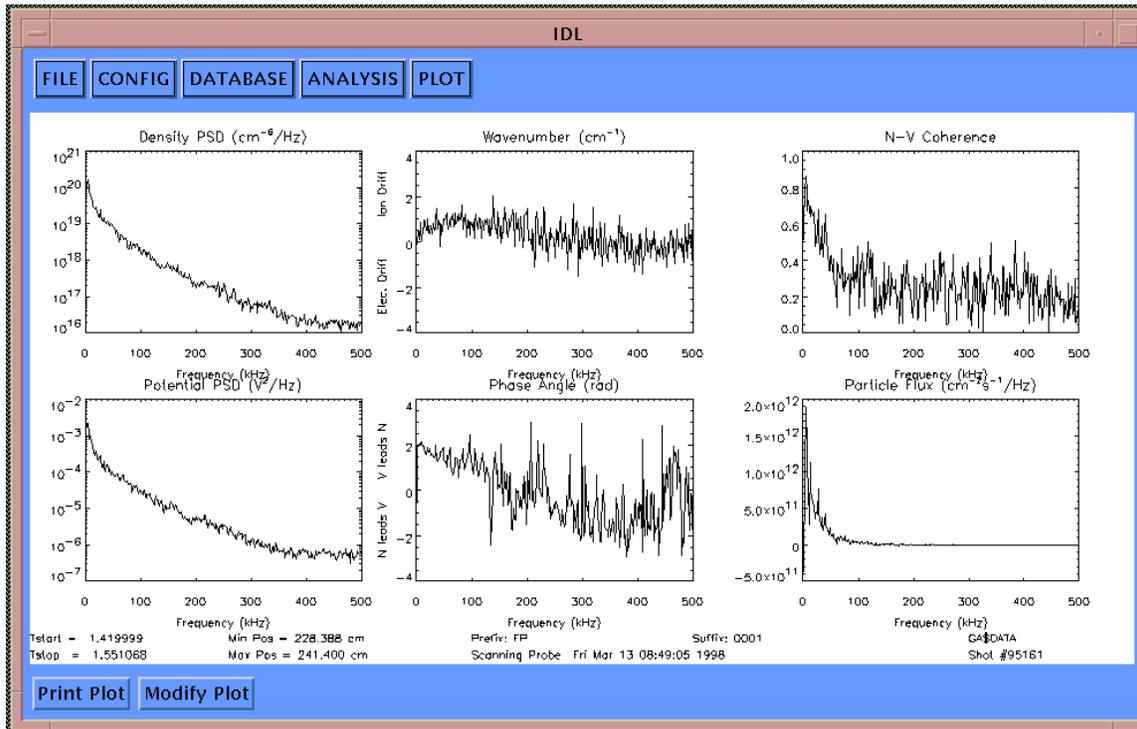


# Synopsis of Programming Projects

## Ronald Lehmer

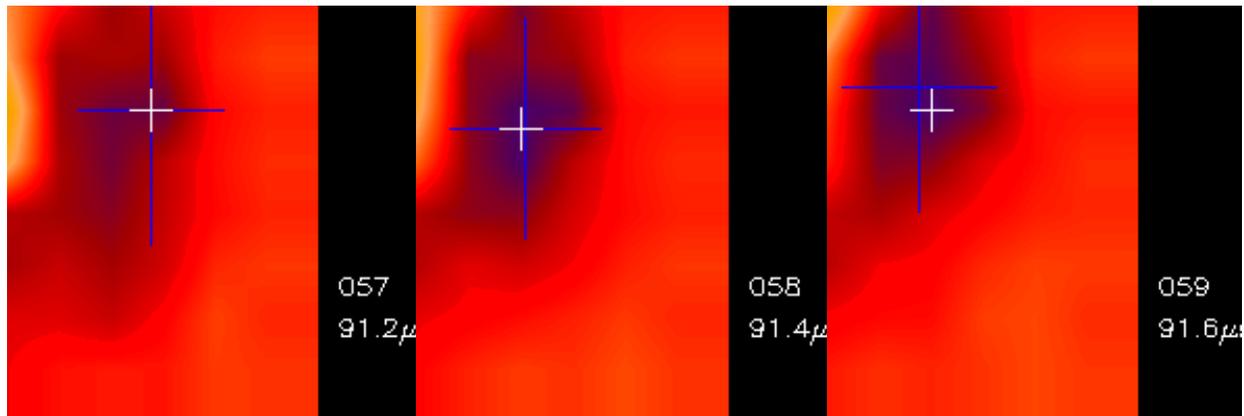
### Analysis Applications Programming

#### FLCTRNS - A Plasma Turbulence Analysis Package

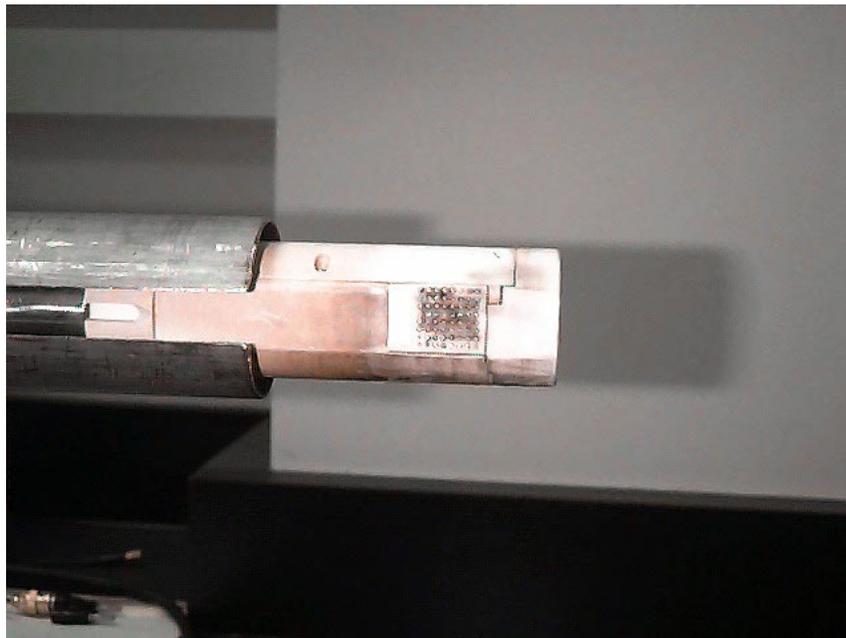


Originally written in FORTRAN with no graphical user interface, the FLCTRNS code has been rewritten in IDL (a 4GL programming language) to provide an intuitive X windows graphical interface. FLCTRNS takes digitized data from an array of Langmuir probes and computes auto and cross power spectra, wavenumber and coherency spectra, dispersion relations  $S(k,f)$ , and an estimation of the transport of plasma particles due to the turbulent fluctuations. Additional modules have been added for analyzing non-time stationary behavior in the turbulence using the Wavelet transform. The modular nature of FLCTRNS has allowed for the simultaneous support of the program at five different facilities running three different underlying database packages.

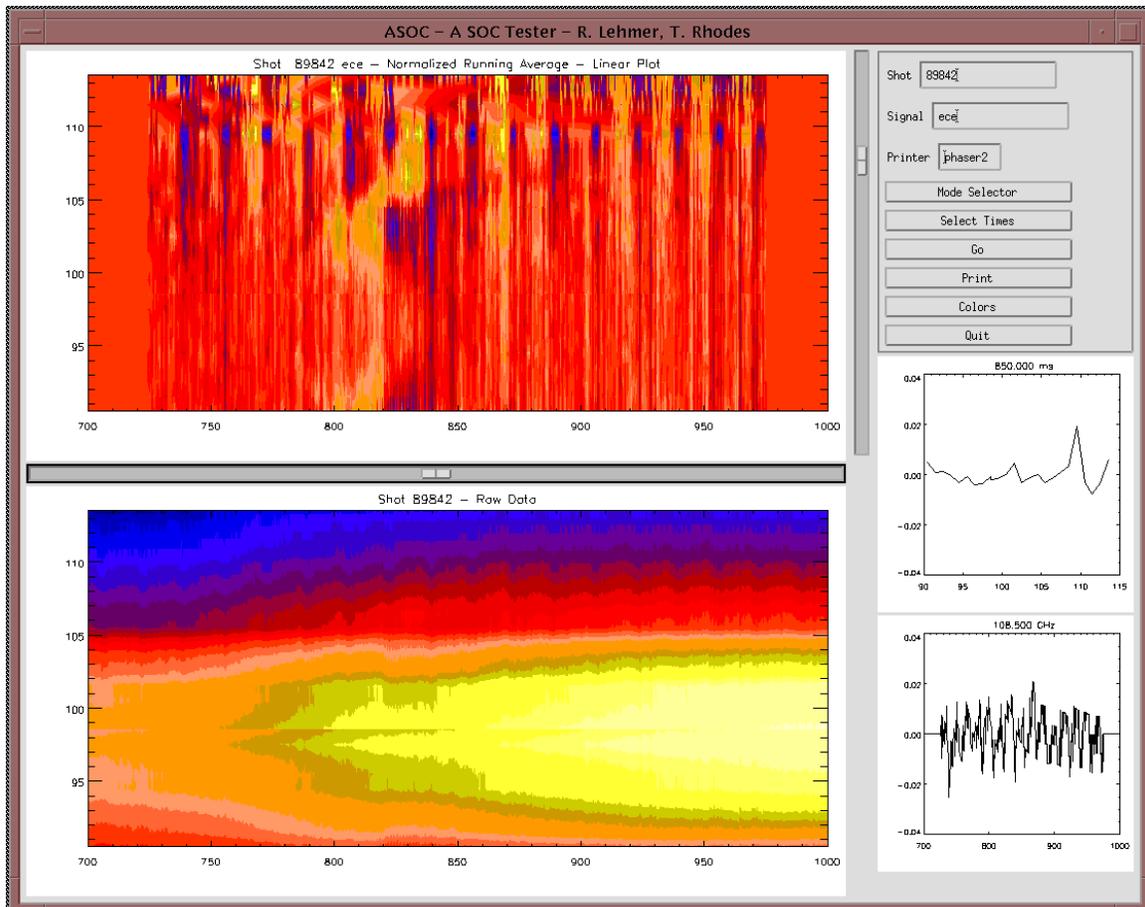
## Time Domain Visualization of Density Structures



One of the major diagnostics in the turbulence measurements at PISCES Lab is an array of Langmuir probes arranged in an 8 by 8 array. Thus, turbulence at 64 spatial locations is recorded simultaneously. One method for analyzing the intermittent turbulent behavior in the plasma is to assemble movies of the density fluctuations, using IDL to extract data from the database and generate shaded color contour plots of the fluctuation levels. The color contour plots are then converted to PICT files and transferred to a Macintosh to generate Quicktime movies of the time dependent motion of the intermittent density blobs in the plasma.

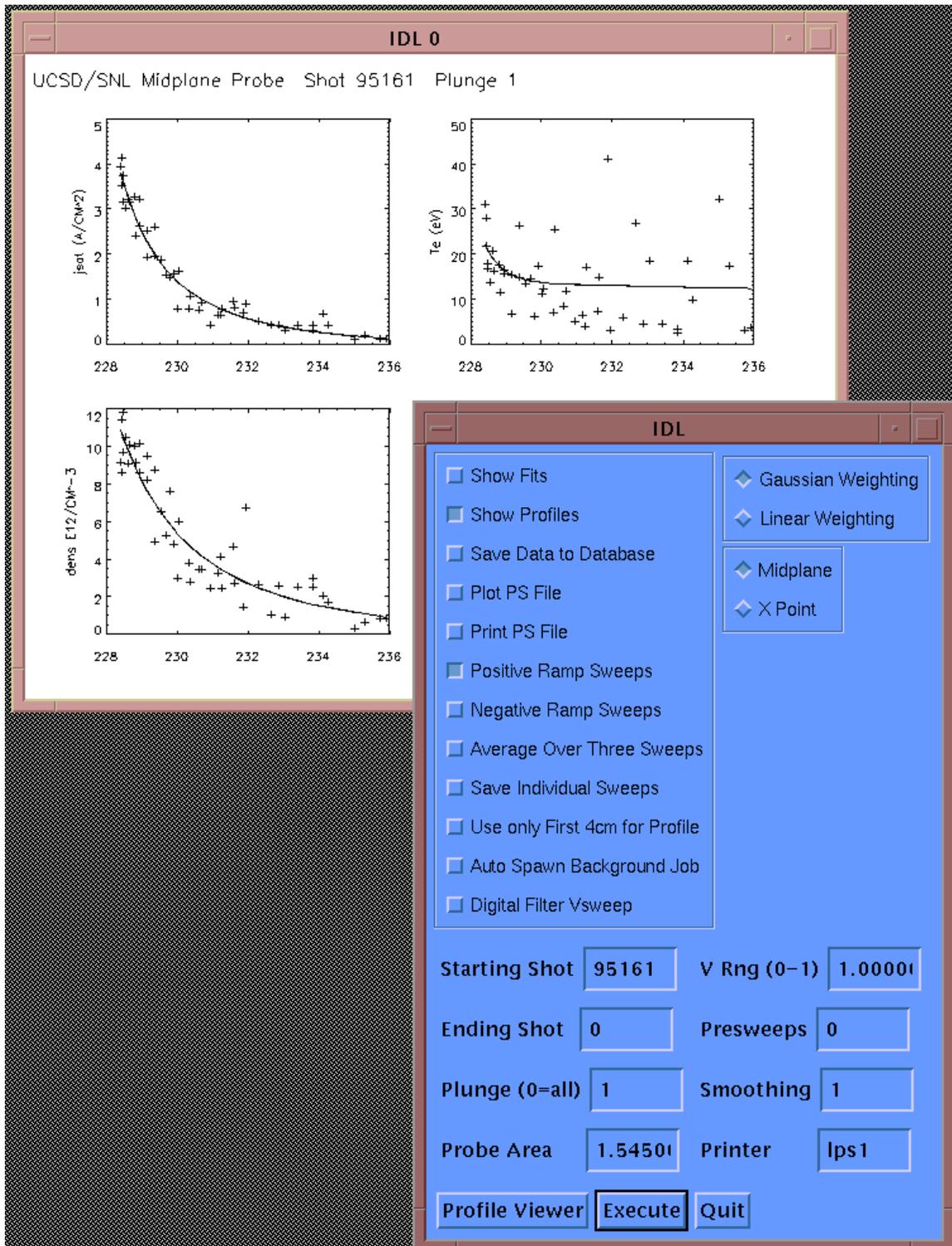


## Self-Organized Criticality Analyzer (Beta Stage)



In conjunction with researchers at UCLA and General Atomics, we have been developing tools to for large scale correlated events in the DIII-D National Fusion Facility plasma. The software provides color contour viewing of two dimensional data and has various filter algorithms for highlighting perturbations in plasma profiles. At this point, the code provides an interface scientific staff to pinpoint selected shots to develop additional analysis tools on.

## Langmuir Probe Analysis Codes



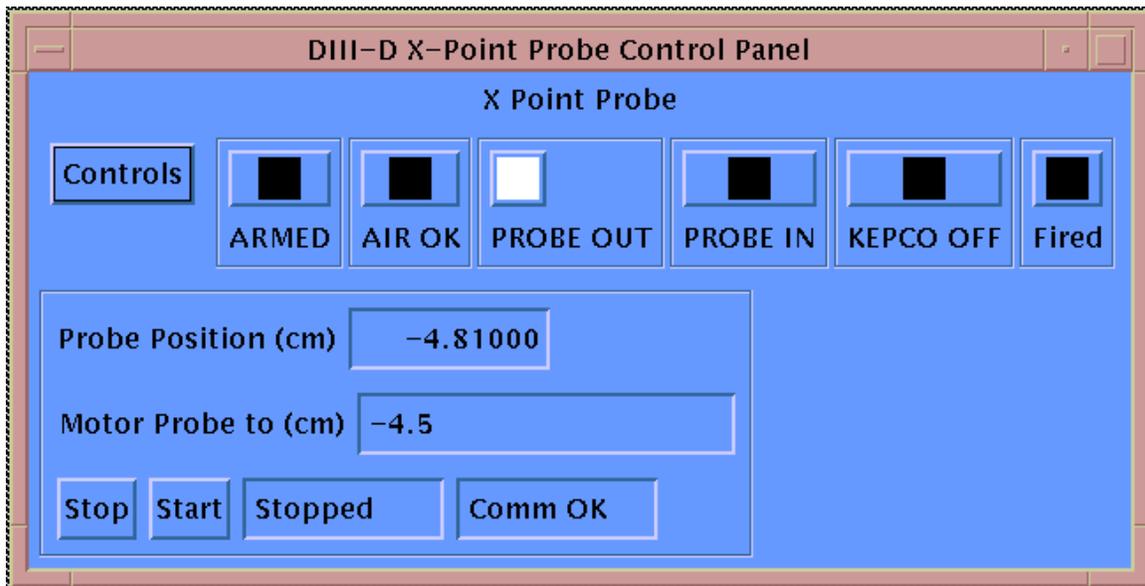
Maintained and enhanced other analysis codes, including Langmuir probe analysis codes for single, double, and triple probes. Developed tools to infer electric field magnitude and shear from emissive probe measurements of the plasma space potential. Maintained automated codes that compute the operating point of power supplies, gas feed systems, and other user specified settings.

# VMS Systems Projects

## SRAM Memory Test System

During the fabrication of the GL\_AD1020 custom waveform recorders, it was determined that a number of small daughter PC boards used for the memory subsystem were defective. In order to isolate which memory boards were defective, a test jig with parallel data and address lines and a clock and strobe system was built. The jig was driven by a DRQ3B high performance parallel interface card installed in a MicroVAX II. All of the driver code for the test was developed in house using QIO calls to the card, as well as the sorting procedure to determine the severity of the memory failures.

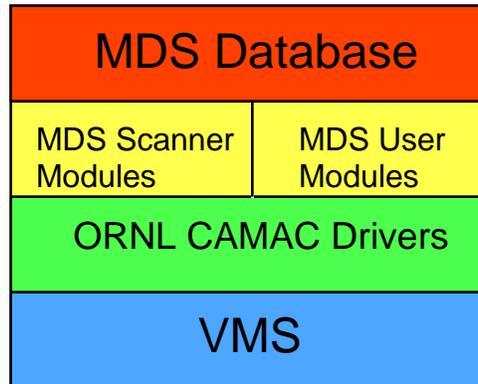
## PLC Communications Interface



Realtime interlocking of key systems of the Midplane and X-point Reciprocating Langmuir Probes on the DIII-D National Fusion Facility is done with GE Fanuc PLC's. In order to have a dedicated and secure remote interface for the physics operator to configure and monitor the probe systems, a serial communications interface has been developed to control a serial port on a VMS workstation. The data stream to and from the PLC is an 8-bit binary stream that precludes the use of terminating characters, however, since the PLC is always operated in a slave mode, the length of responses to queries is known ahead of time. The communications routines are linked as shareable images and can be called as external routines from the user interface, again written in IDL.

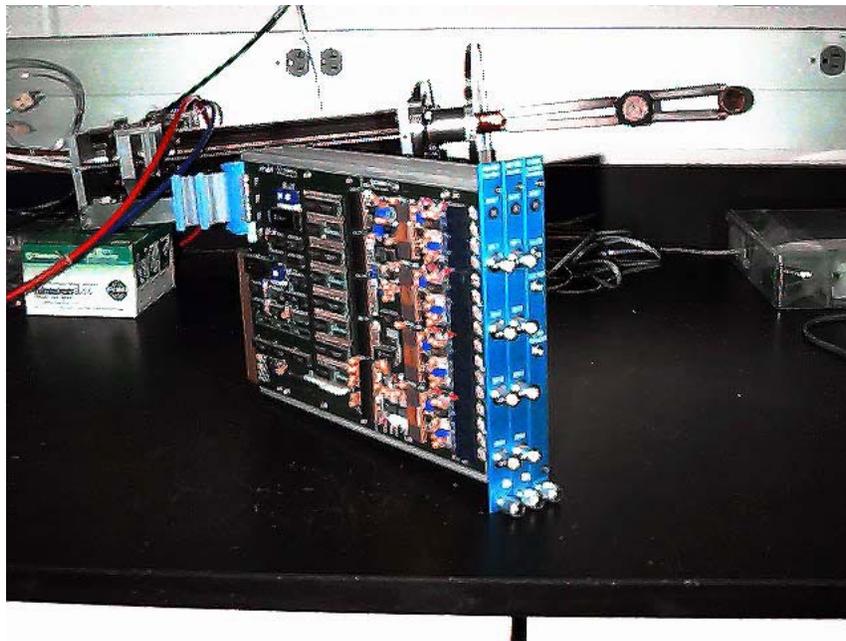
# CAMAC Systems Projects

## Development of Non-standard CAMAC module drivers into MDS



The MDS data acquisition provided the hooks to allow user written CAMAC module drivers to be included in the standard high level MDS interface. For the diagnostic work at DIII-D, drivers for scalers and clock modules not supported in MDS was required. Using templates from MDS written in FORTRAN, the modules' actions can be scripted. In addition, CASE tools such as CMS and CDD are required to correctly build the drivers and the user interface is configured using the TDMS forms package.

## Development of Custom 20MHz Waveform Recorders for the PISCES



In addition to leading the design and fabrication program to assemble the 64 channel A/D system, the development of the MDS user interface was critical in verifying the functionality of the digitizing system. Critical testing included the testing of clock and gain settings, operation of the stop trigger system and post trigger counters, and data integrity. FORTRAN codes and some MDS scripts were used to provide a rudimentary test interface for the engineering team to test each function of the digitizing system.

### **Installation of Hytec Ethernet Crate Controllers at PISCES Lab**

Development of new CAMAC management software (ECCTS) compatible with Hytec ECC software. Based user interface on original CTS (CAMAC Topology Server) developed by ORNL, however, converted logical name management to be compatible with new software environment. In addition, a problem with the Ethernet hardware of the Hytec Controllers precluded their use in a fiber optic Ethernet network that included a repeater. Was able to evaluate network problem and determine that upgraded controllers were necessary.

### **Installation of Hytec Ethernet Crate Controllers at DIII-D Tokamak**

Similar software/hardware integration environment, however, some CAMAC modules used on Langmuir probe diagnostics were affected by presence of an enabled Inhibit line on the CAMAC dataway. Determined by testing that modules were operating normally and that Hytec default configuration is to enable the I-line, rather than ORNL software, that disables it. Wrote software that disables I-line on ECC whenever controllers are reset by user action.

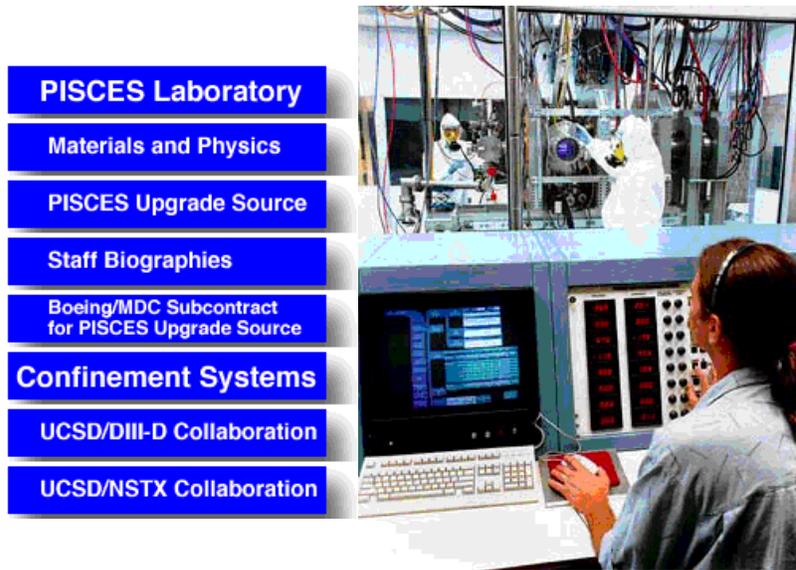
# World Wide Web Experience

WWW Content Development and Solicitation



## Welcome to the Fusion Energy Research Laboratory

Jacobs School of Engineering, UC San Diego



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Two major projects: PISCES Lab Outreach Project and Southern California Railroad Resources. The PISCES Lab Outreach Project involved the conversion of existing progress report material to HTML. In addition, the Beryllium Safety System in the PISCES Lab requires a variety of material updated on a regular basis as well as a real-time digital camera of the facility.

### **WWW Server Configuration and Management**

Experience with OSU HTTP, NCSA httpd, and MacHTTP Servers, including rules and mapping configuration and security considerations. As Webmaster, generated a majority of server content from existing promotional material and scientific reports. Provided support to other users in group in their production of WWW material. Monitored server accesses and generated reports.

### **CGI Programming**

Experience using CGI scripts to generate Metrolink commuter train schedules on the fly. Other CGI scripts give user-customized information about station locator maps and connecting transit information.

### **CGI Programming with RdB Interface**

Developed CGI Web interface to serve the contents of an Oracle/RdB relational database based on keys provided as user input from the browser. In one example, the RdB contained mass transit information for various train station locations, including details of links to maps and schedules provided by other transit agencies. In another example, the RdB was used to produce a searchable index of web pages having to do with fusion plasma physics. However, as the searchable index grew, performance on the web server diminished because of its lack of processing power.

# VMS Software Experience

VMS Operating System

VAXCluster Software (MSCP disks, queue management, redundant design)

DECnet, LAT, LAST

Digital TCP/IP Services for OpenVMS (UCX)

FORTRAN

C (both VAXC and DECC)

VAX Debugger

Common Data Dictionary (CDD)

Code Management System (CMS)

Pathworks for Macintosh