics. $86,917.

Chicago, University of, Chicago, Illinois. William J. Evans, Synthesis, Chemistry, Catalytic Activity Complexes of Lanthanide and Actinide Metals. $45,000.

Chicago, University of, Chicago, Illinois. John C. Light, Laser Induced Chemical Reactions and Laser-Collision Processes. $50,000.

Colorado State University, Fort Collins, Colorado. John K. Stille, Palladium Catalyzed Coupling Reactions: Mechanism of Reductive Elimination. $60,000 (20 months).

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