

## STORAGE RING PROJECT

In the past year the storage ring has been an extremely reliable and versatile source of ultra-violet and soft x-rays. Over the period July 1, 1969 - June 30, 1970 beam was provided to experimenters 210 out of the 255 available workdays. On days that beam was provided, the average number of experiments receiving beam was 1.2. However, on a significant number of operating days as many as four experiments received beam simultaneously. This reduction in time lost to setting up experiments and the increase in number of experiments that can be run simultaneously has come about through the more efficient use of on-site instrumentation (monochromators, etc.) and the construction of mirror systems which allow two experiments to be mounted at a radiation port simultaneously.

Beam lifetime at higher intensities has been increased by a factor of at least three through the use of an operating technique that leads to somewhat increased vertical amplitudes in the motion of the electrons circulating in the machine. A further increase in lifetime as well as large circulating beams are expected when the high power RF amplifier is installed. The power amplifier is now complete and awaits a break in the experimental schedule for installation.

Almost all experiments now in progress at the laboratory utilize digital data acquisition systems thus assuring compatibility with the newly acquired PDP-12 computer. The advantages of digital data handling systems have been well established over the past two years. With the incorporation of digital wavelength control into our new normal incidence monochromator a new dimension of experimental versatility will be realized. The experience gained in the design and construction of this instrument will be invaluable in the development of the grazing incidence monochromator.

Current users of the storage ring and the titles of their experiments are as follows:

Group	Experiment
Prof. Frederick C. Brown University of Illinois	Far Ultraviolet Optical Properties of Solids
Prof. H. Fritzsche University of Chicago	Normal Incidence Reflectance Measurements of Metals and Crystals
Prof. D. W. Lynch Iowa State University (Ames Lab)	(1) Search for Longitudinal Excitations in AgCl Films (2) Reflectivity of Single Crystal Cd. The above experiments have been made and the following experiments are planned: (1) Stark Effect of Excitons in Alkali Halides (2) Photoemission from Solids
Drs. J. Berkowitz & W. Chupka Argonne National Laboratory	Photoelectron Spectroscopy and Photoionization with Mass Analysis
Dr. Edward T. Fairchild University of Wisconsin Space Astronomy	Use of Synchrotron Radiation from Storage Ring as an Absolute Standard of Radiant Flux for the Calibration of the Photometers in the Vacuum UV.
Prof. David Lichtman University of Wis. at Milwaukee	Study of the Interaction of Synchrotron Radiation with Surfaces

Group	Experiment
Prof. F. L. Roesler University of Wisconsin Physics Department	Helium Photoionization - Excitation
Prof. James R. Stevenson Georgia Institute of Technology	Reflectivity of Semiconductor Alloys
Prof. James W. Taylor University of Wisconsin Chemistry Department	(1) Determination of Precise Ionization Potentials, Bond Energies and Observation of Vibrational Fine Structure in the Excited Ionized Species of Large Organic Molecules. (2) Photoelectron Spectroscopy of Large Organic Compounds. (3) Determination of Appearance Potentials of Free Radical Species.
Prof. R. N. Dexter University of Wisconsin Physics Department	Reflectivity of Tellurium Crystals and $Hg_{1-x}CdTe$ Alloys.
Dr. R. I. Schoen Boeing Scientific Research Lab	Photoionization in Molecular Beams
Prof. William M. Yen University of Wisconsin Physics Department	UV Pumping of Visible Fluorescence in Ruby
Dr. R. W. Carlson University of Southern California	(1) Absolute Intensity Measurements of the Synchrotron Radiation. (2) Fluorescence Studies of Photoabsorption Processes in Gases. (3) Gaseous Extreme Ultraviolet Photoabsorption Studies. (4) Lifetime Measurements of Molecular States.
Prof. P. R. Moran University of Wisconsin Physics Department	Determination of Fluorescent and Excitation Spectra of Anthracene Under Hard UV Excitation

Other experimental proposals are pending.

A partial list of publications over the last two years follows. In addition to this, many colloquia have been given throughout the country describing experiments in progress at the facility.

Author and Institution	Title	Publication
E. T. Fairchild U. of Wis. Space Astronomy	Storage Ring Synchrotron Radiation : A Standard of Radiant Flux in the Ultraviolet	Read to Intn'l Astronom. Union Symp. on UV & Ground Based Spectroscopy, Holland 6/69
H. Fujita, C. Gahwiller, & F. C. Brown U. of Ill.	Far-Ultraviolet Spectra Due to 4d Electrons in the Alkali Iodides	Phys.Rev. Let. 22, 25 1369-1371
U. Gerhardt, H. Fritzsche, & G. W. Rubloff U. of Chicago	Reflectance Measurements Using Synchrotron Radiation from the Electron Storage Ring at the University of Wisconsin	Bull. Am. Phys. Soc. Series II, 14, No. 3, p. 396 (Mar 1969)
F. C. Brown, C. Gahwiller, H. Fujita, N. Carrera, & W. Scheifley U. of Ill.	Optical Properties of Solids in the Very Far Ultraviolet	To be published in Phys. Rev. (Presented at Tenth European Conf. on Spectroscopy, Liege, Belgium, 9/69.)

Author and Institution	Title	Publication
C. Gahwiller & F. C. Brown U. of Ill.	Photoabsorption Near the $L_{II, III}$ Edge of Silicon and Aluminum	To be published in Phys. Rev. B, 15 Aug. 70
F. C. Brown, C. Gahwiller, H. Fujita, A. Kunz, W. Scheifley & N. Carrera U. of Ill.	Extreme Ultraviolet Spectra of Ionic Crystals	To be published in Phys. Rev.
F. C. Brown, C. Gahwiller, & H. Fujita U. of Ill.	Extreme Ultraviolet Spectroscopy with the Use of a Storage Ring Light Source	To be published in Rev. Sc. In
M. Elango, C. Gahwiller, & F. C. Brown U. of Ill.	Coloration of KCl and KBr Crystals by Far Ultraviolet Radiation	To be published in Phys. Rev. and accepted for publication in Solid State Communications
W. M. Yen, L. R. Elias, & D. L. Huber U. of Wis.	Utilization of Near and Vacuum Ultraviolet Synchrotron Radiation for the Excitation of Visible Fluorescence in Ruby and $MgO:Cr^{3+}$	To be published in Phys. Rev. Letters
U. Gerhardt & G. W. Rubloff U. of Chicago	A Normal Incidence Scanning Reflectometer of High Precision	Applied Optics 8, p. 305 Feb. 1969
J. W. Taylor, W. L. Stebbings, & J. A. Kinsinger U. of Wis.	Photoionization Mass Spectroscopy Using Synchrotron Radiation	To be published in Proc. of the Amer. Soc. for Mass Spectrometry - Meeting, San Francisco, 6/70
C. Gahwiller & F. C. Brown U. of Ill.	Photoabsorption Near the $L_{II, III}$ Edge of Silicon	To be presented at the 10th Internat'l. Conf. on Physics of Semiconductors, Cambridge Mass., 8/17-21/70. Will be published in Proceed. of that Conf.

\*\*\*\*\*

## STATUS OF CURRENT PSL PROJECTS

### Cosmic Ray

Modifications to the Echo Lake building which is required to house the Happe magnet and associate equipment have been completed. The helium refrigerator liquifier which will be required for the operation of the Happe magnet will be ordered at the end of July. Work is in progress at PSL on the modifications of the liquid hydrogen target. Preparations are being made for the shipment of the Happe magnet from Berkeley to PSL for the purpose of cryogenic testing and magnetic field plotting. The magnet is due at PSL the first part of August.

### NAL

The Pulse Interlock Controls and Reference Generators for the NAL Linac have been completed and shipped. Four of these are in operation now.

### DT Gas Target

Beam quality measurements of the DT generator source are now in progress. Preliminary studies of the performance of the gas target differential pumping system have been completed. It is hoped to bring beam into the gas target in the near future.

## STATUS OF CURRENT PSL PROJECTS (Cont'd.)

### Plasma

The plasma octupole has been operational since March with both gun injected and microwave produced plasmas. Confinement times are consistent with our theoretical estimates and measurements are currently underway to determine the detailed loss process and plasma properties. Cases have been run where levitating the hoops causes a substantial increase in the plasma lifetime and particle temperatures. A preliminary paper describing these results was submitted to the European Fusion Conference to be held at the end of August.

### Storage Ring On-Line Monochromator Computer System

Professor Dexter's PDP-12 computer has been delivered at the Laboratory. In the next few months problems of interfacing detection apparatus to the computer and the development of suitable software and preliminary tests of the system will receive considerable attention. Next year a suitable interfacing will be developed to couple the new PDP-12 computer with the IBM 1401 computer in the main Physical Sciences Laboratory building. The capability of using the two computers together will greatly enlarge the versatility and power of the on-line data handling system at the storage ring.

### Superconductivity

Professor Roger Boom and Bill Winter are studying heat transfer in supercritical helium, 4 to 10 atmospheres. The present effort involves calibrating high purity copper which will be used as a heater and thermometer.

### Other

Design work is in progress for a 50,000 psi pressure vessel for Professor Grieger of Chemical Engineering.

Design work is in progress for a supersonic shock tube for Professor Hugh Powell of Mechanical Engineering.

Design is complete and we are awaiting material for the construction of a high vacuum vessel for Professor Woods of the Chemistry Department. This vessel will be 2 ft. in diameter and 12 ft. in length. Design pressure for this vessel is  $10^{-10}$  torr.

Work is in progress on a spark chamber gas purifier. This is for Professor Cline of the Physics Department.

\*\*\*\*\*

## BUDGET NEWS

As we enter the 1970-71 fiscal year the budget of the Physical Sciences Laboratory is very much like those for other departments on the campus as everyone feels the pinch from the reduced funding by the Legislature. However, it is pointed out that PSL has received generous subsidies from the University for the laboratory operation during the period since July 1, 1967. Amounts provided in the laboratory budget to cover salary costs that were not recovered from research programs have been:

\$311,000 for the 1967-68 fiscal year  
 \$210,000 for the 1968-69 fiscal year  
 \$180,000 for the 1969-70 fiscal year

It is expected that the 1970-71 fiscal year subsidies will be approximately \$150,000. As you all know it was necessary to reduce staff in certain areas last fiscal year in order to operate within our budgeted funds. This reduction of staff has resulted in a more stable operation and no such additional personnel reductions are anticipated during this fiscal year. However, we all know that the squeeze on additional project funds together with increased salary and materials costs will require the full cooperative effort of every member of the laboratory in order to see us through this difficult period. Ideas that will assist us in reducing costs of our operation are always appreciated and welcome.