THE DEPARTMENT OF DEFENSE

FY 1986

UNIVERSITY RESEARCH INITIATIVE

PROGRAM OVERVIEW

PARTICIPATING ORGANIZATIONS:

Department of the Army
Department of the Navy
Department of the Air Force
Defense Advanced Research Projects Agency
in cooperation with the Office of the
Under Secretary of Defense for Research
and Engineering

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December 1985

IMPORTANT NOTICE

This brochure provides a general overview of the DoD's proposed University Research Initiative. It is not intended as a program solicitation. Individuals interested in preparing proposals for funding under URI should contact the individual Services and DARPA as indicated following each technology and component in the body of this publication. The Services and DARPA will provide specific guidance regarding competition, proposal preparation, deadlines for submission, and other relevant information to assist potential offerors to prepare their submissions.

The brochure was prepared jointly by:

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Office of the Under Secretary
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TABLE OF CONTENTS

C. SUBMICRON STRUCTURES

1. Army - High Frequency Microelectronics

2. Navy - Ultra Submicron Electronics

3. Air Force - Structured Electronic Materials and Devices

4. DARPA - Submicron Structures Research

D. BIOTECHNOLOGY

1. Army - Biosystems and Biotechnology

2. Navy - Biotechnology

3. DARPA - Biological Structure/Material Properties

E. ELECTRO-OPTIC SYSTEMS AND SIGNAL ANALYSIS

1. Army - Electro-optics, Signal Processing and Image Understanding.

2. Navy - Free Electron Laser Research Opportunities

3. Air Force - X-ray Sources/Optics

4. Air Force - Opto-Electronics and Optical Processing

F. HIGH PERFORMANCE MATERIALS

1. Army - Ultra Dynamic Performance Materials

2. Army - Advanced Construction Technology

3. Navy - Composite Materials

III. URI COMPONENTS

A. RESEARCH CENTERS AND PROGRAMS

B. PROGRAMS TO DEVELOP HUMAN RESOURCES

1. Graduate Fellowship Programs

(a) Office of Naval Research (ONR) Graduate Fellowship Program

(b) Air Force Laboratory Graduate Fellowship Program

2. Young Investigator Programs

(a) ONR Young Investigator Program

3. Exchange Scientist and Engineer Programs

(a) Air Force Summer Faculty Research Program

(b) Air Force Graduate Student Summer Support Program

(c) Office of Naval Research Bridges Program

(d) Air Force Laboratory/University Associates Programs

C. INSTRUMENTATION

I. INTRODUCTION

The Department of Defense, through the Departments of the Army, Navy, Air Force, and the Defense Advanced Research Projects Agency, announces the FY 1986 University Research Initiative (URI).

URI is a multi-component effort designed to strengthen the capabilities of the universities to perform research and to educate scientific and engineering personnel in key disciplines important to the technologies that underly a strong national defense.

To meet mission-related needs, DoD relies on the universities to:

- conduct fundamental scientific and engineering research which supports Defense technologies;
- educate quality scientific and engineering personnel who perform research and who are employed in both industry and DoD;
- provide sound advice on technical issues related to national defense; and
- assist in transferring new technologies emerging from university research into industrial applications for both military and civilian uses.

DoD has an important stake in both the research produced by universities and the quality of the scientific and engineering personnel being educated in defense-related disciplines: one in six American scientists and engineers is engaged in defense work. The majority of these scientists and engineers -- almost a half million in all -- are involved in state-of-the-art technologies that are not only crucial to defense mission accomplishment, but also are at the cutting edge of technologies essential to modern industry.

In recent years, however, it has become clear that declining investments in the university research and teaching base during the 1970's have resulted in deficiencies that hamper the ability of universities to produce quality research and education in scientific and engineering disciplines. Among these problems are a shortage of faculty qualified to teach certain state-of-the-art technologies; obsolete research instrumentation; and declining numbers of American citizens pursuing science and engineering graduate degrees. The components of URI focus on correcting these deficiencies.

URI was proposed in the President's FY 1986 budget submission to support quality research and education in science and engineering to meet the mutual needs of the DoD and the universities.

URI is designed to improve the quality of research performed at universities to meet defense needs; to strengthen multidisciplinary research which supports selected key defense technologies; to provide expanded opportunities for interactions between universities and the DoD research and engineering community, particularly the laboratories of the three Services; and to support fellowship and instrumentation awards in mission-related disciplines important to critical defense technologies. Each component of the URI program is described within this brochure. These components are designed to increase the number of science and engineering graduate students; to increase the investment in major pieces of research equipment at universities; to increase the investment in higher risk basic scientific research in support of critical defense technologies; and to provide more opportunities for contacts between universities, industry, and DoD laboratories to maximize the benefits to be derived from defense research for the nation's security, both military and economic. Because each component focuses on separate but complementary ways to meet the needs outlined above, each component necessarily has its own approach, application requirements, deadlines, and points-of-contact. This announcement provides a general description of the efforts and opportunities in meeting mutual science and technology goals of the DoD and the university community under the DoD University Research Initiative for FY 1986.

A DoD Steering Committee for the URI program has reviewed the DoD critical technology areas and has identified several technologies for special emphasis in URI; these technologies are listed in the following matrix and are described in the next section of this brochure. In addition, for each technology area, coordinating committees consisting of technical experts representing the Army, Navy, Air Force, DARPA, OSD and DoD laboratories will be established to coordinate the activities of the various program components (such as fellowships, research programs, instrumentation selection and utilization etc.,) within each technology area. Finally each specific component will be managed by a lead service. The components of the URI are listed in the following matrix and are described in the last section of this brochure.

The URI program is brand new; it is expected to evolve rapidly in the next year or two as experience is gained with the program outlined herein.

II. URI TECHNOLOGIES

The technology areas which have been selected for emphasis in the University Research Initiative are those which are critical to the future capabilities of the Department of Defense and those which show promise of rapid advance and potential breakthrough in response to that emphasis. In the discussion below, each of the technologies is summarized briefly, followed by a description of the Service and DARPA specific emphasis in that technology. Each of the specific descriptions includes a listing of the components which will be funded and a point of contact for obtaining additional technical information. Table II-1 lists the technologies and the Service/DARPA emphasis within each technology.

Table II-2 summarizes the technologies and program components. Note that the Army and DARPA plan to incorporate support for instrumentation, fellowships, etc. as part of their funding of single, large research programs. Programmatic details (eligibility, deadlines, points of contact, etc.) of the components may be found in Section III of this booklet. Since the URI funding level is uncertain at this time, the funding for each technology and for components within each technology is not firm. The actual number of components and technologies funded will depend upon the quality of proposals and available funds.

TABLE II-1

URI TECHNOLOGIES AND EMPHASIS

A. ANALYSIS, MODELING AND SIMULATION

1. Navy - Mathematics

2. Air Force - Research in Mathematical Analysis, Modeling and Simulation

B. TECHNOLOGIES FOR AUTOMATION: ROBOTICS, AI, COMPUTERS, MANUFACTURING SCIENCE

1. Army - Intelligent Control Systems

2. Army - Manufacturing Science and Reliability and Maintainability Enhancement

3. Navy - Robotics

4. Navy - Artificial Intelligence

5. Navy - Computer Science

6. Navy - Manufacturing Science and Production Engineering

7. Air Force - Research on Enhanced Computing Environments

8. Air Force - Distributed Parameter Control

C. SUBMICRON STRUCTURES

1. Army - High Frequency Microelectronics

2. Navy - Ultra Submicron Electronics

3. Air Force - Structured Electronic Materials and Devices

4. DARPA - Submicron Structures Research

D. BIOTECHNOLOGY

1. Army - Biosystems and Biotechnology

2. Navy - Biotechnology

3. DARPA - Biological Structure/Material Properties

E. ELECTRO-OPTIC SYSTEMS AND SIGNAL ANALYSIS

1. Army - Electro-optics, Signal Processing and Image Understanding.

2. Navy - Free Electron Laser Research Opportunities

3. Air Force - X-ray Sources/Optics

4. Air Force - Opto-electronics and Optical Processing

F. HIGH PERFORMANCE MATERIALS

1. Army - Ultra Dynamic Performance Materials

2. Army - Advanced Contruction Technology

3. Navy - Composite Materials

4. Air Force - Advanced Electrical and Structural Polymers

5. Air Force - High Temperature Structural Materials

6. Air Force - Surface and Thin Film Sciences

7. Air Force - Cement Paste Matrix Composite Materials

8. Air Force - Lightweight, Flexible Structures

9. DARPA - High Temperature Structural Composites

10. DARPA - Structural and Electronic Polymers

G. FLUID DYNAMIC SYSTEMS

1. Navy - Hydrodynamics

2. Air Force - Unsteady and Separated Flows

3. DARPA - Turbulent Flow in Fluid Dynamic Systems

H. HUMAN PERFORMANCE FACTORS

1. Air Force - Cognitive, Perceptual, and Neural Bases of Skilled Performance

I. ENVIRONMENTAL SCIENCE AND TECHNOLOGY

1. Army - Environmental Sciences Center

2. Navy - Ocean Remote Sensing and Modeling

3. Navy -- Oceanography

4. Navy - Arctic Science and Technology

5. Air Force - Theory and Analysis of the Geo-Plasma Environment

6. Air Force - Surface Reactions in the Space Environment

7. Air Force - Solar Activity and Variability

J. PROPULSION TECHNOLOGY

1. Army - Advanced Propulsion Systems

2. Army - Fast Reaction Kinetics of Energetic Materials

3. Air Force - Turbulent Reacting Flows

TABLE II-2

MAJOR TECHNOLOGIES AND PROGRAM COMPONENTS

- SERVICE/DARPA INTERESTS -

Technology	Army	Navy	Air Force	DARPA
A. Analysis, Modeling and Simulation	P(I,V,F)	I,F,P,Y	I,V,F,P	
B. Technologies for Automation	P(I,V,F)	Y,I,V,F,P	I,F,P	
C. Submicron Structures	P(I,V,F)	Y,I,F,P	I,F,P	P(I,V,F)
D. Biotechnology	P(I,V,F)	Y,I,F		P(I,V,F)
E. Electro-optic Systems and Signal Analysis	P(I,V,F)	Y,I,F,P	I,F,P	
F. High Performance Materials	P(I,V,F)	Y,I,F	I,F,P	P(I,V,F)
G. Fluid Dynamics Systems		Y,I,V,F,P	I,F,P	P(I,V,F)
H. Human Performance Factors			I,V,F,P	
I. Environmental Science and Technology	P(I,V,F)	Y,F,P,I	I,F,P	
J. Propulsion Technology	P(I,V,F)		I,F,P	

Key

P = Research Program or Center
I = Instrumentation
F = Fellowship
Y = Young Investigator
V = Visiting Scientists/Bridges
C = Chairs
( ) = Subcomponents of Large Programs

A. ANALYSIS, MODELING AND SIMULATION

The thrust in mathematical analysis, simulation and modeling will assist in the development of the mathematically sound, physically reliable and computationally efficient mathematical models which are needed for understanding complex, physical processes. The mathematical framework for advances in science and technology will be provided by fundamental studies in the areas of discrete mathematics, nonlinear mathematical methods, computational mathematics and probabilistic analysis. Major effort will be directed towards the development of new and more powerful analytical methods of understanding real systems and their operations. These methods will become the mathematical tools to discover and express in vigorous mathematical equations the basic relationships and laws of mechanics, physics, system control and behavior.

1. Navy - Mathematics

(a) Technology Description

Areas which will be emphasized under URI include discrete mathematics, nonlinear mathematical methods, computational mathematics and probabilistic methods. Within the generic area of discrete mathematics, ONR is interested in graph theory, particularly random graphs and topological graph theory as models for military communication networks and in combinatorial mathematics bearing on computational algorithms and architectures. Geometry and topology are of interest as well. In addition to advanced work in aspects of algebra, geometry, and topology, ONR maintains strong interest in aspects of modern and classical analysis including such topics as multivariable control, inverse methods, mathematical optimization and computational and mathematical statistics.

(b) Components

Young Investigator Program; Instrumentation; Graduate Fellowships; Research Programs.

(c) Technology Contact

Head, Mathematical Science Division
Office of Naval Research, Code 1111
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4310

2. Air Force - Research in Mathematical Analysis, Modeling, and Simulation

(a) Technology Description

An innovative, integrated, interdisciplinary research program will be established to conduct basic research in mathematical analysis, modeling, and simulation, in order to acquire a deeper understanding and an ability to control and use effectively a variety of complex phenomena such as chemical laser burning, plasma flows, nonlinear optical phenomena, optical phased arrays, combustion, turbulent flow, thermomechanics, structural damping of mechanical motion, and mechanisms for robust control of complex processes.

The research sponsored by this program will also be involved in the development of the computational capacity to deal with difficult parameter estimation problems involved in modeling and to carry out simulation analyses and experiments which will be required for testing optimization and validation of experimental system designs.

(b) Components

Research Program; Visiting Scientists; Fellowships; Instrumentation.

(c) Technology Contact

Director, Mathematical and Information Sciences
Air Force Office of Scientific Research/NM
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-5025

B. TECHNOLOGIES FOR AUTOMATION

Technologies for automation is a broad area which encompases the advances in manufacturing science, robotics, artificial intelligence and computer sciences which will revolutionize all aspects of defense. Future automated systems will bring together advanced sensors, real-time computational capability, "intelligent" robots, and other components to achieve unparalleled levels of performance and control.

1. Army - Intelligent Control Systems

(a) Technology Description

Intelligent control systems pose substantial mathematical, computational, algorithmic and systems problems in at least the following areas: automatic and autonomous systems; deterministic and stochastic control of nonlinear dynamical systems; nonlinear mechanics of deformable structures; and data fusion from disparate distributed sensors.

To support these developments, increased efforts are needed in the area of nonlinear anaysis, decision theory, statistical signal processing and random field theory, nonlinear dynamical systems and stochastic and deterministic distributed information processing and control. Implementation of intelligent control systems poses substantial problems in knowledge-based systems, symbolic computation and algorithm development for distributed and parallel computing in these areas, and on software development, efficiency, reliability and portability.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Mathematical Sciences Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

2. Army - Manufacturing Science and Reliability and Maintainability Enhancement

(a) Technology Description

The proposed program initiative in Manufacturing Science and Reliability Enhancement is based on studying areas critically needed in systems for the 1990s and beyond. For example, this would include: (1) cure cycles for polymer-composite resins and pre-impregnated fibers in thick sections; (2) crystal growth for electronic and optical materials; (3) novel consolidation methods for reliably producing aircraft and ground

vehicle engine and drive train components; and (4) improved ceramics. The research will be based on fundamental processing, structure, property relationships; nondestructive characterization for in-process monitoring, feedback, and control of the processing of materials; highly reproducible processing; improved and more realistic test and evaluation methodology; development of new techniques to manufacture materials having fewer processing steps and which allow more control of the final product; research on reliable accelerated characterization which allows low-cost, rapid determination of long-term performance of materiel; incorporation of new and cutting-edge technologies, with special attention to computer software development which models the manufacturing process and is compatible with the research data base; development of nondestructive in-process sensors to monitor processing steps; and automation of production methods to develop the manufacturing methods of the future.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Materials Science Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

3. Navy - Robotics

(a) Technology Description

There are numerous opportunities for research in robotics to advance the scientific basis for high performance, sensor-based robotic manipulators and for automomous mobile robots. Robotics research is very multidisciplinary, posing challenging problems which span mechanical engineering, materials, computer science, electrical engineering, and mathematics. Intensive basic research is vital in all of these disciplines to advance the scientific understanding necessary for improvements in robotics technology.

There is a pressing need, for example, to understand how to design robots which can sense their environment using vision, touch, and acoustics and which can modify

their behavior in response to perceived changes in conditions around them. The role that artificial intelligence might play is potentially very great. Other areas of important research activity are in problems of mechanical and electrical engineering related to the design of dextrous manipulators. Recent research directed at building such manipulators has revealed a great many important and deep problems in the mathematics of geometric modeling and control theory. Research leading to the design and efficient control of robotic arms is also needed, as is research leading to improvements in robot mobility.

(b) Components

Young Investigator Program; Instrumentation; Bridges; Graduate Fellowships; Research Program.

(c) Technology Contact

Head, Computer Sciences Division
Office of Naval Research, Code 1133
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4302

4. Navy - Artificial Intelligence (AI)

(a) Technology Description

An invigorated research program in AI will be initiated. It will focus on cross-disciplinary research involving graduate students in computer science and cognitive science. Its objectives are to accelerate our understanding of ways in which humans organize knowledge for effective performance and problem solving, and to use this understanding to develop AI technology across many knowledge domains. Principal among these are expert systems, systems to facilitate training, natural language understanding systems, systems for crisis alerting, and systems for performing situation assessment (including such subtasks as signal interpretation, information fusion, and the ability to infer plans of other agents and generate plans and counterplans.)

(b) Components

Young Investigator Program; Instrumentation; Graduate Fellowships.

(c) Technology Contact

Head, Computer Sciences Division, and
Head, Psychological Sciences Division
Office of Naval Research, Codes 1144, 1142
800 North Quinch Street
Arlington, VA 22217-5000
Telephone: (202) 696-4302 and 4505

5. Navy - Computer Science

(a) Technology Description

Symbolic Computing is a new and growing field in which the research thrust is to advance the theory and techniques necessary for computers to deal with mathematical symbolism in such a way that mathematicians can use computers in the creative aspect of their work.

Basic research in software engineering seeks to provide a scientific foundation for designing, implementing, and revising software systems. There is a great need for advances that will lead to superior methods for evaluating and predicting software performance, especially for complex, time-critical military systems. A particular concern is the discovery of formal techniques for evaluating programming languages with respect to their potential usefulness in various applications.

Research in computer architecture identifies concepts and techniques crucial to improving the computing speed and reliability of present hardware. The challenges include the bulding of innovative, experimental architectural prototypes; the discovery of techniques to transform software into a form suitable for implementation on parallel architectures; and the enhancement of reliability through fault tolerance in such architectures.

(b) Components

Young Investigator Program; Instrumentation; Graduate Fellowships.

(c) Technology Contact

Head, Computer Sciences Division
Office of Naval Research, Code 1133
800 N. Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4302

6. Navy - Manufacturing Science and Production Engineering

(a) Technology Description

Specific research areas of importance in manufacturing and production include: (1) computer-intensive integration of manufacturing; (2) automation of processing, assembly, and inspection; (3) sensor-intensive adaptive machines; (4) processing of high performance materials to near net shape, surface finish and desired property levels; and (5) precision control of dimensional and geometrical tolerances.

(b) Components

Young Investigator Program; Instrumentation; Bridges; Graduate Fellowships; Research Programs.

(c) Technology Contact

Head, Computer Sciences Division
Office of Naval Research, Code 1133
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4302

7. Air Force - Research on Enhanced Computing Environments

(a) Technology Description

Major advances are underway in new computational hardware expected to achieve performance levels for numerical and symbolic processing needed for realistic systems management for simulation of systems modeled by complex, nonlinear equations for optimal scheduling and use of resources, for data fusion, and for many other applications. While hardware advances are stressing concepts such as massively parallel systems, the means of implementing algorithms and software for the above applications on these radically novel architectures are not well understood. There is an opportunity and need to develop ideas from knowledge-based systems as a guide for the entire computational process, from the setup of the problem, the choice of algorithms to solve the problem, the efficient execution of the algorithms on these new powerful architectures, and the interpretation of the results. Research is needed for the coupling of ideas from knowledge-based systems to this algorithm/simulation process for a broad spectrum of applications.

(b) Components

Interdisciplinary Research Program; Instrumentation; Fellowships.

(c) Technology Contact

Director, Mathematical and Information Sciences
Air Force Office of Scientific Research/NM
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-5025

8. Air Force - Distributed Parameter Control

(a) Technology Description

A major research effort is needed to support basic research in the control of distributed parameter systems. This work will develop analytical tools and computational algorithms for identification, control, and optimization of systems modeled by partial differential equations, integro-differential equations and functional differential equations. The primary issues of interest in the control of distributed parameter systems are approximation methods for parameter estimation, stabilizability, computation of stabilizing controllers, and optimization methods for control design. Particular emphasis will be placed on the subareas:

(1) Active vibration suppression necessary to facilitate fast reorientation of large structures and decrease average reorientation times.

(2) Optimal sensor and actuator placement.

(3) Adaptive control of optical devices, beam wavefront control and jitter suppression.

(4) Computational algorithms for control and identification of material properties.

The research will span several technological areas including controls, computational sciences, optics, structural analysis, continuum mechanics and aerospace engineering.

(b) Components

Fellowships; Research Programs; Instrumentation.

(c) Technology Contact

Director, Mathematical and Information Sciences
Air Force Office of Scientific Research/NM
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-5025

C. SUBMICRON STRUCTURES

To meet the performance requirements for Department of Defense electronics systems in the 1990s and beyond, an increase to five orders of magnitude in real-time signal and information processing capability will be required. The higher speed/frequency of operation and greater levels of integration demanded will mandate smaller feature dimensions of the order of 0.1 micron or smaller, and the exploitation of physical phenomena apparent only in such very small structures.

The exploitation of sub-0.1 micron structures cannot be achieved without theoretical insight into the unique, non-classical relationships governing quantum electronic behavior on this size scale. Furthermore, it has been demonstrated experimentally that significant unexpected changes occur in non-electronic properties (e.g., Young's Modulus) of submicron structures which have significance for design of structural and environmentally robust materials.

1. Army - High Frequency Microelectronics

(a) Technology Description

Fundamental investigations of potential interest include fabrication techniques, computer aided design, and advanced architectures. Microcircuit fabrication at submicron dimensions represents one of the greatest research needs. Technology needed to achieve predicted system goals is envisioned to be based upon quantum transport phenomena, such a tunneling. Such quantum based electronics utilize feature sizes well below 0.25 micrometer and depend upon specially tailored materials (the superlattice).

Research into hybrid, multi-disciplinary techniques may offer significant advantages in these areas. Optical techniques may be employed to perform signal interconnection at the chip level of future generations

of both planar and 3-D integrated circuits, as well as to replace front end electronics of high speed communications systems.

The multiplicity of sensor types needed to acquire and process information characterizing complex situations poses terrific problems to integrating the signals from sensors into coherent information. Integration of the sensor and its signal processor onto one "chip" offers promise in overcoming these difficulties.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Electronics Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

2. Navy - Ultra Submicron Electronics

(a) Technology Description

The research which is emphasized in the on-going Ultra Submicron Electronics Research (USER) program deals with many of the fundamental problems associated with designing, fabricating, and implementing solid state electronic devices and circuits with ultra-small feature size has revealed areas of great scientific and practical importance that are not being addressed. These areas will be emphasized under URI and include:

(1) Quantum effects in ultra-small structures: Careful scientific study of quantum mechanical and other effects which are unique to small structures will eventually form the basis of future ultra-high density integrated circuits, detectors, or millimeter wave components.

(2) Picosecond effects: One line of investigation is in high speed signal propagation and switching transient analysis for high speed/high frequency device or circuit structures. Another is in the area of high speed surface heating or melting for an entirely new look at fundamental material or surface properties.

(3) Collective effects in large device arrays: More research is needed in the area of circuit architectures which utilize nearest neighbor coupling, such as the application of cellular automata to arrays of electronic devices.

(b) Components

Young Investigator Program; Instrumentation; Graduate Fellowships; Research Program.

(c) Technology Contact

Head, Electronics Division
Office of Naval Research, Code 1114
800 North quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4216

3. Air Force - Structured Electronic Materials and Devices

(a) Technology Description

The primary research interests are in high speed/frequency electronic device concepts and related research to advance associated materials and processes, including all aspects of monolithic millimeter wave integrated circuits. The thrust to higher levels of integration in electronic circuits and higher performance for discrete devices has revealed fundamental physical limits closely associated with submicrometer dimensions. The continued evolution of semiconductor electronics will require that these fundamental limits be understood and that appropriate physical theories and models be developed consistent with quantum theory. In addition, the topics of artifically structured magnetic materials, superlattices, and organic electronic structures are of emerging interest in this area. A major focus of this research is in compound semiconductor materials such as GaAs, InP and their related ternary compounds. We are interested in the fabrication and use of heterojunctions and quantum well structures. Characterization techniques employing picosecond and femtosecond time scales are of importance. Work is needed in understanding noise phenomena at the submicrometer scale. Also of interest are new, fundamental approaches to the understanding of reliability and radiation hardness of semiconductor devices and circuits.

(b) Components

Research Programs; Instrumentation; Fellowships.

(c) Technology Contact

Director, Electronic and Material Sciences
Air Force Office of Scientific Research/NE
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4984

4. DARPA - Submicron Structures Research

(a) Technology Description

Research programs are sought which combine the following activities to explore and develop submicron structures and phenomena: (1) the growth, characterization and processing of structures consisting of high quality, thin layers of semiconductors (elemental, compound, alloys), insulators, and/or conductors; (2) the theoretical and experimental study of carrier transport, optical, chemical, and physical properties, non-equilibrium phenomena and localized atomic effects in these structures; (3) the holistic study of closely spaced, interacting structures, collective operations, dissapative relaxations, etc.; (4) first principle calculations of band structures and surface and interface properties.

Within this framework, research areas of particular DARPA interest include:

(1) Semiconductor/metal (or semi-metal)/insulator structures for microelectronic and/or optoelectric applications;

(2) Metal-based layered structures exhibiting novel and/or enhanced physical properties pertinent to increased strength, environmental resistance, magnetic properties, etc;

(3) Monolayer and multi-layer organic and polymer structures for optoelectric and non-linear optical functions in communications and computation; and

(4) Layered structures containing dilute magnetic semiconductors and exhibiting unique electro-optic, magnetic-optical or other properties pertaining to optical device and/or data storage.

(5) Physics, chemistry and properties of sol-gel materials and composites.

A proposed program should incorporate growth, characterization, and experimental and theoretical studies of the materials system(s) selected for research. New concepts for physical and chemical characterization of submicron structures are encouraged as part of an overall research program in submicron size structures and phenomena.

(b) Components

Research Program (possibly incorporating instrumentation, visiting scientists, and fellowships).

(c) Technology Contact

Director, Defense Sciences Office
Defense Advanced Research Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209
Telephone: (202) 694-1959

D. BIOTECHNOLOGY

Biotechnology is one of the most rapidly advancing fields of modern science. The developments of the last few years have led to new materials and synthesis routes which were unattainable through previous technology. Further research in this area can be expected to lead to new chemicals and materials. Research into the operation of biosystems will lead to understanding of complex, multiply-connected systems and provide guidance for advanced information processing and control systems.

1. Army - Biosystems and Biotechnology

(a) Technology Description

Basic research is needed to further our understanding of the mechanisms involved in complex biological system functions, and of the dynamic structures supporting those functions. Research will include efforts to determine to what extent the architecture of proteins is essential to their capacity to function as enzymes in catalyzing chemical reactions; as membrane receptors for electrochemical gating; or as components of complex supramolecular ensembles functioning in photosensitive electron transfer reactions. Compartmentalized and

membrane-interfaced subcellular chemical processing may be studied to gather insight into successful fabrication of novel sensing devices containing a biochemical-physical instrument interface. Research may be undertaken to characterize the molecular events of trans-membrane signalling involved in stretch-or pressure-sense, and this knowledge incorporated into advanced robotics design and evaluative materiel monitoring.

Related research, but of a medical nature, will focus on the application of state-of-the-art approaches in molecular genetics and biotechnology to the ultimate development of prophylactic and therapeutic treatment of toxins of biological origin.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Biosciences Branch
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

2. Navy - Biotechnology

(a) Technology Description

In recent years an explosion of new information and development in the ability to select and manipulate genetic material and protein biopolymers has ignited unprecedented research and development interest in the areas of molecular and microbiology referred to as biotechnology. This technology includes any technique utilizing microorganisms, recombinant DNA or protein engineering to modify or develop new products for specific uses. Industrial and DoD potential applications of these novel genetic and biological techniques include: the production of new drugs, chemicals, biopolymers, fuels, lubricants, underwater adhesives, surface and subsurface sensor devices, energy absorbing materials, bio-reactors, and ways of recovering strategic metals. This list only partially reflects the boundless opportunities likely to be available as progress continues in molecular biology research and its linkage with biotechnology development.

(b) Components

Young Investigator Program; Instrumentation; Graduate Fellowships.

(c) Technology Contact

Head, Biological Sciences Division
Office of Naval Research, Code 1141
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202)-696-4986

3. DARPA - Biological Structure/Material Properties

(a) Technology Description

As part of the University Research Initiative, DARPA seeks innovative research proposals in two fundamental areas of biological materials for exploitation in such applications research areas as advanced sensors, drag reduction, adhesives, composites, etc. The specific areas sought for the URI program are: (1) theoretical and experimental studies to make possible prediction of the quanternary structure of proteins from knowledge of linear amino acid sequences; and (2) theoretical capability to predict bulk or microscopic material properties from a knowledge of quanternary structure, coupled with experimental verification of the theoretical development.

(b) Components

Research Program (possibly incorporating instrumentation, visiting scientists, and fellowships).

(c) Technology Contact

Director, Defense Sciences Office
Defense Advanced Research Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209
Telephone: (202) 694-1959

E. ELECTRO-OPTIC SYSTEMS AND SIGNAL ANALYSIS

Research performed in this area will lead to the development of new and improved sources of coherent and short wavelength

radiation, advanced optical systems and detectors and devices capable of ultra-high speed data processing using optical techniques. Additionally, novel signal analysis and processing techniques will reduce the complexity of image enhancement and interpretation systems.

1. Army - Electro-Optics, Signal Processing and Image Understanding

(a) Technology Description

The requirements for research relevant to this topic include but are not limited to:

(1) Research on detectors and sensors for converting carrier data for processing, with emphasis on electromagnetic detection;

(2) Signal and/or image processing with the object of separating target from background objects. The processing may involve analog as well as digital data, be based on active (transmitter based) or passive (no transmitter) techniques;

(3) Research relevant to the interface to the human operator or for machine input;

(4) Research relevant to target versus background signatures may be sponsored especially insofar as it is critical to target identification. Topics that bear on the loss of signal or degradation of an image in propagation through media may also be of interest;

(5) Research concerning the development of electro-optic and laser techniques are of interest as they bear on optical countermeasures. This includes the development of tunable infrared lasers, and techniques for the rapid switching of moderate power laser beams.

Additional topics which bear on this area include optical processing, optics, detector physics, millimeter waves, pattern recognition and acousto-optics.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Physics Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

2. Navy - Free Electron Laser Research Opportunities

(a) Technology Description

The short wavelength limit of Free Electron Lasers (FELs) will be set by the state-of-art in accelerators, electron beam sources, and wigglers/undulators. Advances in these areas are needed which can push the output wavelengths to shorter and shorter values. In addition, new concepts and configurations for addressing the numerous issues associated with FELs, (efficiency, electron beam emissivity, electron beam energy recovery, particle-radiation interaction, beam quality, optics, accelerators, electron beam sources, and wigglers/undulators), must be explored. Research using FELs as a radiation source may include generation of magnetic excitation (e.g., magnons) and phonons their propagation and their lifetimes. Many fundamental properties of matter such as soft phonon modes, lattice instabilities, pinned charge density waves, etc., could be studied directly. Opportunities for biological and medical research are also abundant.

(b) Components

Young Investigator Program; Instrumentation; Graduate Fellowships; Research Programs.

(c) Technology Contact

Head, Physics Division
Office of Naval Research, Code 1112
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4220

3. Air Force - X-ray Sources/Optics

(a) Technology Description

Research is needed in the generation, control and use of a variety of X-ray sources, including free-electron lasers, enhanced synchrotron radiation from the same

storage ring, laser driven X-ray plasma sources, and possibly in the future, X-ray lasers. The research sould address such topics as X-ray optics, spectroscopy, microscopy and detection. The researchers or research teams should represent a wide variety of disciplines including chemical physics, solid state physics, solid state electronics, surface physics, laser physics, medicine and biology.

(b) Components

Fellowships; Instrumentation; Research Programs.

(c) Technology Contact

Director, Physical and Geophysical Sciences
Air Force Office of Scientific Research/NP
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4906

4. Air Force - Opto-Electronics and Optical Processing

(a) Technology Description

This program will include research in the areas of optical materials, devices, algorithms and architectures. Particular emphasis will be on research that integrates some or all of the above. Specific examples of problems of interest are symbolic processing, parallel processing, image processing and understanding, pattern recognition, spread and burst spectrum communications, data fusion, and optical interconnections for electronic devices. Other areas of interest include nonlinear optical device and associated processing, photorefraction, optical bistable devices, superlattice materials and fast, efficient, inexpensive spatial light modulation. Algorithm and architecture research includes both optical computing and hybrid optical-electronic computing.

(b) Components

Research Programs; Fellowships; Instrumentation.

(c) Technology Contact

Director, Electronic and Material Sciences
Air Force Office of Scientific Research/NE
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4984

F. HIGH PERFORMANCE MATERIALS

High performance materials offer the potential for reduced weight and improved capabilities in a broad spectrum of defense applications. The development of new materials and the realization of their full potential depend upon improved understanding of the factors which control material properties and which contribute to material failure in application. Research in this area will also lead to the development of new materials for electrical structural and propulsion systems.

1. Army - Ultra Dynamic Performance Materials

(a) Technology Description

Research in the following areas will lead to an enhanced understanding of the underlying phenomena and in an increased capability and predictability in the design of advanced materials under conditions of high rates of energy impingement; analytical and numerical modeling (hydrodynamic and elastoplastic codes) of dynamic deformation and impact phenomena; effects of metallurgical variables on the ultrahigh strain rate response of materials and development of constitutive equations; fundamental studies of adiabatic shear bands and dynamic fracture including detailed transmission electron microscopy and other modern analytical techniques; development of high-strength, high-density alloys via powder metallurgy and/or rapid solidification techniques; processing and characterization of these materials; failure modes under ultrahigh strain rate loading; study of mechanisms of damage to materials from high energy impingement; study of means to protect advanced materials and components from damage by high energy inpingement; research on new classes of materials (e.g., composites, ceramics, structural foams, glasses, advanced metallic alloys, ceramic composites). The research should encompass the entire spectrum of interaction of materials with high energy impingement, and will probably require an interdisciplinary approach involving materials science, shock physics, heat transfer, mechanics, mathematics, electrical engineering, and computer modeling.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Materials Science Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

2. Army - Advanced Construction Technology

(a) Technology Description

A research center in advanced construction technology is envisioned which would include both engineering and materials sciences. Research is needed on the integration of the newest materials into advanced lightweight structural concepts based on design to limit principles and the desirable characteristics which might result therefrom. Development of ideas for novel, rapid and reliable nondestructive test techniques for structures and novel ways for implementing built-in prognostics are of interest. Research into the application of such materials as polymer composites, ceramics, fibrous reinforced materials, for example, into facility construction are an important consideration. Of specialinterest and importance to the Army is research on response of various types of structures and structural materials to electromagnetic pulse and shock loading. Techniques for rapid emplacement and fast solidification processes would also be of interest to this technology area. The use of advanced and automated architectural concepts which utilize advancements in artificial intelligence would streamline the Army facility construction program. All of these elements must be focussed on life-cycle cost reduction objectives constrained by structural function.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Engineering Sciences Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

3. Navy - Composite Materials

(1) Technology Description

In order to improve the scientific understanding of composites it is necessary to understand the complex processes (flow initiation, crack growth, vibration absorption, etc.) which occur on the microscopic level and learn how they interact to influence the macroscopic behavior in these materials. Research is needed to devise innovative methods to measure the mechanical properties of composite interfacial zones and other microscopic regions of high property gradients within composites. Because chemical, physical and mechanical processes (e.g. thermodynamic selections, diffusion mechanics, interaction damping) may be different at interfaces than in the bulk material, it is necessary to study them and understand their mechanisms and how they influence the macroscopic behavior of the composite. In order to improve the damage tolerance of composites, it is not only necessary to understand how cracks initiate and propagate but to develop reliable nondestructive techniques to detect and monitor the various forms of damage (e.g. matrix cracks, fiber breaks, interface debonds, delaminations, porosity) which are introduced during processing and during service conditions. Improved techniques for the detection and identification of these defects, together with analytical models for the failure characteristics of these defects are needed to assess the integrity of composites. Techniques for the detection and estimation of moisture in polymer matrix composites, and innovative noninvasive methods for the detection and estimation of defects during processing are also needed for in-process control of composites.

(b) Components

Young Investigator Program; Instrumentation; Graduate Fellowships.

(c) Technology Contact

Head, Materials Sciences Division
Office of Naval Research, Code 1131
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4401

4. Air Force - Advanced Electrical and Structural Polymers

(a) Technology Description

Coordinated research into several areas of polymers with specialized functions is required. The polymer skills required will include synthesis; characterization; physical chemistry; and mechanical, chemical and electrical engineering. It will be a central theme to enhance the capability for "tailoring" polymer molecules of known structure for specific purposes. Several research areas will be emphasized: (1) electrical and magnetic properties of macromolecules; (2) non-linear optical properties; (3) microwave absorption; (4) semi-conductive rigid chain polymer fibrils constitute artificial dielectrics for microwave absorption; (5) semi-conducting polymers; (6) heterocyclic polymers; (7) charable polymers; (8) process/property relationships; (9) polymers, alloys and blends; and (10) multi-functional multi-component systems.

(b) Components

Research Programs; Instrumentation; and Fellowships.

(c) Technology Contact

Director, Chemical and Atmospheric Sciences
Air Force Office of Scientific Research/NC
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4960

5. Air Force - High Temperature Structural Materials

(a) Technology Description

The Air Force has interest in novel and creative approaches leading to higher strength, thermodynamically stable, oxidation resistant, structural materials capable of reliable sustained operation in high temperature environments. The goal of the research is to expand basic understanding of the behavior of both metallic and nonmetallic materials at higher temperatures. This research will include studies of ceramics and ceramic composites, nickel, titanium and refractory metal alloys and carbon-based materials. Potential improvement of aluminum alloy elevated temperature performance will also be examined. Novel processing methods such as rapid solidification, powder metallurgy, sol-gel techniques and

chemical vapor deposition will be explored. Methods for modeling phase stability, and mechanical behavior, particularly in the presence of oxidizing environments, is a related research interest. Being able to relate microstructural features to design limiting phenomena such as toughness, fatigue, creep, and stress rupture is of particular importance.

(b) Components

Research Programs; Fellowships; Instrumentation; Visiting Scientists.

(c) Technology Contact

Director, Electronic and Material Sciences
Air Force Office of Scientific Research/NE
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4933

6. Air Force - Surface and Thin Film Sciences

(a) Technology Description

The Air Force makes extensive use of thin films to achieve desired properties in materials. Unfortunately, the properties of many thin films fall far short of those predicted from bulk properties. This failure is especially true for optical films. Research will address the fundamental understanding of the preparation and properties of thin films in general and optical films in particular. Emphasis will be on reducing the reliance on empirical approaches. Areas of interest include the understanding of the relationship between deposition and resulting microstructure of films, nucleation kinetics, heteroepitaxy and the general atomistic description of crystalline and crystalline/amorphous interfaces. Strong interest exists also in the characterization of films, surface roughness and the understanding of polishing of glasses.

(b) Components

Research Programs; Fellowships; Instrumentation.

(c) Technology Contact

Director, Electronic and Material Sciences
Air Force Office of Scientific Research/NE
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4931

7. Air Force - Cement Paste Matrix Composite Materials

(a) Technology Description

The Air Force has interest in inorganic materials which can be processed under ambient conditions to form structural components possessing mechanical properties far superior to the currently available commercial concretes. In general, hydrated compounds of calcia, alumina and silica such as found in ordinary portland cement are known to react with water at room temperature to form the cement paste found in concrete. Research envisioned in this area will examine the relationship between the phases present in the microstructure and mechanical properties, i.e., strength, stiffness, toughness and durability. Portland cement chemistry may be used as a baseline for these studies but investigations of other cement paste systems are also encouraged. Particular emphasis should be given to determining principles by which this class of materials can be toughened and made much more durable than is possible using current technological practice. We are also interested in examining the potential of tailored composite microstructures on which such cement pastes are used as the matrix material. The interaction of the cement paste matrix materials with carefully controlled dispersed phases of various chemical compositions and morphologies will undoubtedly produce composites with a broad range of mechanical properties. The goal of this research is to reveal the potential of this new class of materials to replace other low temperature structural materials with a low-cost, easily processed alternative.

(b) Components

Research Programs; Fellowships; Instrumentation.

(c) Technology Contact

Director, Electronic and Material Sciences
Air Force Office of Scientific Research/NE
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4933

8. Air Force - Lightweight, Flexible Structures

(a) Technology Description

We are particularly interested in the role nonlinearities play in the behavior and in the ability to control the behavior by active or passive means or by optimizing the design. The interactions between the dynamics of flexible structures in systems and on-board controllers are of special interest, as is the influence of advanced composite materials and metallic alloys on structural characteristics. The research typically involves analytically and experimentally investigating the underlying mechanisms, analytically modeling such mechanisms, or assessing material and configuration concepts for enhancing performance. Constitutive modeling of thermo-mechanical behavior of materials at micro- and macro-structural levels and the development of basic analytical tools are of interest.

Emphasis is on damage growth prediction analysis that is based on a fundamental understanding of damage mechanisms and physically identifiable and measurable damage metrics. Probablistic aspects of damage growth and failure are pursued by considering the development of damage states as a stochastic process. A significant portion of this research addresses composite materials.

(b) Components

Instrumentation; Visiting Scientists; Fellowships.

(c) Technology Contact

Director, Aerospace Sciences
Air Force Office of Scientific Research/NA
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4987

9. DARPA - High Temperature Structural Composites

(a) Technology Description

The objective of this research is to study the micromechanics of failure, the mechanical behavior and properties, characterization of the interface between matrix and reinforcing phase, and processing of four classes of composites: ceramic matrix, intermetallic matrix, carbon-carbon, and metal matrix composites.

These interrelated topics are aimed at optimizing mechanical behavior of these advanced materials. Theoretical studies could include focus on calculations involving fibers reinforcements ahead of matrix cracks to provide design guidelines for brittle matrix composites, emphasizing debonding of fibers in nonlinear crack tip zones, and creep inhibition induced by coherent reinforcements. Experimental studies could emphasize measurements of crack propagation in various whisker-reinforced ceramics, and the processing of ultrafine filamentary and dispersion strengthened/particulate reinforced composites using directional and rapid solidification techniques.

(b) Components

Research Program (possibly incorporating instrumentation, visiting scientists, and fellowships).

(c) Technology Contact

Director, Defense Sciences Office
Defense Advanced Research Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209
Telephone: (202) 694-1959

10. DARPA - Structural and Electronic Polymers

(a) Technology Description

The objective of this research is to develop tailored materials properties in organic and inorganic polymers from structural, electronic and optical applications via molecular design and synthesis of new polymers which relate molecular structure to specific macrostructural properties, including mechanical behavior (e.g., strength, toughness), thermal and chemical stability in harsh environments, and special functional requirements (e.g., specific electrical, magnetic or optical properties). Studies could include new processing routes; the role of molecular structure (especially ordering) in tailored second and third order nonlinear optical response; molecular design of new electronic polymers for resists and electronically tailored planarizing polymers for layered microelectronic structures; and routes to synthesis of conducting polymers without chemical oxidation or reduction mechanisms.

(b) Components

Research Program (possibly incorporating instrumentation, visiting scientists, and fellowships).

(c) Technology Contact

Director, Defense Sciences Office
Defense Advanced Research Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209
Telephone: (202) 694-1959

G. FLUID DYNAMIC SYSTEMS

Fluid dynamic systems arise in the study of many physical problems. These include aerodynamics, atmospherics, acoustics, hydro-dynamics, solar wind, etc. While much progress has been made, many major unsolved problems remain. The most outstanding of these problem areas is turbulent flow, encountered in such common areas as propulsion systems (engines, rockets, etc.), flow over aircraft and naval vehicles and the astmosphere. Research in the fluid dynamic systems area is largely focused on understanding and controlling turbulent flow phenomena.

1. Navy - Hydrodynamics

(a) Technology Description

Increased platform speed through drag reduction with reduced flow generated noise can make major contributions to the capabilities of the submarine and surface forces.

There are research opportunities in turbulence control and turbulence modification for noise and drag reduction. Research is also needed on elimination of turbulent streaks in a boundary layer with an active boundary control. New concepts in theoretical turbulence are needed that will permit the theoretical foundation for these break throughs in turbulence control and modification.

Research is needed to provide a rational scientific basis for understanding the manner in which layered elastic/visoelastic solids interacting with fluid pressure fluctuations due to turbulent flows and incident acoustic waves generate interfacial stresses.

The Navy is the nation's prime user of ship hydrodynamics research. Research is needed to enhance the basic understanding, prediction, and control of nonlinear body/free-surface interactions to increase the speed and performance of surface vessels in both calm and rough water. The body/free-surface interactions include the near and far field of ship wakes interacting with environmental surface waves, currents, and winds, and the interaction of these surface signatures with electromagnetic, optical, and infrared waves originating from remote sensors. Research also is much needed to increase the understanding and control of unsteady flow phenomena such as flow separation, cavitation, and trailing vortices on rotating blades of complex geometry in a sheared turbulent flow field.

Research is also needed to develop a comprehensive mechanical theory of the behavior of novel ferroelastic transducer material. Application of large area transducers constructed of materials such as flexible piezoelectric composites requires new research and researchers familiar with these materials. Advanced research is needed into the coupled fluid dynamics and combustion processes of new, higher specific energy and energy density liquid metals and oxidants for thermochemical power sources.

(b) Components

Young Investigator Program; Instrumentation; Bridges; Graduate Fellowships; Research Programs.

(c) Technology Contact

Head, Mechanics Division
Office of Naval Research, Code 1132
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4403

2. Air Force - Unsteady and Separated Flows

(a) Technology Description

Exploiting unsteady aerodynamics and control of turbulence will require understanding and controlling the fluid separation and flow structures and coupling this insight with improved controls and structural dynamics. We are interested in investigating physical mechanisms and developing a modeling capability based on that understanding; devising advanced theoretical analysis techniques; and originating new concepts that promise to expand the boundaries of current aerodynamic performance.

Research on separated flows will be focused on the nature of large-scale organized separations that frequently occur on low aspect ratio aerodynamic shapes at high incidence. It includes research issues associated with fluid dynamics and controls coupling.

Research on turbulence in shear flows will involve numerical simulation of time-evolving turbulence features, development of new analytical and computational approaches to turbulence, and new methods for passively, actively, or interactively controlling turbulence characteristics and flow separation.

Another objective is to understand the behavior of attached and separated unsteady shear layers affected by time-dependent boundary conditions. Research is needed to develop the scientific basis for productively exploiting unsteady flow characteristics to improve aerodynamic performance.

(b) Components

Instrumentation; Visiting Scientists; Fellowships.

(c) Technology Contact

Director, Aerospace Sciences
Air Force Office of Scientific Research/NA
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4935

3. DARPA - Turbulent Flow in Fluid Dynamic Systems

(a) Technology Description

Research on understanding turbulent flows will focus on the following areas:

(1) The development of suitable mathematical models, where none currently exists. Recently it has been found that chaos models of dynamical systems are effective models for describing turbulent behavior. Therefore, effort should be directed toward obtaining these types of models.

(2) The study of the transition from laminar flow to turbulent flow. Laminar flow is characterized by the exixtence of regular patterns and is well understood. Therefore, the transition is a natural point at which

to concentrate effort. Understanding this transition will reveal physical situations in which turbulence is likely to arise.

(3) The development of algorithms to solve existing models which consist of nonlinear partial differential equations. This effort would incorporate the use of advanced computer architectures, in particular parallelism and cellular automa. Experimental and theoretical effort will be considered in areas as diverse as turbulence in large crystal growth melts and as related to aerodynamic structures.

(b) Components

Research Program (possibly incorporating instrumentation, visiting scientists, and fellowships).

(c) Technology Contact

Director, Defense Sciences Office
Defense Advanced Research Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209
Telephone: (202) 694-1959

H. HUMAN PERFORMANCE FACTORS

An improved/understanding of performance is essential to the optimum design of advanced systems. Research to determine the human limitations to and capacity for information input and information processing will guide the future design of man-machine interfaces.

1. Air Force - Cognitive, Perceptual, and Neural Bases of Skilled Performance

(a) Technology Description

This program will support research on the fundamental mechanisms and processes that underlie skilled human performance. Work in three areas will be supported (1) cognitive processes, especially representation and utilization of perceptual knowledge, attention, memory, and the structure of knowledge; (2) auditory and visual information processing, with emphasis on psychophysical research and theoretical models addressing behavioral data; (3) the neural bases of behavior, especially

learning and memory, arousal, attention, and circadian variations in the state of responsiveness of the organism.

(b) Components

Instrumentation; Fellowships; and Collaborative Research with Scientists in Air Force Laboratories.

(c) Technology Contact

Director, Life Sciences
Air Force Office of Scientific Research/NL
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-5021

I. ENVIRONMENTAL SCIENCE AND TECHNOLOGY

Understanding of the environment in which systems must operate is an essential element in design and performance evaluation. That understanding comes from measurement, analysis, and modeling of those environmental factors and interactions which limit systems capability. Since there is a vast range of environments, the Service interests reflect their operational needs, from ocean to space.

1. Army - Geosciences Center

(a) Technology Description

Research using new sensing techniques, coupled with improved methods of analysis and newly developed algorithms for combining the data from a variety of sensors, can result in reliable, near-term predictions of developing weather and environmental effects.

Additional research topics could include:

(1) Extension of the current capabilities of numerical modeling of the planetary boundary layer, e.g., large eddy simulation, to include inhomogeneities in the near surface layer.

(2) The nonlinear interaction of aerosols with high intensity laser beams.

(3) The limitations on propagation and imaging imposed by naturally occurring as well as battlefield

disturbed atmospheres. The wavelengths of interest range from microwaves to the ultraviolet.

(4) Improved methods of estimating the areal distribution of rain and rainfall rate for inputs to hydrology codes.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Geosciences Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

2. Navy - Ocean Remote Sensing and Modeling

(a) Technology Description

Research opportunities exist in ocean circulation, and the development and application of remote sensing. Ocean circulation is extremely complex. Global ocean circulation is not yet understood, and our understanding of the distribution and circulation of mesoscale feature is still emerging. The ocean can be viewed as a system similar to the atmosphere. The Navy must have the capability to model and predict "ocean weather." Our ability to understand and ultimately predict ocean features on a scale of interest to the Navy has been severely limited by a lack of understanding and measurements. New global information available from planned satellites which will overcome current data limitations and provide requisite synoptic data required for model initiatization and large-scale model development.

Specific areas of interest include: physics of synthetic aperture radar imaging of ocean features, including ice, ship wakes, internal waves and surface waves; advanced sensor development, data handling, and algorithm development; combining multiple sensor and multiple satellite data; and the use of manned space oceanography observations.

(b) Components

Young Investigator Program; Instrumentation; Graduate Fellowships; Research Programs.

(c) Technology Contact

Associate Director, Environmental Sciences Directorate
Office of Naval Research, Code 112
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4530

3. Oceanography

(a) Technology Description

The two dominant themes in the ONR oceanography program are scale interaction and discipline interaction. The space scales of primary interest to the Navy are hundreds of kilometers and below. Virtually all ocean processes that are active at these scales, interact highly with others at larger and smaller scales. Understanding this complicated interaction between scales is the first key element of ONR's oceanography program.

The second key element of the program concerns discipline interaction. Important interactions here include those between the ocean and its boundaries; the ocean's constituents; acoustic and/or optical transmitters and/or sensors and the ocean surface, interior, and floor.

Specific areas of scientific interest include ocean mixed layer processes, fronts and eddies, southern ocean features, numerical ocean prediction, nearshore/beach processes, sea straits, ocean bioluminescene, biodeterioration, marine photochemistry, heavy weather at sea, tropical cyclones, marine clouds, shallow water acoustics, acoustic tomography, marginal ice zone processes, ocean bottom structure, and ocean optics.

(b) Components

Young Investigators Programs; Instrumentation; Graduate Fellowships; Research Programs.

(3) Technology Contact

Associate Director, Environmental Sciences Directorate
Office of Naval Research, Code 112
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4530

4. Navy - Arctic Science and Technology

(a) Technology Description

Arctic environment is the most unique environment on the earth due to its frigid conditions, six months light and six months dark, perennial ice cap, extreme meterorologic forcing, and its limited connections to the major ocean through the Bering and the Fram Straits. These conditions create climate, oceanographic acoustic responses that are different from the temperature areas. These factors plus the remoteness of the Arctic pose major challenges for Arctic science.

Sufficient work has been done to clearly demonstrate that the Arctic Basin acts as a nearly enclosed system. This means that all forcing functions are coupled to basin type reactions. Formulations of cause and effect have to properly address all the environmental coupling since no events occur independently. Theory has to be formulated that accounts for the dependent coupling between forces and responses. Experimental measurements required to guide theory and verify hypotheses must be multidisciplinary (meteorology and oceanography) and gathered in a large spatial domain over meaningful time frames. Research must integrate and invert large data bases using fast computer methods to resolve and understand all the interdependent force/effect processes.

(b) Components

Instrumentation; Graduate Fellowships.

(c) Technology Contact

Head, Geophysical Sciences Division
Office of Naval Research, Code 1125
800 North Quincy Street
Arlington, VA 22217-5000
(202) 696-4120

5. Air Force - Theory and Analysis of the Geo-Plasma Environment

(a) Technology Description

At the present time there is unique opportunity to support the theoretical analysis of existing and future experimental results in geo-plasma physics. From that effort we expect to develop a theoretical understanding of the basic phenomena of the natural and disturbed ionospheric-magnetospheric system and the associated plasma instabilities and wave-particle interactions leading to the creation intense electric fields, particle acceleration and diffusion, included plasma turbulence, and related phenomena.

(b) Components

Research Programs; Instrumentation; and Fellowships.

(c) Technology Contact

Director, Physical and Geophysical Sciences
Air Force Office of Scientific Research/NP
Bolling Air Force Base
Washington, D.C. 20332
Telephone: (202) 767-4904

6. Air Force - Surface Reactions in the Space Environment

(a) Technology Description

A coherent, systematic research program is needed to study the physical and chemical changes taking place when materials interact with ions and neutrals at energies corresponding to orbital velocities. Not only will such reactions lead to electrical damage and weakening of structure, but the fluorescent radiation produced will interfere with surveillance missions. Understanding such surface reactions is central to the design of space systems for effective, long-term operation.

The microscopic physical mechanisms associated with macroscopic materials modification and damage are not yet understood. Forging this link between atomic-scale and large-scale surface phenomena requires a means of identifying specific atomic and molecular species before, during and after the interaction with the surface; appropriate ways of characterizing the state of the surface before and after the interaction; and spatially - and temporally-resolved measurement of the surface and the atoms/molecules in its vicinity.

All of the tools necessary to do this research are now available with the exception of monoenergetic neutral beam sources for any desired atom or molecule. Several groups are developing neutral sources The successful solution of the puzzle of particle-surface interactions depends on bringing together an appropriate collection of hardware and a collection of scientists with broad training and experience which cuts across traditional disciplinary boundaries.

(b) Components

Instrumentation; Research Programs; Fellowships.

(c) Technology Contact

Director, Chemical and Atmospheric Sciences
Air Force Office of Scientific Research/NC
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202)

7. Air Force - Solar Activity and Variability

(a) Technology Description

Due to the increased use of space and the reliance upon sophisticated microelectronics, research is needed to develop the capability to provide reliable predictions and warnings of solar activity. Knowledge of the solar output of x-rays and particles over the past few hours, days, and weeks, coupled with predictions of the Sun's activity in the near future, can allow mission planners to initiate action to reduce or eliminate these detrimental effects.

Space missions such as NASA's Solar Maximum Mission (SMM), Spacelab 2, the Solar Optical Telescope (SOT), and the proposed USAF Solar Activity Measurements Satellite Experiment (SAMEX) will provide a data base on solar activity and variability of unsurpassed quality. Effective use of this data for developing activity forecasting techniques will require a concerted theoretical effort.

(b) Components

Fellowships; Instrumentation; Research Programs.

(c) Technology Contact

Director, Physical and Geophysical Sciences
Air Force Office of Scientific Research/NP
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4904

J. PROPULSION TECHNOLOGY

Advances in the performance and efficiency of propulsion systems for space, air and ground vehicles will be realized through the results of research into the processes controlling the spatial and temporal rate of energy release. The research area is broad, encompasing solid and liquid fuel, conventional propulsion systems such as rockets and engines, and novel, plasma propulsion systems which will be used on future space misions.

1. Army - Advanced Propulsion Systems

(a) Technology Description

Within these propulsion requirement generalities, research groups need to be established which can address a variety of related yet interdisciplinary tasks in a synergistic fashion. Such basic research tasks may, for example, be related to internal aerodynamics, combustion, heat transfer, composite/ceramic material applications, power transmission, compound cycle concepts and analyses, bearings and seals, lubrication, shaft dynamics, etc. Aeropropulsion research conerned with small radial and exial flow componentry, compressor-diffuser interfaces and turbines is of strong interest. Applications of advanced materials for heat management and weight reduction need consideration. High temperature combustion regions including steady and transient effects, fuel injection, evaporation, ignition and two-phase turbulent flows are, of course, important for efficient energy extraction.

(b) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Engineering Sciences Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

2. Army - Fast Reaction Kinetics of Energetic Material

(a) Technology Description

Studies of energy release should be undertaken to clarify the mechanisms for the initial decomposition and subsequent reactions of the fragments (probably radicals). Studies would involve both experimental identification and measurement of reaction species and determination of their kinetics, and theoretical calculations of potential energy surfaces for reacting species and their dynamics. After preliminary work in the gas phase, emphasis would be directed at both liquid and solid energetic materials. Work on diagnostic methods would require development of new experimental methods for detecting species and measuring their kinetics in the very hostile environment (high temperature and pressure) of energetic materials combustion. The principal need is for methods suitable for studying combustion involving condensed phases. Advances in the understanding of combustion of available energetic materials should lead to suggestions for improved formulations and, consequently, a program to synthesize new materials with better burning rate control, higher energy release, lower vulnerability, and greater stability.

(2) Components

Multidisciplinary Research Program (including instrumentation, fellowships, visiting scientists).

(c) Technology Contact

Director, Chemistry Division
Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

3. Air Force - Turbulent Reaction Flows

(a) Technology Description

Fundamental understanding of the physics and chemistry of multiphase turbulent reacting flows is essential for improving performance of airbreathing propulsion and chemical laser systems. We will assign highest priority to research relevant to studying supersonic combustion, using boron fuels, atomizing and spraying slurries and liquids, and understanding the chemistry of fuel combustion. Other topics of interest include, but are not limited to, turbulent combustion, soot formation, and combustion instability.

We are interested in new diagnostic techniques for analyzing surface reactions and flames of propellants; in controlling the state of combustion products in plumes; and in acquiring standard data on thermodynamic, kinetic, and transport properties. Emphasis on synthesizing and using advanced propellant ingredients to increase propulsion efficiency and to satisfy specific burning rate requirements.

Topics of interest in plasma propulsion include pulse and steady-state plasmas; equilibrium and nonequilibrium flowing plasmas; characteristics of electrical and hydrodynamic flows; instabilities of plasma bulk and wall layers; interactions of plasma-surface, -electrode, -magnetic, and -electric fields; losses to inert parts; plasmas in magnetic fields and pressures; and plasma diagnostics (new and unique noninterference measuring techniques).

Research in sensing and diagnostic techniques and strategies will include quantitative imaging of plasma flows, monitoring of rapid surface reactions, using nonoptical sensors, instantaneous mapping of velocities, and formalisms for exploiting array data.

(b) Components

Instrumentation; Faculty Exchange; Fellowships.

(c) Technology Contact

Director, Aerospace Sciences
Air Force Office of Scientific Research/NA
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4937

III. URI COMPONENTS

Components to be funded under URI have been carefully selected to provide a range of opportunities and options for achieving the goals of the program. For each technology selected for accelerated growth under URI, a balanced program will be selected to include some or all of the following components:

A. Research centers and/or research programs, with emphasis on inter disciplinary interactions wherever they can speed the emergence of new technologies, to provide opportunities for scientists and engineers from different fields and from different organizations to work toward a common goal;

B. Human resource development programs including fellowships, young investigator opportunities and exchange scientist and engineer programs to facilitate the flow of ideas between the university community and DoD laboratories; and

C. Instrumentation grants to increase productivity of university research.

Each of these components is described in the section which follows.

A. RESEARCH CENTERS AND PROGRAMS

Research centers and programs, designed to foster interdisciplinary research efforts in a range of disciplines important to DoD, and to increase interaction between academic and DoD laboratory researchers, will be a major element of the University Research Initiative.

Support for centers and programs will result not only in the development of multidisciplinary science and engineering research in high payoff science and technology areas important to the DoD mission, but also in improved research instrumentation, involvement of graduate and postdoctoral students and exchange scientists in research thrusts with potential long-term significance to DoD, and strengthening of relationships between DoD laboratories and academic researchers.

This component will accomplish two major goals of the URI program: initiation of multidisciplinary science and engineering research programs in high payoff science and technology areas; and expansion of fellowship, assistantship and exchange scientist programs, and improved instrumentation. The purpose is to foster closer interactions between university and other (especially DoD) researchers until they reach "critical mass" and multiply the effectiveness of the research. The opportunity to conduct research side-by-side with prominent academic and DoD scientists will provide incentives for attracting the best graduate students and postdoctoral fellows.

Research proposals are invited in areas described in Table II-2.

Mechanics. Current plans call for centers and programs to be awarded through a competitive process and announced in the Commerce Business Daily, briefings, and/or other appropriate forums.

Among the elements which proposers may be asked to address are:

- A rationale for their selection of the area (or areas) of science and technology and how the research to be performed will contribute to defense needs;
- Mechanisms fostering close technical cooperation between academic and DoD organizations;
- Staffing requirements to include faculty, postdoctoral fellows, visiting scientists, graduate students, co-op students, etc.;

- Capabilities and experience of the principal faculty personnel;

- A rationale for equipment requested; and

- Management and administrative procedures to be employed if a university consortium is proposed.

Universities may elect to include formal links with industry or DoD laboratories in order to effect technology transition that will strengthen national security and economy. While no classified work is expected to be required, universities may propose to do clasified work if there is a genuine contribution to the effectiveness of the activity.

Proposals will be evaluated by the Services and DARPA. Criteria will include: originality and potential impact of proposed research; degree to which multidisciplinary research is fostered; demonstrated quality of the principal investigator(s), the research staff, and graduate students as evidenced by prior and ongoing research achievements, publications, etc.; university commitment to the research area(s) proposed as evidenced by faculty appointments, facilities investment, and long-term commitment to viable undergraduate and graduate research programs; the extent to which government and industry interactions with the research staff are evident; and viability of a plan for initiative completion or to develop support for continuation. The degree of integration within centers will vary; for example, larger centers may administer their own fellowships or visiting-scientist programs (indicated parenthetically in Figure II-2). The number and variety of centers and programs to be funded will depend on the funds available.

For more information on specific Service and DARPA plans for research centers and programs contact:

Army Research Office
P.O. Box 12211 - ATTN: SLCRO-URI-86
Research Triangle Park, NC 27709-2211
Telephone: (919) 549-0641

Director, Research Programs
Office of Naval Research
800 North Quincy Street
Arlington, VA 22217-5000
(202) 696-4101

Air Force Office of Scientific Research
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4937

Director, Defense Sciences Office
Defense Advanced Research Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209
Telephone: (202) 694-1959

B. PROGRAMS TO DEVELOP HUMAN RESOURCES

The proposed research centers and programs described in the prior section will include funds to support a variety of human resource development programs, (e.g., fellowships, exchange scientists and engineers, etc.). In addition, the programs described in this section will be funded separately from the research centers and programs and are designed to develop the capabilities of scientific and technical personnel in those disciplines which will advance the technologies selected for accelerated growth under URI. These programs are targeted at various groups of professionals at various stages in their careers, from those just starting to those with a long and distinguished record of research.

Since opportunities for fellowships, exchange scientist programs, etc. are included in the centers and programs to be funded by the Army and DARPA, the programs which follow in this section are those to be sponsored by the Navy and Air Force. These programs include:

1. Graduate Fellowship Programs:

   (a) Office of Naval Research Graduate Fellowship Program
   (b) Air Force Laboratory Graduate Fellowship Program

2. Young Investigator Programs:

   (a) Office of Naval Research Young Investigator Program

3. Exchange Scientist and Engineer Programs:

   (a) Navy and Air Force Summer Faculty Research Program (SFRP)
   (b) Air Force Graduate Student Summer Support Program (GSSSP)
   (c) Office of Naval Research Bridges Program
   (d) Air Force Laboratory/University Associates Programs

1. Graduate Fellowship Programs

(a) Navy - ONR Graduate Fellowship Program

The ONR Graduate Fellowship Program is designed as one means of increasing the supply of U.S. citizens trained in disciplines of science and engineering critical to the U.S. Navy. The program is open to U.S. citizens who propose to pursue Ph.D's in specified science and engineering fields supporting those technologies identified in the matrix of Table II-2. Applications are sought from individuals who have not begun graduate work and are evaluated and ranked by expert panels from the Navy and academe. Evaluation is based on GRE scores, transcripts, and recommendations. ONR makes final selection from ranked lists.

ONR's program is administered by the American Society for Engineering Education (ASEE). In 1986, stipends will amount to $13,000, $14,000, and $15,000 annually for the first, second, and third years, respectively, which must be taken during a five year period. These stipends are paid directly (and monthly) to the students, while full tuition, required fees, and $2,000 to the student's department are paid annually directly to the institutions. Special consideration is given to students requiring fourth year support on a case-by-case basis.

A special feature of the ONR program advances the Secretary of the Navy initiatives in oceanography by distinguishing fellowships in this field as "Secretary of the Navy Fellowships in Oceanography." Another feature of the program is the opportunity for the students to particpate in an active DoD research effort by continuing their studies in a Navy laboratory during the summer, an activity communicated annually to the students by ONR, the laboratories, and ASEE.

(1) Reference

ONR Poster - distributed to 20,000 addresses in August 1985

(2) Contact

The American Society for Engineering Education (ASEE)
11 Dupont Circle, Suite 200
Washington, D.C. 20036
Telephone: (202) 745-3616
(202) 293-7080

(3) Deadline

January 31, 1986

(4) Size

45 to 50 new awards per year

(b) Air Force - Laboratory Graduate Fellowship Program

As a means of increasing the supply of doctoral-level U.S. citizens who are educated in disciplines of science and engineering of interest to the United States Air Force, the Air Force Office of Scientific Research (AFOSR) is offering forty-five, three-year fellowships during 1986. These new fellowships will be for study and research in the following areas: (1) Aerospace Sciences; (2) Chemical and Atmostpheric Sciences; (3) Electronic and Material Sciences; (4) Mathematical and Information Sciences; (5) Life Sciences; (6) Physical and Geophysical Sciences.

Graduate Fellowships are awarded on the basis of merit. The evaluation of applicants will be based on all available evidence of ability, including academic records, recommendations regarding each applicant's qualifications, and scores attained in the Graduate Record Examinations (GRE). The applicant must be a U.S. citizen, and be studying or working in an area leading to a doctoral degree in the areas listed.

Air Force Graduate Fellowships are tenable at any appropriate nonprofit United States institution of higher education offering the Ph.D. in science or engineering. The normal tenure of a Graduate Fellowship is 12 months each fellowship year. Fellows may reduce the tenure of any fellowship year to no less than 9 months, with forfeiture of the remaining months of that fellowship year. Air Force Graduate Fellows will receive stipends as follows:

$13,000 for the first year:
$10,000 Academic Year, $3,000 Summer Session

$14,000 for the second year:
$11,000 Academic Year, $3,000 Summer Session

$15,000 for the third year:
$12,000 Academic Year, $3,000 Summer Session

Stipends will be prorated for tenure shorter than 12 months. There are no dependency or travel allowances. In addition to stipends, the Air Force Fellowship includes

funding of the institution's tuition and fees (not to include room and board) and provides $2,000 per year to the Fellow's department.

(1) Contact

Air Force Fellowship Program Director
SCEEE Management Office
1101 Massachusetts Avenue
St. Cloud, FL 32763
Telephone: (305) 892-6146

(2) Deadline

Program planned to start in early 1986.

2. Young Investigator Programs

(a) ONR - Young Investigator Program

The ONR Young Investigator Program is intended to attract bright young academic researchers to areas of research that are important to future Navy requirements by providing special recognition and stable funding for research at a level consistent with the purchase of equipment and support of graduate students. The goal of the program is to provide a future resource of informed, committed scientists and engineers, and to establish strong long-term ties between DoD and outstanding academics.

The ONR Young Investigator Program is open to U.S. academic researchers who received Ph.D. or equivalent degrees on or after the first day of January no more than five years prior to award date (for example, in 1986, on or after January 1, 1981). Proposals are sought from a wide range of disciplines and are selected by ONR. Selection is based on (1) creativity of proposal in demonstrating the potential for making progress in important scientific areas of interest to the Navy; (2) past performance of the Young Investigator as evidenced by published work, awards, and similar recognition; (3) a long-term commitment by the university to the applicant and the research. It must be clear that the proposed investigator is a potential leading faculty member with strong commitment from the university officials.

Base funding is $50,000 per year for three years. As an incentive for becoming involved with such Navy research activities as the Navy laboratories and the Navy Systems Commands, ONR will match on a 2-for-1 basis support gained from these sources. ONR matching funds are limited to $80,000, but this does not prohibit a young investigator from

getting more than $40,000 from other Navy sources. Further, because the Young Investigator's range of Navy contacts may be limited at the outset of the application, matching funds can be arranged any time during the award and need not be in place initially. ONR program managers may augment a Young Investigator award beyond the basic and matching funds by contributing from their own program funds. Two-years additional support is possible for particularly creative and productive Young Investigators as demonstrated during the first years of the initial three-year award.

(1) Reference

ONR brochure titled Young Investigator Program FY 86
Latest Edition
Published September 1, 1985

(2) Available From

Office of Naval Research, Code 11
800 North Quincy Street
Arlington, VA 22217-5000
(202) 696-4103

(3) Deadline

March 17, 1986

(4) Size

10-30 Awards Annually

3. Exchange Scientist and Engineer Programs

(a) Air Force - Summer Faculty Research Program (SFRP)

The Air Force Summer Faculty Research Program (SFRP) allows university faculty researchers to spend a summer working at an Air Force research activity. It stimulates the interest of the faculty in Air Force research and encourages them to develop and continue working relationships with their professional peers in the Air Force. It also enhances an institution's scientific capabilities in areas of interest to the Air Force.

For regular summer appointments, the research assignment is for a continuous 10-week period between April 1 and September 30, 1985; the start-date is flexible. For the 10-week research period, each fellow receives $550 per week, an expense allowance of $37.00 per day, and travel allowances to cover the costs of traveling to and from the Air Force

research site. Fellows may visit the research sites before the research period. Research sites and areas of interest are listed in Table III-I.

SFRP appointments are made on the basis of ability. Applicants are evaluated on evidence of that ability, which may include professional experience and recommendations about qualifications. The applicant must be a U.S. citizen; be a faculty member at an accredited U.S. college, university, or technical institute; and have at least 2 years of teaching and/or research experience. Candidates should be eligible for a Department of Defense SECRET security clearance because selectees will need full access to work areas. SFRP participants may receive up to $20,000 to continue their research upon returning to their universities by applying for a Research Initiation in Science and Engineering (RISE) award; approximately 50% of SFRP participants receive follow-on RISE awards.

(1) Contact

Summer Faculty Research Program Director
Universal Energy Systems, Inc.
4401 Dayton-Xenia Road
Dayton, Ohio 45432
Telephone: (513) 426-9876

(2) Deadline

February 1, 1986. Awards will be announced by March 1, 1986.

(b) Air Force - Graduate Student Summer Support Program (GSSSP)

The GSSSP is directed at engaging outstanding graduate students in Air Force's research programs. Students may accompany faculty members who have been selected as SFRP Fellows, or may apply individually for summer appointments.

The period of appointment is for a continuous 10-week period, (a maximum of 50 working days) between April 1, and September 30. The student's research period should coincide with the appointment period of the supervising professor with whom the student will be working. A laboratory scientist will be assigned to supervise students who are not accompanying SFRP fellows.

A selectee receives a predetermined salary based on educational level: those holding BS degrees will receive $57.00 a day and those with MS degrees, $68.25 a day. Each

selectee also receives an expense allowance of $27.00 a day for a maximum of 70 days and a travel allowance to cover the costs of traveling to and from the Air Force research sites noted on Table III-I.

GSSSP appointments are made on the basis of ability. Applicants are evaluated on evidence of that ability, which may include academic records, the Graduate Record Examination, and recommendations.

(1) Contact

Summer Faculty Research Program Director
Universal Energy Systems, Inc.
4401 Dayton-Xenia Road
Dayton, OH 45432
Telephone: (513) 426-9876

(2) Deadline

April 15, 1986. Awards will be announced by April 25, 1986.

(c) Navy - Bridges Program

The Bridges Program, is designed to generate closer ties between laboratory and center scientists/engineers and those on university campuses. Individual Principal Investigators (PIs) either associated with the ONR Contract Research Program (CRP) or new to the CRP program will combine efforts in research with personnel at Navy labs and centers.

In the Bridges Program the laboratories and selected PIs are encouraged to explore areas of mutual interest and methods of cooperation. The ONR Scientific Officers work with the parties to create a plan for substantive interaction. Once a potential plan exists the Director of Research Programs provides funding directly to the Scientific Officer to support a research contract with the university professor. The contract is designated as a Bridges contract. It differs from the usual CRP contract in that there is a definite understanding that the university PI will have "substantive interaction" with the laboratory as planned.

There is of course a great deal of informal cooperation between people supported under the CRP and people in Navy laboratories. The Bridges Program will formalize some of these arrangements and encourage others.

(1) Contact

Director, Research Programs
Office of Naval Research, Code 11
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4101

(2) Deadline

OPEN

(3) Size

Variable

(d) Air Force - Laboratory/University Associates Programs

The University Resident Research Program (URRP) and the Air Force Systems Command/National Research Council Resident Research Associateship Program constitute the Laboratory/University Associates Programs.

(1) University Resident Research Program (URRP)

The University Resident Research Program enables highly qualified university faculty members to spend one or two years at Air Force Laboratories or at AFOSR working on research problems of interest to the Air Force. Through this program, faculty members have an opportunity to direct their expertise and contribute fresh ideas to Air Force research. The Air Force Office of Scientific Research (AFOSR) funds the program and furnishes the necessary support services, facilities, and equipment for the research. Assignees will continue to receive their salary from their universities. AFOSR or the Air Force laboratories negotiate with the university for travel and moving expenses and the amount of the salary needed to cover the time of the sabbatical or leave of absence. These locations and areas of interest are listed in Table III-I. The Director of the Scientific Directorate under whose purview the proposed research will be conducted reviews the application and makes a recommendation to the AFOSR Commander and Technical Director, who make the final decision. The applicant must be a U.S. citizen; be a faculty memeber at an accredited U.S. college, university, or technical institute; have an earned Ph.D. in a scientific discipline or engineering field; and have a publication record in his or her proposed area of research.

(a) Contact

Major Amos L. Otis, Program Manager
Special Faculty Programs
Air Force Office of Scientific Research/XOT
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (202) 767-4970/71

(b) Deadline

Open Ended

(2) National Research Council Resident Research Associateship Program

The Air Force Systems Command (AFSC)/National Research Council (NRC) Resident Research Associateship Program provides postdoctoral scientists and engineers opportunities to research problems of their own choice that are compatible with the research interests of selected sponsoring Air Force Laboratories. This program is intended to be analogous to fellowships, associateships, and similiar temporary programs at the doctoral level in universities and other organizations. Two types of awards are made: a regular associateship and a senior associateship. Persons who have held a Ph.D. for less than five years may be awarded a regular research associateship and those who have held a Ph.D. for five years or more may be awarded a senior associateship. The date on which tenure begins is negotiable.

Each regular associate receives $25,000 per year, which is increased appropriately for senior associates. A stipend supplement may be given to awardees in fields in which a shortage of new doctoral graduates exists. A stipend supplement of up to $5,000 may be added to the basic stipend for awardees with Ph.D.'s in engineering, computer science, and clinical space-biomedical science. Awardees will also receive a relocation reimbursement and funds for limited professional travel, if the research advisor recommends the travel and the NRC approves it in advance. AFSC provides the funds to support this program. It furnishes the support services, facilities, and equipment for the approved research program of each associate. These locations and areas of interest are listed in Table III-I.

An applicant's proposed plan of research must be approved by a laboratory research advisor and endorsed by

an AFSC program committee. NRC evaluation panels review and rank the proposal and make the final decision. The program is open to U.S. citizens and to citizens of other countries who have full command of the English language. Selectees must produce evidence of having received a Ph.D., Sc.D., or other doctoral degree equivalent to the Ph.D. or must have completed all of the formal academic requirements for one of these degrees. Applicants must have demonstrated superior ability for creative research.

(a) Contact

Associateship Programs (JH 608)
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
Telephone: (202) 334-2760

(b) Deadline

Applications are evaluated only during February, June, and October and must be postmarked no later than January 15, April 15, and August 15.

C. INSTRUMENTATION

Instrumentation is essential to modern research. Modern instruments with qualitatively superior capabilities for analysis and measurement often open new fields of scientific inquiry. In some scientific areas, access to the most advanced scientific instrumentation determines in large measure the extent to which scientists can work at the cutting edge of their field. Moreover, the cost of scientific instrumentation has gone up faster than inflation, therefore, requiring special funding to compensate for the additional costs.

DoD currently is addressing the research instrumentation needs of universities through two principal mechanisms. Approximately 10% of the university research awards made by the three Services and DARPA is applied to the purchase of instrumentation. In addition, the acquisition of more research equipment is accomplished through a second program, the University Research Instrumentation Program (URIP) - a $30M/yr DoD program.

In FY 84, approximately $76 million was applied toward university instrumentation purchases via these two mechanisms; however, there is ample evidence to indicate that the need far outstrips this rate of investment. URI affords an opportunity to enhance the DoD support for the renovation and replacement of research equipment.

(1) Contact

Director, Research Programs
Office of Naval Research, Code 11
800 North Quincy Street
Arlington, VA 22217-5000
Telephone: (202) 696-4103

Technical Director
Air Force Office of Scientific Research
Bolling Air Force Base
Washington, D.C. 20332-6448
Telephone: (301) 767-4969

(2) Reference

Announcements will be published in the CBD and through special mailings.

(3) Deadline

To be announced.

(4) Size

When special awards are made for instrumentation, they will be in amounts greater than $50,000. Smaller instrumentation awards are expected to be part of research, contracts, or grants.

TABLE III-1
AIR FORCE RESEARCH LOCATIONS AND AREAS OF INTEREST**

NAME OF RESEARCH FACILITY	LOCATION	AREAS OF INTEREST
AERO PROPULSION LABORATORY*	Wright-Patterson AFB Dayton, OH	Engineering (electrical and mechanical), mathematics, and science (basic and computer)
AEROSPACE MEDICAL RESEARCH LABORATORY*	Wright-Patterson AFB Dayton, OH	Engineering (aeronautical, biomedical, communications, electrical, and industrial) and sciences (basic and life).
ARMANENT DIVISION	Eglin AFB Ft. Walton Beach, FL	Chemistry, computer science, engineering (aeronautical, electrical, and mechanical), mathematics, operations research, and physics.
ARNOLD ENGINEERING DEVELOPMENT CENTER	Arnold AFB Tullahoma, TN	Engineering (aeronautical, electrical, and mechanical), and physics.
AVIONICS LABORATORY*	Wright-Patterson AFB Dayton, OH	Engineering (electrical), mathematics, and sciences (basic, computer, management, and software).
BUSINESS RESEARCH MANAGEMENT CENTER	Wright-Patterson AFB Dayton, OH	Engineering (industrial and systems), operations research, and sciences (behavioral and socioeconomic)
EASTERN SPACE AND MISSILE CENTER	Patrick AFB Cocoa Beach FL	Engineering (astronautical and electrical) and physics
ELECTRONIC SYSTEMS DIVISION	Hanscom AFB Bedford, MA	Engineering (electrical and industrial), mathematics, operations research, and physiology

** Similar lists for Army and Navy laboratories may be obtained from the Army Research Office in Durham, North Carolina, and the Office of Naval Research in Arlington, Virginia.

TABLE III-1 Continued

NAME OF RESEARCH FACILITY	LOCATION	AREAS OF INTEREST
ENGINEERING AND SERVICES CENTER	Tyndall AFB Panama City, FL	Chemistry, engineering (chemical, civil, electrical, geotechnical, mechanical, and structural), economics, environmental planning, food technology, meterology, sciences Behavioral, computer, and environmental) and sociology.
FLIGHT DYNAMICS LABORATORY	Wright-Patterson AFB Dayton, OH	Engineering, (Aaronautical, electrical, and mechanical) mathematics.
FRANK J. SEILER RESEARCH LABORATORY*	USAF Academy Colorado Springs, CO	Chemistry, engineering, (aerospace, and electrical) mathematics, and operations research
GEOPHYSICS LABORATORY*	Hanscom AFB Bedford, MA	meteorology and sciences (basic)
HUMAN RESOURCES LABORATORY	Logistics and Technical Training Division Wright-Patterson AFB Dayton, OH	Econometrics, engineering (human factors, industrial, logistics, and systems) industrial psychology, inventory theory, management (logistics, production, and systems), operations research, organizational theory, science (management),
	Operations Training Division Williams AFB Phoenix, AZ	Engineering (aeronautical, electrical, and systems), mathematics, operations research, physics, and science (computer)
	Manpower and Personnel Division Brooks AFB San Antonio, TX	Mathematics, pyschology (educational, experimental, and industrial), and statistics

TABLE III-1 Continued

NAME OF RESEARCH FACILITY	LOCATION	AREAS OF INTEREST
HUMAN RESOURCES LABORATORY	Logistics Training Division Lowry AFB Denver, CO	Education (instructional), technology, psychology, (research), and science (computer, and management)
LEADERSHIP AND MANAGEMENT DEVELOPMENT CENTER	Maxwell AFB Montgomery, AL	Engineering (industrial) and management business
LOGISTICS COMMAND	Wright-Patterson AFB Dayton, OH	Econometrics, engineering (industrial), management science, mathematics, operations research, and statistics
LOGISTICS MANAGEMENT CENTER	Gunter AFS Montgomery, AL	Engineering (industrial) and operations research
MATERIALS LABORATORY*	Wright-Patterson AFB Dayton, OH	Engineering (industrial, and mechanical), manufacturing technology, metallurgy, and sciences, (basic)
ROCKET PROPULSION LABORATORY*	Edwards AFB Rosamond, CA	Chemistry (analytical, inorganic, organic, and physical), engineering (aeronautical, electrical, mechanical, and nuclear), and physics.
ROME AIR DEVELOPMENT CENTER	Griffiss AFB (Rome), NY	Engineering (electrical), mathematics, physics, and science (computer)
	Electronic Technology Branch Hanscom AFB Bedford, MA	Chemistry, engineering (electrical) and physics

TABLE III-1

NAME OF RESEARCH FACILITY	LOCATION	AREAS OF INTEREST
SCHOOL OF AEROSPACE MEDICINE*	Brooks AFB San Antonio, TX	Biochemistry, biomathematics, biostatistics, cell biology, engineering (biomedical and industrial), mathematics, operations analysis, physiology, sciences (basic, computer, and veterinary)
WEAPONS LABORATORY*	Kirtland AFB Albuquerque, NM	Engineering (Civil, Electrical, Mechanical, and Nuclear), and Sciences (Basic and Computer)

*The National Research Council has certified these laboratories to participate in the Air Force Systems Command/National Research Council Resident Research Associateship Program.