

SECURITY CLASSIFICATION OF THIS PAGE

IDENTIFICATION PAGE

Form Approved OMB No. 0704-0188

AD-A241 611

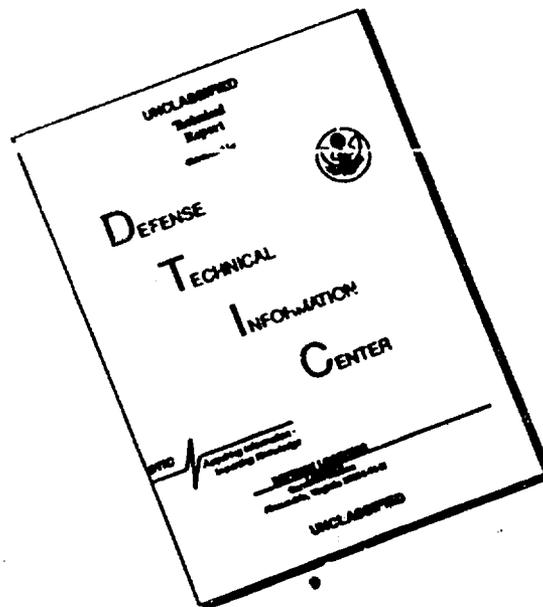


1a. RE L		1b. RESTRICTIVE MARKINGS n/a	
2a. SE n/a		3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release- distribution unlimited	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE n/a		5. MONITORING ORGANIZATION REPORT NUMBER(S) <del>AFOSR-88-0118</del> 91 0801	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFOSR-88-0118		7a. NAME OF MONITORING ORGANIZATION AFOSR-Air Force Office of Scientific Research	
6a. NAME OF PERFORMING ORGANIZATION Optical Society of America	6b. OFFICE SYMBOL (if applicable)	7b. ADDRESS (City, State, and ZIP Code) Room C-114, Bldg. 410 Bolling Air Force Base Washington, D.C. 20332-6448	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Same as 7a	8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR-88-0118	
8c. ADDRESS (City, State, and ZIP Code) Same as 7b		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO. 61102	PROJECT NO. 2301
		TASK NO. A1	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Organization of the Topical Meeting on Free-Electron Laser Applications in the Ultraviolet			
12. PERSONAL AUTHOR(S) Jarus W. Quinn			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM 02/01/88 to 02/03/89	14. DATE OF REPORT (Year, Month, Day) 89/02/03	15. PAGE COUNT
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) The objectives of this conference were to discuss, evaluate, and promote unique and new applications that are awaiting Free Electron Laser devices that will operate at wavelengths below 300 nm. The subjects included: atomic and molecular spectroscopy, materials and surface physics, surface photochemistry, chemical dynamics, industrial photochemical processes, photoelectron spectroscopy, photolithography, materials processing, biological structures and radiation effects, plasma physics, and laser radar.			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Jarus W. Quinn, Executive Director		22b. TELEPHONE (Include Area Code) 202-462-767-4906	22c. OFFICE SYMBOL NP

91-13089



# DISCLAIMER NOTICE



THIS DOCUMENT IS BEST  
QUALITY AVAILABLE. THE COPY  
FURNISHED TO DTIC CONTAINED  
A SIGNIFICANT NUMBER OF  
PAGES WHICH DO NOT  
REPRODUCE LEGIBLY.

# **FREE-ELECTRON LASER APPLICATIONS IN THE ULTRAVIOLET**

## **1988 TECHNICAL DIGEST SERIES VOLUME 4**

**POSTCONFERENCE EDITION**

**Summaries of papers presented at the  
Free-Electron Laser Applications in the Ultraviolet  
Topical Meeting**

**March 2-5, 1988**

**Cloudcroft, New Mexico**

*Cosponsored by the*

**Optical Society of America  
Air Force Office of Scientific Research  
Department of Energy**

**Optical Society of America  
1816 Jefferson Place, N.W.  
Washington, D.C. 20036  
(202) 223-8130**

*[Faint, illegible text and markings, possibly a stamp or library label]*

A-1

## TABLE OF CONTENTS

PROGRAM .....	v
WA FEL FACILITIES I .....	1
WB SOLID-STATE SPECTROSCOPY .....	15
WC ATOMIC AND MOLECULAR SPECTROSCOPY I .....	39
ThA ATOMIC AND MOLECULAR SPECTROSCOPY II .....	61
ThB FEL FACILITIES II .....	71
ThC PHYSICS OF SURFACES AND FILMS .....	81
ThD MATERIALS AND SURFACE PROCESSING .....	101
FA BIOLOGICAL STRUCTURES .....	117
FB PHOTOCHEMICAL PROCESSES I .....	137
FC RADIATION EFFECTS AND MEDICAL APPLICATIONS .....	153
SA SPECTROSCOPY OF HIGHLY IONIZED GASES AND ION BEAMS .....	181
SB PHOTOCHEMICAL PROCESSES II .....	197
KEY TO AUTHORS, PRESIDERS AND PAPERS .....	211

**TUESDAY, MARCH 1, 1988**

**CRYSTAL ROOM**

**3:30 PM-6:30 PM REGISTRATION/RECEPTION**

**FIRESIDE ROOM IN REBECCA'S**

**6:30 PM-9:00 PM DINNER**

**WEDNESDAY, MARCH 2, 1988**

**FIRESIDE ROOM IN REBECCA'S**

**6:30 AM-8:15 AM BREAKFAST**

**CRYSTAL ROOM**

**7:30 AM-1:00 PM REGISTRATION/SPEAKER CHECKIN**

**MARCIA ROOM**

**8:30 AM-9:00 AM OPENING REMARKS**

Howard R. Schlossberg, *Air Force Office of Scientific Research*

Ryszard Gajewski, *Department of Energy*

**9:00 AM-10:00 AM**

**WA FEL FACILITIES I**

Howard R. Schlossberg, *Air Force Office of Scientific Research, Presider*

**9:00 AM (Invited Paper)**

**WA1 Projected Performance of rf-Linac-Driven Free-Electron Lasers in the VUV and Soft X-Ray Regions**, Brian E. Newnam, *Los Alamos National Laboratory*. Recent advances in rf-linac electron injectors and high-reflectance mirrors will enable future FEL oscillators to operate at wavelengths  $< 100$  nm with both high-peak and high-average power. (p. 2)

**9:30 AM (Invited Paper)**

**WA2 Ultraviolet Source Characteristics of the Storage-Ring Free-Electron Laser**, David A. G. Deacon, *Deacon Research*. Laser operation can be obtained in the 500-50 nm range, and eventually from 50 to 10 nm. We discuss the output characteristics and illustrate with numerical examples from two facilities now under construction. (p. 9)

**WEDNESDAY, MARCH 2, 1988 — Continued**

**MARCIA ROOM**

**10:00 AM-12:50 PM**

**WB, SOLID-STATE SPECTROSCOPY**

Aloysius J. Arko, *Los Alamos National Laboratory, Presider*

**10:00 AM (Invited Paper)**

**WB1 High-Resolution Photoelectron Spectroscopy: Emphasis on Actinides**, Aloysius J. Arko, *Los Alamos National Laboratory*. The impact of the high flux, high energy and spatial resolution of the FEL on photoelectron spectroscopy is discussed, in particular, measurements of resonances and gaps. (p. 16)

**MEZZANINE**

**10:30 AM-10:50 AM COFFEE BREAK**

**MARCIA ROOM**

**10:50 AM (Invited Paper)**

**WB2 Novel Magnetic Materials Research Using Free-Electron Lasers**, S. D. Bader, *Argonne National Laboratory*. Spin-polarized photoemission using soft x-ray FELs provides unprecedented opportunities to study ultrathin magnetic films, surfaces, dilute alloys, and other novel magnetic materials. (p. 20)

**11:20 AM (Invited Paper)**

**WB3 High-Resolution Photoemission Spectroscopy Measurements of Superconductors**, David W. Lynch, *Iowa State U.* The ultrahigh resolution of the proposed free-electron laser sources of extreme ultraviolet radiation will allow, for the first time, a direct photoemission measurement of gap anisotropy in superconductors. (p. 24)

**11:50 AM**

**WB4 High-Resolution Photoemission Studies of Transuranic Actinides with an FEL**, L. E. Cox, *Los Alamos National Laboratory*. A high-intensity, highly monochromatic light source such as an XUV free-electron laser will be required to properly characterize the quasiautomic features in the valence-band spectrum of plutonium and its alloys. (p. 26)

**12:10 PM**

**WB5 X-Ray Absorption Spectroscopy of Elements of  $Z \leq 10$  Using a Free-Electron Laser Source**, Steven D. Conradson, *Los Alamos National Laboratory*. Direct measurements of the electronic and molecular structures of low- $Z$  elements for systems inaccessible to synchrotron radiation are possible with an XUV FEL. (p. 29)

**WEDNESDAY, MARCH 2, 1988 — Continued**

**12:30 PM**

**WB6 Angle-Dependent Photoemission with High Resolution**, S. D. Kevan, *U. Oregon*. Advanced instrumentation has enabled progressively higher resolution, angle-resolved photoemission studies of surface electronic structure. The current status and future prospects using FELs are summarized. (p. 32)

**FIRESIDE ROOM IN REBECCA'S**

**12:50 PM-1:50 PM LUNCH**

**1:50 PM-5:00 PM FREE TIME**

**RED DOG SALOON**

**5:00 PM-5:45 PM SOCIAL**

**FIRESIDE ROOM IN REBECCA'S**

**5:45 PM-7:00 PM DINNER**

**CRYSTAL ROOM**

**6:30 PM-10:00 PM REGISTRATION/SPEAKER CHECKIN**

**MARCIA ROOM**

**7:00 PM-9:50 PM**

**WC, ATOMIC AND MOLECULAR SPECTROSCOPY I**

James A. R. Samson, *University of Nebraska, Presider*

**7:00 PM (Invited Paper)**

**WC1 New Research Opportunities in Atomic Photoionization with a High-Intensity, Narrow Bandwidth Photon Source**, Manfred O. Krause, *Oak Ridge National Laboratory*. Scientific problems that can be foreseen to be successfully approached by photoionization experiments with photon source of high brilliance are presented and discussed. (p. 40)

**7:30 PM (Invited Paper)**

**WC2 Free-Electron Laser Induced Dissociation of Molecules Probed With Synchrotron Radiation**, P. Morin, *CEA/Centre d'Etudes Nucleaires de Saclay, France*. The simultaneous use of FEL and synchrotron radiation to photodissociate molecules and ionize the fragments is shown to be a unique tool to probe the dissociation pattern and its dynamics. (p. 43)

**WEDNESDAY, MARCH 2, 1988 — Continued**

**8:00 PM**

**WC3 Polyatomic Shape Resonances and Dispersed Fluorescence Spectroscopy**, L. A. Kelly, E. D. Poliakoff, *Boston U.* Highly resolved fluorescence spectra illuminate shape resonant excitation in the photoionization of nitrous oxide, and extensions possible with an FEL are suggested by these results. (p. 47)

**MEZZANINE**

**8:20 PM-8:40 PM COFFEE BREAK WITH DESSERT**

**8:40 PM (Invited Paper)**

**WC4 Nonlinear Spectroscopy of Atomic Systems Using XUV FELs**, Thomas J. McIlrath, *U. Maryland*. The narrow-band, intense output of the FEL allows both resonant and nonresonant excitation of atoms. Core electrons can be excited and probed. (p. 50)

**9:10 PM**

**WC5 Vacuum Ultraviolet FEL for Laser Cooling of H Atoms**, Robert K. Sander, *Los Alamos National Laboratory*. The vacuum-ultraviolet free-electron laser could be used to reduce the velocity of H atoms, for improved spectroscopic resolution and to generate collimated beams. (p. 53)

**9:30 PM**

**WC6 UV FEL Uses in Resonance Ionization Mass Spectrometry**, N. S. Nogar, B. L. Fearey, C. M. Miller, *Los Alamos National Laboratory*. Potential uses of an ultraviolet free-electron laser for RIMS analyses are discussed, with particular emphasis on coupling FEL-based photoionization with synchronous laser desorption. (p. 57)

THURSDAY, MARCH 3, 1988

**FIRESIDE ROOM IN REBECCA'S**

**6:30 AM-8:15 AM BREAKFAST**

**CRYSTAL ROOM**

**8:00 AM-1:00 PM REGISTRATION/SPEAKER CHECKIN**

**MARCIA ROOM**

**8:30 AM-9:30 AM**  
**ThA, ATOMIC AND MOLECULAR SPECTROSCOPY II**  
Thomas J. McIlrath, *University of Maryland, Presider*

**8:30 AM (Invited Paper)**  
**ThA1 Uses of a Free-Electron Laser in Atomic and Molecular Physics**, James A. R. Samson, *U. Nebraska*. The combination of VUV high-flux sources with photoelectron and fluorescence spectroscopy is required to study energy levels, autoionization, and molecular dissociative ionization processes. (p. 62)

**9:00 AM (Invited Paper)**  
**ThA2 Use of UV/VUV Free-Electron Lasers in Photoionization Mass Spectroscopy**, R. L. Woodin, D. S. Bomse, *Exxon Research & Engineering Company*. Tunable VUV radiation promises to extend photoionization to include more chemical species and afford selective, sensitive detection of trace chemical constituents in complex systems. (p. 66)

**9:30 AM-10:10 AM**  
**ThB, FEL FACILITIES II**  
Ryszard Gajewski, *Department of Energy, Presider*

**9:30 AM**  
**ThB1 Projected Operation of the SCA/FEL in the Ultraviolet**, H. A. Schwettman, T. I. Smith, *Stanford U.* The superconducting accelerator-driven free-electron laser (SCA/FEL) has been established as a facility for producing picosecond photon beams. The facility at present is capable of operating between 3  $\mu\text{m}$  and 350 nm. Viable options for extending the range to at least 200 nm are discussed, as are the facilities for experimenters using the photon beams. (p. 72)

THURSDAY, MARCH 3, 1988 — *Continued*

**9:50 AM**  
**ThB2 Research Opportunities Below 300 nm at the NBS Free-Electron Laser Facility**, Philip H. Debenham, B. Carol Johnson, *U.S. National Bureau of Standards*. Average output power of 25 W in 3-ps pulses at 75 MHz will be available at fundamental wavelengths from 200 to 300 nm beginning in April 1990. (p. 76)

**MEZZANINE**

**10:10 AM-10:30 AM COFFEE BREAK**

**MARCIA ROOM**

**10:30 AM-12:30 PM**  
**ThC, PHYSICS OF SURFACES AND FILMS**  
E. Ingolf Lindau, *Stanford University, Presider*

**10:30 AM (Invited Paper)**  
**ThC1 Time-Resolved Ultraviolet Photoemission Studies of Surface Dynamics**, J. Bokor, *AT&T Bell Laboratories*. The scientific motivations and technical requirements for picosecond studies of surface dynamics using angle-resolved photoemission techniques are discussed. (p. 82)

**11:00 AM (Invited Paper)**  
**ThC2 Scientific and Technological Uses of Free-Electron Lasers in Ultraviolet Photon-Stimulated-Desorption Spectroscopy**, R. F. Haglund, Jr., *Vanderbilt U.* Photon-stimulated desorption experiments using synchrotron light sources suggest that ultraviolet free-electron lasers will enrich fundamental studies of photon-surface interactions and lead to new developments in ultraviolet optical technology. (p. 85)

**11:30 AM**  
**ThC3 Use of VUV/XUV Free-Electron Lasers in the Study of Defects in Amorphous Optical Materials**, Virgil E. Sanders, Brian E. Newnam, *Los Alamos National Laboratory*. We propose to use the VUV/XUV free-electron laser as a source of UV radiation-induced defects in amorphous optical materials. The optical materials include thin-film coatings and windows used in lasers. (p. 89)

**11:50 AM**  
**ThC4 Vacuum Ultraviolet FEL Uses in the Analysis of Laser-Surface Vaporization Dynamics and Chemistry**, A. O'Keefe, *Deacon Research*. The primary processes occurring during laser vaporization of solids can be revealed using species-selective VUV FEL photoionization. Profiles over the FEL macropulse duration are possible. (p. 91)

THURSDAY, MARCH 3, 1988 — *Continued*

12:10 PM

**ThC5 Surface Analysis Using Time-Resolved Techniques in Vacuum Ultraviolet FEL Radiation**, Victor Rehn, *U.S. Naval Weapons Center*. Particle and photon emission from surfaces irradiated by high-intensity FEL pulses in the VUV can be analyzed to determine surface structure. Examples relevant to semiconductor heterostructure materials and yttrium-barium-cuprate superconductors are discussed. (p. 95)

**FIRESIDE ROOM IN REBECCA'S**

12:30 PM-1:30 PM LUNCH

**LOBBY**

1:30 PM-5:00 PM TOUR TO SUNSPOT OBSERVATORY

**RED DOG SALOON**

5:00 PM-5:45 PM SOCIAL

**FIRESIDE ROOM IN REBECCA'S**

5:45 PM-7:00 PM DINNER

**MARCIA ROOM**

7:00 PM-8:50 PM

**ThD, MATERIALS AND SURFACE PROCESSING**  
Victor Rehn, *U.S. Naval Weapons Center, Presider*

7:00 PM (Invited Paper)

**ThD1 Lithography with Free-Electron Lasers Compared with Deep UV, X-Ray, and Ion Lithography**, R. Kent Watts, *AT&T Bell Laboratories*. Lithography with a free-electron laser source operating in the 30-100-nm range and a reflective mask is a promising way of extending the resolution of optical lithography. Comparisons are made with deep UV, x-ray, and ion lithography. (p. 102)

7:30 PM (Invited Paper)

**ThD2 Challenges in the Design and Fabrication of XUV Projection Lithographic Optics**, F. Zemike, *Perkin-Elmer Corporation*; F. Y. Wu, *IBM T. J. Watson Research Center*. The possibility of making a projection microlithography system capable of printing features with 0.1  $\mu\text{m}$  critical dimension is examined. A preliminary optical design is presented. (p. 106)

THURSDAY, MARCH 3, 1988 — *Continued*

8:00 PM (Invited Paper)

**ThD3 Use of an UV FEL in Studies of the Photoablation of Organic Polymers and Tissue**, Thomas F. Deutsch, *Massachusetts General Hospital*; R. Srinivasan, *IBM T. J. Watson Research Center*. FEL-based diagnostics of the ablation of polymers and tissue are considered in light of present knowledge of photoablation by pulsed UV excimer lasers. Two wavelength and femtosecond-pulse ablation experiments are described. (p. 109)

8:30 PM

**ThD4 FEL Applications in Laser Etching and Ablation**, R. C. Estler, *Fort Lewis College*; N. S. Nogar, *Los Alamos National Laboratory*. Results are presented on mass spectral detection of the volatile products produced by photoablation of polymers and insulating ceramics. Applications of the FEL to photoetching will be discussed. (p. 113)

**MEZZANINE**

8:50 PM-9:10 PM COFFEE BREAK WITH DESSERT

FRIDAY, MARCH 4, 1988

**FIRESIDE ROOM IN REBECCA'S**

**6:30 AM-8:15 AM BREAKFAST**

**CRYSTAL ROOM**

**8:00 AM-1:00 PM REGISTRATION/SPEAKER CHECKIN**

**MARCIA ROOM**

**8:30 AM-10:30 AM  
FA, BIOLOGICAL STRUCTURES**

John C. Sutherland, *Brookhaven National Laboratory,*  
*Presider*

**8:30 AM (Invited Paper)**

**FA1 Potential Revolution of Free-Electron Lasers for UV Resonance Raman Spectroscopy for Biological Structural and Dynamic Studies**, Sanford A. Asher, *U. Pittsburgh*. We discuss the utility of UV resonance Raman spectroscopy for examining the local structure of biological molecules and the local dynamics. Excitation within different chromaphoric segments of biological molecules permits local studies of both intermolecular interactions and  $T_1$  optical relaxations. (p. 118)

**9:00 AM (Invited Paper)**

**FA2 High-Resolution Circular Dichroism Spectroscopy in the Vacuum Ultraviolet**, Patricia A. Snyder, *Florida Atlantic U.* These measurements need a high-intensity, polarized, collimated, continuum source. The progress which has been made as well as future possibilities is reviewed. (p. 121)

**9:30 AM**

**FA3 Biophysical Uses of the XUV Free-Electron Laser**, Roger G. Johnston, Stephen P. Edmondson, Shermila B. Singham, Gary C. Salzman, *Los Alamos National Laboratory*. A free-electron laser would be useful in at least three of our research areas: (1) ultrasensitive spectrophotometry, (2) measurements of the Mueller scattering matrix, and (3) flow cytometry. (p. 126)

**9:50 AM**

**FA4 Time-Resolved Fluorometry of the Aromatic Amino Acids**, William R. Laws, J. B. Alexander Ross, Panayotis G. Katsoyannis, Herman R. Wyssbrod, *Mount Sinai School of Medicine*. Protein structure/dynamics can be investigated by time-resolved fluorescence of the aromatic amino acids excited by a high-repetition continuous, coherent, picosecond-pulse light source in the ultraviolet. (p. 129)

FRIDAY, MARCH 4, 1988 — *Continued*

**10:10 AM**

**FA5 Potential of Free-Electron Lasers for X-Ray Holographic Microscopy of Biological Specimens**, Chris Jacobsen, Janos Kirz, *SUNY-Stony Brook*; Dick DiGennaro, Malcolm Howells, Stephen Rothman, *Lawrence Berkeley Laboratory*. X-ray microscopy is a rapidly developing field that could benefit greatly from  $\lambda \leq 4.5$ -nm FELs. Work in holographic microscopy could make possible the recording of suboptical resolution images of hydrated specimens in a matter of milliseconds. We discuss the exposure requirements of x-ray holographic microscopy, the opportunities and problems associated with reducing exposure times to the millisecond range, and the potential that FELs hold for dramatically advancing work in this field. (p. 133)

**MEZZANINE**

**10:30 AM-10:50 AM COFFEE BREAK**

**MARCIA ROOM**

**10:50 AM-12:30 PM**

**FB, PHOTOCHEMICAL PROCESSES I**

Andrew Kaldor, *Exxon Research & Engineering Company,*  
*Presider*

**10:50 AM (Invited Paper)**

**FB1 Spectroscopic and Chemical Uses of High-Flux VUV and XUV Sources**, William C. Stwalley, *U. Iowa*. High-flux VUV and XUV sources offer opportunities for generating very high-energy, very low-entropy systems in novel ways, yielding novel spectra and photochemistry. (p. 138)

**11:20 AM (Invited Paper)**

**FB2 Time-Resolved Studies in the Gas Phase: Reaction Dynamics and Threshold Photoelectron Spectroscopy**, Tomas Baer, *U. North Carolina*. Pump-probe and high-resolution threshold photoelectron spectroscopy experiments are described. Both make use of the high resolution, the short pulse duration, and the high intensity of the FEL. (p. 141)

**11:50 AM**

**FB3 Use of a Free-Electron Laser in Knudsen Effusion Mass Spectrometry Studies of Actinide Materials**, Phillip D. Kleinschmidt, *Los Alamos National Laboratory*. Accurate bond dissociation energies and ionization potentials of actinide molecules generated in a Knudsen effusion source can be obtained using a free-electron laser ionization source. (p. 148)

FRIDAY, MARCH 4, 1988 — *Continued*

12:10 PM

**FB4 Ultrahigh-Speed Measurement of Supersonic Combustion with a UV Free-Electron Laser**, Robert W. Pitz, *Vanderbilt U.* The potential of a UV FEL to make ultrahigh-speed measurements of turbulent mixing and chemistry in supersonic combustion using laser-induced fluorescence and Raman scattering is described. (p. 150)

#### FIRESIDE ROOM IN REBECCA'S

12:30 PM-1:30 PM LUNCH

1:30 PM-4:30 PM FREE TIME

#### RED DOG SALOON

4:30 PM-5:45 PM

POSTDEADLINE POSTER SESSION

#### FIRESIDE ROOM IN REBECCA'S

5:45 PM-7:00 PM DINNER

#### MARCIA ROOM

7:00 PM-10:10 PM

**FC, RADIATION EFFECTS AND MEDICAL APPLICATIONS**  
Sanford A. Asher, *University of Pittsburgh, Presider*

7:00 PM (*Invited Paper*)

**FC1 Ultraviolet Photobiology**, John C. Sutherland, *Brookhaven National Laboratory*. Ultraviolet light damages DNA and other biological molecules resulting in death, mutations, cancer, and other deleterious effects. Ultraviolet from FELs will permit studies not feasible with other sources. (p. 154)

7:30 PM

**FC2 Absorption Properties and Desirable Photon Fluxes for Experiments Using Biological Cells and Viruses in the Ultraviolet (100-400-nm) Wavelength Region**, Thomas P. Coohill, *Western Kentucky U.* The absorption properties and inactivation fluences of biological cells and viruses at several UV wavelengths are compared to the available or proposed outputs from various radiation sources, including the rf-linac free-electron laser. (p. 158)

7:50 PM

**FC3 Radiobiology of Ultrasoft X Rays**, James Freyer, Mario Schillaci, Susan Carpenter, Michael Comforth, Robert Sebring, Patricia Schor, Mark Wilder, Kathryn Thompson, Mudundi Raju, *Los Alamos National Laboratory*. The proposed Los Alamos XUV FEL should greatly expand our current project using ultrasoft x rays to investigate the mechanisms of radiation damage in biological systems. (p. 162)

FRIDAY, MARCH 4, 1988 — *Continued*

8:10 PM

**FC4 Multiphoton Ionization and Chemical Reaction in DNA: a Theoretical Study of Ionizing Radiation by an FEL**, K. T. Lu, *Atomic Engineering Corporation*. The characterization of the interaction of FEL radiation with DNA is studied theoretically as a function of wavelength, pulse duration, power, geometric size, and penetration depth. (p. 166)

#### MEZZANINE

8:30 PM-8:50 PM COFFEE BREAK WITH DESSERT

8:50 PM

**FC5 Biomedical Uses of the Free-Electron Laser in the Ultraviolet**, Richard Z. Straight, *U. Utah*. Biomedically important molecules and all tissues strongly absorb UV light. Tunable UV FELs (190-390 nm) will have potentially valuable diagnostic, therapeutic, and surgical uses in biomedicine. (p. 170)

9:10 PM

**FC6 Potential Medical Uses of UV Free-Electron Lasers**, Laura Esserman, *Stanford U. Medical Center*; Steven D. Conradson, *Los Alamos National Laboratory*. Ultraviolet FELs have unique, potential biomedical uses. Through the process of ablative photodecomposition, they should be particularly useful in the areas of neurosurgery, orthopedic surgery, and wound healing. (p. 175)

9:30 PM

**FC7 Generation of Backscattered X Rays within an FEL Oscillator for Coronary Angiography**, William E. Stein, Brian E. Newnam, Alex H. Lumpkin, *Los Alamos National Laboratory*. Intracavity generation of Compton-backscattered 33-keV photons within a 1- $\mu$ m FEL resonator, together with a gated, intensified camera, is proposed for coronary angiography. (p. 179)

SATURDAY, MARCH 5, 1988

SATURDAY, MARCH 5, 1988 — *Continued*

**FIRESIDE ROOM IN REBECCA'S**

6:30 AM-8:15 AM BREAKFAST

**CRYSTAL ROOM**

8:00 AM-12:00 M REGISTRATION/SPEAKER CHECKIN

**MARCIA ROOM**

8:30 AM-10:10 AM  
SA. SPECTROSCOPY OF HIGHLY IONIZED GASES AND ION BEAMS

John M. Dawson, *University of California at Los Angeles, Presider*

8:30 AM (Invited Paper)

SA1 Vacuum UV Free-Electron Lasers as Diagnostic Probes of Magnetic Fusion Plasmas, W. A. Peebles, *UC-Los Angeles*. The possible use of VUV free-electron lasers to probe the role of neutral particles in magnetic confinement fusion plasmas is described. (p. 182)

9:00 AM (Invited Paper)

SA2 Use of XUV Free-Electron Radiation for Opacities of Highly Ionized Atoms, A. L. Merts, *Los Alamos National Laboratory*. Standard emission and transmission measurements are inadequate for determining the cross section over the spectral range needed for opacity calculations. Free-electron lasers offer possible answers. (p. 187)

9:30 AM

SA3 Impact of VUV/Soft X-Ray Free-Electron Lasers on the Study of Electron Correlation in Ions, Pascale Roy, Roger J. Bartlett, *Los Alamos National Laboratory*. Experiments are proposed to study electron correlation effects in ions. These differential measurements on low density targets require the spectral brightness of free-electron lasers. (p. 190)

9:50 AM

SA4 Highly Charged Ion Precision Spectroscopy Using Free-Electron Laser Radiation, D. A. Church, S. D. Kravis, *Texas A&M U.* Precision spectroscopy of stored, thermal hydrogenlike ions using extreme-UV FEL radiation is discussed, with particular emphasis on the hydrogenlike sodium ground-state hyperfine structure. (p. 193)

**MEZZANINE**

10:10 AM-10:30 AM COFFEE BREAK

**MARCIA ROOM**

10:30 AM-12:10 PM

SB, PHOTOCHEMICAL PROCESSES II

Yuan T. Lee, *University of California at Berkeley, Presider*

10:30 AM (Invited Paper)

SB1 Time-Resolved Spectroscopy as a Probe of the Electronic Structure and the Dynamics of Clusters, Georg Zimmerer, *U. Hamburg, F. R. of Germany*. The feasibility of an investigation of the electronic structure and the dynamics of rare gas clusters in a crossed-beam experiment with VUV FEL radiation for excitation is demonstrated. (p. 198)

11:00 AM (Invited Paper)

SB2 Experiments on the Electronic and Geometric Structure of Molecules and Clusters Using XUV Free-Electron Lasers, W. Eberhardt, *Exxon Research & Engineering Company*. Free-electron laser sources will open up the possibility to study the electronic structure, geometry and chemistry of dilute species like free radicals and clusters. Taking experiments carried out on molecules and deposited clusters as examples, I illustrate the possibilities we have with an XUV FEL to improve our understanding of these more dilute systems. (p. 202)

11:30 AM

SB3 Photoionization and Photofragmentation Studies of Van Der Waals Complexes Using VUV Radiation, E. A. Walters, *U. New Mexico*; J. R. Grover, *Brookhaven National Laboratory*. Potential uses of short-wavelength tunable radiation from a free-electron laser to the chemistry of solvation phenomena through weakly bound molecular complexes are described. (p. 204)

11:50 AM

SB4 Molecular Photoionization and Photofragmentation Studies Using VUV Radiation, Robert K. Sander, Joe J. Tise, *Los Alamos National Laboratory*. Extension of state-selective photofragmentation experiments to the VUV will generate a broader distribution of product states and require brighter photolysis sources than currently available. (p. 208)

**MARCIA ROOM**

12:10 PM-12:15 PM CLOSING REMARKS

**FIRESIDE ROOM IN REBECCA'S**

12:15 PM-1:15 PM LUNCH