

Control and data acquisition system for lower hybrid current drive in Alcator C-Mod

Alcator
C-Mod

Nils P. Basse

in collaboration with

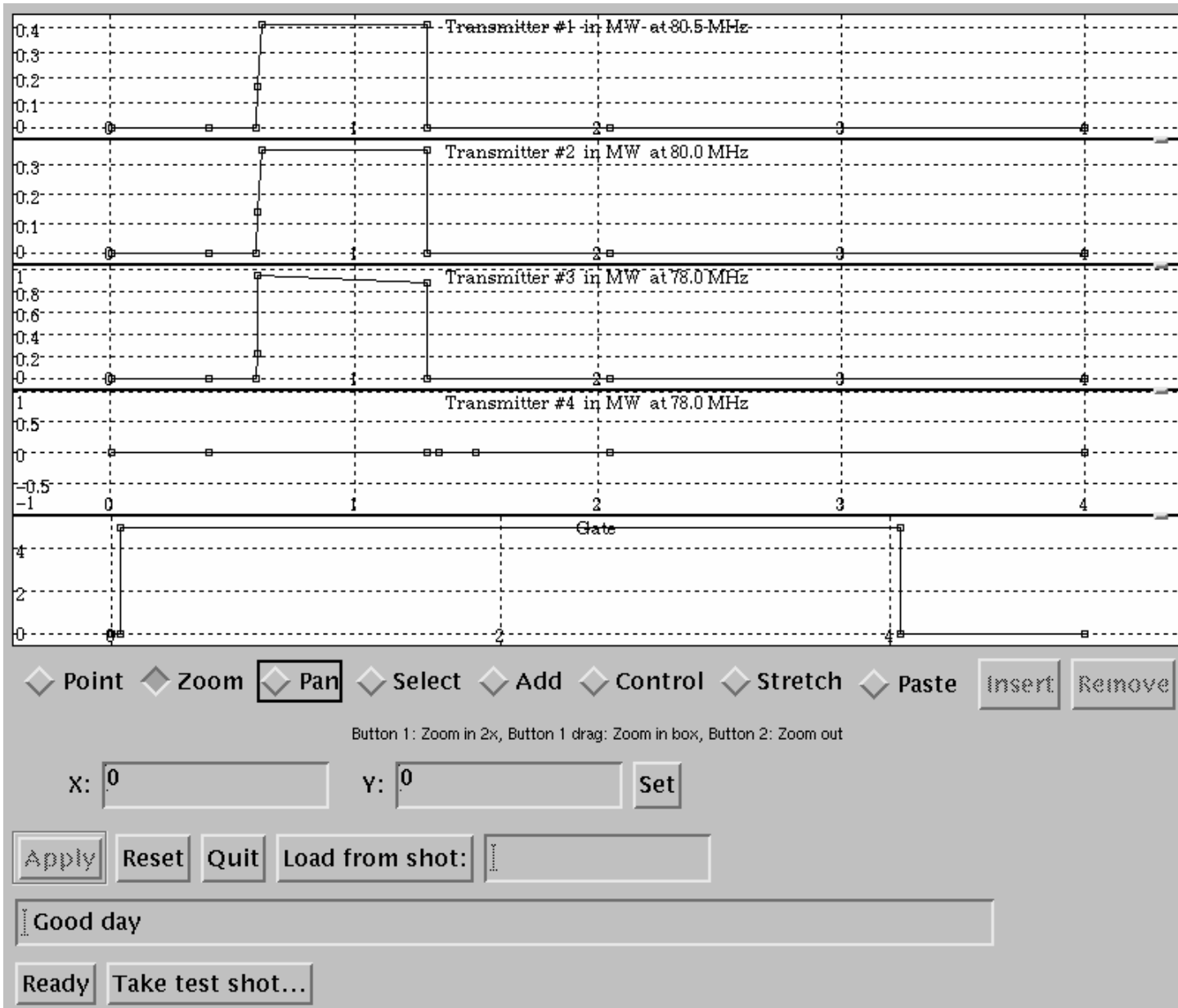
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N.D.Kambouchev, Y.Lin, B.Lipschultz, R.R.Parker,
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Outline:

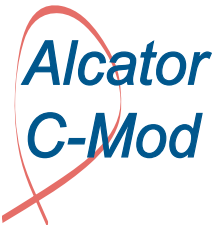
- **Existing control systems**
- **The lower hybrid control system (LHCOSY)**
- **LH tree structure**
- **Data acquisition using the cPCI cards**
- **Coupler camera design**
- **Future work**



RF_CONTROL



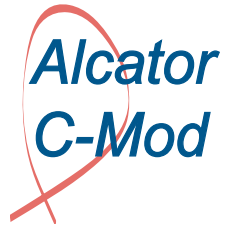
LH_CONTROL



The interface displays a grid of 12 plots arranged in 6 rows and 2 columns. The left column contains plots showing a sawtooth-like waveform, while the right column contains plots showing a linear ramp. The bottom-left plot is labeled "K11 Amplitude" and has a y-axis ranging from -0.5 to 1.0. Below the plots is a control panel with the following elements:

- Buttons: Point, Zoom, Pan, Select, Add, Control, Stretch, Paste,
- Text: Button 1: Zoom in 2x, Button 1 drag: Zoom in box, Button 2: Zoom out
- Input fields: x: y:
- Text input:
- Buttons:

LHCOSY



The program is written in IDL and runs on the Linux machines. The source files can be found here:

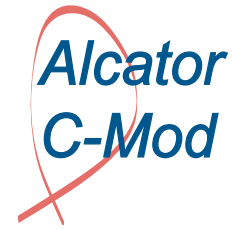
`/home/basse/idl/lhcosy`

The main program is lhcosy.pro. Additional files needed (at the moment) are on the VMS platform:

`/user10/basse/idl`

LHCOSY has a graphical user interface and makes use of widgets: Popup windows where various quantities can be modified. NOTE: This is my first experience with widgets....!

LHCOSY



New shot number:

Selected shot number:

New start time:

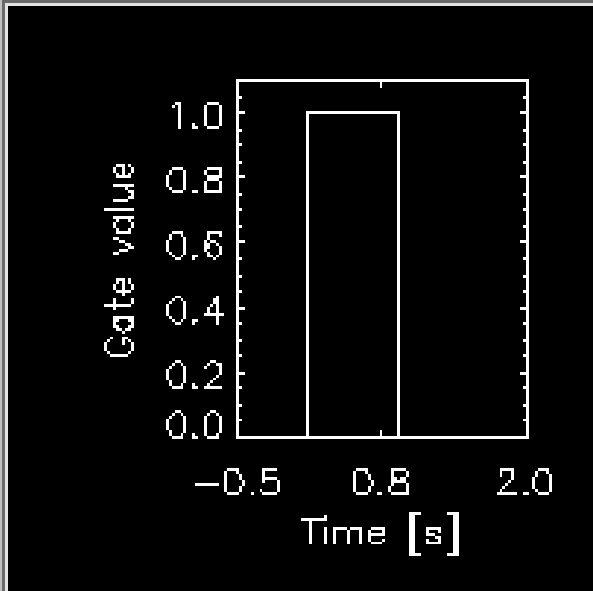
Selected start time:

New stop time:

Selected stop time:

Amplitudes


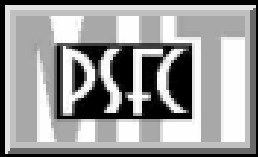
Phases



Gate value

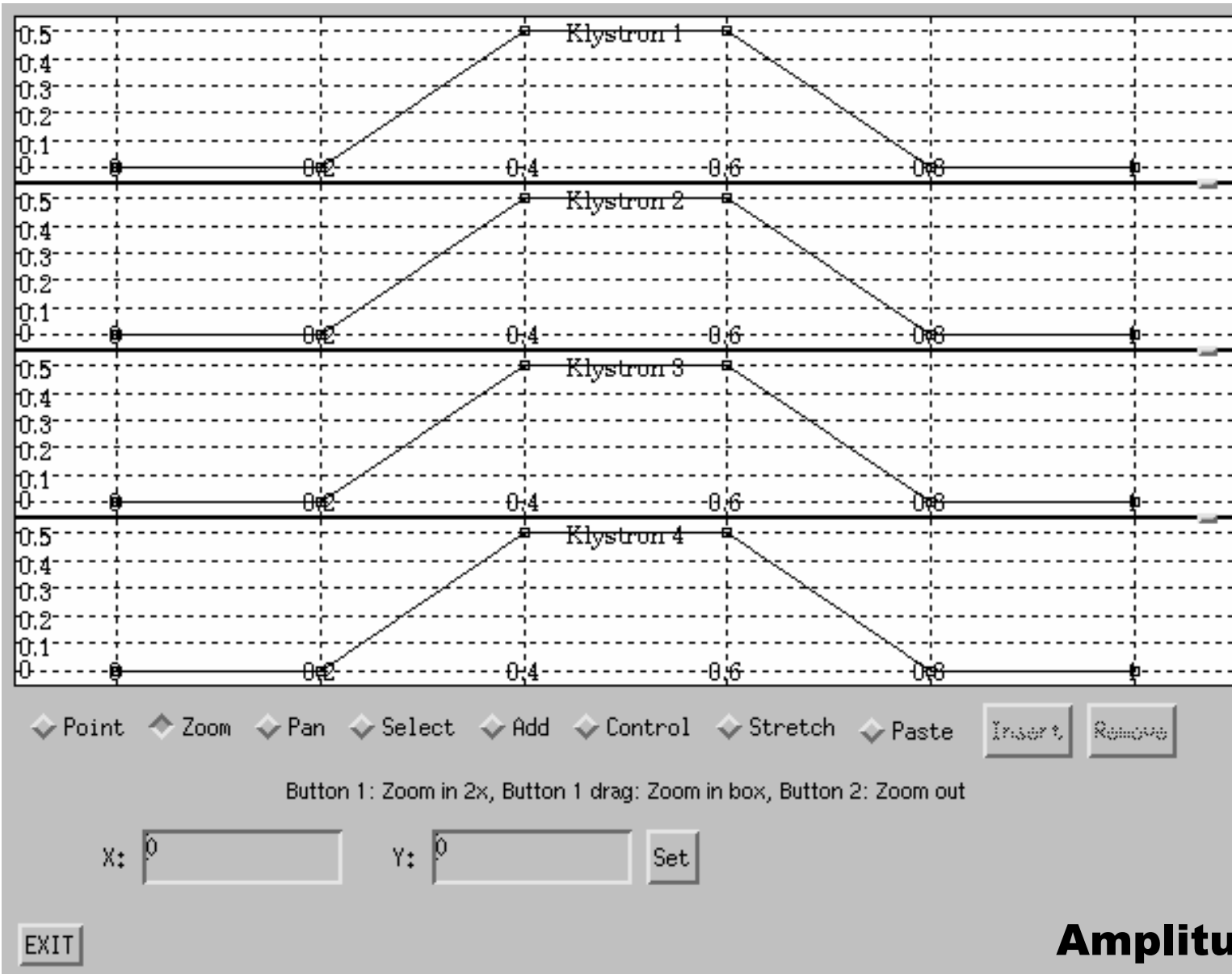
Time [s]

Gate signal

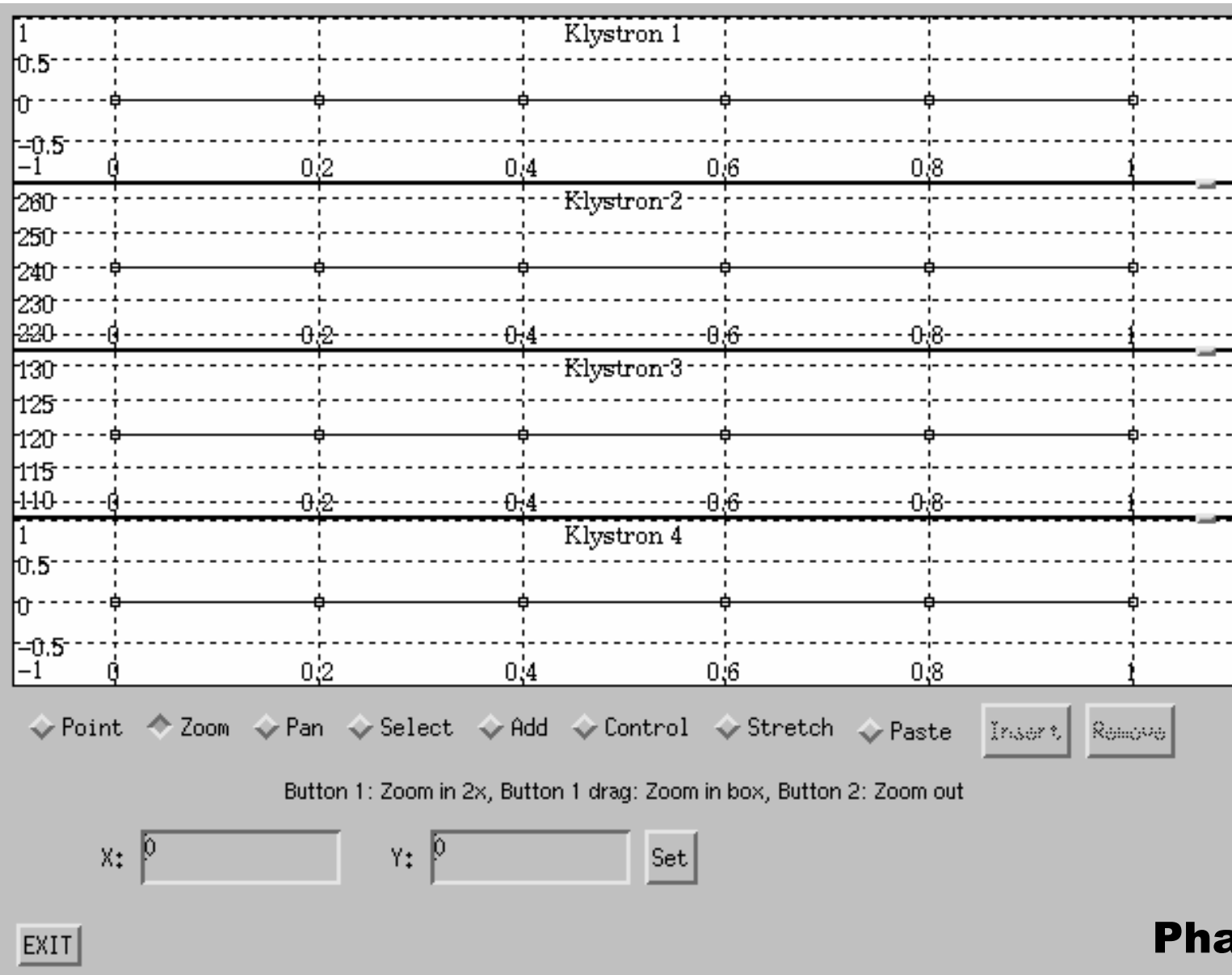


| Time [s] | Gate value |
|----------|------------|
| -0.5 | 0.0 |
| 0.0 | 1.0 |
| 2.0 | 0.0 |

LHCOSY



LHCOSY



LHCOSY

Step-by-step explanation:

- **Shot number: Default is model shot -1.**
- **Start time and stop time: Klystron amplitude is set to zero beyond those time points.**
- **FIRE button:**
 1. **Desensitize LHCOSY panel.**
 2. **Write data to LH tree (amplitude checks).**
 3. **Initialize, trigger and store cPCI cards.**
 4. **Sensitize LHCOSY panel**
- **Amplitudes: One window per cart. Calls function `cw_wvedit.pro`.**
- **Phases: See amplitudes.**
- **Default waveforms: Load default parameters.**

LHCOSY

Step-by-step explanation (cont'd):

- **EXIT button.**
- **ACS, TPS, CPS: Plots data acquired using the cPCI cards.**
- **Date & time button: Prints date and time when data was written to shot.**
- **LOAD button: Loads currently selected shot.**

Design criteria:

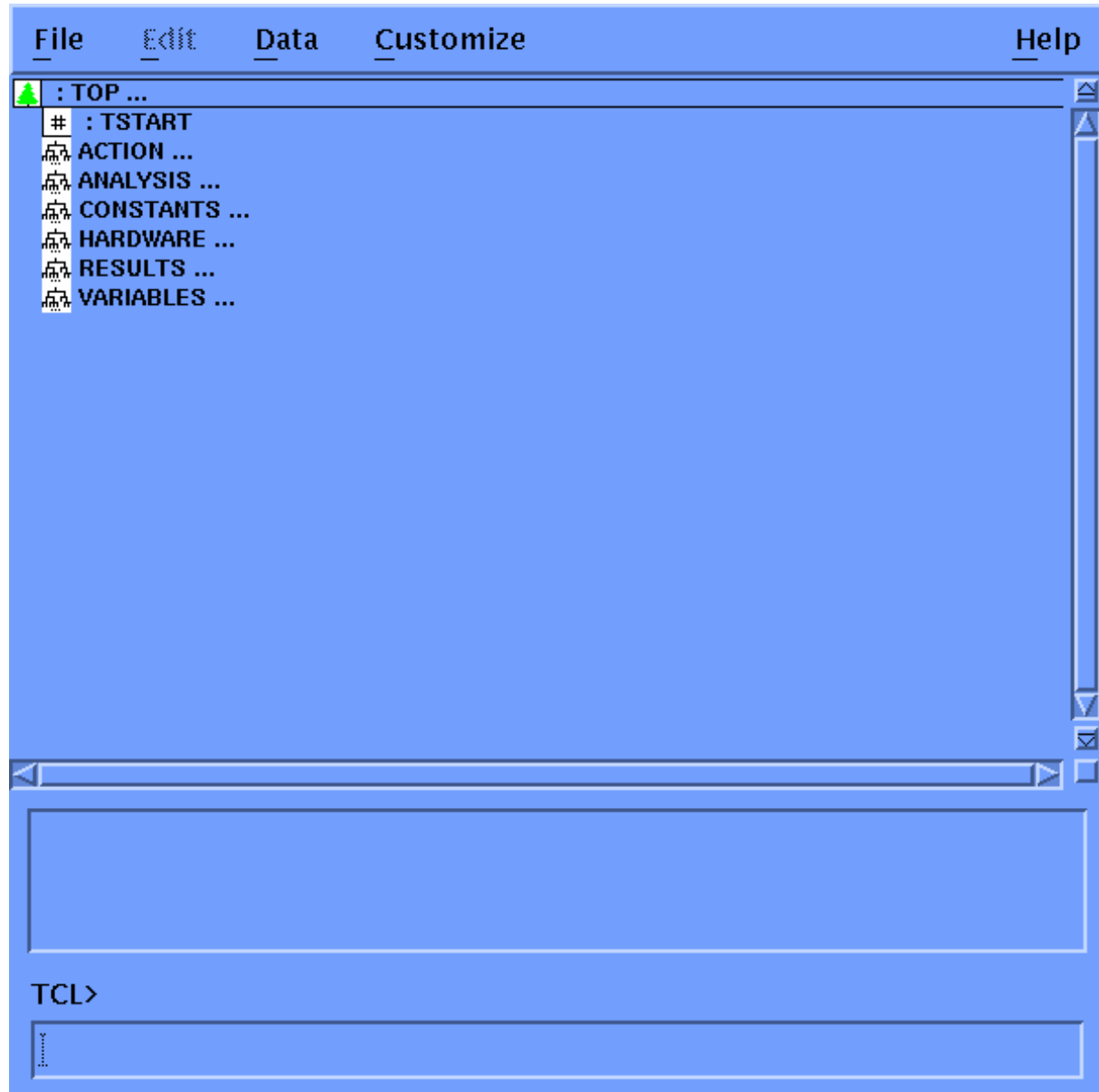
- **Simple to use.**
- **Similar to RF_CONTROL.PRO.**
- **Hard to crash.**

LH tree

Use traverser to view/edit the LH tree. Currently, the following persons have write access:

Joe, Nayden, Ron, Stuart, Josh, Dave and Nils.

The children created by Nayden/Josh (ACTION, CONSTANTS, VARIABLES) will not be treated.



LH tree



The image shows three terminal windows displaying the LH tree structure. Each window has a menu bar with "File", "Edit", "Data", "Custo", and "Help".

Window 1 (Left): Shows the root node "# : TOP ..." expanded to show a list of nodes including "# : TSTART", "ACTION ...", "ANALYSIS ...", "CALIBRATION", "INPUT ...", "# : BACKGROUND", "# : DATETIME", "# : EN_DIS", "# : LH_TSTART", "# : LH_TSTOP", "# : NO_SAMPLES", "# : SAMPLE_FREQ", "CART1 ...", "# : K1_AMP", "# : K1_PHASE", "# : K2_AMP", "# : K2_PHASE", "# : K3_AMP", "# : K3_PHASE", "# : K4_AMP", "# : K4_PHASE", "CART2", "CART3", "CONSTANTS ...", "HARDWARE ...", "RESULTS ...", and "VARIABLES ...".

Window 2 (Middle): Shows the root node "# : TOP ..." expanded to show a list of nodes including "# : TSTART", "ACTION ...", "ANALYSIS ...", "CONSTANTS ...", "HARDWARE ...", "ACS ...", "# : DT_5 ...", "# : DT_8 ...", "# : J221 ...", "# : LH_DECODER ...", "# : LH_ENCODER ...", "CPS", "TPS", "RESULTS ...", and "VARIABLES ...".

Window 3 (Right): Shows the root node "# : TOP ..." expanded to show a list of nodes including "# : TSTART", "ACTION ...", "ANALYSIS ...", "CONSTANTS ...", "HARDWARE ...", "RESULTS ...", "COUPLING", "FINAL_AMP", "FINAL_PHASE", "P_FWD", "P_REV", and "VARIABLES ...".

Each window has a "TCL>" prompt at the bottom, followed by a vertical cursor.

cPCI cards

We have 13 cPCI cards, 6 chassis in total:

- **1 chassis, 2 cards for the ACS.**
- **3 chassis, 3 cards for the TPS.**
- **Steve has borrowed: 1 chassis, 5 cards (CPS).**
- **Bob will borrow: 1 chassis, 3 cards (CPS).**

All cards are D-TACQ (www.d-tacq.com), 32 channel, 16 bit, 250 kHz, 128 MB memory. Anti-aliasing filters.

One additional card has been ordered for LH, a D-TACQ 16 channel, 16 bit, 10 MHz, 1 GB memory. My idea is to use this card to acquire from some of the forward/reverse power detectors. The coupled power is an indirect measure of edge density fluctuations.

Camera

Bruce and Brian have a visible light camera (plus a fiber) in a re-entrant tube in K-port. This has been observing the limiter between G- and H-ports.

This camera could probably be rotated to observe the coupler, which is to be installed in C-port.

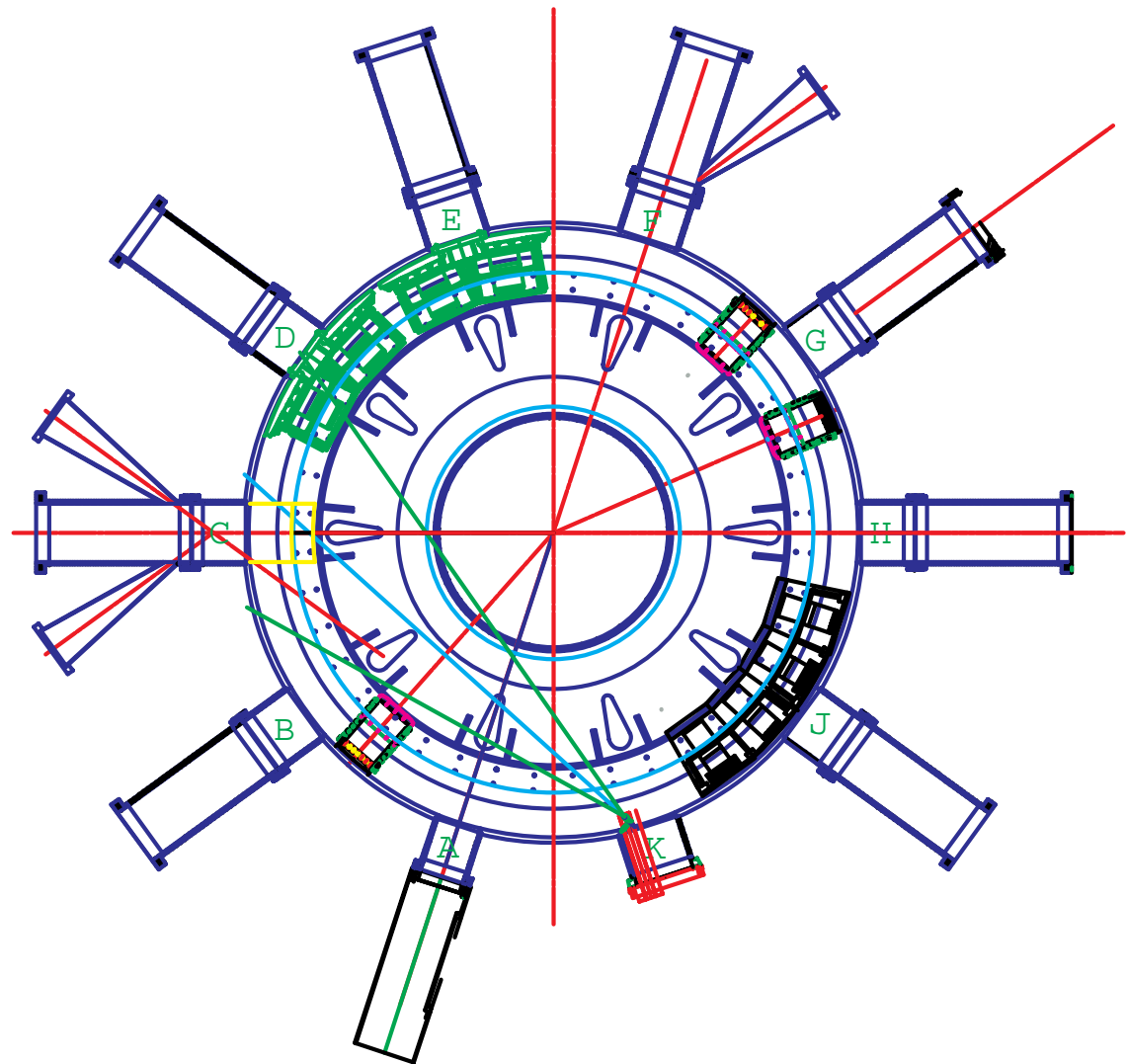
Bruce helped me clean the tube (quartz window opaque), we put it and the camera back in. Rotating the camera about 180 degrees, a partial view of C-port was obtained.

Henry is designing new camera/filter holders – the angle has to be changed about 10 degrees.

Camera

- Coupler in C-port [yellow]
- Camera field-of-view is 26 degrees [green]
- Camera center line [blue]

The camera looks 10 degrees beyond the coupler end; due to tilt of view, since camera is looking up at C-port.



Future work

- **Complete the LHCOSY program.**
- **Complete the User's Guide.**
- **Complete camera design, re-install camera, check that acquisition works.**
- **Once ethernet is established at the TPS racks, add those cPCI cards to the LH tree and LHCOSY.**
- **Handshaking of IDL vs. Matlab/Opal-RT/Labview with Joe and Yuri.**

This presentation and the current version of the User's Guide are available at

<http://www.npb.dk/lhcd/lhcd.html>