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Publication Date

1988-03-01



Lawrence Berkeley Laboratory

UNIVERSITY OF CALIFORNIA

Materials & Chemical Sciences Division

National Center for Electron Microscopy

Presented at the Annual Meeting of the Electron Microscopy Society of America, Milwaukee, WI, August 7-12, 1988, and to be published in the Proceedings

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March 1988

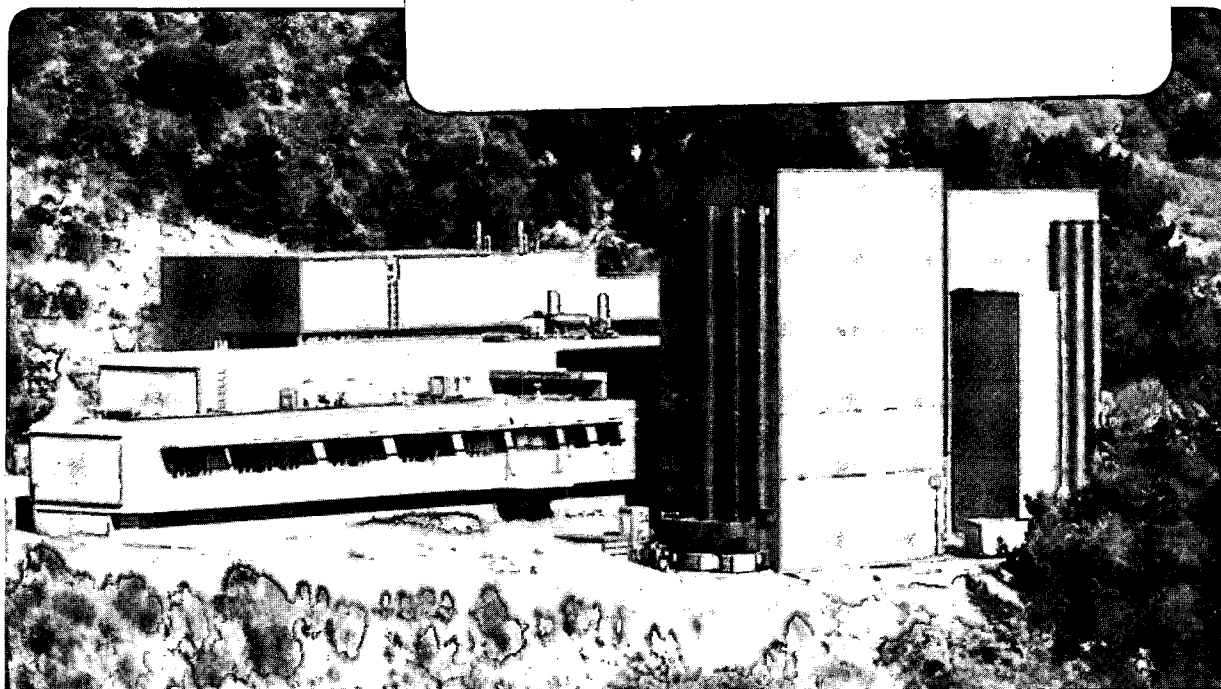
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AN OVERVIEW OF NORTH AMERICAN USER FACILITIES FOR ELECTRON MICROSCOPY IN THE PHYSICAL SCIENCES

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Physical scientists working in North America have access to five major User Facilities for advanced applications of electron microscopy. These Facilities are distributed geographically as shown in Figure 1, and provide a wide range of sophisticated instrumentation not normally found in the conventional electron microscope laboratory. Born of the need to maintain state-of-the-art equipment for research in the physical sciences and created because of the increasing cost and sophistication of such instrumentation, they operate on a "shareable" basis, having been funded by the government agencies to serve as regional and national resources, not for exclusive parochial access.

The five facilities described here[†] are: [1] the National Center for Electron Microscopy at the Lawrence Berkeley Laboratory, funded by the Department of Energy; [2] the Facility for High Resolution Electron Microscopy at Arizona State University, funded by the National Science Foundation; [3] the Center for Microanalysis of Materials at the University of Illinois, Urbana-Champaign, funded by both the Department of Energy and the National Science Foundation; [4] the High Voltage Electron Microscope Tandem Ion Accelerator National User Facility at Argonne National Laboratory, funded by the Department of Energy; and [5] the Shared Research Equipment Program (SHaRE) at Oak Ridge National Laboratory, funded by the Department of Energy. Together they represent an annual operating budget in the \$4.5 million range.

An impressive arsenal of equipment is housed within these facilities as well. At last count, there were 5 high voltage (over 500 kV) electron microscopes, 3 intermediate voltage electron microscopes for high resolution imaging, 3 intermediate voltage electron microscopes for analytical applications, 9 transmission electron microscopes in the 100 kV to 200 kV range, 4 scanning transmission electron microscopes, also in the 100 kV to 200 kV range, 2 dedicated scanning transmission electron microscopes, 2 scanning electron microscopes, and 16 "other" types of instrumentation, including FIM, XPS, SIMS, SNMS, AES, RBS, and user-friendly software for image simulation, processing, and analysis.

Access to the facilities is universally based upon the submission of a proposal, usually short, describing the project and justifying the need for the instrumentation requested. Proposals are normally read by a committee (often chaired by an "outsider"), whose members are also sensitive to the need for some instruction on the specialized microscopes and peripherals at the facilities. In fact the education of users and potential users is also a primary goal of the facilities, and many of these institutions run schools or workshops on a periodic basis in addition to more frequent "in-house" training sessions. Although it may be necessary to make a few visits to a specific facility before a project is complete, the sessions scheduled for outside users are often the most productive because of advanced planning and staff attention.

Costs are most often limited to travel alone, and in some instances, partial travel assistance is also available. The only stipulation for such unencumbered access is that the research performed at the facilities be non-proprietary. As long as the results will eventually be published in the open literature (the goal of most users of the facilities anyway), access to the facilities is essentially free of charge. There may be a nominal contribution requested for reimbursement of expendable supplies, computer time, etc. but the most costly portion of instrument time (power, staff salary, etc.) is invisible to these users.

It should be noted that proprietary work is also permitted at these facilities, but in general those users who wish to keep their results from the scientific community at large must pay "full cost

[†] Detailed descriptions of each facility appear in separate abstracts in this issue.

recovery" and not work at the government's expense. However, even at cost recovery, the five facilities highlighted here are a bargain.

Although hundreds of scientists use these facilities on a yearly basis, they are by no means "overbooked". After submission of a proposal, microscopists can expect a rapid turn-around of a verdict, and in most instances will be able to schedule specific times (around other travel plans, for example) for their visits. Unlike the "beam lines" at the major photon sources, electrons are much more dependable, and the microscope facilities share none of the "beam crash" problems of those other user facilities. Furthermore the "crash" of one instrument can normally be repaired before a scheduled session ends, during which time the user might choose to conduct some complementary analysis (image simulation vs high resolution imaging, or microanalysis vs high voltage *in-situ* work, etc.) on one of the other work stations nearby.

The message here is that we should all take a careful look at the manner in which we have been conducting our electron microscopy studies in the past. Rather than fretting over having to garner big money for a new microscope, it might be wise to invest a few travel dollars in visits to one or more of these facilities. Above all, the most valuable resource they have to offer is their resident staff, who are available to assist, consult, and collaborate. With such an approach, efficiency is assured.

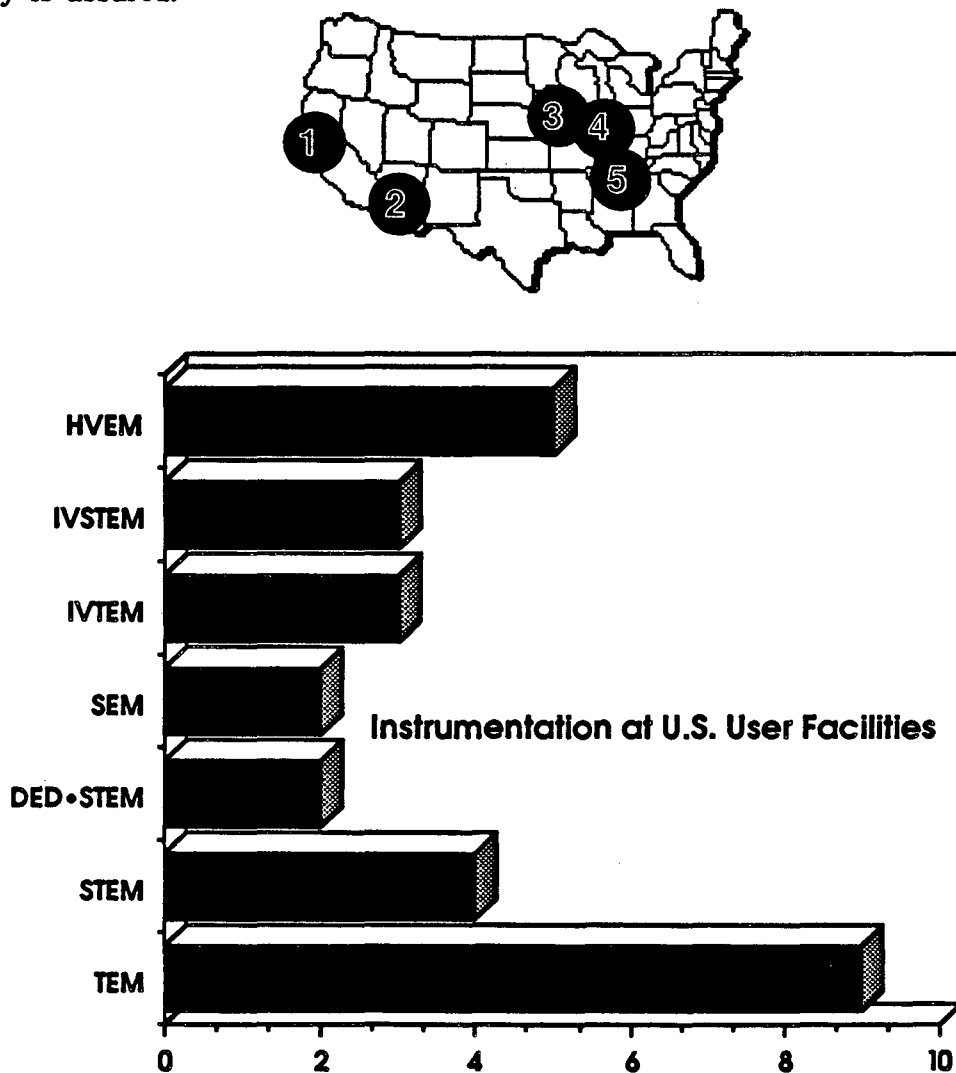


FIG. 1--Geographical distribution of North American User Facilities for electron microscopy in the physical sciences. Numbered locations are identified in the text.

FIG. 2--Plot of number of research instruments at the U.S. User Facilities. Not tabulated are a large number of "other" instruments (FIM, AES, SIMS, XPS, RBS, etc.) also available.

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