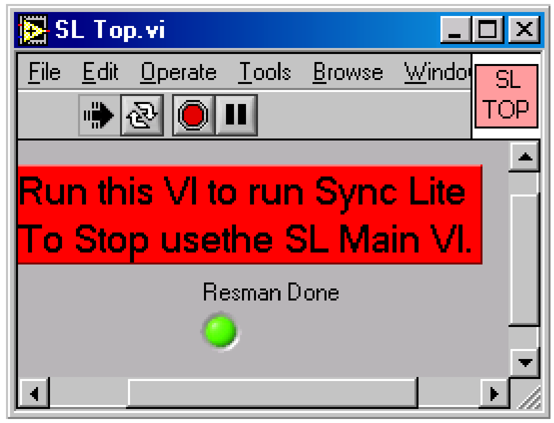
Synclite Version 3: The Front End System

General Description

The Synclite system in the Tevatron uses the Synchrotron Light emitted by the beam to measure beam intensity, position and transverse profile. The particles that are emitting the light get bent by magnets, and the light travels straight, which permits for the location of a mirror in the beam pipe that is far enough from the beam to not cause any interruption to beam operation. The synchrotron light is reflected off the mirror in the vacuum pipe, passes through a glass window, is focused with a BK7 Glass lens, and with the help of some additional mirrors is directed onto an image intensifier/camera system. The photo-cathode of the image intensifier is gated to allow for sampling of individual bunches.



The SL3 data-acquisition and control system ('front end') is built to start up on its own. It is a rackmount PC running WindowsXP and LabVIEW. The LabVIEW code is now permanently archived under \\Beamssrv1\inst.bd\Instruments\Synclite\LabVIEW Code\. In addition to the user code, the present code uses some image processing VI's found in the Vision package from national instruments. The things that need to be powered on before the front end itself are the VME crate, the HV power supplies, the 15V DC supply that provides power to the Cameras in the tunnel, and the -150V power supply and pulser that drives the gates. When the PC starts, it should automatically start the "SL Top.vi" file that should start the program. If the VI does not load, there is a shortcut to it on the Desktop; it is running if it has the Black Arrow as in the image above. The front end will now be operational, and will run measurement specification 0 until told otherwise by the operator.

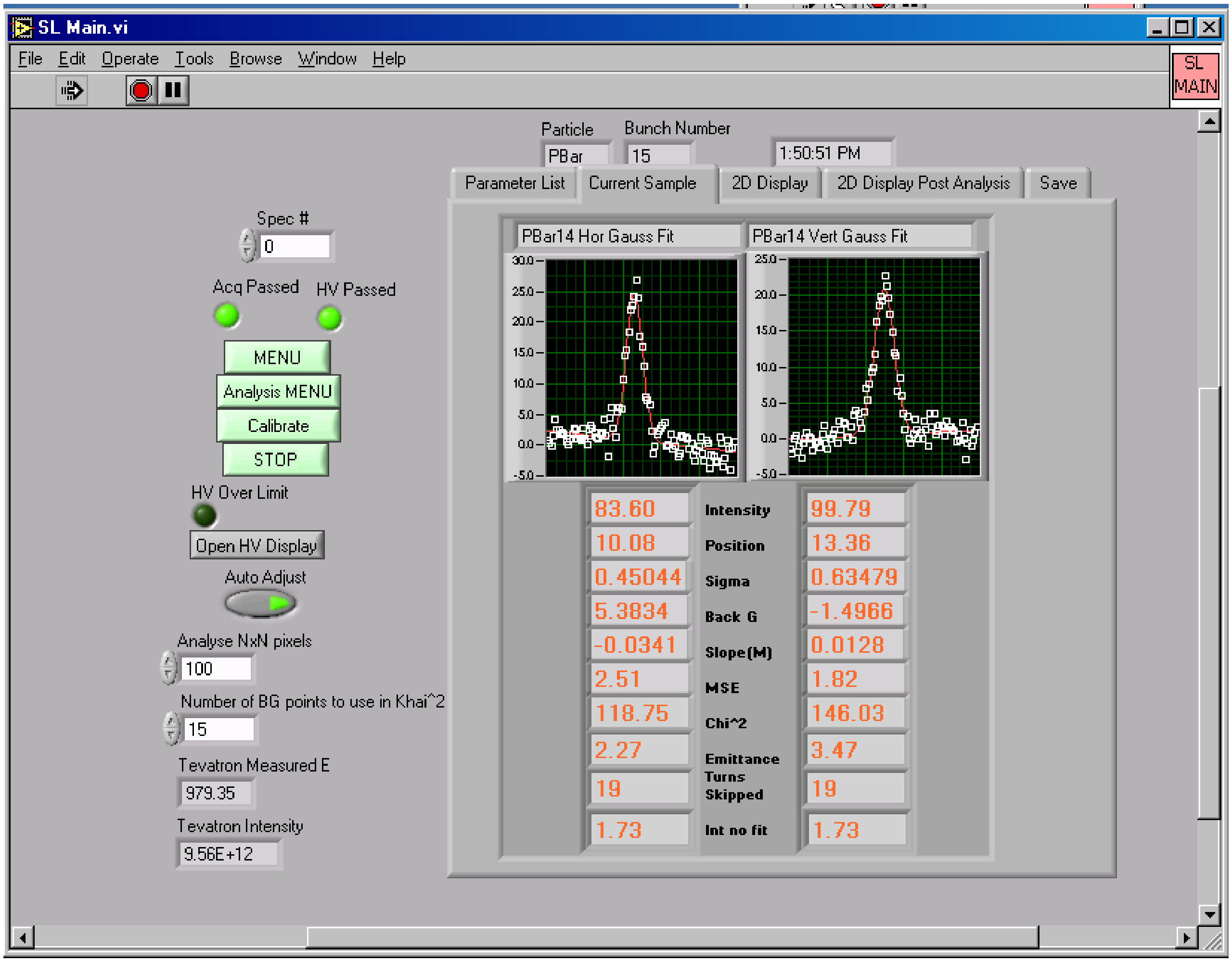
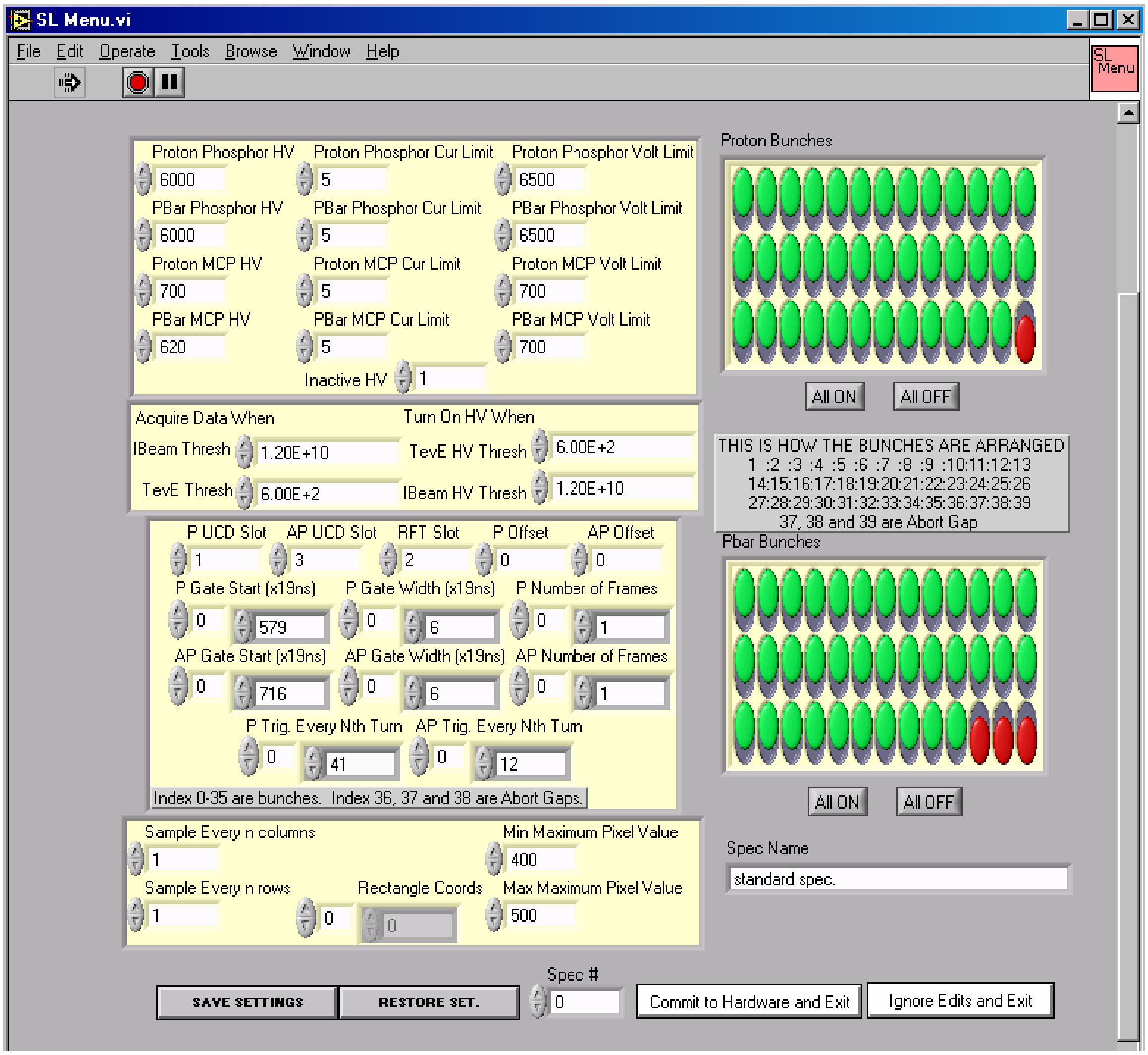


Figure 1 SL3 Main.vi

SL3 Specs from Front End and ACNET

The Sync Light 3 system uses measurement specifications to determine how to perform the data taking and analysis. These specs control the timing of the gates for each individual bunch, the High Voltage settings, as well as which bunches will be sampled.

On the SL3 Front End, clicking the "MENU" button in the "SL Main .vi" opens the display below which can be used to edit, save and restore the Specs. In the "Spec #" input box the user can enter the spec to save or restore. Clicking on the "RESTORE SET." button will restore saved values



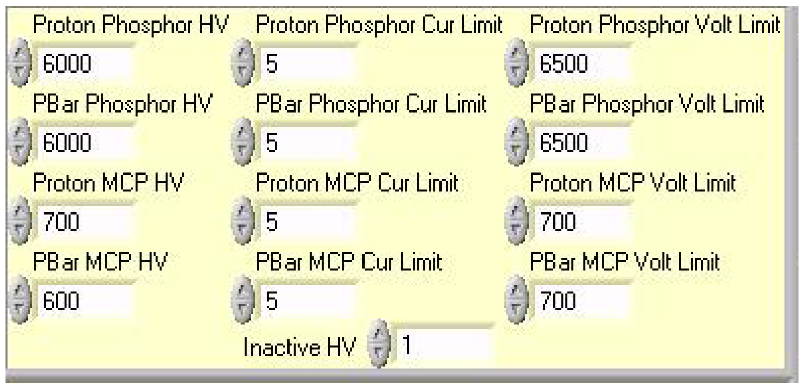
into the values on the display. These can then be edited to make the desired changes and saved by clicking on the "SAVE SETTINGS" button. They will be saved in the "Spec #" which is selected at the time of the save action. Once all editing is done, just click on the "Commit to Hardware and Exit" button. This will commit the settings that are currently being displayed on the screen to hardware. One does not necessarily have to save a spec every time a change to the way the program is running has to be made. If you want the change to be permanent, the spec should be saved, if it's temporary it will work by just having the right values in all the controls, and committing those values to the hardware settings. If the user wishes to exit without committing changes to hardware the "Ignore Edits and Exit" button should be used.

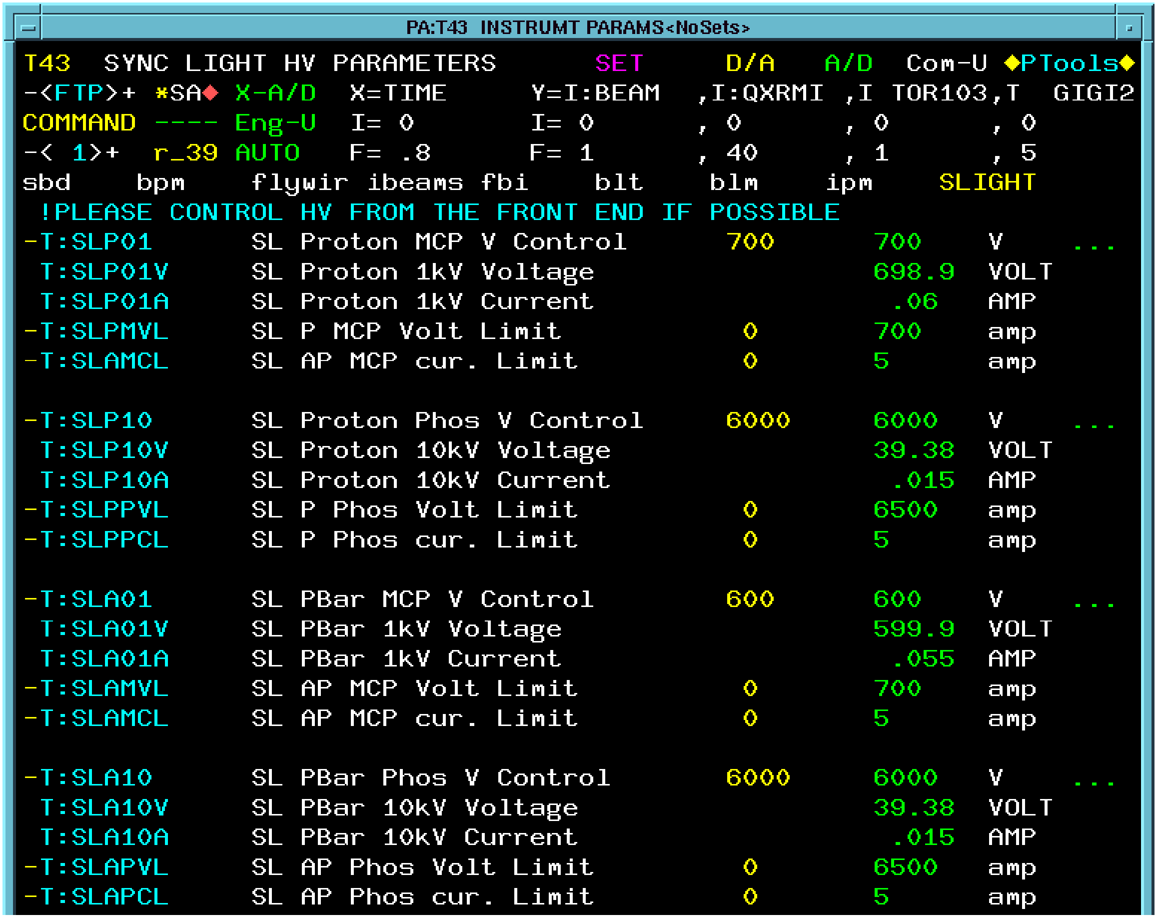
The ACNET interface to the Specs is on a parameter page and is capable of performing all the same tasks as the Front End one, but is not designed for ease of use. To load a spec, the spec number needs to be entered into T:SLSPEC, and a command of 2, into T:SLCMD. This will read the spec file from the front end, and load it as the current values. Saving a Spec is a bit harder from ACNET and should be left to the experts until an ACNET interface can be developed to ease the process. It is difficult, because the sampling parameters are spread over a number of sub pages under T43-SLIGHT, and all of the parameters need to be just right for it to work. Considering that they are all arrays, it's a lot of data entry that has to happen which is easier handled by logging into the Front End itself.

Figure 2 T43-SLIGHT-1. Spec and Command parameters

SL3 High Voltage System

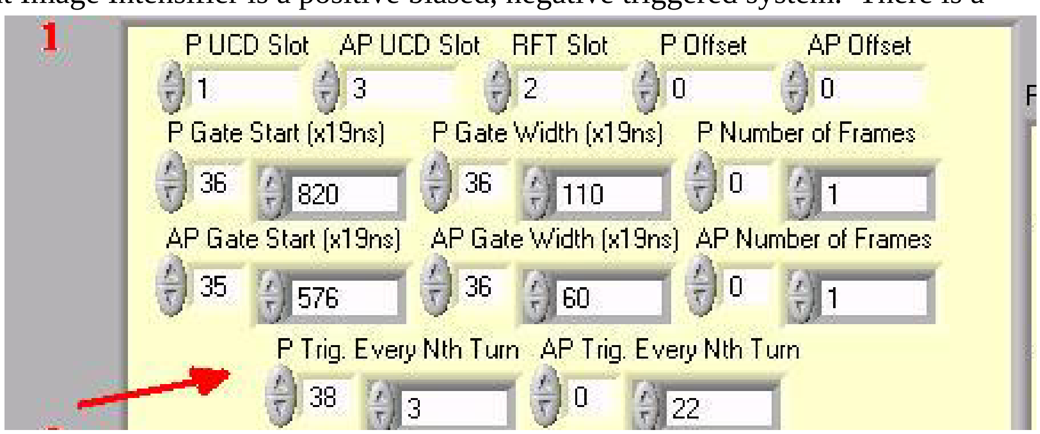
The Synclite system uses 4 Bertan MPS power supplies capable of producing 1kV or 10kV. There is also a remote control module that is used to control the voltages as well as read back of settings. The High Voltage control is done by a C053 card in TEV Camac Crate $2C, slot 18. There are two 1kV supplies for the MCP Voltage, and 2 10kV supplies for the Phosphor screens. The setting limits of the 1kV are limited to 800 Volts through ACNET and to 700V by the software limit in the SL3 system. The read back is done by an MADC card (C190) in the same crate $2C, slot 4. The channels are 56-64 in the MADC. The Front End monitors the Voltage read backs for Limit excursions about once a minute. It does not however monitor for the proper voltage to be present on the HV supply, because of the time it takes to read the MADC parameters. Changes to HV should not be made directly from ACNET because their changes will not be known to the Analysis Program. The Voltage settings are not changed during sampling, meaning that all bunches are sampled at the same HV setting.





SL3 Gating System

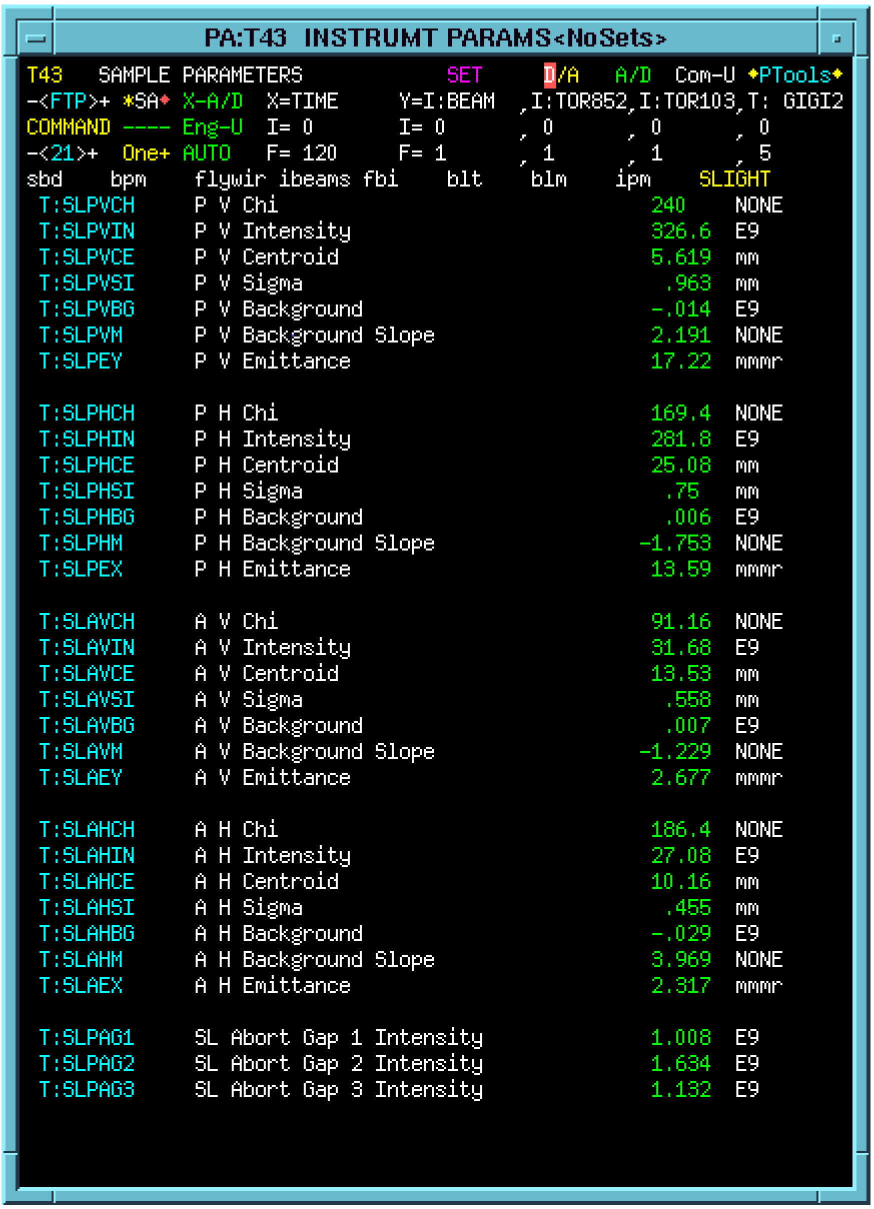
The Sync Light Image Intensifier is a positive biased, negative triggered system. There is a -150V supply that provides the voltage for the pulse. The pulses are generated by a VME based trigger system and a Pulser, designed and built by Brian Fellenz and Andrea Saewert, which contains the +30V positive bias



The VME system uses two UCD (Universal Clock Decoder) modules, and one RFT (RF Timer) module to generate gates with the proper position with respect to the beam marker ($AA) and with the appropriate widths for gating bunches and abort gaps. The reason for using two UCD's is that each one can only decode one type of beam sync clock. To be able to sample both Protons and PBars one needs to be able to decode both clock signals. One UCD decodes the $AA event from the proton BS and the other the $AA event from the antiproton BS. The gates which they generate are then passed along to the RFT board for further processing. The RFT board has a programmable pulse memory which operates on the 53MHz clock frequency which is distributed throughout the FermiLab complex. The RFT memory is large enough to be able to accommodate 44 Tevatron turns of signals, before having to loop over the same block. The way that the board is programmed for the SL3 operation is with an offset, width, and initial number of turns to skip for each bunch. All of these parameters can be accessed through the menu, and are also available through ACNET. The gate offset should never need to be changed. The number of turns skipped is a starting point under normal operation; the SL3 system changes this number to optimize the image intensity from the camera. The lower limit is settable and currently set to 2 for historical power reasons (not necessary for the Fellenz-Saewert pulser). The upper limit is 44 for RFT limitation reasons.

SL3 Analysis Output

All parameters listed in the figure below are arrays of 40 elements. Index 0 is the intensity weighted average of the rest, Abort Gaps are excluded. Indexes 1-36 are the bunches, in order, and 37-39 are abort gaps.



Appendix A

System Location and Startup

The Synchrotron Light Monitor resides in Racks C005 and C006 in the C0 service building. It consists of the devices listed in the table below plus a few others not listed.

<table>
<tr><td></td><td>VME Crate</td></tr>
<tr><td></td><td>Motion Controllers</td></tr>
<tr><td>
</td><td>HV Power Supplies</td></tr>
<tr><td>
</td><td>High Voltage Pulser consisting of -200 V Supply (black) and 2 pulsers designed and built by Brian Fellenz and Andrea Saewert. The supply should be set to 150 V.</td></tr>
<tr><td>
</td><td>PC running Windows XP and Labview</td></tr>
</table>

All of the devices have to be powered on before the actual computer.

The PC is a Rack Mount system built by KOI Computers. One has to unlock the front door to the computer. If it is powered off, the toggle switch will power it back on. To reset one can use the red reboot button. The computer should come up on its own once it has been started. If the LabVIEW VI does not start, there is a link to it from the desktop.