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ENGINEERING DIVISION

NEWSNOTES

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FOREWORD

Engineering Division Newsnotes are short descriptions of significant contributions or items of general interest to the staff. They are prepared periodically by the principal contributors and submitted to the Director of Engineering through their Department Offices. This compilation of newsnotes is prepared quarterly and distributed as a communication tool for Engineering Division Personnel and Laboratory Management. Comments on the effectiveness of this document are solicited.

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Engineering Division

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W. M. KECK TELESCOPE ACTIVE CONTROL SYSTEM SEPTEMBER 1990

The Active Control System (ACS) of the Keck Observatory Telescope Mirror has always been recognized as one of the high risk parts of the telescope project. The risk assessment is based on two concerns. First, it is not practical to correct for excitation of the predicted mechanical resonances in the mirror support structure. Resonances were predicted from 10-60 Hz at about 1 Hz intervals; the maximum predicted control loop bandwidth with stability is about 2 Hz. Second, this type of control system with nanometer accuracy has never been attempted before with a large segmented mirror. The complete multi-element servo mechanism is composed of 168 position sensors and 108 positioning actuators.

To help resolve the two concerns the mirrors were mounted on the telescope for the first time in August. The ACS was successfully tested with three mirrors. The mirror control system was run for 72 hours with a closed loop bandwidth of 0.2 Hz. Position sensor errors were 6 nm rms during the experiment. This corresponds to an image width of 0.015 arc seconds (atmosphere on a good night generally limits the seeing to 0.5 arc seconds), well within the error budget. The second concern was addressed by turning off the control loop and observing the motions recorded by the position sensors. Image widths (derived from the position sensor readings) were about 0.1 arc seconds with either the elevation or azimuth drives running and one half that amount with the dome rotating. These numbers are slightly larger than the error budget specifies; however, they are not considered significant problems and steps will be taken to reduce the excitation of the mechanical structure.

Mirrors have since been removed from the telescope to allow for continuing mechanical work. It is expected that 5 to 9 mirrors will be mounted in November, 1990. At that time, star light will be used to evaluate and verify other parts of the ACS and telescope system.

Submitted by:
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Engineering Division

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AN AUTOMATED COLONY PICKING SYSTEM FOR THE HUMAN GENOME PROJECT **SEPTEMBER 1990**

As part of the overall goal of automating routine, repetitious laboratory tasks for the Human Genome Project, a system has been developed which combines image processing and robotics to automatically pick individual colonies of yeast or bacteria clones from Petri dishes and array them in 96-well microtiter plates. Digital images of the colony distribution in the dishes are acquired using a video camera and imaging hardware. Image processing software is used to identify the individual colonies and determine their coordinates. A Hewlett-Packard Microassay System robot reads the resulting coordinate files for each dish, picks the cells from each identified colony and transfers the cells to a microtiter plate well. A disposable pipet tip is currently used as the sterile implement for picking. The system is calibrated to correct for the depth of agar in the dishes. We have built custom hardware to hold the Petri dishes during imaging and picking in order to establish an invariant coordinate system across both steps of the process.

The robot can process up to 10 dishes and 20 plates in a single run. It has run unattended overnight and, in its first major task, successfully arrayed a library of a yeast genome consisting of approximately 6000 clones in 30 Petri dishes in about 40 hours of robot time.

Submitted by:
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SOLENOIDAL DETECTOR COLLABORATION EFFORTS AT LBL

SEPTEMBER 1990

The Solenoidal Detector Collaboration (SDC) is an international collaboration of high energy physicists interested in building a large detector for the SSC. Roughly 600 physicists from the US, Japan, USSR, Europe, China and Canada are involved. Engineering for the SDC is being provided by national labs in the US and around the world, plus industrial partners such as Westinghouse, Hughes, Kawasaki Heavy Industries and others.

George Trilling and Gil Gilchriese, of LBL's Physics Division, are Spokesman and Technical Manager, respectively, for the collaboration. Engineering Division personnel are assisting in the overall integration and project management tasks, including preparation of the Work Breakdown Structure, schedules, and budgets. Presently, the collaboration is in the midst of writing and submitting several pre-proposal documents. The expression of interest (EOI) was delivered to the SSCL at the end of May and the letter of intent (LOI) is due at the end of November.

LBL has responsibility for several subsystem technology options as well. Of the four major subsystems in the detector (tracking, solenoid magnet, calorimeter, and muon detection), LBL is involved in two, tracking and calorimetry. As part of the tracking subsystem, we are developing a conceptual design and cost estimate for a silicon vertex tracker (of order $40M) in conjunction with physicists and engineers from LANL and Hughes. In calorimetry, LBL is involved in two technologies, both of the "liquid ionization" type. Along with scientists and engineers from Japan we are developing a conceptual design and cost estimate for a full-sized liquid argon calorimeter (LAC). We are also designing a "warm" liquid prototype module at LBL that can be tested next year at CERN and developing a conceptual design and cost estimate for a full-sized SDC warm liquid calorimeter.

Decision points for selecting competing subsystem technologies are approaching fast. At a September meeting in Dallas, the collaboration decided the style of the superconducting solenoid magnet. In early November, at a collaboration meeting to be held at LBL, the number of calorimetry technologies to be funded for further detector-scale engineering design will be reduced from four to two.

While engineering efforts are going on here and around the globe on detector subsystems, at LBL we are also working on the interfaces between subsystems and with the accelerator and interaction hall, and on overall integration of the different subsystems into a detector to do first class physics at the SSC.

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SSC 5-METER MAGNET WINDER

SEPTEMBER 1990

The Engineering Division is supporting the Super Con group in AFRD in the development of superconducting magnets for the SSC. One task in this development program is the fabrication of demonstration dipole and quadrapole superconducting magnets. The winding machine used for making these prototype magnets exhibited stability problems on early attempts to wind the magnets. These problems were corrected by stabilizing the servo loops both electrically and mechanically. The wire supply is carried on a cart which travels on a steel track around a stationary arbor. The cart drive uses a DC motor and controller which may be set to a cart speed between zero and 2 ft/sec. A long time constant RC ramp was added to control acceleration.

The wire tension control, also a DC motor and controller, presented greater problems. A tachometer was added to stabilize the loop. Due to large variations in feed rate, it was necessary to differentiate the feedback signal from the tachometer. Mechanical oscillations due to gear box backlash, flexible drive belt, tachometer coupling and adhesion of the epoxy impregnated wire overwrap were identified and corrected. The present system is located in the Building 64 high bay.

In order to achieve greater consistency, a system for partial computer control is proposed. Both the cart drive and the arbor drive will use stepping motors. A local microcomputer (a 87C51 single chip with RS232 handler on board) will perform stepping, ramping and position reporting for each motor. Another 87C51 will handle the user interface. Communication to the central computer via an RF telemetry RS232 link will allow the main programming effort to be focused in a high-level language. Training of the machine will be done in discrete positions which will then be smoothed in actual operation. Construction of this prototype has merit for commercial consideration.

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