Users' Guide

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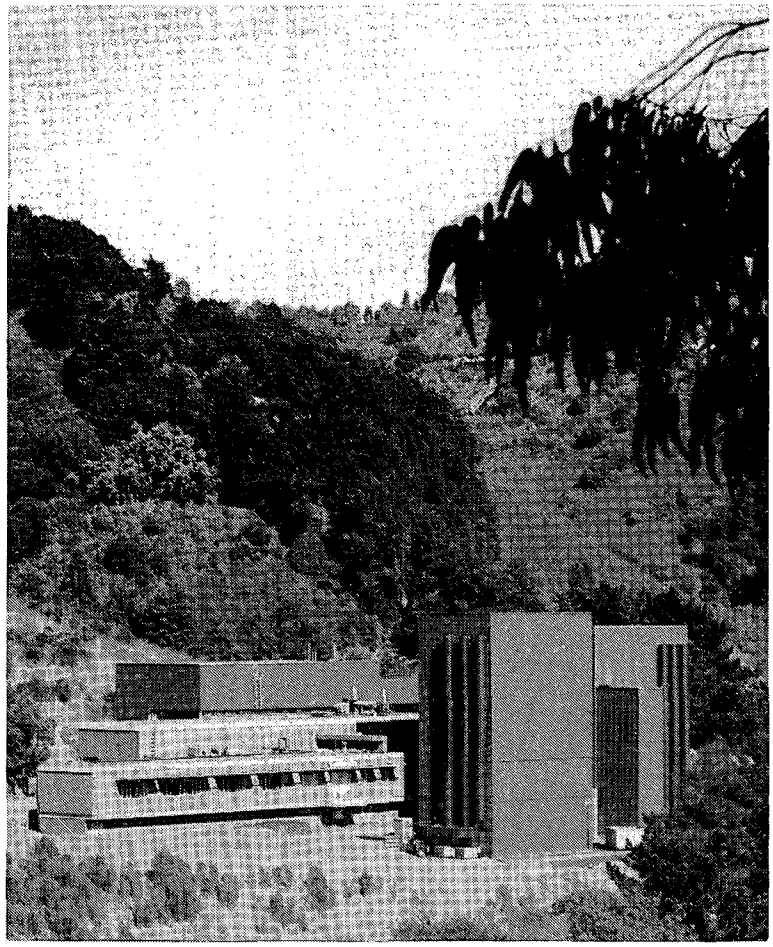

NATIONAL CENTER FOR ELECTRON MICROSCOPY
Lawrence Berkeley Laboratory
University of California

Prepared for the U.S. Department of Energy under Contract No. DE-AC03-76SF00098

PUB-475 Rev. c.2

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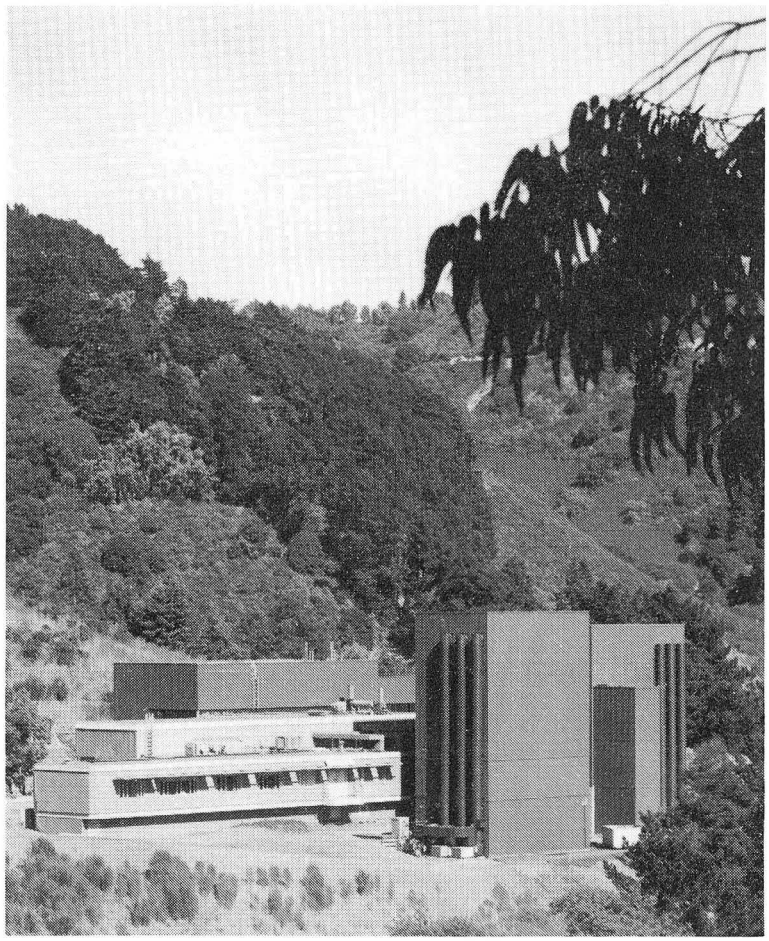

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NATIONAL CENTER FOR ELECTRON MICROSCOPY

The National Center for Electron Microscopy (NCEM) in the Materials and Molecular Research Division of the Lawrence Berkeley Laboratory is a high voltage electron microscope facility for ultra-high resolution or dynamic in-situ studies. It is supported by the Director, Office of Energy Research, Office of Basic Energy Sciences, Materials Science Division, U.S. Department of Energy under Contract No. DE-AC03-76SF00098.

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Phone: (415)486-5006; FTS 451-5006

Tape-Recorded Microscope Status Report
(415)486-6368; FTS 451-6368

1.1. KRATOS EM-1500

This instrument is designed primarily for dynamic in-situ studies but it can also resolve structures at the 0.3nm level. It is the first electron microscope to be built by Kratos with a maximum acceleration voltage of 1.5 MeV. As such, it provides accelerating voltages in the range 1200-1500kV not available elsewhere in the U.S. To achieve the higher accelerating voltage the number of stages of the Cockroft-Walton generator was increased to 9 and the SF_6 insulating gas pressure was increased to $\approx$ 70 p.s.i. Conditioning of the accelerator tube is carried out at 1.6 MeV. A series of 15 push buttons allows the accelerating voltage to be set at 150kV or 200-1500kV in 100kV increments. In addition the voltage can be varied continuously for critical voltage or convergent beam diffraction studies. The accelerated vacuum has been improved to allow use of LaB_6 filaments. A photograph of the microscope is shown in Fig. 1.

The more important instrument specifications are listed in Table I.

TABLE I: EM-1500 SPECIFICATIONS

Max^m Accel. Voltage	1500
High Voltage Stability	$>5\times10^{-6}$/min
High Voltage Ripple	$<3\times10^{-6}$
Accelerator Vacuum	10^{-7}
Obj. Lens Current Stab.	3×10^{-6}/3min
Focal Length	6.8mm
Spher. Abb. Coeff.(Cs)	10.5mm
Chrom. Abb. Coeff.(Cc)	5.4mm
$NI/E^{1/2}$(at 1000kV)	11
Goniometer Tilts	$\pm45^o$
Specimen Drift Rate	$<$0.3 nm/sec (0.5 hr)
Vacuum--Column	$\approx10^{-7}$
Vacuum--Spec. Chamb.	$<3\times10^{-7}$
External Vibr. (pk-pk)	$<1\mu$m
Resolution (pt-pt)	0.3nm
Specimen Diam.	3mm
Film Load	50

The microscope is equipped with both a top-entry stage for high resolution studies, and a side-entry stage for general, dynamic in-situ, and environmental cell studies. Several different specimen stage rods are available (see Table II) and this inventory will be added to as demand develops and funding permits.

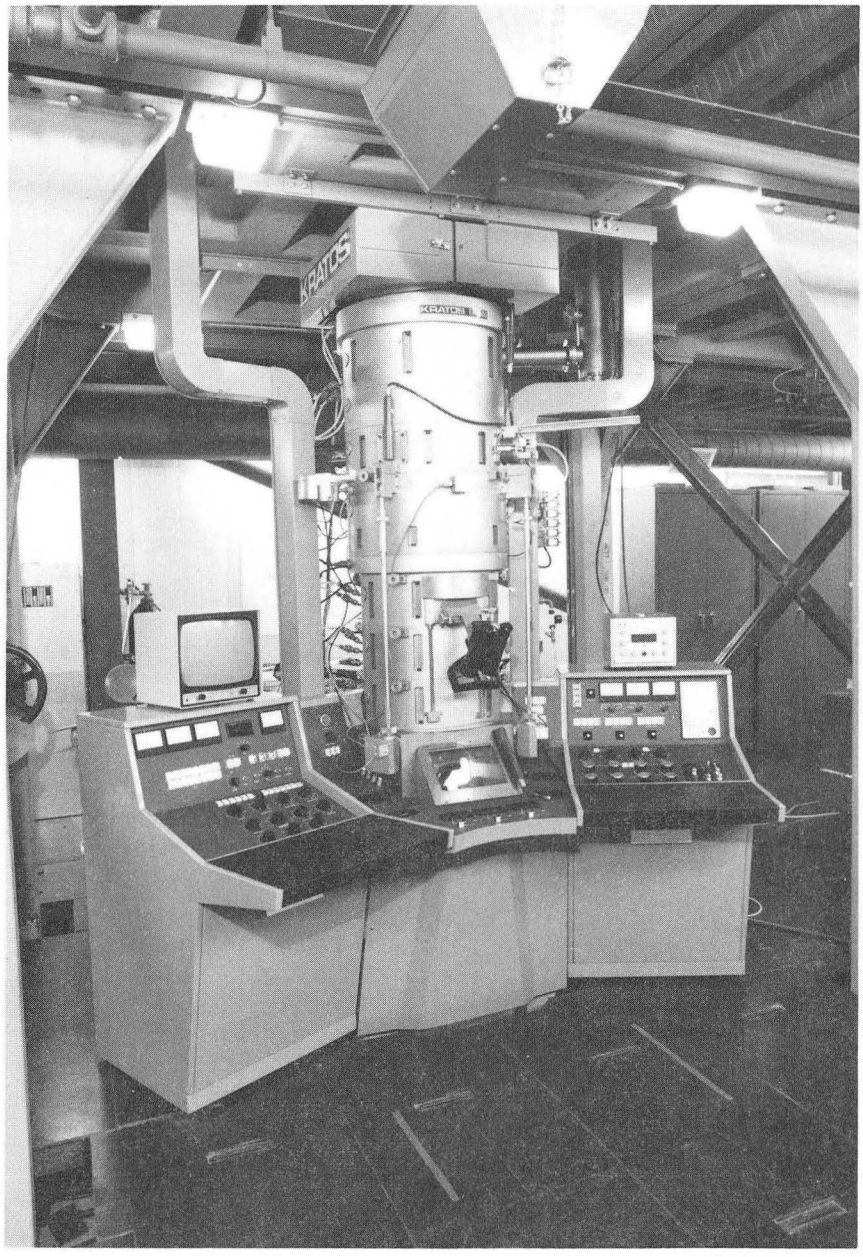

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Fig. 1

TABLE II: SPECIMEN STAGES FOR EM-1500

Top Entry
Double Tilt -- $\pm 30^o$
No Tilt -- 0

Side Entry -- Y Tilt = Rod Axis, X Tilt = 90° to Rod Axis
Single Tilt on Rod Axis -- $\pm 45^o$ Y Axis
Double Tilt -- $\pm 45^o$ Both Axes
Single Tilt Heating E-Cell -- $750^o\ C \pm 45^o$ Y Axis Tilt
Single Tilt Heating -- $1000^o\ C \pm 45^o$ Y Axis Tilt
Double Tilt Heating -- $750^o\ C \pm 30^o$ X Axis $\pm 45^o$ Y Axis Tilt
Double Tilt Cooling/Heating -- $+140^o$ to $-184^o\ C \pm 30^o$ Both Axes

Straining
Piezo crystal drive no higher than 3kV Tilts $\pm 45^o$ (Y axis microscope, X axis motor on rod); 25 kg strain maximum.

Single Tilt Heating/Straining Stage
Max. Temp. $650^o\ C$
Max. Load 2200g

Environmental Cell
$\pm 10^o$ Tilt about Y Axis

Gas Concentration
Oxygen -- 25%
H_2 -- $\approx$12% in argon

Gas Flow vs. Temp.*
Argon 100mBar -- Max. Temp. $\approx 500^o\ C$
N^2 100 mBar -- Max. Temp. $\approx 500^o\ C$
He 100mBar -- Max. Temp. $350^o\ C$

* E-Cell heating holder temperature depends on gas used and the flow rate/pressure used.

Planned Additions
1. Top entry double tilt heating stage $>1200^o\ C$;$\pm 30^o$ Both Axes
2. Video Camera for real-time recording of experiments. Betamax recorder; 3/4" cassette recorder.

1.2 JEOL-ARM-1000

This instrument has been specifically designed for ultimate performance in the high resolution imaging mode. Proven point-to -point resolution of 1.5 Angstroms has been achieved and its combination of resolution performance and specimen tilting capabilities ($\pm 45^o$ biaxial) are unmatched by any other microscope in the world. Attention has also been given to the potential problem of specimen sensitivity to the electron beam at higher accelerating voltages, and by incorporating a microprocessor-controlled height (Z)-variable goniometer, the microscope will operate with a constant $C_s\ \lambda$ product over its entire voltage range (400kV to 1000kV). Specifications for the Atomic Resolution Microscope (ARM) at maximum voltage are given in Table III; the instrument is shown in Fig. 2.

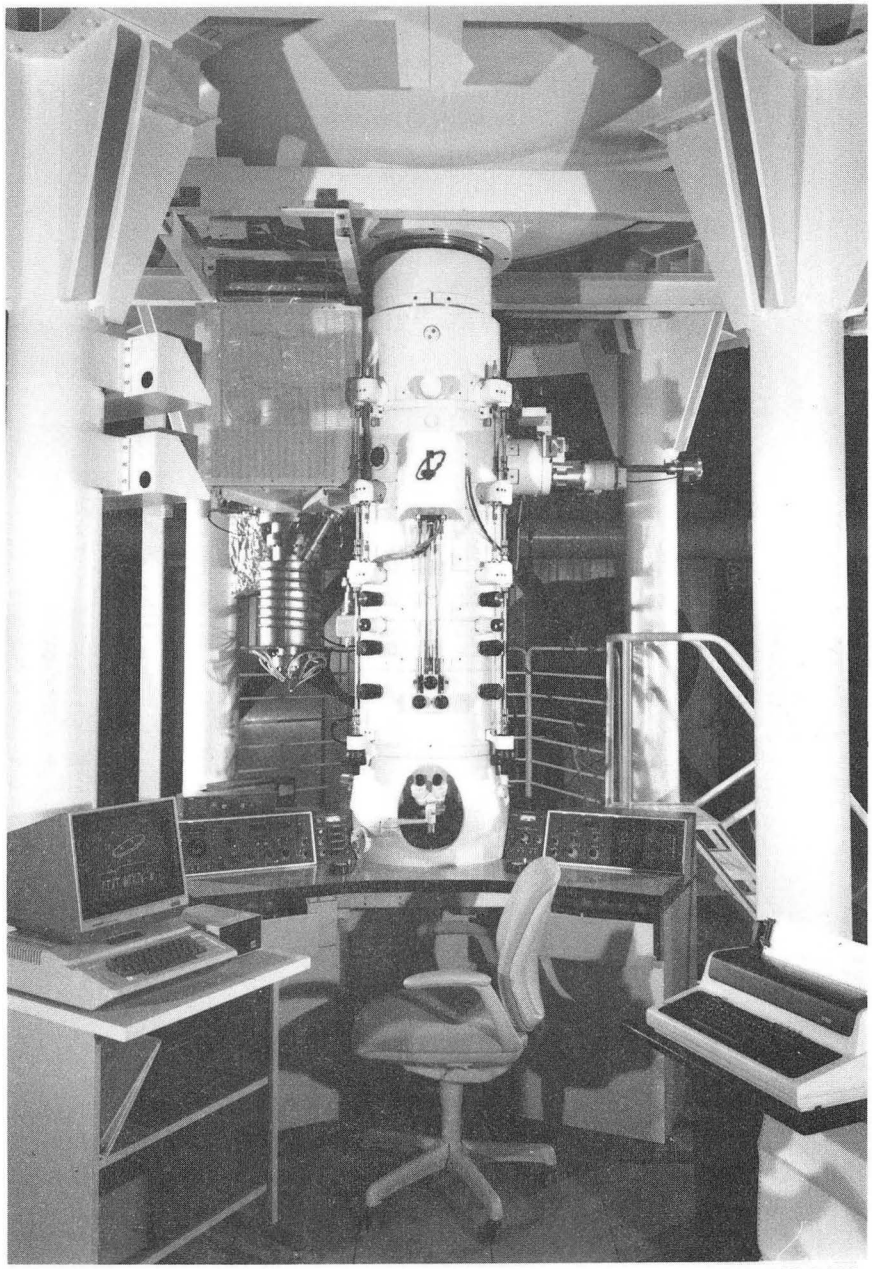

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Fig. 2

TABLE III: JEM ARM 1000 SPECIFICATIONS	
Max^m Accel. Voltage	1000kV
High Voltage Stability	1×10^{-6}/min
High Voltage Ripple	1×10^{-6}/min
Accelerator Vacuum	5×10^{-8}torr
Obj. Lens Current Stab.	1×10^{-6}/min
Focal Length	2.6mm
Spher. Abb. Coeff. (Cs)	2.8mm
Chrom. Abb. Coeff. (Cc)	3.3mm
$NI/E^{1/2}$(at 1000kV)	23
Goniometer tilts	$\pm40^o$ biaxial with lift
Specimen Drift Rate	.002nm/sec
Vacuum--Column	10^{-8}torr
Vacuum--Spec. Chamb.	5×10^{-8}torr
External Vibr. (pk-pk)	$<1\mu$m
Resolution (pt-pt)	<0.18nm
Specimen Diam.	3mm
Film Load	50

It is also important to note that at higher lens excitation values, the microscope can be run in condenser-objective mode, enabling convergent beam electron diffraction (CBED) patterns to be taken from the same specimen areas imaged in high resolution. For increased stability, the stage configuration on this machine is top entry. The microscope uses LaB_6 filaments and a unique viewing glass for additional brightness. It will soon be equipped with a video system.

1.3 JEOL JEM 200-CX

A support instrument to the ARM, the JEM 200-CX is well known for its high resolution performance. Relevant specifications for this machine, equipped with ultrahigh resolution goniometer (top entry), are given in Table IV. Note that due to a modification of the specimen cartridge, specimens for this microscope can be 3mm in diameter rather than the standard 2.3mm.

TABLE IV. JEM 200-CX SPECIFICATIONS	
Max^m Accel. Voltage	200kV
Focal length	2mm
Spher. Abb. Coeff. (Cs)	1.1mm
Chrom. Abb. Coeff. (Cc)	1.4mm
Goniometer Tilts	$\pm10^o$
Specimen Drift Rate	<0.05nm/sec
Vacuum--Column	10^{-7}torr
Vacuum--Spec. Chamb.	10^{-7}torr
External Vibr. (pk-pk)	$<3\mu$m
Resolution (pt-pt)	$\approx$0.24nm
Specimen Diam.	3mm
Film Load	50

1.4 HITACHI HU-650 (See Fig. 3)

The accelerating voltage on this instrument is continuously variable between 200kV and 650kV, but it is calibrated for, and most conveniently used at, three fixed voltages: 300, 500, or 650kV.

The resolution of this instrument is not high (see Table V) but it is adequate for some studies--especially thicker films that cannot be observed at 100kV, exploratory experiments, and many hot stage or environmental cell experiments (see Table VI).

TABLE V: HU-650 SPECIFICATIONS

Max^m Accel. Voltage	650
High Voltage Stability	10^{-5}/min
High Voltage Ripple	$<7\times10^{-6}$
Accelerator Vacuum	10^{-6}
Obj. Lens Current Stab.	5×10^{-5}/min
Focal Length	8.4mm
$NI/E^{1/2}$ (at 1000kV)	12.8
Goniometer Tilts	$\pm45^o$
Vacuum--Column	6×10^{-6}
Vacuum--Spec. Chamb.	$\approx10^{-5}$
Resolution (pt-pt)	$\approx$2nm
Specimen Diam.	3mm
Film Load	20

TABLE VI: SPECIMEN STAGES FOR HU-650

	X-Axis	Y-Axis	Temp.
Double-tilt, cartridge-type	$\pm45^o$	$\pm45^o$	Ambient
Single-tilt, cartridge-type*		$\pm45^o$	Ambient
Double-tilt, furnace-type	$\pm30^o$	$\pm30^o$	Ambient-850
Single-tilt, furnace-type*		$\pm25^o$	Ambient-850
Single-tilt, ribbon-type*		$\pm30^o$	Ambient-1000
Single-tilt, straining*		$\pm30^o$	Ambient

*For use with Environmental Cell at pressures up to $\approx300torr$

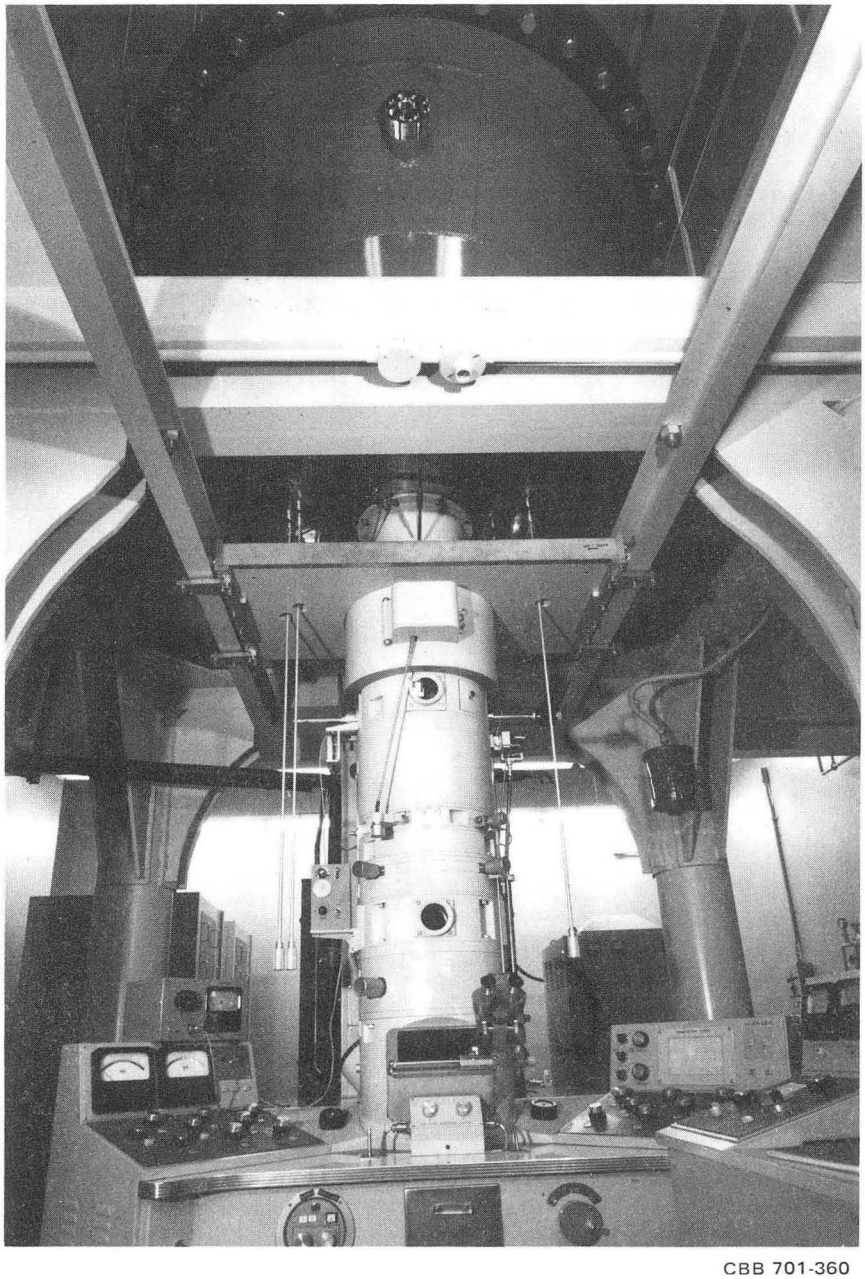

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Fig. 3

1.5 JEOL JEM 200CX AEM

This instrument provides state-of-the-art microanalytical capabilities to the users of the Center (some relevant specifications are shown in Table VII). The microscope as shown in Fig. 4 has a side-entry double-tilt goniometer stage with an assortment of specimen holders (Table VIII) and can be operated either in transmission or scanning modes.

The microanalytical capability of the machine is built around a KEVEX System 8000 with a DEC LSI 11/73 computer and is configured flexibly to run standard quantification and imaging software for routine microanalysis while maintaining the capability of program development for more sophisticated applications. Hardware includes: (1) a well-characterized high angle energy dispersive x-ray detector with a resolution of 155eV for MnK_α radiation and a take-off angle of 72° to maximize peak to background ratios; (2) an ultra-thin window EDX detector with a resolution of 109eV for FK_α radiation and capable of detecting all elements with $Z \geq 6$; and (3) a Gatan 607 electron energy loss spectrometer capable of routinely achieving 2eV resolution. All signals, electron energy loss and x-ray, can be acquired either separately or simultaneously using probes of diameter $>10nm$ and can also be used for energy filtered imaging and/or elemental mapping. Use of a standard single sided double-density 7" floppy disk in addition to a 30 mbyte Winchester facilitates easy data transfer for external users of the Center.

TABLE VII

Accelerating voltage range	80kV to 200kV (40kV in scan)
Filament	LaB_6 type
Vacuum	$\approx 2\times10^{-7}$torr
Free lens control with selectable digital multimeter	
Specimen size	Std. 3mm dia. disc $\leq$.38mm thick
(Bulk specimen not to exceed 8mm(l)$\times$2mm(w)$\times$ 1mm(h))	
Resolution	CTEM 0.2nm
	STEM 2.5nm
	SEM 4nm
Magnifications	CTEM 400X to 330,000X
	STEM 300X to 800,000X
	SEM (std) 300X to 800,000X
	(low mag. 10X to 800,000X)
Other Accessories	Scan rotation and tilt correct
	Gamma control

TABLE VIII: Specimen Holders Used with "Z" Corrected Side Entry Goniometer Stage

1. Specimen quick exchange EM-SQH
2. Common specimen holder EM-SCSH (single tilt $\pm60^o$ bulk and analytical)
3. Specimen tilting holder EM-BST (double tilt $\pm60^o$;$\pm45^o$)
4. Cryogenic specimen holder Gatan 636 (double tilt $\pm60^o$;$\pm45^o$ analytical)

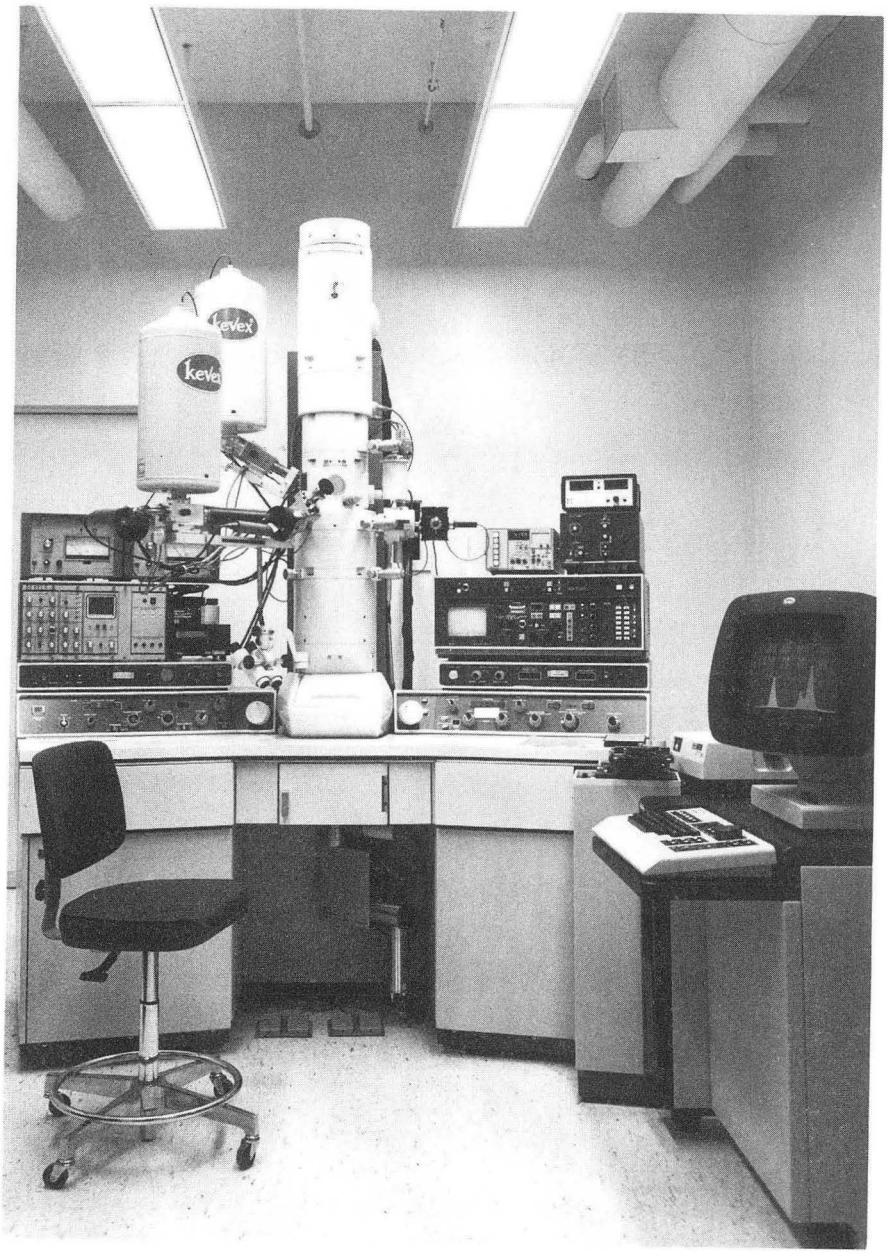


Fig. 4

In addition to the preceding, the electron diffraction capability of the microscope includes: (a) Selected area diffraction 800nm - 1000nm area.

(b) Microbeam diffraction 100nm - 150nm area.

(c) Convergent beam diffraction $\approx$60nm beam, $\approx 14^o$ convergence angle.

(d) Micro-micro diffraction 20nm ($2\times10^{-3} rad$) standard with λl calibrated projector free lens control.

(e) Rocking beam electron channelling pattern $\pm 5^o \approx \pm 30^o$ (variable in 6 steps).

Finally, because of the versatility of the machine and the need for the continued maintenance of a clean specimen environment, all users are required to fill out a detailed "User Request Form" [see last page] to provide background information before obtaining time on this microscope.

2. Support Instrumentation

2.1 NCEM Image Processing

In its initial configuration, the NCEM computer system provides an interactive image simulation facility where users can enter hypothesized models of specimen structure and obtain an image simulated under appropriate experimental conditions.

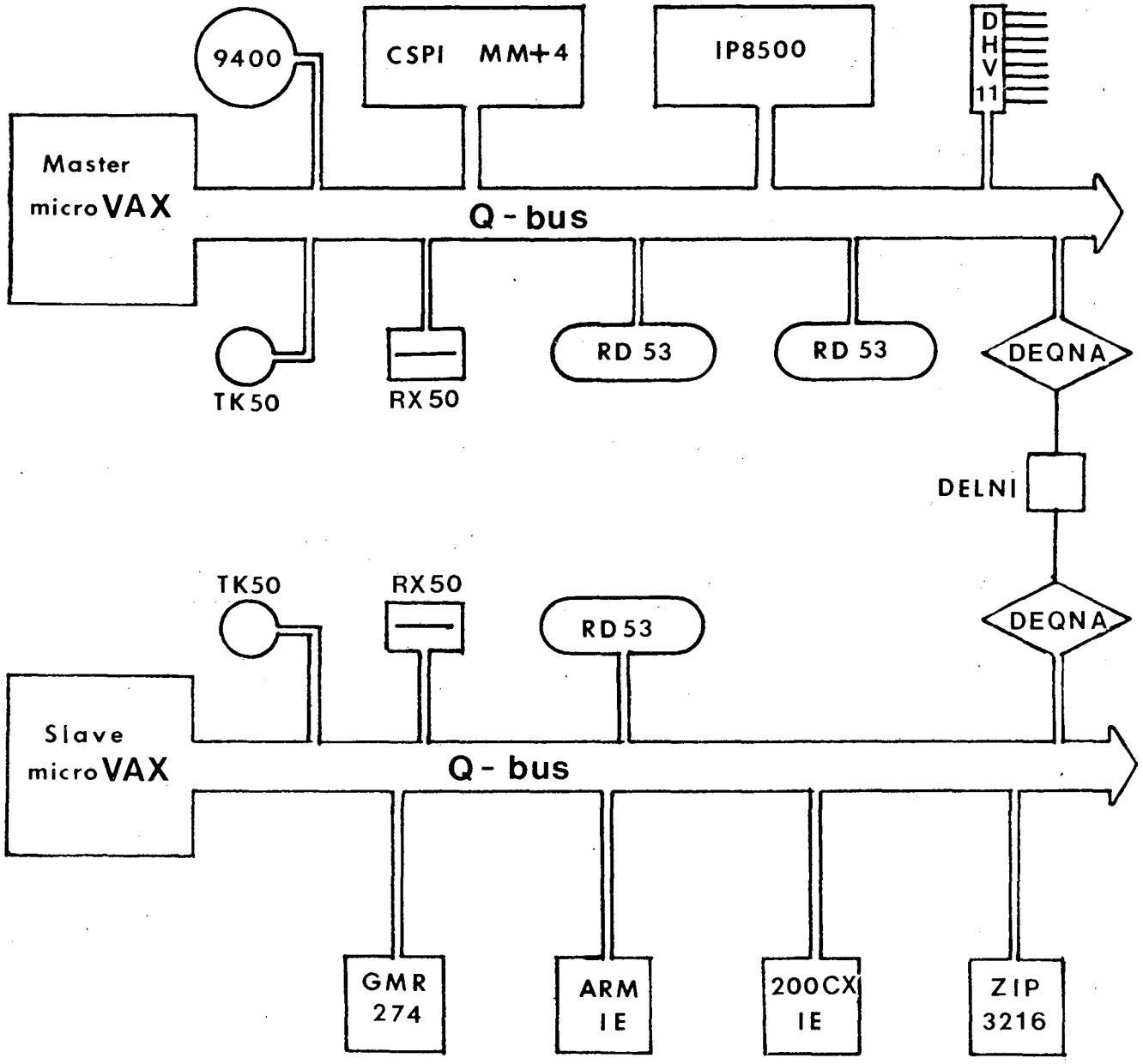
For the second-stage configuration, it is planned to connect the computer to the image pickup (video) systems of the Kratos EM-1500, the JEOL-ARM-1000 and the JEOL-JEM-200CX, in order to provide the microscope user with on-line digital image filtering, on-line diffractograms, and the ability to store digitized images for later comparison with simulations. A third-stage configuration will include extensive image processing facilities available at the user image-simulation workstation, as well as a scanning micro-densitometer to provide the ability to input large areas of experimental micrographs.

The main components of the computer system are shown in Fig. 5. The system is based on two DEC microVAX II computers. The master microVAX controls a Gould IP8500 image processor (for display and processing of simulated and experimental images), a CSPI Minimap+4 array processor (for image manipulation and simulation), and 8 user terminals. The slave microVAX acts under command of the master, and executes programs to control the Grinnell GMR274 image enhancer (connected to the Kratos video system), and the two other image enhancers connected to the ARM and the 200CX.

User data (mainly images) can be output on 9-track tape at 800, 1600 or 6250 bpi using the Kennedy 9400 tape drive, or on 5-1/4" floppy disks from the DEC RX50. Alternatively tape cartridges from the DEC TK50 can be used. Hardcopy is available from an Apple LaserWriter.

2.2 Specimen Preparation

Users who require final specimen treatment can find assistance at NCEM in a well-equipped specimen preparation laboratory. Specimens can be cleaned just before insertion in the microscopes by an ion beam flush in the Gatan Dual Ion Mill Model 600, which has a cold stage for heat sensitive materials.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CSPI MM+4
IP8500
DHV 11
Master microVAX
Q - bus
TK50
RX50
RD 53
RD 53
DEQNA
DELNI
TK50
RX50
RD53
DEQNA
Slave microVAX
Q - bus
GMR 274
ARM IE
200CX IE
ZIP 3216

Fig. 5

Touch-up specimen coating to reduce electron beam charging can be carried out in either a dedicated carbon evaporator or a Polaron evaporator for metallic species. Interim storage in evacuated containers can also be arranged for the duration of the user's stay at NCEM.

2.3 Photographic Facilities

There are two semi-automated dark rooms available to NCEM users for rapid processing of all photographic negative materials obtained on the microscopes or the optical bench. These are maintained daily to ensure high quality results.

3. User Policies

3.1 General

Beam time on either the HVEM or the ARM is allocated after review and acceptance of research proposals submitted in advance. The Steering Committee, composed of recognized scientists drawn from universities, industry and the national laboratories, meets at regular intervals to review, discuss, and accept project proposals and advise LBL management on facility policies and operating procedures. The criteria used in assessing research proposals and assigning priorities are: appropriateness, scientific merit, and time availability. Proposals will remain valid for a period not to exceed 18 months. Scheduling beam time is the responsibility of the center staff.

No charges will be assessed for use of the NCEM facilities provided the proposed work is of documented programmatic interest to DOE and the results are published in the open literature. Items provided at no cost include time on the instrument, some staff assistance and advice, and use of dark rooms. Costs associated with use of effort and services outside the facility, e.g. machine shop, electronic shops, computer, stores, etc., must be borne by the user at the standard Laboratory internal rates.

If the proposed research is not of interest to DOE or is proprietary, full cost recovery (including overhead and DOE added factor) will be charged.

At the conclusion of an experimental program, regardless of the outcome, a brief report of the results and conclusions must be submitted to the center. Copies of any publications resulting from the research must also be sent. These papers can be used to support applications for continuing or new experiments. They will also be useful as a permanent record of NCEM research activity.

Users must be qualified and experienced transmission electron microscopists. It will be the responsibility of the Principal Investigator on each proposal to vouch for the competence of members of his team, particularly the microscopist. Instruction sessions on the specific uses of the instrument will, of course, be given. Any malfunctioning of the instruments must be reported (immediately, if serious in nature) to the facility support staff. Unscheduled down-time and repairs will be minimized if all users operate the microscopes with care and consideration. Because of the disruption and inconvenience to other users, any damage to the instrument or stages resulting from operator ignorance or negligence will be repaired at the cost of the group responsible. *If in doubt, seek assistance from the facility staff.*

At least 24 hours notice is required if a microscope booking is cancelled. Failure to do so will result in loss of priority in subsequent scheduling. Users are encouraged to complete Feedback Sheets at the end of their session, reporting any problems, suggestions, successes or failures.

3.2 Analytical Electron Microscope (AEM)

All NCEM users who have approved proposals for conducting research on either the ARM or HVEM where there is need for complementary data from the AEM may have access to the instrument for one full session in a time window which borders their session on the high voltage machines at NCEM. This need will have been specified and justified in the original proposal, and its merits judged by the NCEM Steering Committee (listed on the first page of this brochure) during its normal review cycle. Users seeking operator assistance on the microscope must specify their level of competence and experience in the operation of an AEM. However, regardless of experience, no user should expect to be able to solo on the AEM until approval is given by NCEM staff. Users in this category may request a single return session for just the AEM; however, their next session (number three) must again border their time on one of the high voltage machines.

General access and scheduling of time on the AEM will be made on the basis of a priority system. Details of the policies and procedures governing this system are available upon request. Due to the complexity of the AEM and inherent potential for disaster, utmost care is expected of all users, who bear financial responsibility for any damage.

4. Proposal Submission and Scheduling

A research proposal for using the ARM-1000 or EM-1500 should be submitted at least 6 weeks prior to the earliest proposed starting date [see last pages of this brochure].

The proposal may be brief but should state clearly the scientific objective. It should include use justification for the particular high voltage instrument, and a list of materials to be examined. Specimens should be prepared in advance. Any possible hazards associated with the specimens must be specified, and their possible effect on the microscope environment or specimen area must be evaluated, e.g., whether contaminating, radiation sensitive, volatile, likely to react with hot stage, etc.. Any special scheduling arrangements should be indicated.

In the case of the ARM-1000, the proposal should be accompanied by high resolution micrographs taken on any conventional high resolution instrument together with their complete analysis and interpretation. This information will be used in assessing the need for the higher resolution or flexibility available on the ARM, and will also serve to demonstrate the operational skills of the applicants. Upon recommendation by the Steering Committee, some ARM proposals may be given trial runs on the JEM 200CX when users have no access to such a microscope. Graduation to the ARM will then be granted at the discretion of the center staff.

Before departing for Berkeley, users should phone (415) 486-6368 for a late report on the operational status of the microscopes.

5. Safety

Shifts run until 10:30 pm Monday through Friday. However, no one is allowed to do microscopy or specimen preparation unless at least one other person is in the building.

Women Employees

The National Council of Radiation Protection (NCRP) has recommended that the total occupational radiation dose to the fetuses of fertile women not exceed 0.5 rem. It is Laboratory policy that fertile women working in radiation areas where it is possible to receive 0.5 rem or greater be

notified, as well as their supervisors, of this recommendation and the reasons for it. It is DOE policy, however, that no woman be denied a job or work assignment solely because of this recommendation.

As soon as an employee learns that she is pregnant, she is required to inform Medical Services of the expected date of childbirth (see RMP, Sec. 2.09, D3). A physician will discuss her work environment with her and will determine whether or not any changes in the environment should be made to ensure her good health and that of her baby. All new employees are given a copy of the booklet, "Pregnancy and Radiation".

All occupants of Bldg. 72 (NCEM) and visitors using the facilities must familiarize themselves with LBL's Health and Safety Procedures to ensure the maintenance of a safe work environment. Copies of the Health and Safety Manual and Rule and Procedures for the Design and Operation of Hazardous Research Equipment are located in Bldg. 72 Library, Rm. 121.

Any questions should be addressed to the Building Manager or Assistant Manager.

6. Accommodation and Travel

The responsibility for making travel and accommodation arrangements will rest with the user. However, the NCEM administrative staff will be glad to give advice and assistance in making accommodation reservations when appropriate. There is a shortage of accommodation in the Berkeley area and a marked seasonal variation, so advanced reservations are highly recommended.

SUGGESTED HOTELS AND MOTELS

Hotel	Minimum Rate/Single	Distance from LBL
Berkeley House Motor Hotel 920 University Avenue Berkeley, CA 94710 (415) 849-1121	$48.00 + tax	about 2 mi.
Durant Hotel 2600 Durant Avenue Berkeley, CA 94704 (415) 845-8981	$68.00 + tax	adjacent to UC Campus
Marriott Hotel 200 Marina Blvd. Berkeley, CA 94710 (800) 228-9290	$70.00 + tax	about 2.5 mi.
Claremont Hotel 41 Tunnel Road Berkeley, CA 94705 (415) 843-3000	$114.00 + tax	about 1 mi.
The Shattuck Hotel 2086 Allston Way Berkeley, CA 94704 (415) 845-7300	$49.00 + tax	about 1 mi.
French Hotel 1538 Shattuck Ave. Berkeley, CA 94709 (415) 548-9930	$58.00 + tax	about 1 mi.

OTHER TEMPORARY HOUSING

Men's Faculty Club (415) 848-5678-- On U.C. Campus. Single w/private bath: $48/day by the week; $35/day by the month. (Use LBL as sponsor; reserve 1 mo. in advance, if possible.)

Women's Faculty Club (415) 845-5084-- On U.C. Campus. Single with private bath, private telephone and continental breakfast. $49/night + $1.90 weekly membership. No weekly rates; $931/month (reserve in advance, if possible).

Bed and Breakfast Facilities (415) 525-4569-- This is clearing-house for most of the B & B's in this area. We can specifically recommend Hank and Beta Lewis at 853 Contra Costa Avenue.

DRIVING DIRECTIONS (see map following page)

SF Airport to LBL-Berkeley-- Driving time: 45 minutes to 1 hour; Distance: about 25 miles

Upon leaving the airport, bear right and go north on Highway 101 to San Francisco-Oakland Bay Bridge approach (about 13 miles). Watch for signs for "Bay Bridge" and Interstate 80.

After crossing bridge (about 4.5 miles), bear left and look for signs pointing to Interstate 80 and to Berkeley. (About 1.5 miles from the end of the bridge there is a major intersection from which Interstate 80 goes northward.)

Go north about 2.4 miles on Interstate 80 and take the University Avenue turnoff (right) into Berkeley. Stay on University Ave., about 2.6 miles to its eastern end at Oxford St. (western side of UC Campus), bearing left.

Turn left onto Oxford St. and, bearing right, take the first right turn onto Hearst Ave., and follow it up the hill to the second stop light. Turn right onto Gayley Road and follow it to Rimway Road which is the first left. Follow up Rimway Road to the first left behind the Stadium--Centennial Drive. LBL's Strawberry Canyon Gate is .8 mile up Centennial Drive on the right. Turn left after passing through the gate. The second building up the hill is Bldg. 72, NCEM. Parking is just past the building.

Oakland Airport to LBL-Berkeley-- Driving time: 35 minutes; Distance: about 16.5 miles

Take Hegenberger Road eastward from the airport for about 1.7 miles to Highway 880 (Nimitz Freeway). When approaching the Highway 880 intersection, bear right and watch for signs pointing to the turnoff to downtown Oakland.

Then go northwest about 8.5 miles on Highway 880, bearing right to the intersection with Interstate 80 (Eastshore Freeway). Go north on it for about 2.4 miles, again bearing right, and take the University Avenue turnoff (right) into Berkeley. Stay on University Avenue about 2.6 miles to its eastern end at Oxford St. (western side of UC Campus), bearing left.

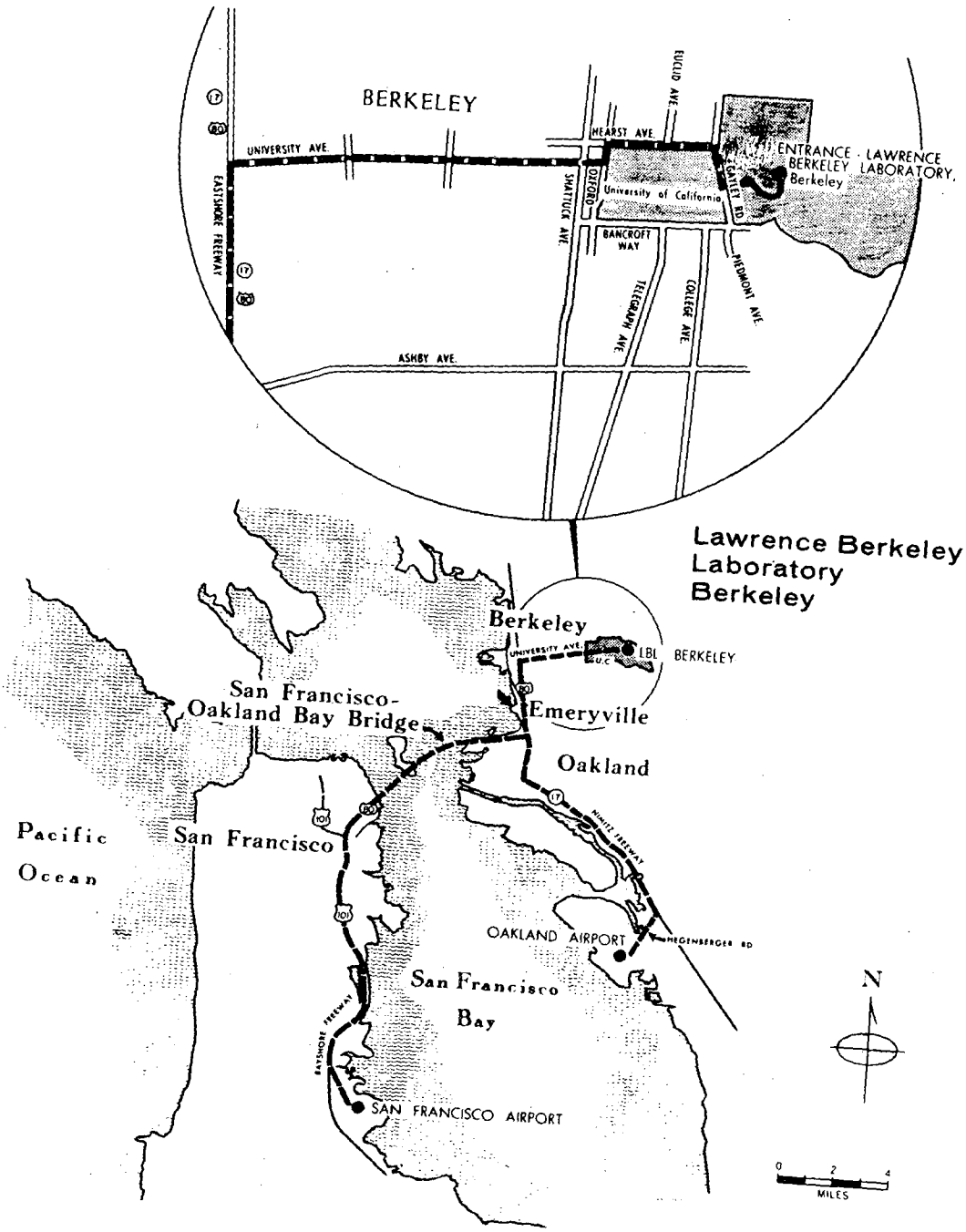
Turn left onto Oxford St. and bearing right, take the first right turn onto Hearst Ave. and follow it up the hill to the second stop light. Turn right onto Gayley Road and follow it to Rimway Road which is the first left. Follow up Rimway Road to the first left behind the Stadium--Centennial Drive. LBL's Strawberry Canyon Gate is .8 mile up Centennial Drive on the right. Turn left after passing through the gate. The second building up the hill is Bldg. 72, NCEM. Parking is just past the building.

OTHER TRANSPORTATION

Lawrence Berkeley Laboratory is located in the hills east of the University of California's Berkeley Campus. Berkeley is served by both Oakland and San Francisco Airports. More flights come into San Francisco but Oakland is closer.

Airport Connection (415) 841-0150. Connects from San Francisco Airport to the Durant Hotel in Berkeley (next to UC Campus); the Marriott Hotel on the Berkeley Marina; Holiday Inn in Emeryville (just west of Berkeley); and the Claremont Hotel. $12/person one-way. Reservations made in advance.

Taxi is about $45.00 from San Francisco; $26.00 from Oakland.


BERKELEY
UNIVERSITY AVE.
EASTSHORE FREEWAY
HEARST AVE.
EUCLID AVE.
ENTRANCE · LAWRENCE BERKELEY LABORATORY, Berkeley
University of California
OXFORD
SHATTUCK AVE.
GAYLEY RD.
BANCROFT WAY
PIEDMONT AVE.
TELEGRAPH AVE.
COLLEGE AVE.
ASHBY AVE.
Lawrence Berkeley Laboratory Berkeley
Berkeley
UNIVERSITY AVE.
U.C.
LBL
BERKELEY
San Francisco-Oakland Bay Bridge
Emeryville
Oakland
Pacific Ocean
San Francisco
NIMITZ FREEWAY
OAKLAND AIRPORT
HEGENBERGER RD
San Francisco Bay
BAYSHORE FREEWAY
SAN FRANCISCO AIRPORT
N
0 2 4
MILES

Please attach this page as Cover Page to your NCEM Proposal

ARM ☐ HVEM ☐

NCEM PROPOSAL

NUMBER

Project Title:

Investigator(s)

Name(s)

Address

Phone

Microscopist(s)

Name(s)

Address

Phone

Funding: _____

(Specify Source and Contract Number)

Other resources needed : ☐ Image Simulation ☐ Image Processing

☐ HVEM Environmental Cell (Specify Temp_____ Gases/Pressure_____)

☐ HVEM Hot Stage (Specify Temp_____)

☐ HVEM Straining Stage (Specify Temp_____)

☐ AEM (Please complete the enclosed "User Request" form)

We the investigators named above have read, have understood, and will comply with all of the NCEM operational requirements as set forth in the User's Guide.

Signature date

For NCEM Steering Committee Review ⇨ **Approved** ☐ **Rejected** ☐

Comments:

Committee Member Signature: _____ date: _____

Please return to: Madeline Moore, Building 72, Lawrence Berkeley Laboratory, Berkeley, California 94720

AEM USER REQUEST

Please read the policies and procedures for the use of the AEM, (Section III, 1986 NCEM User's Guide) and complete requirements for one or two specific experiments only. Answer all questions.

NAME: _____ PHONE NO.: _____

AFFILIATION AND ADDRESS: _____

_____

FUNDING:
____NSF ____DOE ____DOD ____Classified ____Other (please specify)

DIVISION: ____Campus ____MMRD ____CAM ____Other

MATERIAL:
What is the material? _____ Approx. Chemical Composition: _____

____Thin Foil ____Bulk ____Crystalline ____Amorphous
____Ceramic ____Powder ____Metallic ____Semiconductor
____Cross-sections
____Polymer ____Biological ____Interfaces ____Other
____Unknown

PREPARATION:
____Ion-mill ____Electrochemical Polishing ____Microtome
____Powder ____Extraction Replicas ____Other
____Dispersion ____Substrate?

NATURE OF THE SPECIMEN: ____Self-supporting ____3mm grid ____Be
____Cu
____Other

____Glued to grid ____Epoxy
____Ag paint
____Other

____Substrate for particle suspension other than carbon
____Carbon coated ____Other coatings
____Beam sensitive ____Radioactive ____Toxic

MORPHOLOGY:
____Precipitates ____Interfaces & Grain Boundaries ____Bulk
____Other

EXPERIMENT TO BE PERFORMED:

____EDXS ____UTW (Z>6) ____HAD (Z>11)

____Chemical Microanalysis:
____Quantitative ____Qualitative
____Bulk (>1wt%)
____Trace element (<1wt%)
____Standardless
____With standard
____Chemical Mapping ____Line Profiling
____Channelling Enhanced Microanalysis
____Other (please specify)

____EELS:
____Chemical Microanalysis
____Quantitative ____Qualitative
____Imaging ____Thickness measurement
____EXELFS ____ELNES ____Other (please specify)

____Diffraction:
____ Diffraction ____CBED ____Rocking Beam ____SAD

____Imaging:
____Digital image acquisition ____Z-contrast imaging ____Other

____Computer:
____EDXS Data Processing ____Image Processing
____EELS Data Processing ____Other

____Development:
____Software ____Hardware ____Other (please specify)

Background:
(Please rate your level of competence on the following scale:
1-fully conversant
5-beginner

____200CX Operation ____STEM Operation ____Diffraction Technique
____EDXS Operation ____EELS Operation ____KEVEX 8000 routine operation
____EDXS Data Processing ____EELS Data Processing ____Computing (RT-II Operating System)
____KEVEX Advanced Imaging Software

Please see other side

BACKGROUND INFORMATION ON PROJECT (50-100 words including a micrograph of the regions of interest and any other related preliminary results)

DEFINE NEED TO USE AEM (50-100 words)

This report was done with support from the Department of Energy. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the Department of Energy.

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TECHNICAL INFORMATION DEPARTMENT
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720