

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION
WASHINGTON 25, D.C.

1-4 Budget Bureau No. 51-772
Approval expires 1-1-61
Personal Copy -
Oct 1960
Sgt

GRADUATE FELLOWSHIP PROGRAM APPLICATION
(Under Title IV of the National Defense Education Act of 1958)

A. Initial Program Approval and an Allotment of Fellowships

INSTRUCTIONS: See accompanying directives.

An application is hereby made by this institution for the initial approval by the U.S. Commissioner of Education of a graduate program in the following department and under the following specific program title for the academic year 1961-62:

INSTITUTION Georgetown University
ADDRESS 37 and O, N.W. Washington 7, D.C.
DEPARTMENT Physics
SPECIFIC PROGRAM TITLE Atomic and Molecular Spectroscopy
(If appropriate)

A. Institutional Priority Ranking (Ranking should be made on the basis of all applications submitted.)

1. The total number of 1961-62 applications 4
2. The rank order for this program _____

B. Optimum number of fellowships requested 10 Minimum number of fellowships requested 5

C. PROGRAM SUBMITTED FOR INITIAL APPROVAL

- | | | | |
|--|------------------------------------|---|---|
| 1. Description (Check one) | | 2. Additional Staff & Facilities, 1961-62 | |
| a. Ph.D. or similar degree to be offered for the first time in program field _____ | b. Senior staff appointments _____ | c. Increased facilities _____ | d. Additional library holdings _____ |
| b. Ph.D. or similar degree now offered in program field <u>X</u> | b. Junior staff appointments _____ | c. Increased facilities <u>yes</u> | d. Additional library holdings <u>yes</u> |

NAME OF SCHOOL OR SCHOOLS IN WHICH PROGRAM IS TO BE GIVEN
Graduate School, Georgetown University

NAME OF DEPARTMENT OR DEPARTMENTS IN WHICH PROGRAM IS TO BE GIVEN
Department of Physics

NAME OF DEPARTMENT HEAD OR PROGRAM DIRECTOR RESPONSIBLE FOR PROPOSED PROGRAM
Matthew P. Thekkarakara S.J.

NAME AND TITLE OF FINANCIAL OFFICER
Joseph F. Cohalan S.J.

NAME AND TITLE OF PERSON RESPONSIBLE FOR ALL TITLE IV PROGRAMS IN INSTITUTION
James B. Horigan S.J.

ADDRESS
37 and O Sts N.W. Washington 7, D.C.

AGREEMENT

The attachments hereto are a part of this application. It is understood and agreed that (1) the new program will be carried out in accordance with this application, except as changes are approved by the Commissioner; (2) the applicant institution will comply with regulations of the Commissioner under Title IV of the National Defense Education Act of 1958, including provisions with respect to accounting for funds and the availability of records for audit by the United States Government; and (3) in the acceptance of persons for study in this program, preference will be given to persons interested in teaching in institutions of higher education. All statements made in this application are accurate and complete to the applicant's best knowledge and belief.

NAME AND TITLE OF AUTHORIZED OFFICIAL Joseph F. Cohalan S.J.
Treasurer
(Please type)

PERSONAL SIGNATURE _____

(This certification must carry the actual signature of the official authorized to sign on the institution.)

NATIONAL DEFENSE GRADUATE FELLOWSHIP PROGRAM

Name of Institution:		Department:		Period of Cost Data					
Georgetown University		Atomic & Molecular Spectroscopy - Physics		From:		To:			
				Sept., 61		Aug., 62			
EQUIPMENT									
Description	Quantity	Cost Per Unit	Total Cost	% Annual Depreciation	Amount Annual Depreciation	Allocated to other Departments		Allocated to this Department	
						%	Amount	%	Amount
Wadsworth Spectrograph	2	12,000	24,000	10%	\$2400	60%	\$1,440	40%	\$960
Littrow Spectrograph	1	9,000	9,000	10%	900	60%	540	40%	360
Telecordex	1	13,000	13,000	10%	1,300	80%	1,040	20%	260
Telereadex	1	18,000	18,000	10%	1,800	80%	1,440	20%	360
Interferometer	1	2,000	2,000	10%	200	50%	200	50%	200
Densitometer with recorder	1	480	480	To be purchased under this program					480
Total								2620	

NATIONAL DEFENSE GRADUATE FELLOWSHIP PROGRAM

Name of Institution Georgetown University	Department: Atomic & Molecular Spectroscopy	Period of Cost Data From: Sept., '61 To: Aug., '62
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RENTAL OF EQUIPMENT

Description	Quantity	Rental Price Per Unit	Total Rental	Allocated to Other Departments		Allocated to This Department		
				%	Amount	%	Amount	
Time on two Burroughs E101 computers	300 hrs	\$2.60 per hr.	\$780.00	-	-	100%	\$780.00	
Total								\$780.00

NATIONAL DEFENSE GRADUATE FELLOWSHIP PROGRAM

Name of Institution Georgetown University	Department: Atomic & Molecular Spec- troscopy	Period of Cost Data: From: To: Sept., '61 Aug., '62			
INDIRECT COSTS					
Item	Total Cost	Allocated to Other Departments		Allocated to This Department	
		%	Amount	%	Amount
General Administration and General Expenses *					
Operation and Maintenance Expenses*					
Library Expenses*					
Use Allowance for Buildings, Capital Improvements, and Equipments*					
Indirect Departmental Expenses *					
25% of Direct Costs	\$6,620			25%	\$1,655
* Show basis of allocation or proration					
Total					\$1,655

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education, Washington 25, D.C.

NATIONAL DEFENSE GRADUATE FELLOWSHIP PROGRAM - ATTRIBUTABLE COSTS

NATIONAL DEFENSE GRADUATE FELLOWSHIPS - TITLE IV, PUBLIC LAW 85-864

Name and Address of Institution: GEORGETOWN UNIVERSITY Washington 7, D. C.	Actual or Estimated Costs for the Period: 7-1-61 to 6-30-62. \$ 8,275.00
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Name of Program, Department, or other level for which data are submitted:
 Atomic and Molecular Spectroscopy, Physics Department

<u>Direct Costs</u>	<u>Total Cost</u>
Salaries (Schedule A)	\$ 3,000.00
Employee Services and Benefits	
Travel	100.00
Supplies and Materials	120.00
Communications	
Printing	
Equipment (Schedules B and C)	3,400.00
Fees	
Other Direct Costs (Itemize):	
Subtotal, Direct Costs	6,620
<u>Indirect Costs (Schedule D)</u>	
General Administration and General Expenses	
Operation and Maintenance Expenses	
Library Expenses	
Use Allowance for Buildings, Capital Improvements and Equipment ...	
Indirect Departmental Expenses	
Subtotal, Indirect Costs	1,655
Total Cost	8,275
Number of Students Enrolled in Program, Department, or other level...	2
Cost Per Student	4,137.50
Less Tuition and Fees Collected per Fellow	
Cost Per Fellow	4,137.50

Signature, Name, and Title of Person Certifying Accuracy of Cost Data Joseph F. Cohalan, S.J., University Treasurer	Date April 15, 1961
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NATIONAL DEFENSE GRADUATE FELLOWSHIP PROGRAM

Name of Institution: Georgetown University	Department Atomic & Molecular Spec- troscopy	Period of Cost Data From: Sept., 61 To: Aug., 62
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DIRECT SALARIES

Title	Salary Rate Per Annum	Total Salary During Period	Duties Other than This Department		This Department	
			% of Time	Amount of Salary	% of Time	Amount of Salary
Rev M.P. Thekaekari, S.J., Assoc. Prof. Act. Chm., Program Director	10,000	\$10,000.00	70%	\$7,000.00	30%	\$3,000.00
Total						\$ 3,000.00

This has to be typed all first copies on ^{three photostat copies of} four yellow sheets
No carbons.

Application for additional allotment of fellowships

Institution Georgetown University
Address 37 and O, N. W., Washington T, D. C.
Department Physics
Specific program title Atomic and Molecular Spectroscopy.

A 1] Leave blank - to be filled by Fr. Horigan.
2]

B Φ The number 2

How many awarded 1959-60 0 ; in 1960-61 0 ; 1961-62 2

D Name School Graduate School, Georgetown University
Department Department of Physics
Department Head Matthew P. Thekkarakara, S.J.
Financial Officer Joseph F. Cochran, S.J.
Person Title Director James B. Horigan, S.J.
Address Georgetown University
37 and O Sts, N. W. Washington T, D. C.

Name & Title Joseph F. Cochran, S.J.,
Treasurer.

PROGRAM DESCRIPTION

1. BRIEF SUMMARY

The research program in atomic and molecular spectroscopy is an extension of the work which we have been doing during the past four years in the departments of physics and astronomy. We have already developed several semi-automatic techniques for rapid reduction of spectroscopic data. With three newly acquired pieces of equipment, the telecordex, telereadex and E 101 Computer, many time-saving features have been introduced. Electrodeless discharge tubes provide efficient laboratory sources. The relative advantages of these sources, compared to conventional arc and spark discharges, have been demonstrated by our work as by that of several other investigators. The techniques of making such tubes have still to be perfected. Several spectra of astrophysical interest need to be studied. A great deal of work still needs to be done in connection with the accurate determination of energy levels. The semi-automatic techniques in interferometry which we have devised permit such work to be accomplished rapidly, economically and with sufficiently high degree of precision. The vastly improved facilities of the new science building to be opened in 1962, will permit us to attempt these problems. The problems in which we are interested are of a basic nature. These are problems which will give to the graduate students familiarity with many different types of instruments and with many different aspects of physical theory. Hitherto, our work has been in the visible and photographic region of the spectrum. Facilities which we have acquired recently or will be getting in the near future will permit us to study the ultraviolet and infrared region. Our spectroscopic studies in the physics department will be closely related to and will benefit considerably the research work carried on at the Georgetown College Observatory on the atmospheres of the planets and in our laboratories of biophysics and physical chemistry.

2. PRESENT PROGRAM AND FACILITIES

(a) Research Opportunities.

Our graduate course offerings are such that the students can approach their experimental work with an adequate knowledge of the physical theory. The courses specially suited to the program are:

Geometrical and Physical Optics: A study of the fundamental principles of geometrical and physical optics; diffraction, interference, reflection, dispersion, polarization, double refraction and crystal optics. Experiments on the above subjects and use of the Michelson interferometer, the spectroscope, the camera, and various other optical instruments.

Quantum Mechanics: This course treats the Schroedinger wave equation and its application to the energy levels of simple systems and to collision theory; the Heisenberg matrix formulation; and the application of approximate methods to atomic and molecular problems. The Dirac electron.

Atomic Structure and Spectra: A brief discussion of the history and instruments of spectroscopy, alkali spectra and penetrating orbits, the alkaline earths, electron spin and multiplet structure, space quantization, Pauli principle, the periodic system of the elements, spectral intensities, anomalous terms, perturbation, pre-ionization, comparisons of types of coupling, hyperfine structure, electron affinity and width of spectral lines.

Molecular structure and spectra: Rotational, vibrational, and electronic structure of diatomic molecules. Rotational and vibrational structure of polyatomic molecules.

Other graduate courses which are offered in the department of physics are: Classical Mechanics, Electromagnetic Theory, Advanced Thermodynamics, Statistical Mechanics, Relativity, Nuclear Physics, Experimental Nuclear Physics, Theory of the Solid State, Advanced Optics.

For our experimental work the following pieces of equipment are available:

- i A Wadsworth spectrograph in the basement of the Observatory, with an original Rowland grating, 20 000 lines per inch.
- ii Another Wadsworth spectrograph with a Gale grating, 30 000 lines per inch. It is housed in a separate building and is specially designed and equipped with a heliostat for astrophysical work.
- iii Various accessories for the excitation of different types of spectra, including raytheon and klystron oscillators.
- iv Three comparators all of which are high precision instruments measuring to a micron.
- v An analog digital converter (Telecordex) for automatic recording of comparator settings.
- vi A telereadex for projection of plate images on a screen, suitable for more precise estimate of intensity and for detection of the fainter lines.

- vii Two electronic digital computers (Burroughs E 101) for rapid reduction of wavelengths and wave numbers and for analysis of spectra.
- viii An interferometer of very high quality.
- ix A Littrow spectrograph specially suited for the ultraviolet region.
- x An infrared spectrograph.

Various other accessories will be added as the need arises. Lack of adequate space has been for long a major handicap. But, since there is adequate space in the new building we can permit a larger number of students to profit by the research opportunities.

(b) Present Instructional Staff.

<u>Name</u>	<u>Academic Rank</u>	<u>Degrees & Where Conferred</u>	<u>Field of Specialization</u>
Carl C. Kiess	Lecturer	B.A. (Indiana) Ph.D. (Lick Obs.)	Spectroscopy Astrophysics
Matthew P. Thekaekara, S.J.	Assoc. Prof. Acting Chairman Dept. of Phys.	M.S. (Madras U.) Ph.D. (Johns Hopkins)	Spectroscopy Astrophysics
Francis J. Heyden, S.J.	Professor Director, George- town Observatory	A.B., M.A., S.T.L. (Woodstock Coll.) M.A., Ph.D. (Harvard)	Astronomy Astrophysics
Charles L. Beckel	Assoc. Prof.	B.S. (Scranton); Ph.D. (Johns Hopk.)	Molecular Struc- ture; Spectro- scopy.
Donald E. McCarthy	Instructor	B.S. (Providence C.) B.S., M.S. (Boston College)	Spectroscopy; Infra-red.
Edward J. Finn	Asst. Prof. (on leave)	B.S. (Holy Cross) M.S. (Catholic U. of Am.) (will be taking Ph.D. in June, 1961)	Molecular Structure
Vera C. Rubin	Instructor	A.B., M.A. (Vassar) Ph.D. (Georgetown)	Astronomy Astrophysics

In addition there are several in closely related fields of physics, biophysics, chemical physics and astronomy on the research staff of the physical sciences group of the graduate school and of the Georgetown Medical Center. The services of all these men are available for consultation and guidance.

Spectroscopy is likely to become our strongest field, partly because of the century old tradition of the Georgetown College Observatory, and partly because of our close association with the Spectroscopy Division of the National Bureau of Standards.

Our staff has grown considerably during the past five years, since the inception of the Ph.D. program. Basic Research is the major aim of the New Science Building. Its expanded facilities will naturally call for additions to the instructional and research staff of the physics department.

(c) Library, Laboratory and Other Facilities

Our library holdings are fully adequate for research purposes. The physics library is located in two large rooms in the basement of the Healy Building. The astronomy library on the Observatory Hill is also well equipped with journals and monographs of astrophysical interest. In the new building 9000 square feet of floor area is allotted to library.

Our laboratory facilities will improve considerably during the next two years. The main drawback at present is lack of sufficient space and will soon be remedied.

(d) Graduate Enrollment.

In Physics and allied fields during the period 1957-60, the number of graduate students enrolled were as shown below:

	<u>Physics</u>	<u>Astronomy</u>	<u>Chemistry</u>	<u>Mathematics</u>
1959-60	31	32	99	18
1958-59	30	29	115	19
1957-58	25	22	83	12
1956-57	30	19	116	6

Our enrollment is not a true indication of the demand for research opportunities which exists among science workers and science students in the Washington metropolitan area. We have to increase our facilities to meet adequately these demands.

(e) The Number of Degrees Conferred.

In the four branches, Physics, Astronomy, Chemistry and Mathematics the number of degrees conferred were:

	<u>Master's</u>				<u>Doctor's</u>			
	<u>Phys.</u>	<u>Ast.</u>	<u>Chem.</u>	<u>Math.</u>	<u>Phys.</u>	<u>Astr.</u>	<u>Chem.</u>	<u>Math.</u>
1959-60	2	0	6	2	0	0	8	0
1958-59	1	0	6	1	0	1	7	0
1957-58	1	1	8	0	0	0	14	0
1956-57	1	0	15	0	0	0	17	0

The majority of these degrees was conferred in chemistry. The mathematics department was recognized last year for granting doctor's degrees. The Ph.D. program in physics is still in the process of development. Four Ph.D. degrees will be given in physics in the next year or two. There are fifteen graduate students at present actively engaged in spectroscopy. Their fields of research cover a wide spectrum of problems, atomic and molecular spectra, photographic and infra-red regions, laboratory sources and atmospheres of the sun and the planets, experimental and theoretical work.

(f) Financial Aid for Students

In the spectroscopy division the available financial aid is altogether inadequate. This is the main reason for our making the present application. Five teaching assistantships are available in the department of physics. One of these teaching assistants is doing research in spectroscopy. A university grant of \$6000 a year supports a Ph.D. candidate working on molecular structure. A National Science Foundation fellowship supports another. Two more receive partial support from the university through government contract work at the observatory. The majority of our students work with governmental scientific agencies in the area and have to be content with graduate work in the evenings or over week-ends.

Regarding financial aid to graduate students from university sources, the following statement in the Self Evaluation Report of the Georgetown University Graduate School, September, 1960, is worth quoting: "Fellowships and scholarships for the current academic year will reduce the income of the Graduate School in the neighborhood of some one hundred and thirty-five thousand dollars. This largesse is made possible only through the Annual Alumni Giving Fund. It is not justified by Georgetown's total financial position." (Self Evaluation Report for the Middle States Association, Vol. III, p. 44).

(g) Alumni of the Graduate School

The Ph.D. program in astronomy is relatively older and several of our graduates have distinguished themselves in teaching and research. Mention may be made of three of our alumni. Dr. R. Zalubas, who taught for a few years and is a research physicist at the National Bureau of Standards recently completed an analysis of the spectrum of Thorium I, a unique example of the richest spectrum, one of 14000 lines, all measured by one person. Dr. Vera Rubin who is on the teaching faculty of Georgetown has made a voluminous contribution to the spectroscopic literature

on iron. Dr. John P. Hagen, who took a Ph.D. in radio-astronomy and taught for several years in the same field here, has won national recognition as former Chief of the Vanguard Earth Satellite program, and is now in charge of one of the main divisions of the National Aeronautics and Space Administration.

A questionnaire was sent last year to all students who received graduate degrees from Georgetown between 1937 and 1959. Replies were received from 412, about 38 per cent. Of these, 233, about 57 per cent, are now teaching or have taught since leaving Georgetown. The subjects taught do not afford any significant evidence as to whether the physics graduates prefer teaching more or less than students in other fields.

3. EXPANSION OF THE PRESENT PROGRAM

(a) Course Offerings.

An expanded program in spectroscopy would require a few additional course offerings. Among the courses which have been planned and which will be taught when there are enough number of sufficiently advanced students, are the following: Quantum Electrodynamics, Group Theory, Advanced Topics in Astrophysics, Advanced Spectroscopy Lab.

(b) Additional enrollment.

Our present facilities will permit ten more full-time research students in spectroscopy in the academic year 1961-62.

(c) Additions to the Faculty

The number, in full-time equivalents, of new staff appointments under this program will be one each at the professor's level and at the assistant professor's level. This does not mean, however, that the new faculty members will devote their time exclusively to graduate students. Teaching assignments in college and graduate school will be distributed and more time will be available to all our research men in spectroscopy for mentoring dissertations and for consultation in allied fields in other departments and in the medical school.

(d) Additions to the Physical Plant

Within eighteen months the new Science and Basic Research building will be ready for occupancy. The building which has been described as one having the most modern functional design will house all major research activities in the physical sciences. Except for the corridors, movable partitions will be used to meet the changing needs of each research team. A total of 14 170 square feet of floor space has been allotted to graduate research in physics and another 20 368 square feet to undergraduate work in all fields. About 25% of this space will be available directly or indirectly for the projects in spectroscopy. The areas at present occupied by the physics department will revert to the main university library. The physics departmental library will be transferred to the new building.

These very substantial additions to our facilities are entirely outside the regular budget of the physics department and will be provided for from funds raised by the University Development Office.

It is of the utmost importance that along with these substantial additions and improvements in the physical plant, the department provide for itself an adequate complement of research staff and graduate students to benefit by them. The present application has been drawn up with this objective in view

(e) University Approval

The Title IV Coordinator who reviewed this application is the Dean of the Graduate School. The program has the full approval and support of the University Administration and the application bears the signature of the authorized official.

(f) Past Efforts and Planning

All previous efforts to expand the spectroscopy program had been made through the department of astronomy. The Physics Department had heavy responsibilities towards the undergraduate students, and with the severe limitations on space and manpower it could not plan for any rapid expansion.

(g) The Future of the Program

Georgetown plans to continue its spectroscopy program because this program has grown out of a long tradition. Spectroscopy is one of very few branches of physical sciences where Jesuit scientists have made a significant contribution. The grating as an instrument for dispersing light was first conceived by a Jesuit, Grimaldi; and another, Seechi, discovered the spectral classification of stars. If with the waning of outside support the basic aspects of spectroscopic research tend to be de-emphasized, much of the research program will still continue because it is a necessity for several other fields such as astrophysics, biophysics and physical chemistry to which Georgetown scientists are heavily committed. The start which we are now making will have borne satisfactory results.

(h) Contribution to College Teaching.

Teaching is a Jesuit tradition with four centuries of known achievement. Georgetown is and will continue to be very strong at the college level. Teaching here has been all along far stronger than research. Basic research in general provides more teachers than applied research.

(i) Spectroscopy in Washington Area

Georgetown is the only university in the area which has facilities for any extensive program in spectroscopy. There are indeed in Washington and vicinity a very large number of research laboratories maintained by the government. The work they achieve and the training they give to the workers, though of indisputably high calibre, are nonetheless, of a very different type from what an educational institution and a university atmosphere can achieve.

(j) Details of the Program

The faculty members who are particularly interested in the spectroscopy program and helped to develop it are Carl C. Kiess and M.P. Thekaekara.

Dr. Kiess brings to this program almost half a century of unequalled experience and uniformly rich productivity. He is a physicist who has gained world recognition for helping to make spectroscopy "the master key of the universe." His published papers include sixty titles many of which are the first analyses ever attempted of highly complex spectra and a hundred more titles in collaboration with others. Our present knowledge of the energy levels of several of the elements is due to the pioneering work of Dr. Kiess. He is now retired from the National Bureau of Standards, and is currently engaged on an extensive program for the study of the atmospheres of the planets.

Fr. M. P. Thekaekara did his earlier graduate work at the University of Madras. He was chairman of the department of physics at a Jesuit college in India when Johns Hopkins University selected him for a research position. He took his Ph.D. in experimental spectroscopy at Johns Hopkins and was the only student of the department to be elected to Phi Beta Kappa in his year of graduation. He later joined Georgetown University where he is now Acting Chairman of the Physics Department. His work in spectroscopy has been reported in monographs published by Johns Hopkins University and Georgetown College Observatory and in articles in the Physical Review, Journal of the Optical Society of America and Astrophysical Journal.

Our spectroscopy program will have the able assistance of Dr. Charles L. Beckel whose specialty is theoretical molecular spectroscopy and of Mr. Donald E. McCarthy who has done significant work in experimental infra-red spectroscopy.

Our spectroscopic work will be mainly experimental, but we will also be interested in the theory of molecular structure in so far as it is a complement to our experimental study and help to suggest new lines of investigation. The fields in which we will be interested have been briefly stated in the summary at the beginning of this program description.

We are at present mainly concerned with the spectrum of titanium. Titanium after iron is the element responsible for the largest number of lines of the solar spectrum. Of the 26 000 known solar lines 7000 are still unclassified. A more complete description of the spectrum of titanium will, it is hoped, help identify these lines. We have measured nearly 10 000 lines of titanium in the range 2000 to 10 000 A. An IBM 705 computer was used to predict the 9000 possible lines among the known 370 levels of Ti I. A computer program has been developed to determine new energy levels from known wave numbers of lines. Some of our preliminary work on the revision of energy levels has already been published. A technique has been developed for rapid reduction of data from interferometric plates, and it has been used successfully in a limited wavelength range.

Our semi-automatic methods are being used also for the analysis of the spectra of yttrium and zirconium, and of the molecular bands observed with some of our yttrium tubes. At a later stage we will also be interested in the spectrum of hafnium and other elements and in the spectra of all these elements in the higher stages of ionization.

We have also begun an extensive survey of faint lines in the solar spectrum. In a limited wavelength range 6000 A to 7500 A we have measured nearly 6000 lines; of these over 2000 are "new" lines, not listed previously.

Our research work under the expanded program will naturally continue along the lines we have pursued hitherto. We expect to proceed at a much quicker pace and gain in depth and coverage. Techniques of producing spectra and of analysing them will be improved. Each new spectrum will call for its own special techniques.

The present rapid development of the program is due primarily to the fact that the physics department is soon to move into the new science building. The university is now in a position to meet the ever growing demand in the Washington area for more science education and at a higher level. The Office of University Development which so ably conceived the new building and made it possible can give only the shell, the framework. The body and the substance of research will have to come from the faculty and the graduate students. For these a university like Georgetown which is neither tax-supported nor heavily endowed needs the assistance of outside agencies. This present application is an attempt to seek such assistance.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

OFFICE OF EDUCATION WASHINGTON 25, D. C.

GRADUATE FELLOWSHIP PROGRAM APPLICATION (Under Title IV of the National Defense Education Act of 1958)

B. An Additional Allotment of Fellowships in an Approved Program

Departmental file Copy

Personal Copy

Budget Bureau No. 51-R274.2

Approval expires: 1-30-62

Oct 1961

INSTRUCTIONS: See accompanying directives.

An application is hereby made by this institution for additional National Defense Graduate Fellowships, to begin in the academic year 1962-63, in an already approved program in the following department and under the following specific program title:

INSTITUTION Georgetown University
ADDRESS 37th & O Streets, N. W., Washington 7, D.C.
DEPARTMENT Physics
SPECIFIC PROGRAM TITLE Atomic and Molecular Spectroscopy

A. Institutional Priority Ranking (Ranking should be made on the basis of all applications submitted)

- 1. The total number of 1962-63 applications
2. The rank order for this program

B. The number of additional Fellowships requested for 1962-63 Two

C. FELLOWSHIPS AWARDED IN 1959-60, 1960-61, or 1961-62

How many NDEA Fellowships were awarded in the academic year 1959-60? 0, in 1960-61? 0; in 1961-62 2

D. NAME OF SCHOOL OR SCHOOLS IN WHICH PROGRAM IS TO BE GIVEN

Graduate School, Georgetown University

NAME OF DEPARTMENT OR DEPARTMENTS IN WHICH PROGRAM IS TO BE GIVEN

Department of Physics

NAME OF DEPARTMENT HEAD OR PROGRAM DIRECTOR RESPONSIBLE FOR PROPOSED PROGRAM

Matthew P. Thekaekara, S.J.

NAME AND TITLE OF FINANCIAL OFFICER

Joseph F. Cohalan, S.J.

NAME AND TITLE OF PERSON RESPONSIBLE FOR ALL TITLE IV PROGRAMS IN INSTITUTION

James B. Horigan, S.J.

ADDRESS

Georgetown University
37th & O Streets, N. W., Washington 7, D.C.

AGREEMENT

The attachments hereto are a part of this application. It is understood and agreed that (1) the expanded program will be carried out in accordance with this application, except as changes are approved by the Commissioner; (2) the applicant institution will comply with regulations, policies and procedures of the Commissioner under Title IV of the National Defense Education Act of 1958, including provisions with respect to accounting for funds and the availability of records for audit by the United States Government, and (3) in the acceptance of persons for study in this program, preference will be given to persons interested in teaching in institutions of higher education. All statements made in this application are accurate and complete to the applicant's best knowledge and belief.

NAME AND TITLE OF AUTHORIZED OFFICIAL

Joseph F. Cohalan, S.J., Treasurer (Please type)

PERSONAL SIGNATURE

(This application must carry the personal signature of the official authorized to sign for the institution.)

Oct 10, 1962
for NDEA IV

GRADUATE FELLOWSHIP PROGRAM APPLICATION
(Under Title IV of the National Defense Education Act of 1958, as amended)

B. AN ADDITIONAL ALLOTMENT OF FELLOWSHIPS IN AN APPROVED PROGRAM

INSTRUCTIONS: See accompanying directives.

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A. Institutional Priority Ranking (Ranking should be made on the basis of all applications submitted)

1. The total number of 1963-64 applications _____
2. The rank order for this program. _____

B. The Number of Additional Fellowships Requested for 1963-64 4 or at least 2

C. FELLOWSHIPS AWARDED IN PREVIOUS YEARS.

How many NDEA fellowships were awarded in this program in the academic year 1959-60? _____; in 1960-61? _____; in 1961-62? 2; in 1962-63? _____.

D. NAME OF SCHOOL OR SCHOOLS IN WHICH PROGRAM IS TO BE GIVEN.

Graduate School, Georgetown University

NAME OF DEPARTMENT OR DEPARTMENTS IN WHICH PROGRAM IS TO BE GIVEN

Department of Physics

NAME OF DEPARTMENT HEAD OR PROGRAM DIRECTOR RESPONSIBLE FOR PROPOSED PROGRAM

Matthew P. Thekaekara, S.J.

NAME AND TITLE OF FINANCIAL OFFICER

Joseph A. Haller, S.J.

NAME AND TITLE OF PERSON RESPONSIBLE FOR ALL TITLE IV PROGRAMS IN INSTITUTION

James B. Horigan, S. J.

ADDRESS

37th and O Streets, N.W., Washington 7, D. C.

AGREEMENT

The attachments hereto are a part of this application. It is understood and agreed that (1) the expanded program will be carried out in accordance with this application, except as changes are approved by the Commissioner; (2) the applicant institution will comply with regulations, policies and procedures of the Commissioner under Title IV of the National Defense Education Act of 1958, as amended, including provisions with respect to accounting for funds and the availability of records for audit by the United States Government; and (3) in the acceptance of persons for study in this program, preference will be given to persons interested in teaching in institutions of higher education. All statements made in this application are accurate and complete to the applicant's best knowledge and belief.

NAME AND TITLE OF
AUTHORIZED OFFICIAL

Joseph A. Haller, S.J., Treasurer
(Please type)

PERSONAL SIGNATURE*

*(This application must carry the personal signature of the official authorized to sign for the institution.)

STATEMENT

1. Brief Summary. The research program in atomic and molecular spectroscopy is an extension of the work which we have been doing during the past six years in the departments of physics and astronomy. We propose to develop further the techniques of gas discharges, of semi-automatic methods of data reduction, and of interferometric methods of precision measurement.

Two students were enrolled under the program and started work at the beginning of the Fall semester 1961. During the first year they took the basic courses in physics which are required of every graduate student in the department, but they also spent a certain part of their time working alongside the more advanced students who are engaged on projects in spectroscopy. Now they are in their second year and are starting on their own individual projects.

2. Expansion of faculty and facilities. Several major changes in teaching schedules were made, so that more time is available for research for each faculty member. No faculty member teaches more than two courses according to our present schedule.

Dr. Ralph S. Henderson rejoined the faculty as a full time member in 1961. Mr. Edward J. Finn also rejoined the faculty. Both of them had been on a year's leave during 1960-61. In September 1961 the department made two new appointments, Dr. Edward M. Corson, Professor and Dr. Misri L. Vatsia, Assistant Professor.

Faculty members directly involved in the spectroscopy program are Fr. Matthew P. Thekaekara, program director, and Dr. Misri L. Vatsia. Dr. Vatsia's special field is experimental spectroscopy. Fr. Thekaekara's teaching schedule has been reduced to half so that he can devote more time to this program. A new course entitled, Advanced Spectroscopy Laboratory, was introduced in September 1961 and is taught by Fr. Thekaekara. This course is of special interest to students enrolled in this program.

Funds committed for the establishment of the program include the following:

Faculty	
Direct salary Rev. M. P. Thekackara, 30% of time	\$3,000.00
Depreciation Costs of equipment allocated to this program	\$2,620.00
Time on two Burroughs E 101 computers	780.00
	<hr/>
	\$6,400.00

No funds have been committed from this program for the time which Dr. M. L. Vatsia contributes to it and his whole salary is from University funds. Under depreciation costs of equipment, and time on two Burroughs Computers, the amounts committed form only a small part of the actual cost to the departments of physics and astronomy.

The Department of Physics has installed a new Jarrell-Ash Monochromator with recording electronics at a total cost of about \$10,000.00. The monochromator with an eight-speed automatic drive, a 30,000 lines per inch grating in Ebert Mounting, the photomultiplier tube, recording electronics and other accessories, is a versatile and highly precise instrument. The power supply for the photomultiplier, which costs about three percent of the total cost was acquired under this NDEA Title IV Program.

3. Changes in the Original Plan. There have been no changes in the original plan as set forth in the proposal which was approved last year.
4. Expansion of the Program. Two additional fellowships are highly desirable. Available space and facilities easily permit the addition of more than two, perhaps of four or six.

The Physics Department moved to the new Science Building in August 1962. About ten thousand square feet of space in the new building are now available either directly or indirectly for projects in spectroscopy.

These very substantial additions to our facilities are entirely outside the regular budget of the Physics Department or of any specific program, and are provided from funds raised by the University Development Office.

There is provision in the Departmental budget for the addition of two more faculty members. More of the time of Associate Professor Thekara and Assistant Professor Vatsis will be released for the research program in atomic and molecular spectroscopy.

5. Student Enrollment. The student enrollment figures given below include both the departments of Physics and Astronomy. Many of the pieces of equipment used in spectroscopy are located at the observatory and have been developed by the Astronomy Department. The basic training in spectroscopy is given mainly through courses offered in the Physics Department. Students of both Physics and Astronomy Departments are engaged in spectroscopy projects. Hence it would seem that figures including both Departments are relevant to the present proposal.

The enrollment in the Fall semester of 1962 is for the first year 23, second year 17, third year 22. Of our students, nearly half the number are part-time and the rest full time. The anticipated enrollment for the Fall semester 1963 is about 20 full time and 15 part-time in these two Departments.

The number of degrees given in June 1962 was: 5 Masters, 2 Doctoral, in Physics; 2 Masters, 2 Doctoral, in Astronomy; 92 Masters, 30 Doctoral in all Departments of the Graduate School.

6. Financial Aid for Students. There are 6 teaching assistantships and 5 research fellowships in the Physics Department. There are also several research fellowships and 1 teaching assistantship in the Astronomy Department. The amount is: \$1800 for first year, \$2100 for second year and \$2400 for the third year. Of the 7 teaching assistants, 3 are in the spectroscopy program. Three of our graduate students hold the National Science Foundation Cooperative Fellowships, and of these, one student is doing research in spectroscopy. Three other graduate students engaged in this program are partially supported by research assistantships from Government

sources other than Title IV.

7. Institutional Support. The development plans of the University include more intensified research in all branches of the physical sciences. Hence the new Science Building was constructed. Preliminary plans have been drawn up for a new building for Astronomy.

Spectroscopic research is likely to become our strongest field in Physics and Astronomy, partly because of the century-old tradition of the Observatory and partly because of our close association with the spectroscopy division of the National Bureau of Standards. Faculty members in both Physics and Astronomy are exploring the possibilities for more outside support from private foundations so that we might increase the number of our full time students. The University has authorized a substantial increase in the Physics Department budget, so that the spectroscopy program may be adequately supported. The expenses involved in starting the new course, "Advanced Spectroscopy Lab" are covered solely by the University.

The new Science Building has been a heavy strain on the resources of the University. The University cannot give much beyond the bare shell of the building. Resources must be found elsewhere for what keeps a research program going - competent students and faculty men and adequate equipment.

The present proposal is one to insure us more of competent students for the spectroscopy project.

8. Spectroscopy in the Washington Area. Georgetown is the only University in the area which has facilities for any extensive program in spectroscopy. The Georgetown Observatory, which dates back to 1841, is well equipped for astrophysical and spectroscopic research.

There are, indeed, in the area a very large number of research laboratories maintained by the Government. The work they achieve and the training they give to their workers, though of indisputably high caliber, are nonetheless of a very different type from what an educational institution and a university atmosphere can achieve.

The program we propose is a very essential complement to the research installations of the Federal Government.

A new section of the Optical Society of America, the National Capital Section, was started in March 1962, and the Physics Department of Georgetown University was the host for the first two organizational meetings of the section. Dr. Thekackara is the Vice-President of the National Capital Section.

9. Development of Graduate Work. Detailed plans for development of graduate work at Georgetown were drawn up when the new Science Building was first planned. Basic to these plans was the realization that the various fields of research are closely related. Hence it is that one large building close to the medical center was thought of. Very Reverend Edward B. Bunn, President of the University, was responsible for these plans, and he worked in close cooperation with the scientists representing each of the active fields of research. Development of spectroscopy is essential to the plan since it is a field common to Physics and Astronomy, and has applications in Chemistry and Chem-medicine.

Teaching at a high level is a long-standing tradition at Georgetown. A large percentage of our graduate students choose teaching as a career. This is true no less in the sciences than in the humanities. Spectroscopy which requires a broad-base training in both classical and modern Physics is a field more likely to yield competent teachers for colleges than many of the so-called glamour fields of Physics, which have immediate applications in industry, and hence can attract plentiful research support. Several departments in the University are engaged in teacher-training programs. Particular mention might be made of the In-Service Institute in Physics for high school teachers and the Summer Conference on "Recent Advances in Astro-Geophysics" for college professors (both under the direction of Dr. Thekackara, the program director of this application), and the Summer Conference on the new methods of high school mathematics. All these programs under the sponsorship of the National Science Foundation have been held

every year for periods varying from two to five years.

We believe that an additional grant of two fellowships is very necessary for carrying out successfully the program in atomic and molecular spectroscopy for which the University has already made a very substantial contribution.
