



Distributed Beamline Control System at SSRL

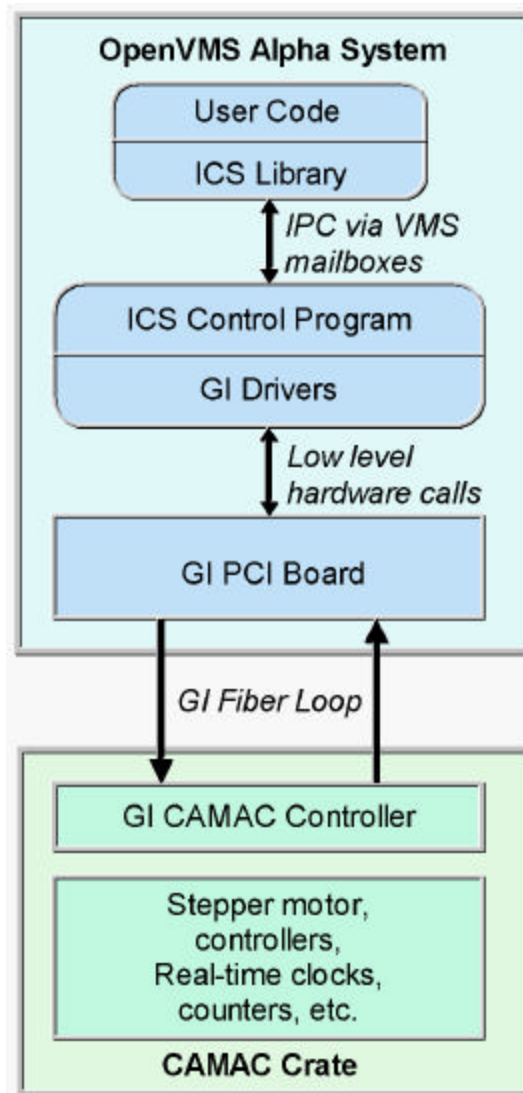
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Overview



- **Introduction**
 - ▢ SSRL Beamline Control Systems
 - ▢ Specific Needs of Crystallography Beamlines
- **Distributed Control System**
 - ▢ Single Beamline Server Process
 - ▢ Multiple Hardware Hosts
 - ▢ Simultaneous User Interface Clients
- **General Purpose Control GUI**
- **Future Plans**

Current Control System at SSRL



- **CAMAC Modules**
 - ❏ Stepper motor controllers.
 - ❏ Real-time clocks, counters, etc.
 - **Grand Interconnect (GI)**
 - ❏ Hosted by DEC Alpha systems running VMS.
 - ❏ Fiber optic connection to CAMAC crate(s).
 - **Instrument Control System (ICS)**
 - ❏ GI driver calls wrapped in general purpose routines.
 - ❏ Asynchronous control using VMS ASTs.
- ➔ **VMS Workstation Needed to Control Beamline**

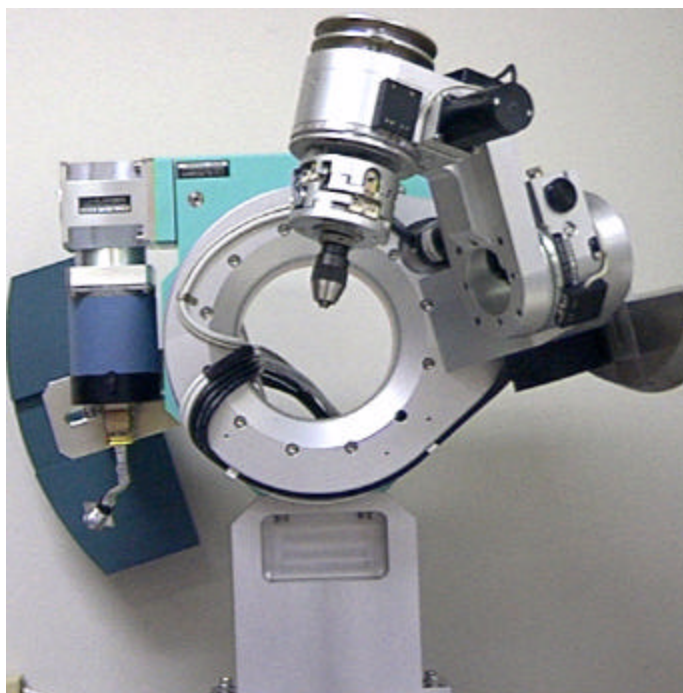
UNIX Workstations Needed to Run User Interfaces



- **Data Collection Software Runs on Digital UNIX**
 - ❏ MAR 300, MAR 345 imaging plate systems.
 - ❏ ADSC Quantum4 2x2 CCD detector.
 - ❏ High capacity RAID storage system for diffraction data.
 - **UNIX Workstations Used at Beamlines for Computation**
 - ❏ 500 MHz DEC Alphas running Digital Unix
 - ❏ SGI Octanes with dual R10000 CPUs running IRIX
- ➔ **UNIX Software Must Communicate with ICS System on VMS Machine**



Additional Needs Of Crystallography Beamlines

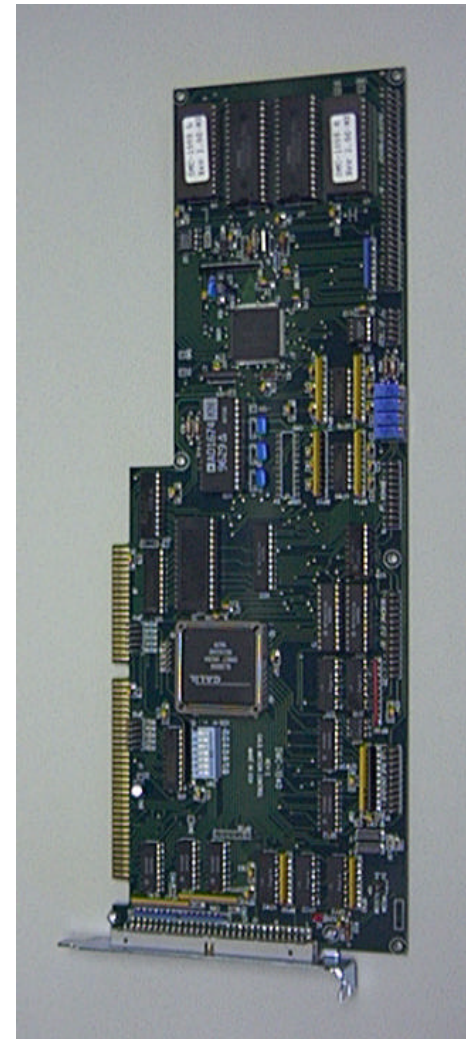


- **Huber Kappa Goniometer**
 - ❏ Translation stage driven by DC motors.
 - ❏ Omega axis may be driven by DC or stepper motors.
 - **ICS/GI/CAMAC does not support DC motors.**
- **Fast Shutters**
 - ❏ Short exposure times on BL9-1 and BL9-2 (~1 sec).
 - ❏ Need synchronization with data collection motor (< 1 msec).
 - **CAMAC timing too slow (latency > 10 ms).**

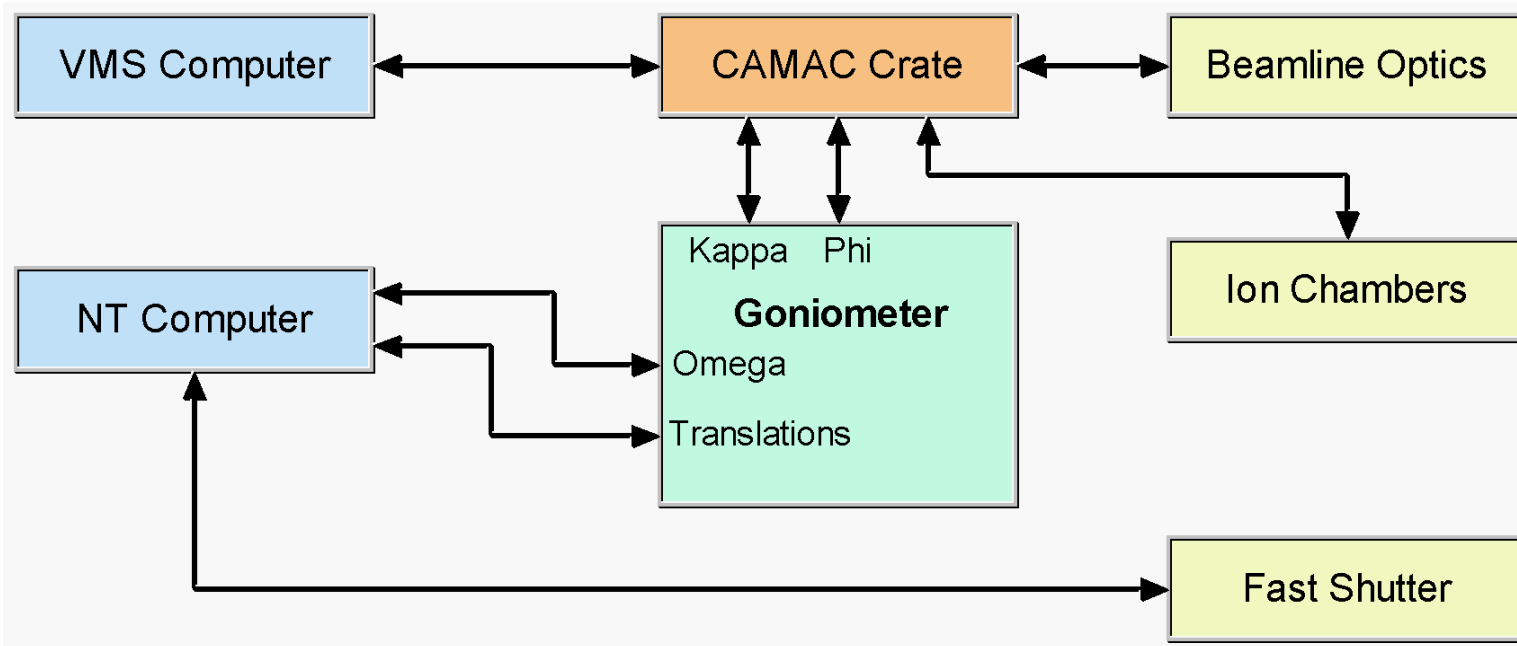
DMC-1040 Controller from Galil Motion Control



- **4 Axes DC or Stepper**
 - ☐ (1) Omega axis
 - ☐ (3) Translations
- **Digital I/O**
 - ☐ Fast shutter control
 - ☐ Additional limit switches
- **Highly Programmable**
 - ☐ S-curve profiling for smooth acceleration
 - ☐ Synchronization of shutter and omega axis on-board
- **No Device Driver to Write**
 - ☐ ISA card for PC
 - ☐ Device drivers available for Windows NT



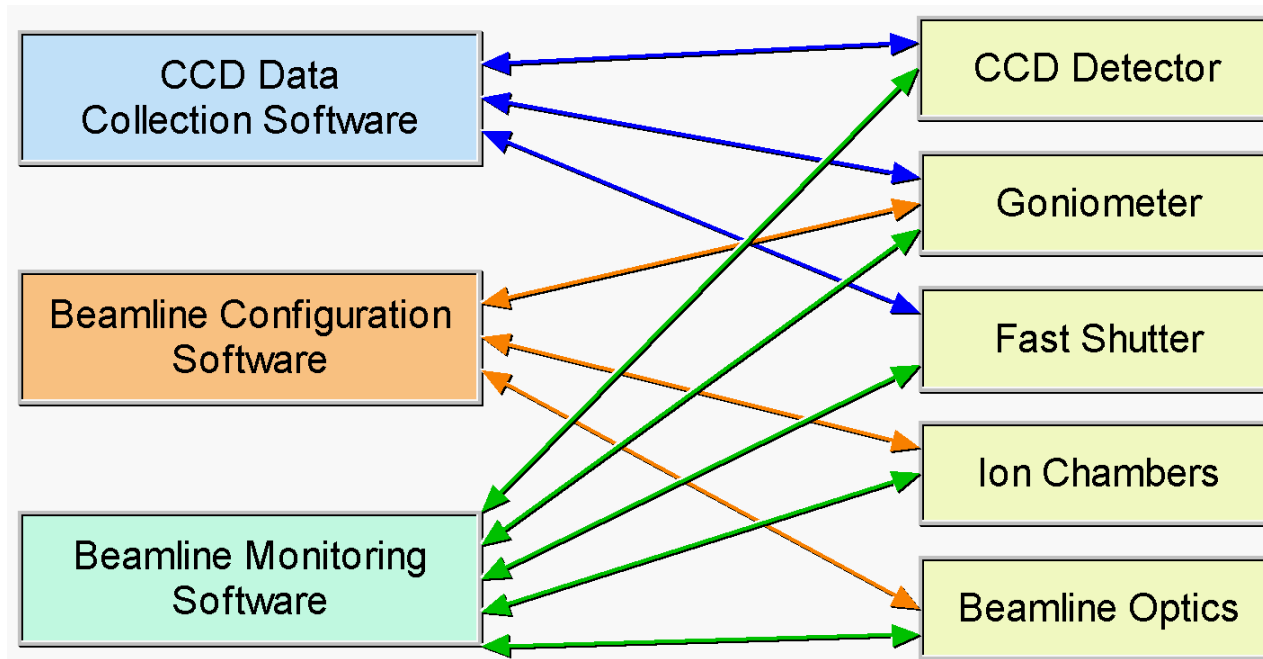
Problem 1: Multiple Hardware Hosts



→ Need Centralized Control of Beamline Components

- ❏ Oversee operation of an arbitrary number of hardware hosts on multiple computing platforms.
- ❏ Maintain a single database of component positions.
- ❏ Coordinate motions and prevent collisions.

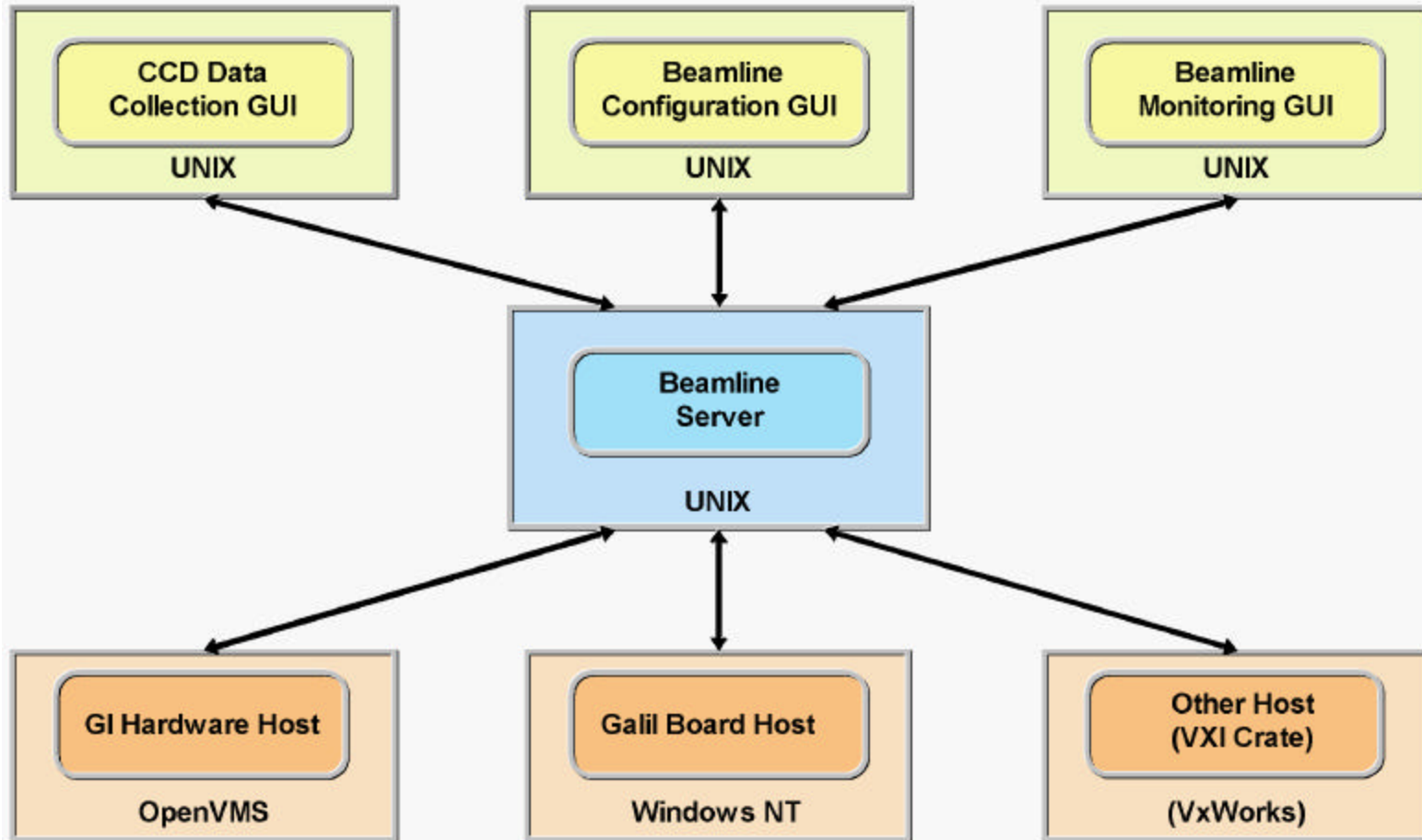
Problem 2: Multiple, Simultaneous User Interfaces



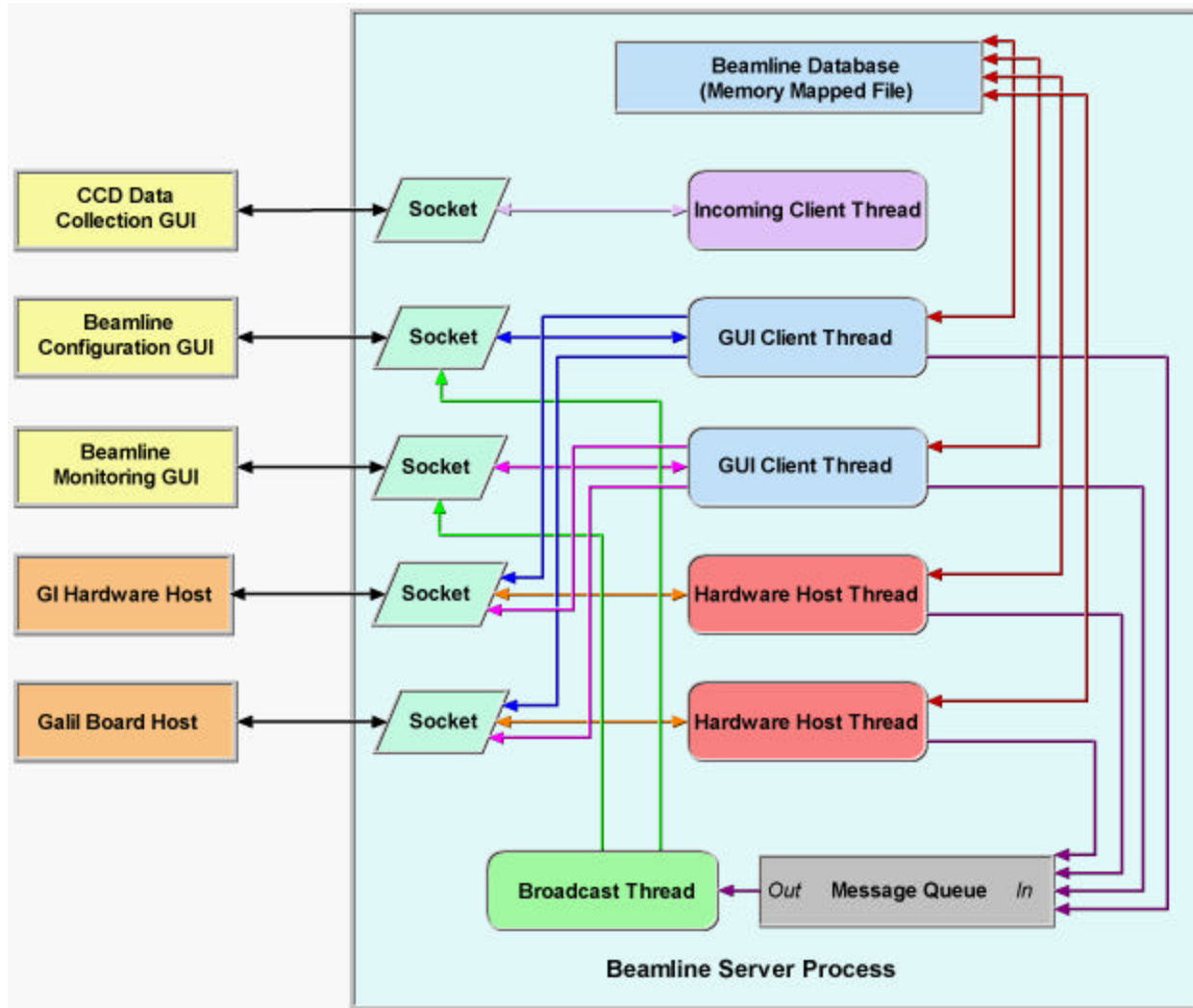
→ Need Centralized Authorization of User Interfaces

- 🖥️ Prevent conflicts between user interfaces.
- 🖥️ Oversee transfer of control between processes.
- 🖥️ Allow interfaces to run anywhere on the network.
- 🖥️ Protect beamline from unauthorized access.

Solution: Distributed Control System (DCS)



DCS Beamline Server Process



Example: General Beamline Control GUI



The screenshot displays the 'Beamline 9-1 Configuration' software interface. At the top, a menu bar includes 'File', 'Component', 'Action', 'Options', 'Window', and 'Help'. Below the menu, a 'Selected Motor' dropdown is set to 'table_vert_2'. A row of control buttons includes 'Move by', 'Move to', 'Set to', 'Abort Move', 'Do Again', 'Scan', 'Abort All', 'Undo Move', and 'Configure'. The 'Move by' field is currently set to '4 mm'. The main workspace is divided into several panels: 'table_vert_1 configuration' on the left, 'Foils' in the center, and 'Mirror Control' on the right. The 'table_vert_1 configuration' panel shows 'Position and Limits' (Upper limit: 360.00 mm, 7200 steps; Set Position: 43.00 mm, 860 steps; Lower limit: -10.00 mm, -200 steps) and 'Stepper Motor' (Scale factor: 20.000000 steps/mm) settings. The 'Foils' panel shows 'Foil States' for Pb 13.041 KeV and Au 11.921 KeV. The 'Mirror Control' panel shows 'mirror_slit_high' at 47.80 mm (4780 steps). A central 'Table Control' panel features a 3D diagram of a table with six axes: table_vert_1 (43.00 mm, 860 steps), table_vert (0.00 mm), table_vert_2 (4.00 mm, 800 steps), table_yaw (0.00 deg), table_pitch (0.00 deg), table_horz_1 (123.42 mm, 49369 steps), table_horz (0.00 mm), and table_horz_2 (3.26 mm, 652 steps). A log window at the bottom shows the following entries: '05 Dec 1997 18:13:15 NOTE: Move of motor table_vert_2 to 49.7491 mm started.', '05 Dec 1997 18:13:19 NOTE: Move of motor table_vert_2 completed.', '05 Dec 1997 18:13:26 configure table_vert_2 position 4 mm', '05 Dec 1997 18:13:26 Position of motor table_vert_2 set to 4 mm.', '05 Dec 1997 18:18:00 NOTE: Selected motor mirror_slit_high.', '05 Dec 1997 18:19:01 NOTE: Selected motor table_vert_1.', and '05 Dec 1997 18:19:12 NOTE: Selected motor table_vert_2.'. The status bar at the bottom left reads 'remove_filter Au'.

Status and Future Plans



- **Rollout of Distributed Control System**
 - 🖥️ Initial test on BL7-1 and BL9-1, Fall 1997.
 - 🖥️ Full installation on BL9-1, January 1998.
 - 🖥️ Use in testing BL9-2, Spring 1998.
 - 🖥️ Installation on BL7-1, Summer 1998 shutdown.
- **Further Development**
 - 🖥️ Adaptation of CCD data collection software.
 - 🖥️ Adaptation of MAR imaging plate software.
 - 🖥️ Goniometer control and crash-avoidance routines.
 - 🖥️ Ports of server to OpenVMS and Windows NT.
 - 🖥️ Interface to Sean Brennan's SUPERvisor.
- **Other Applications of the DCS Paradigm**
 - 🖥️ Multisession data collection software.
 - 🖥️ Multisession data processing software.

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