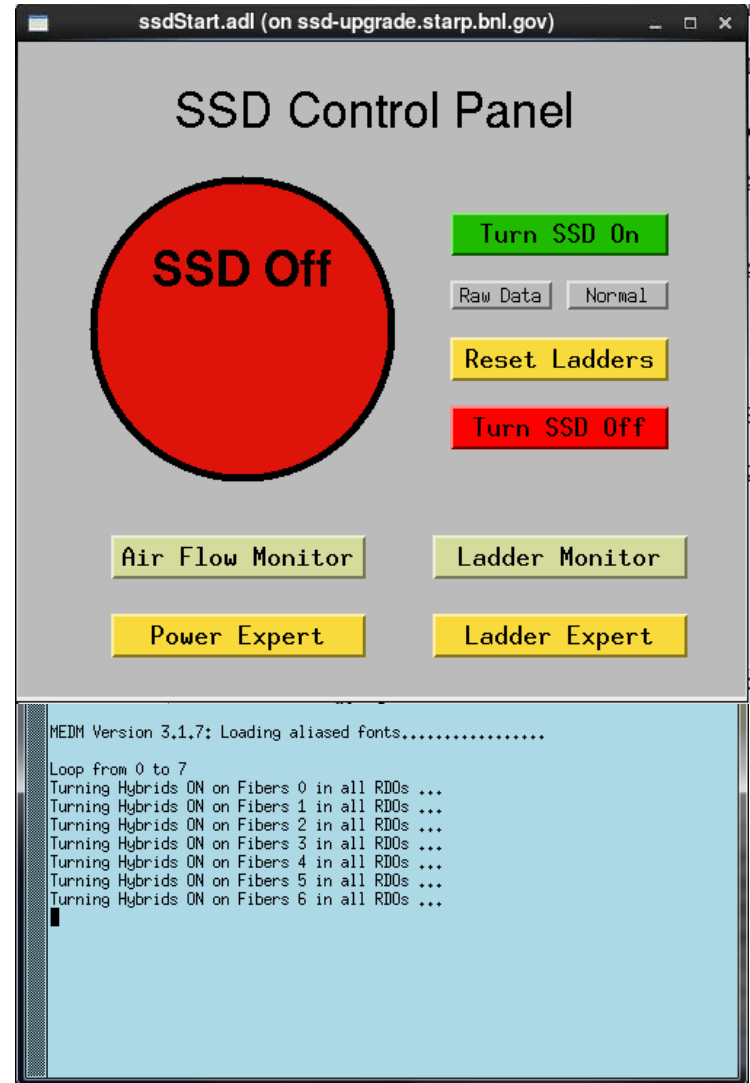


The Main Control Panel for the SSD

- For normal operations push
 - “Turn SSD On” (5 minutes)
or
 - “Turn SSD Off” (3 minutes)
- Turn the SSD “ON” when beams are stable and ready for “Physics Running”
 - Include the “SST” in the run at the DAQ console
 - Include the “SST” trigger in the run
 - Start Run
 - Turn the SSD “OFF” in preparation for a beam dump
 - Turn the SSD “ON” for Pedestals or Cosmics then OFF again when done. See next page.
- The large circle will change Red / Yellow / Green
 - The detector is “ON” when the console screen says “SSD Detector is ON and configured for Normal Ops”
 - The detector is “OFF” when the console screen says “SSD Detector is OFF”
- Call an expert if you have questions



How to take a Pedestal run or a Cosmics run



- Cosmics are taken in “Raw Data” mode
- Ensure that the beam is off
- Turn the SSD “ON” (5 minutes)

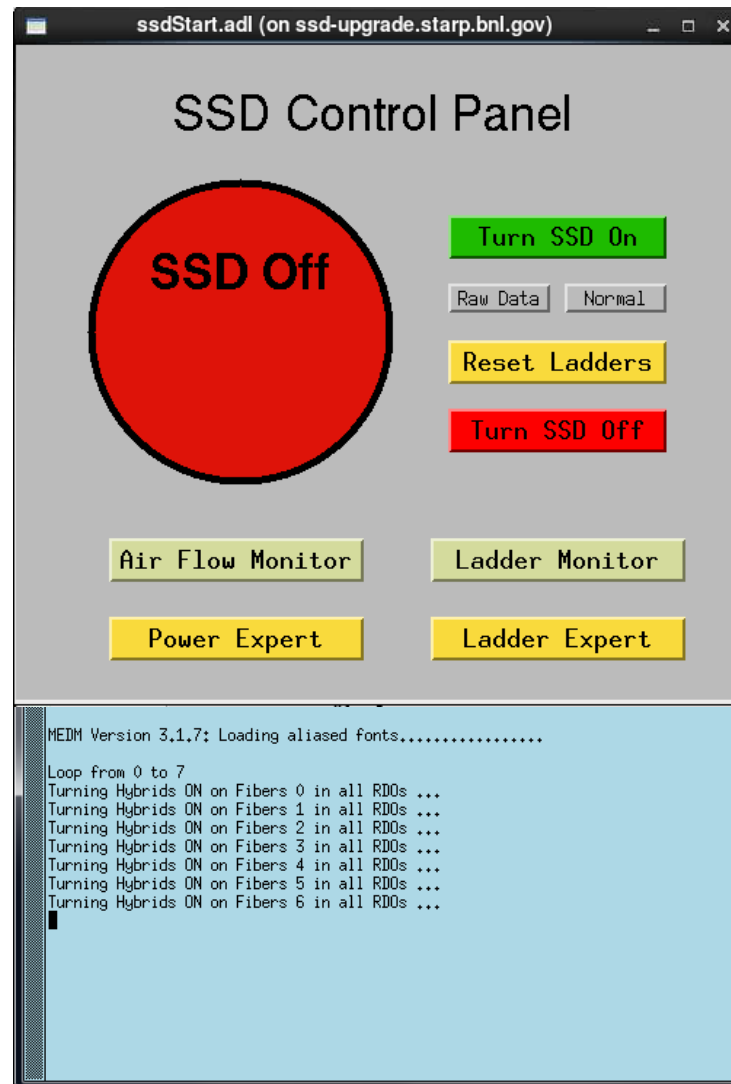
The detector is “ON” when the console screen says “SSD Detector is ON and configured for Normal Ops”. Wait for it.

- Push the “Raw Data” button to switch to raw data mode when taking Pedestal runs and/or Cosmics

Wait until console screen says “RDOs are ready to take RAW Data (e.g. for Pedestal files or Cosmics)”

- Set DAQ and Trigger for Pedestals or Cosmics, as required. Start run/take data
- Push the “Normal” button when done with pedestals and/or cosmics

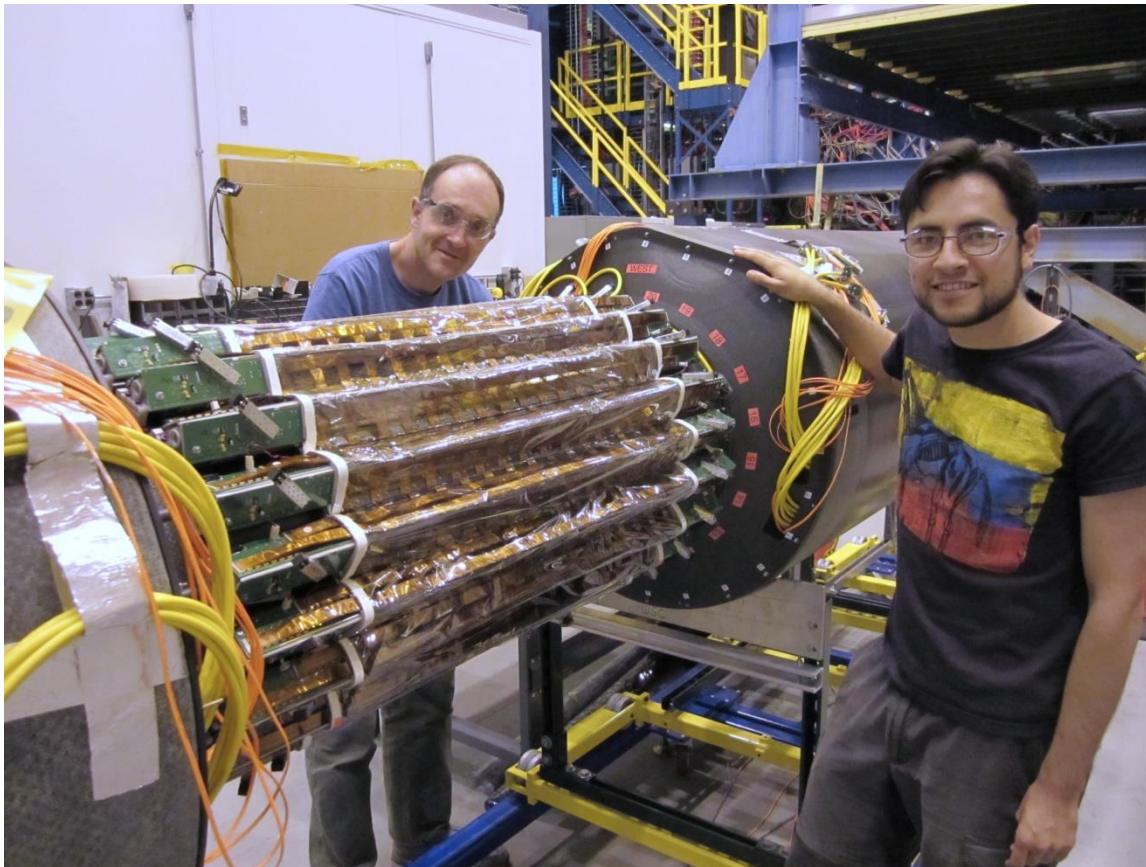
Leave the detector ON and in raw data mode if the next run will be a cosmic run. Otherwise, turn the detector off.



SSD Operations Notes

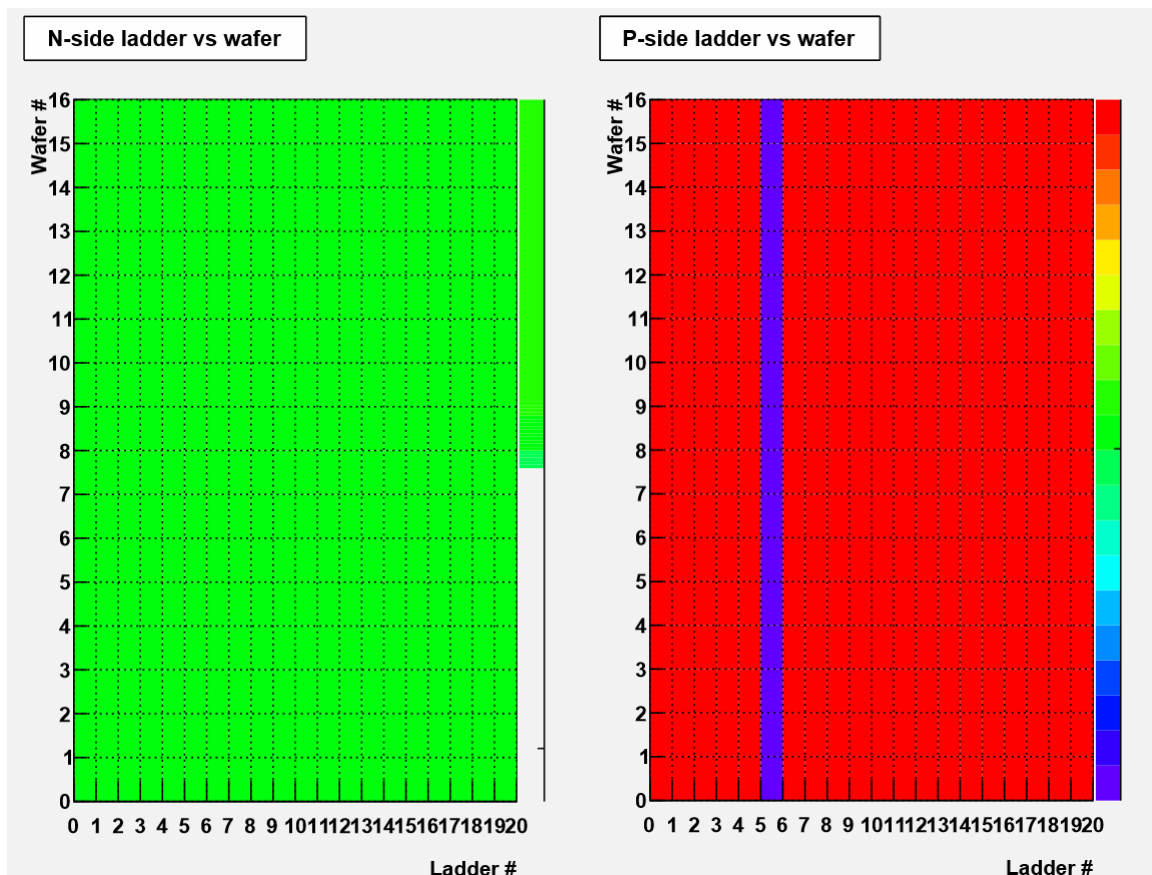


- The SSD should be on when the PXL+IST detectors are on (Unless otherwise instructed)
 - Usually, this means “Normal data taking” but also includes Cosmic, Pedestal and Raw Data runs



- You may reset bad ladders when they appear in the online plots or on the SSD console screen
 - Do not stop the run
 - Alternatively, check the SSD console at the end of each run. Good time to reset.
- Major issues can be resolved by power cycling the SSD
 - Stop the run and remove the SSD from DAQ. Start a new run without the SSD while cycling power. Start a new run with the SSD when ready.

SSD QA Plots



- Plots show the number of events recorded per ladder
- These plots are OK ... if the Ladder Monitor is also OK

- The SSD is also known as the “SST”.
 - SSD is for hardware, SST is used by DAQ
- The SSD uses Si P/N junction diodes
 - The SSD reads data from both the P side and N side of the Si
- The right most bar on each plot is the vertical scale for the histogram
 - Note that the scale is zero suppressed and auto scaled
- Thus, the blue bar indicates fewer counts than red, but NOT zero

Starting the SSD Control Panel ... if it is off



- Start or restart the SSD Computer and login
 - it's a windows box, so do windows things
 - User: `.\ssd` (the “.” represents the local domain name)
 - Password: ask the shiftleader
- Start an ssh terminal session and connect to `ssd-upgrade.starp.bnl.gov`
 - Start “MobaXterm Personal Edition” (there should be a shortcut on the desktop)
 - Click on sessions tab (on left) and select “ssd-upgrade.starp.bnl.gov (ShiftCrew)” in the menu that contains a list of logon accounts
 - Wait for a terminal window to open and greet you with a prompt
 - You should be in the home directory for the ssd account, if not type “`cd /home/ssd`”
 - The ssd-upgrade machine is running Scientific Linux 5.9 ... it even has ROOT, but it is the main EPICS & DAQ computer for the SSD so please don't use it for anything other trivial CPU activity
- Start the SSD main control panel
 - From the ssd home directory, type “`sh ssdTop`”
 - Wait for the Control Panel to pop up and then click “Ladder Monitor”
 - Done. This is the normal run-time configuration for the SSD.

Ladder Monitor ... shown during starting up



- If you see red alarms on the monitor screen

- This is normal during startup and shutdown
- But ... push "Reset Ladders" on the start screen if you see red alarms while running

- Power Supply Voltages

- Green = on, Red = off

- FPGA status

- Green = on, Red = off

- RDO # ... (0-4)

- the SSD has 5 RDO's

- LC # ... (0-7)

- 8 ladder cards per RDO

- Hybrid Power (16 total)

- Status of the hybrids on each LC (red/green)

- Raw Bits

- For expert analysis

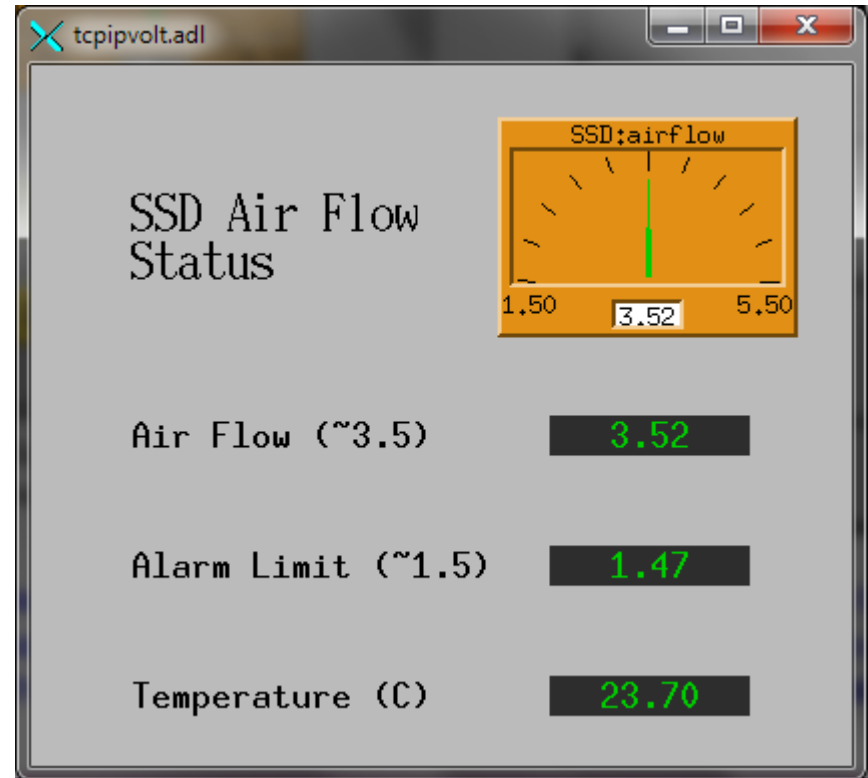
testMon.adl (on ssd-upgrade.starp.bnl.gov)

temp sensors (deg C)				5V	+2V	-2V	HV	Lad	LCid	FPGA	tokens	tests	holds	aborts	RDO LC	Hyb Pwr	bits
0	1	2	3														
29	28	27	26	●	●	●	●	W01N	61	●	0	0	0	0	0 0	██████████	QRaw
30	29	26	28	●	●	●	●	W02N	27	●	0	0	0	0	0 1	██████████	QRaw
32	28	26	28	●	●	●	●	W03N	58	●	0	0	0	0	0 2	██████████	QRaw
30	30	26	28	●	●	●	●	W04N	46	●	0	0	0	0	0 3	██████████	QRaw
32	28	24	28	●	●	●	●	W05N	14	●	0	0	0	0	0 4	██████████	QRaw
31	28	25	27	●	●	●	●	W06N	42	●	0	0	0	0	0 5	██████████	QRaw
31	27	26	27	●	●	●	●	W07N	53	●	0	0	0	0	0 6	██████████	QRaw
31	29	25	27	●	●	●	●	W08N	38	●	0	0	0	0	0 7	██████████	QRaw
33	29	26	29	●	●	●	●	W09N	25	●	0	0	0	0	1 0	██████████	QRaw
29	29	25	28	●	●	●	●	W10N	20	●	0	0	0	0	1 1	██████████	QRaw
31	29	26	29	●	●	●	●	W11N	59	●	0	0	0	0	1 2	██████████	QRaw
32	29	25	26	●	●	●	●	W12N	55	●	0	0	0	0	1 3	██████████	QRaw
29	28	26	27	●	●	●	●	W13N	39	●	0	0	0	0	1 4	██████████	QRaw
31	29	27	27	●	●	●	●	W14N	57	●	0	0	0	0	1 5	██████████	QRaw
31	28	25	26	●	●	●	●	W15N	16	●	0	0	0	0	1 6	██████████	QRaw
29	28	26	27	●	●	●	●	W16N	34	●	0	0	0	0	1 7	██████████	QRaw
30	29	26	28	●	●	●	●	W17N	19	●	0	0	0	0	2 0	██████████	QRaw
33	29	26	27	●	●	●	●	W18N	43	●	0	0	0	0	2 1	██████████	QRaw
31	29	26	28	●	●	●	●	W19N	31	●	0	0	0	0	2 2	██████████	QRaw
32	30	26	29	●	●	●	●	W20N	51	●	0	0	0	0	2 3	██████████	QRaw
30	28	24	27	●	●	●	●	E01P	62	●	0	0	0	0	2 4	██████████	QRaw
29	29	26	26	●	●	●	●	E02P	23	●	0	0	0	0	2 5	██████████	QRaw
28	27	25	27	●	●	●	●	E03P	40	●	0	0	0	0	2 6	██████████	QRaw
31	28	25	26	●	●	●	●	E04P	28	●	0	0	0	0	2 7	██████████	QRaw
30	28	25	27	●	●	●	●	E05P	36	●	0	0	0	0	3 0	██████████	QRaw
30	27	24	27	●	●	●	●	E06P	13	●	0	0	0	0	3 1	██████████	QRaw
29	27	25	27	●	●	●	●	E07P	33	●	0	0	0	0	3 2	██████████	QRaw
31	28	24	26	●	●	●	●	E08P	30	●	0	0	0	0	3 3	██████████	QRaw
31	26	25	27	●	●	●	●	E09P	41	●	0	0	0	0	3 4	██████████	QRaw
28	28	22	27	●	●	●	●	E10P	17	●	0	0	0	0	3 5	██████████	QRaw
30	28	26	27	●	●	●	●	E11P	45	●	0	0	0	0	3 6	██████████	QRaw
	32		32	●	●	●	●	E12P	44	●	0	0	1803	0	3 7	██████████	QRaw
30	28	25	26	●	●	●	●	E13P	60	●	0	0	0	0	4 0	██████████	QRaw
30	28	24	27	●	●	●	●	E14P	24	●	0	0	0	0	4 1	██████████	QRaw
29	27	25	28	●	●	●	●	E15P	18	●	0	0	0	0	4 2	██████████	QRaw
31	27	25	26	●	●	●	●	E16P	37	●	0	0	0	0	4 3	██████████	QRaw
30	29	25	28	●	●	●	●	E17P	54	●	0	0	0	0	4 4	██████████	QRaw
30	29	23	27	●	●	●	●	E18P	50	●	0	0	0	0	4 5	██████████	QRaw
31	28	25	27	●	●	●	●	E19P	32	●	0	0	0	0	4 6	██████████	QRaw
30	28	25	27	●	●	●	●	E20P	21	●	0	0	0	0	4 7	██████████	QRaw

Air Flow Monitor



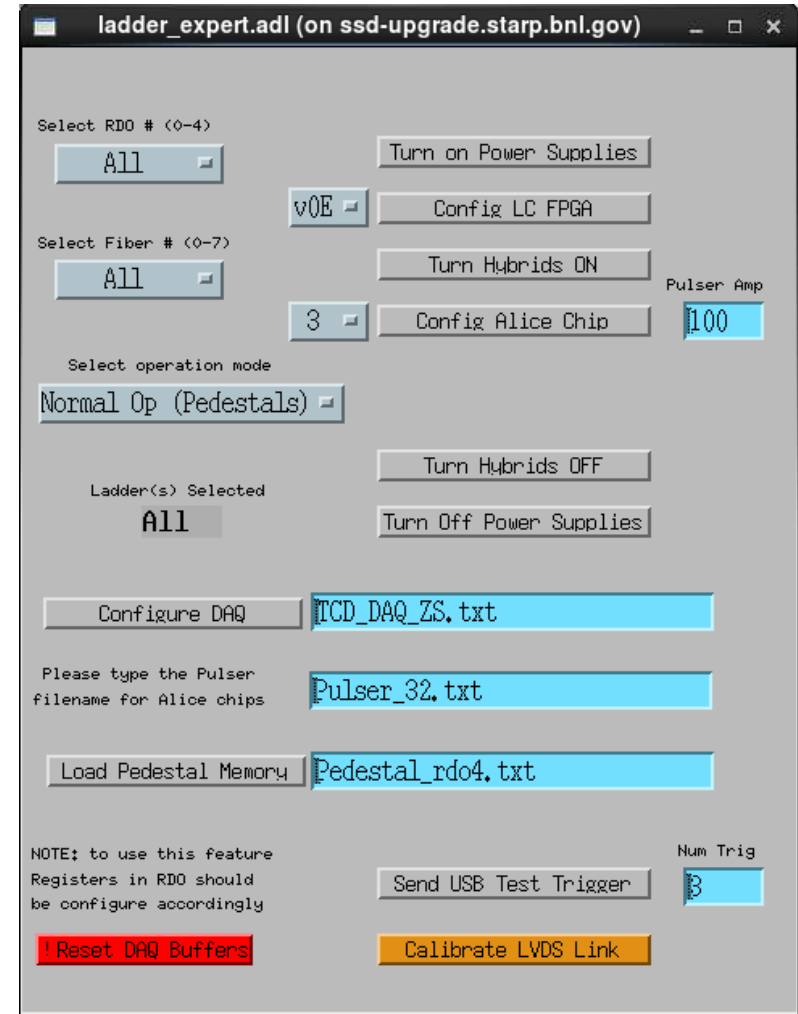
- The air flow gauge monitors the cooling air flowing through the SSD ladders
 - Normal reading ~ 3.5
- The interlock system will shutdown the SSD if the air cooling fails.
 - No operator action is required to shutdown the system although many alarms will be activated.
 - Recovery after a cooling failure requires an expert.



- The temperature of the cooling air is not very sensitive to the temperature of the detector. The value shown here will rarely rise above room temperature. See the “Ladder Monitor” page for more useful temperature readings.

Ladder Expert

- Panel for configuring ladder cards
EXPERTS ONLY!
- Power up the SSD by selecting “All” and “All” in the RDO and Fiber menu boxes
 - Push: 1.) Turn On Power 2.) Config LC
3.) Turn Hybds ON 4.) Config Alice
 - Important: wait for “done” in console window between each step
- RDOs and Fibers can also be configured (On/Off) one at a time.
(In this context, “fiber” is a synonym for “ladder card”)
 - 1.) Config LC 2.) Turn Hybds ON 3.) Config Alice
 - “Turn On Power” is only done once per session, not per Fiber
- Configure DAQ is for superExperts
- Calibrate LVDS is for superExperts
- etc.



Power Expert

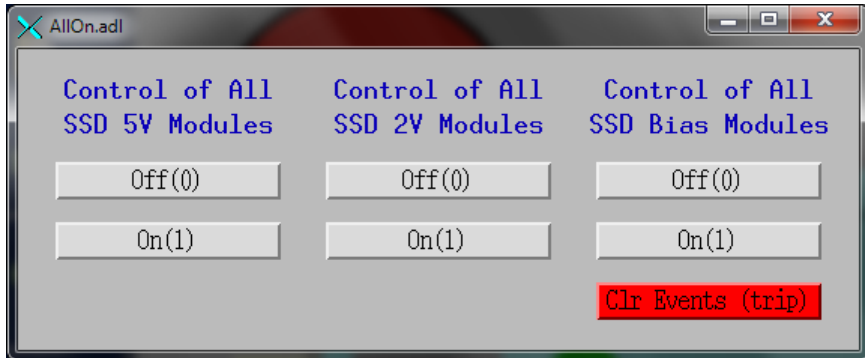


The screenshot shows the 'Power Expert' software interface. It features a 'Main Power Switches' section with two green indicator lights and two fan speed controls, both set to 2400 RPM. Below these are 'Batch Mode' and 'Expert Info' buttons for both Crate 1 and Crate 2. The central part of the interface displays a table of power distribution for two crates, with temperatures and power distribution buttons for each slot.

Temperature (°C)	Crate 1	Temperature (°C)	Crate 2
slot 0: 23	West 2V L01-L04	slot 0: 23	West 5V L01-L08
slot 1: 23	West 2V L05-L08	slot 1: 23	West 5V L09-L16
slot 2: 24	West 2V L09-L12	slot 2: 24	West 5V L17-20 E01-E04
slot 3: 23	West 2V L13-L16	slot 3: 24	East 5V L05-L12
slot 4: 23	West 2V L17-L20	slot 4: 24	East 5V L13-L20
slot 5: 23	East 2V L01-L04	slot 5: 25	Bias HV L01-L08
slot 6: 23	East 2V L04-L08	slot 6: 26	Bias HV L09-L16
slot 7: 23	East 2V L09-L12	slot 7: 26	Bias HV L17-L20
slot 8: 24	East 2V L12-L16	slot 8: [blank]	Empty
slot 9: 26	East 2V L17-L20	slot 9: [blank]	Empty

- The main power should never be switched off. Fans always at 2400 RPM.
 - Not even in an emergency. (SSD Interlocks will automatically switch off the power in case of emergency.)
- Experts only!
 - Use the “All On / All Off” to turn power on manually. On: 5V first, then $\pm 2V$, then Bias. Off: Reverse order

Power Expert: “All On” and “Batch Mode”



- All On / All Off
 - On: 5V first, then $\pm 2V$, then Bias.
 - Off: Reverse order
- Clear Events (on HV trip)
 - Press Clr Events if an HV channel has tripped off. Reset HV channel manually to prescribed voltage.



- Experts only!
 - Note Crate_1 or Crate_2 controls
- Batch mode
 - For controlling groups of modules

Power Expert: Setting individual channels



LVmodule.adl (on ssd-upgrade.starp.bnl.gov)

Channel:	Set Voltage (V)	Set Current Limit (A)	Terminal Voltage (V)	Sense Voltage (V)	Measured Current (A)	Rise Rate (V/s)	Supervision Behavior
u0_West_L01_2Vplus	2.200	2.000	3.307	2.203	0.591553	100	17680
u1_West_L01_2Vminus	2.500	4.000	6.503	2.507	2.133789	100	17680
u2_West_L02_2Vplus	2.200	2.000	3.296	2.191	0.585693	100	17680
u3_West_L02_2Vminus	2.500	4.000	6.404	2.500	2.072266	100	17680
u4_West_L03_2Vplus	2.200	2.000	3.223	2.201	0.540039	100	17680
u5_West_L03_2Vminus	2.500	4.000	6.370	2.503	2.034912	100	17680
u6_West_L04_2Vplus	2.200	2.000	3.313	2.196	0.588135	100	17680
u7_West_L04_2Vminus	2.500	4.000	6.439	2.508	2.080322	100	17680

Experts Only!

- Note: complex mapping from channel # to SSD Ladder #
- Highlight value to be changed, enter change and hit (CR)
- (very important to hit (CR))
- Changes made here are permanent

For setting individual channels

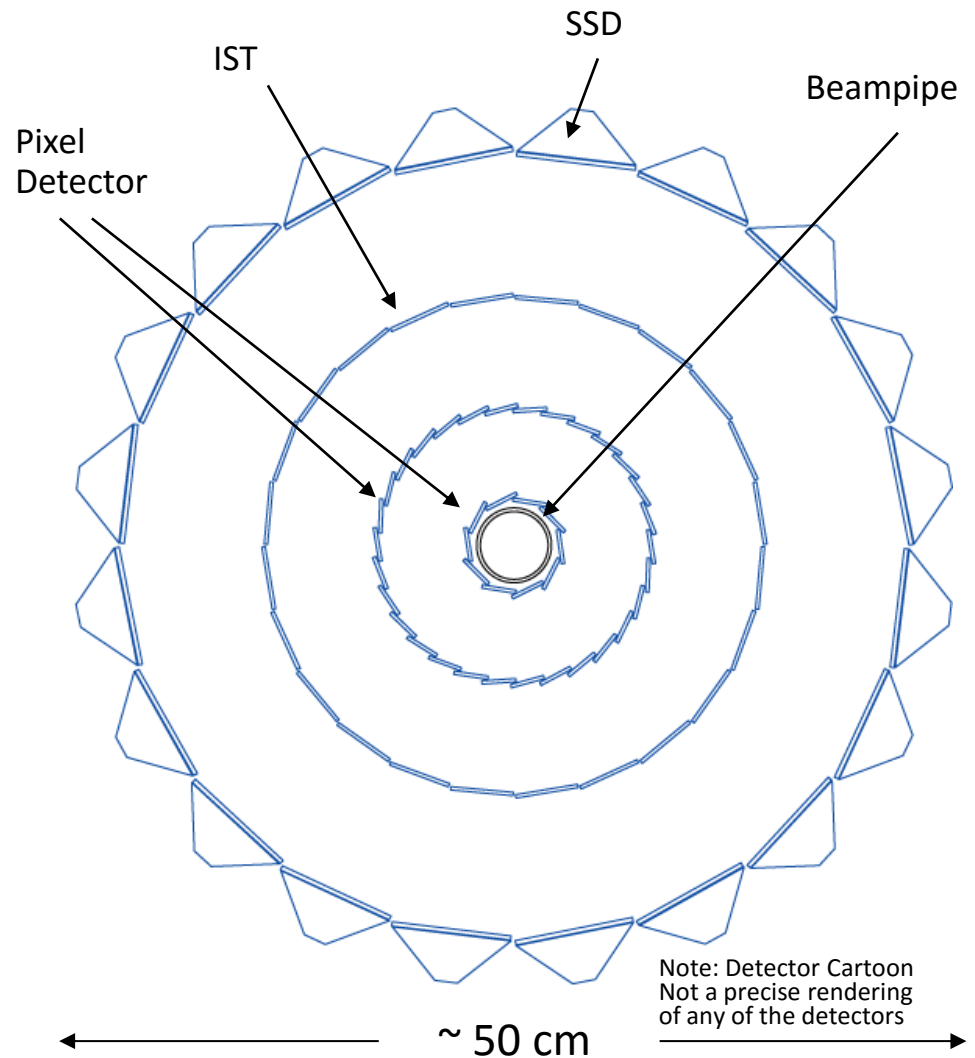
- On/Off
- Set Voltage (target voltage)
- Current limit
- Rise rate (volts per second)
- Supervision behavior (on trip)
- "Sense" voltage is the actual voltage on the detector

Channel:	Set Voltage (V)	Set Current Limit (A)	Trip Time Out (ms)	Measured Voltage (V)	Measured Current (A)	Rise Rate (V/s)
u700_HV_Bias_17	46.000	0.010	504	0.044	0.000000	1
u701_HV_Bias_18	53.000	0.010	504	0.024	0.000001	More
u702_HV_Bias_19	40.000	0.010	504	0.030	0.000000	More
u703_HV_Bias_20	70.000	0.010	504	0.002	0.000000	More
u704_HV_Spare_1	0.000	0.010	504	0.019	0.000001	More
u705_HV_Spare_2	0.000	0.010	504	0.011	0.000001	More
u706_HV_Spare_3	5.000	0.010	504	5.000	0.000002	More
u707_HV_Spare_4	0.000	0.010	504	0.001	0.000001	More

Schematic Representation of the HFT



- The STAR Heavy Flavor Tracker – the full suite
- TPC – SSD – IST – PXL
- TPC pointing resolution at the SSD is ~ 1 mm
- SSD pointing at the IST is ~ 400 μm $\epsilon = 0.98$
- IST pointing at PXL 2 is ~ 400 μm $\epsilon = 0.98$
- PXL 2 pointing at PXL1 is ~ 125 μm $\epsilon = 0.93$
- PXL1 pointing at the VTX is < 40 μm $\epsilon = 0.94$
- ϵ = track matching efficiency





Annual Expert-Only Start-up Tasks

- STAR Global Interlocks OK. STAR inner field cage air ON.
- Check that SSD interlock permissive is OK (behind Wiener crates)
- Start SSD cooling air (industrial vacuum on North Platform)
- Wiener Power Crates plugged in and ON (rack 1C6) VME crate for RDO ON (rack 1C3, crate 97, see next page)
- USB hubs up and fibers OK
 - Two behind VME crate for RDO's, in control room (SSD desk) and DAQ room (behind `ssd-upgrade`)
- SSD computer in control room is up & `ssd-upgrade.starp.bnl.gov` is up
- Wiener LV Settings
 - 2.2 Volts @ 2 Amps Group 2 PWM = 3.5 Moderate Reg checked, Slow Reg checked, Enable inhibit checked
 - 2.5 Volts @ 4 Amps Group 2 PWM = 7.0 Moderate Reg checked, Slow Reg checked, Enable inhibit checked
 - 5.0 Volts @ 3 Amps Group 5 PWM = 4.6 Moderate Reg checked, Slow Reg checked, Enable inhibit checked
- Start IOCs on `ssd-upgrade.starp.bnl.gov` (`/ioc/siocps > sh run`, `/ioc/siocftdi > sh run`)
 - (Cntrl-A + Cntrl-D) to disconnect, `screen -list` to view running screens, `screen -r #####` to reconnect
- `cd` to `/home/ssd` and start SSD Control Panel with “`sh ssdTop`”
- Read, review and set HV Bias and Alarms settings with scripts in `epics/ioc/siocps/head/scripts`
 - `sh SSDPower_Bias_Set`
 - `sh SSDPower_Bias_Alarm`
 - `sh SSDPower_Alarm_Set`
- Calibrate LVDS link ... you should see `0xFF...FF80400000` for all 5 RDO's if successful
 - a button under the Ladder Expert screen. Start SSD and perhaps do again, if necessary, and restart SSD
- Start SSD with special attention to Pedestal (Raw) versus Normal running

File Locations & VME Crate Numbers

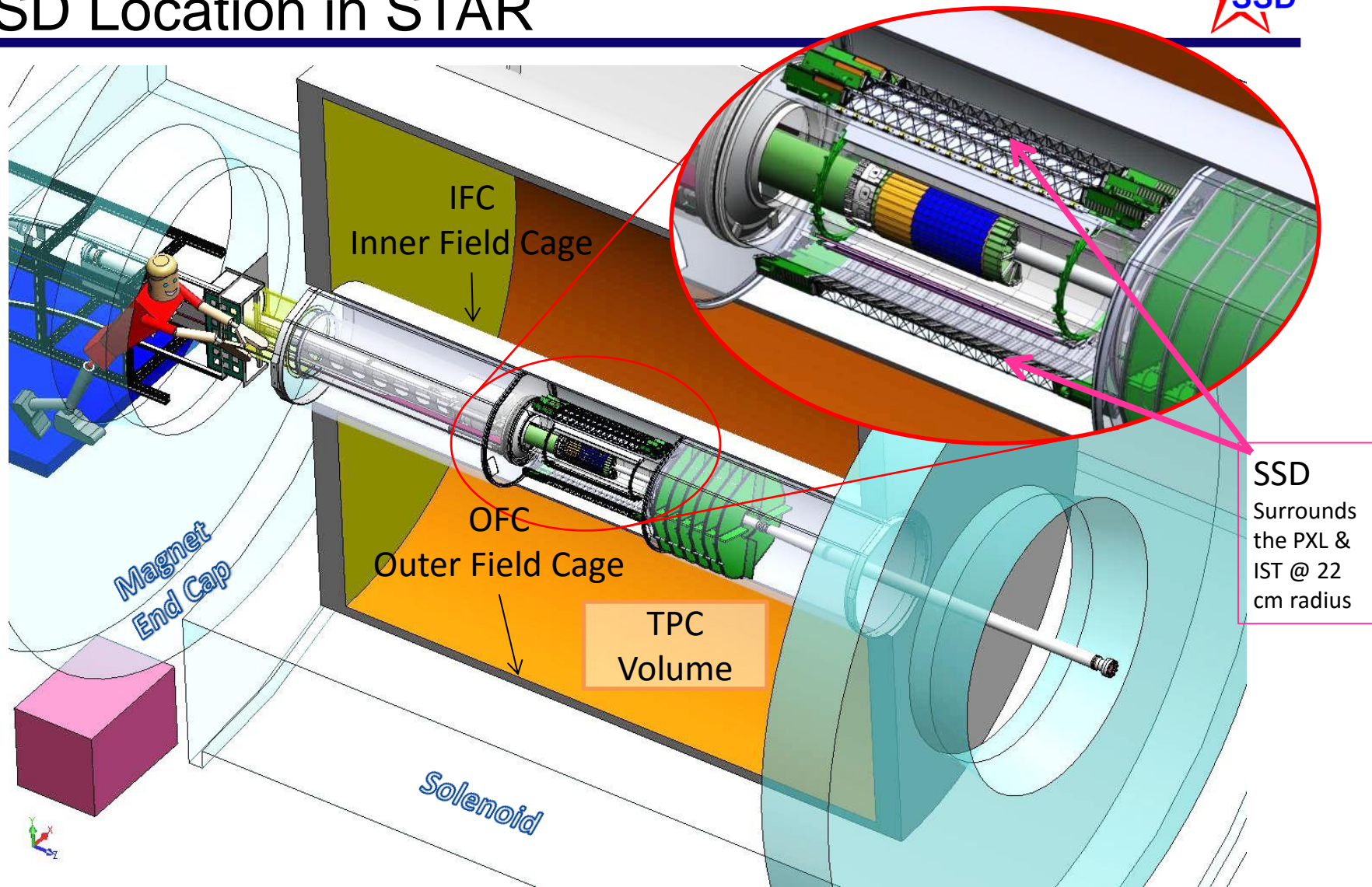
- Pedestal files from DAQ on ssd-upgrade.starp.bnl.gov
 - /data/PEDESTALS
- Pedestals to be installed in RDOs on ssd-upgrade
 - /usr/local/epics/ioc/siocftdi/head/scripts/cmd/PEDESTALS
- High resolution online plots ... use ROOT TBrowser to view
 - /net/evp.starp.bnl.gov/a/jevp/rootfiles/*.root
- Cycle power on RDO VME crate 97 to reload firmware in RDO's
 - SSH to sysuser@sc5.starp.bnl.gov
 - type “vme_plat1” alias for “medm -x -cleanup /home/sysuser/GUI/vme/vme_1st_plat.adl &”
 - Select pink square on crate 97, mouse over and click vme 97
 - Click “Control Off”, wait 3 minutes, click “Control On”
 - Check that fans ramp up to 3120 ... bump up if necessary
- To load RDO firmware, go to MobaXterm \ssd account (on Windows)
 - Execute “/RDO_Config_BIT.sh -v 0039 -s 1” (and then 2). See page 7 of Luis's SSD operations manual, section 11, for more details.
- To start online plots, logon to rts05 and start jevp (ignore server tags on file menu(?))
- MPOD Crates for Wiener Power supplies: 130.199.60.11 and 130.100.60.15

Tuning a new MPOD or ISEG module

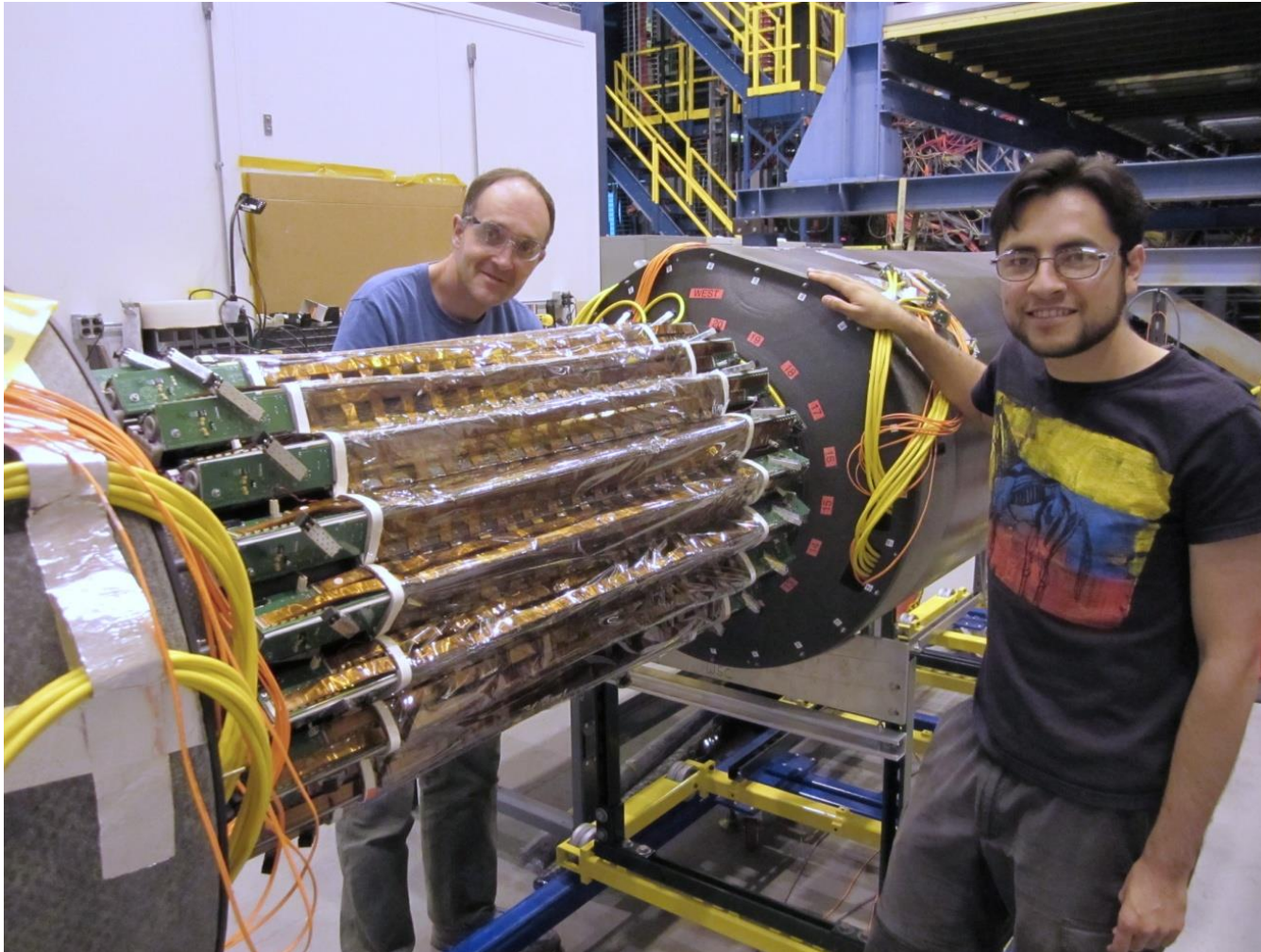
- Changes to MPV8016 “2” volt modules (all 8 channels)
 - Even Channels => 2.2 Volt Sense at 2 amps
 - Odd Channels => 2.5 Volt Sense at 4 amps
 - Untick internal reference, tick external, >1m and > 50m (3 tick boxes)
 - 10.0 Max voltage, 10.0 Max voltage
 - Group 2
 - PWM offset 3.5 for even channels, 7.0 for odd channels
 - Use Muse control Admin Mode to adjust PWM offsets
- MPV8016 “5” volt modules have different settings
 - 5.0 Volt Sense at 3 amps
 - Untick internal reference, tick external, >1m and > 50m (3 tick boxes)
 - 10.0 Max Voltage, 10.0 Max voltage
 - Group 5
 - PWM offset 4.6
- ISEG HV modules
 - Activate external safety loop with a jumper on the back of the module (!)

Backup Slides

SSD Location in STAR



The SSD before inserting into the TPC

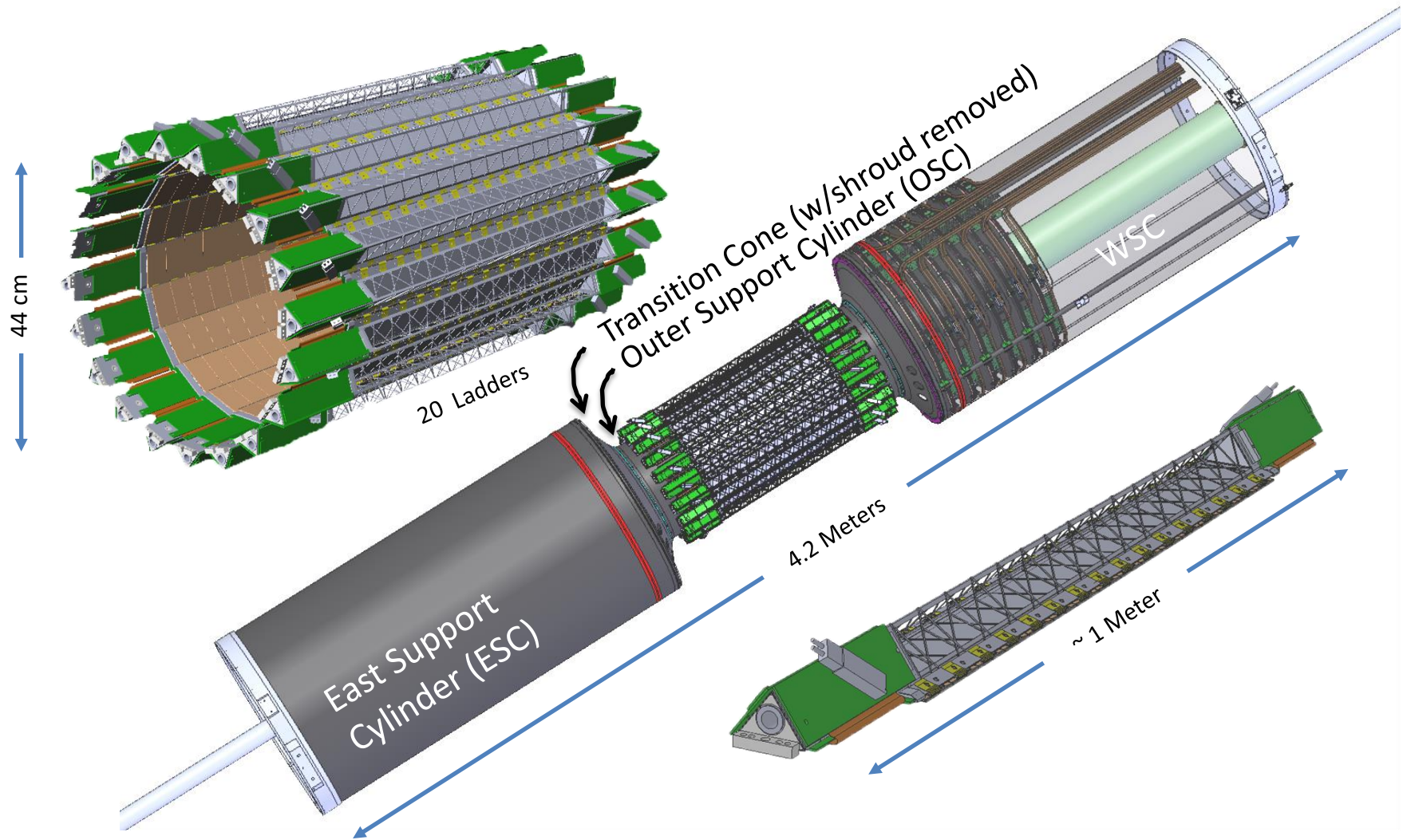


Special thanks to Thorsten and Luis for this small miracle

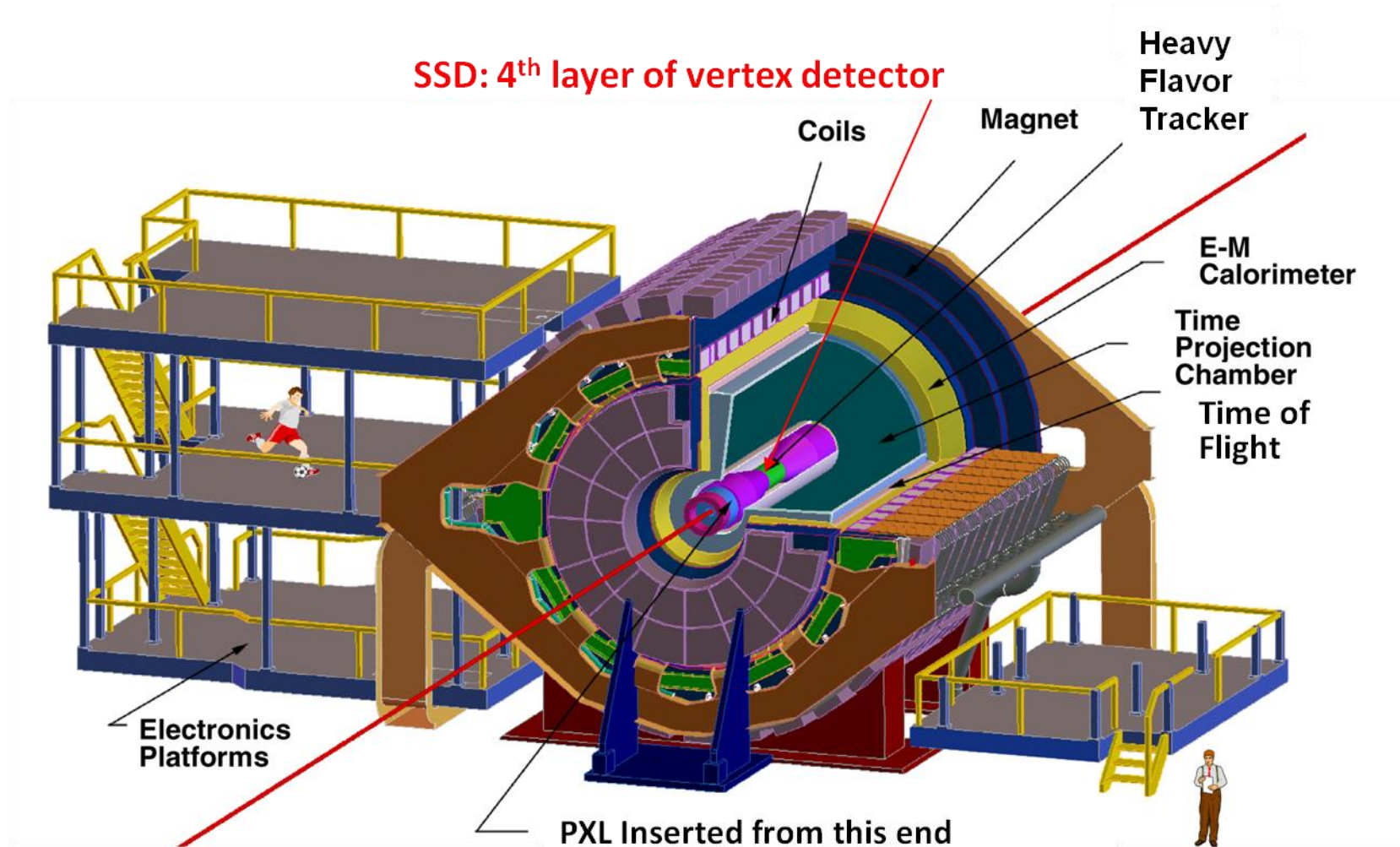
Ladder card performance is excellent

Performance of ladders is as good as it was in 2007 (i.e. 90-95% live modules)

SSD Overview – the SSD sits on the OSC

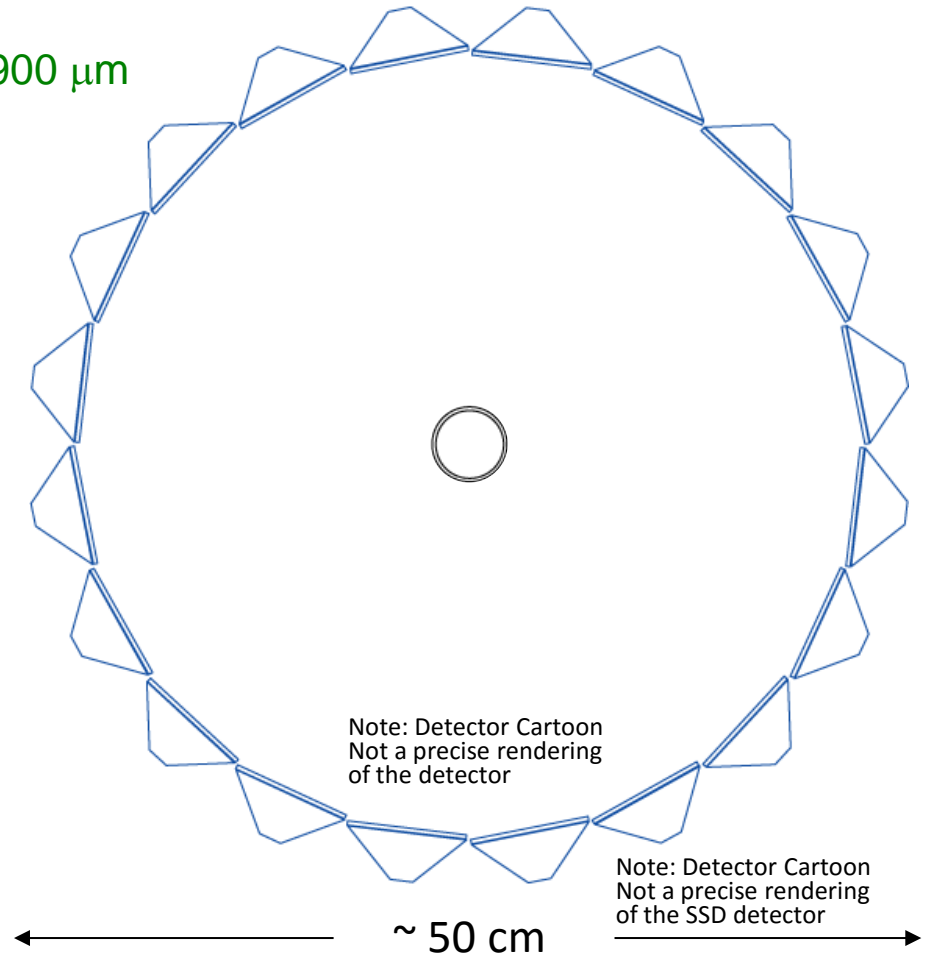
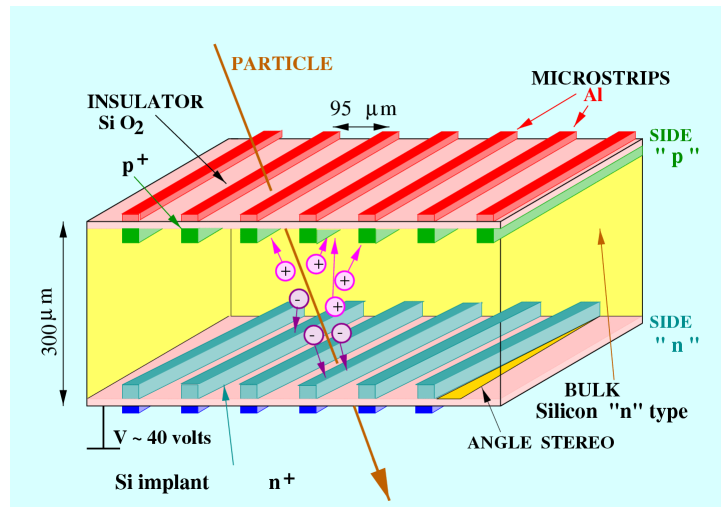


The STAR Silicon Strip Detector

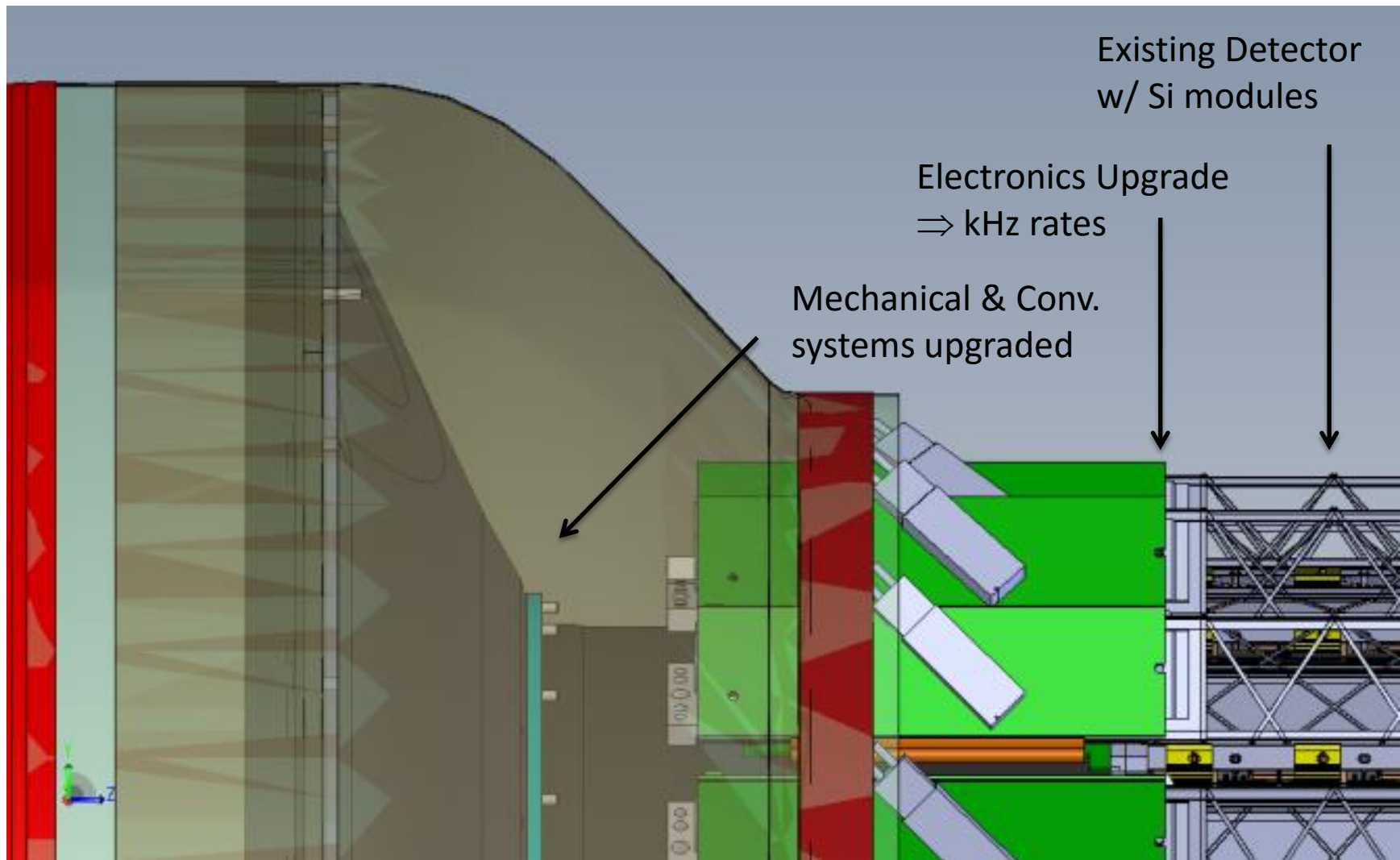


SSD Parameters

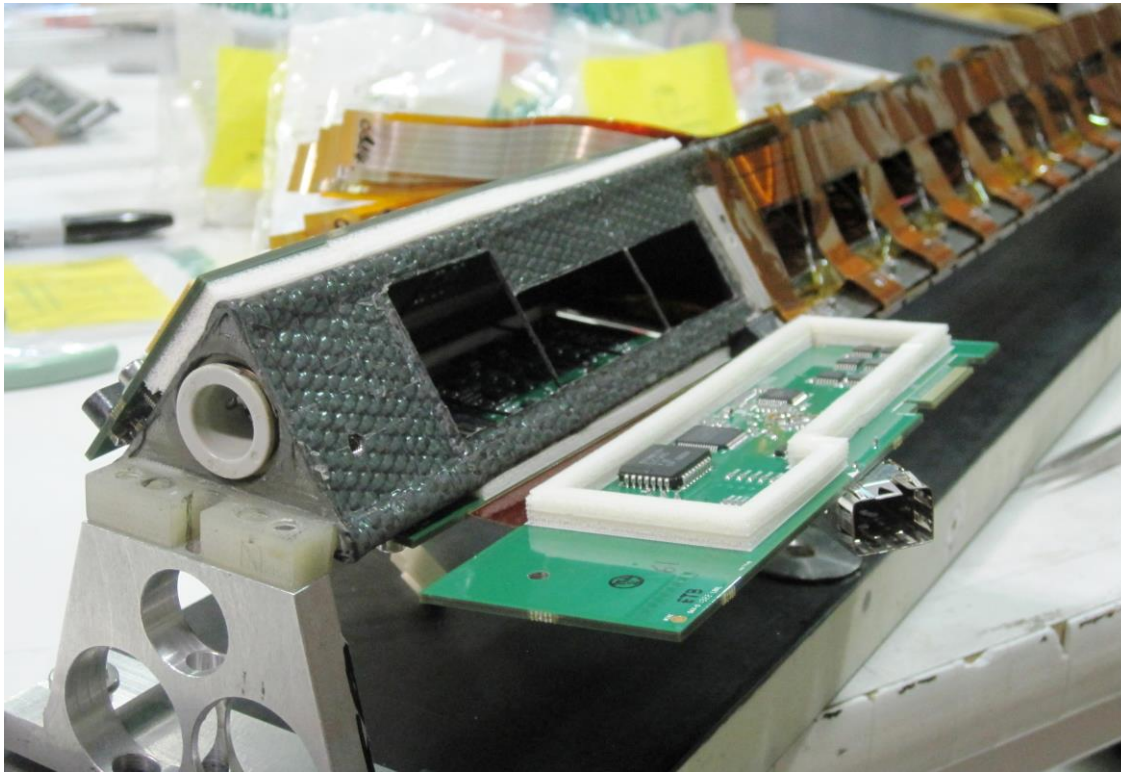
- Double sided Si wafers 300 μm thick with 95 μm strips that are 4.2 cm long
 - Strips crossed at 35 mrad
 effective resolution 30 μm x 900 μm
- Located at 22 cm radius
 - 20 ladders, 67 cm long
- air cooled
- $|\eta| < 1.2$
- 1 % radiation length @ $\eta = 0$



The SSD was an existing detector \Rightarrow upgrade

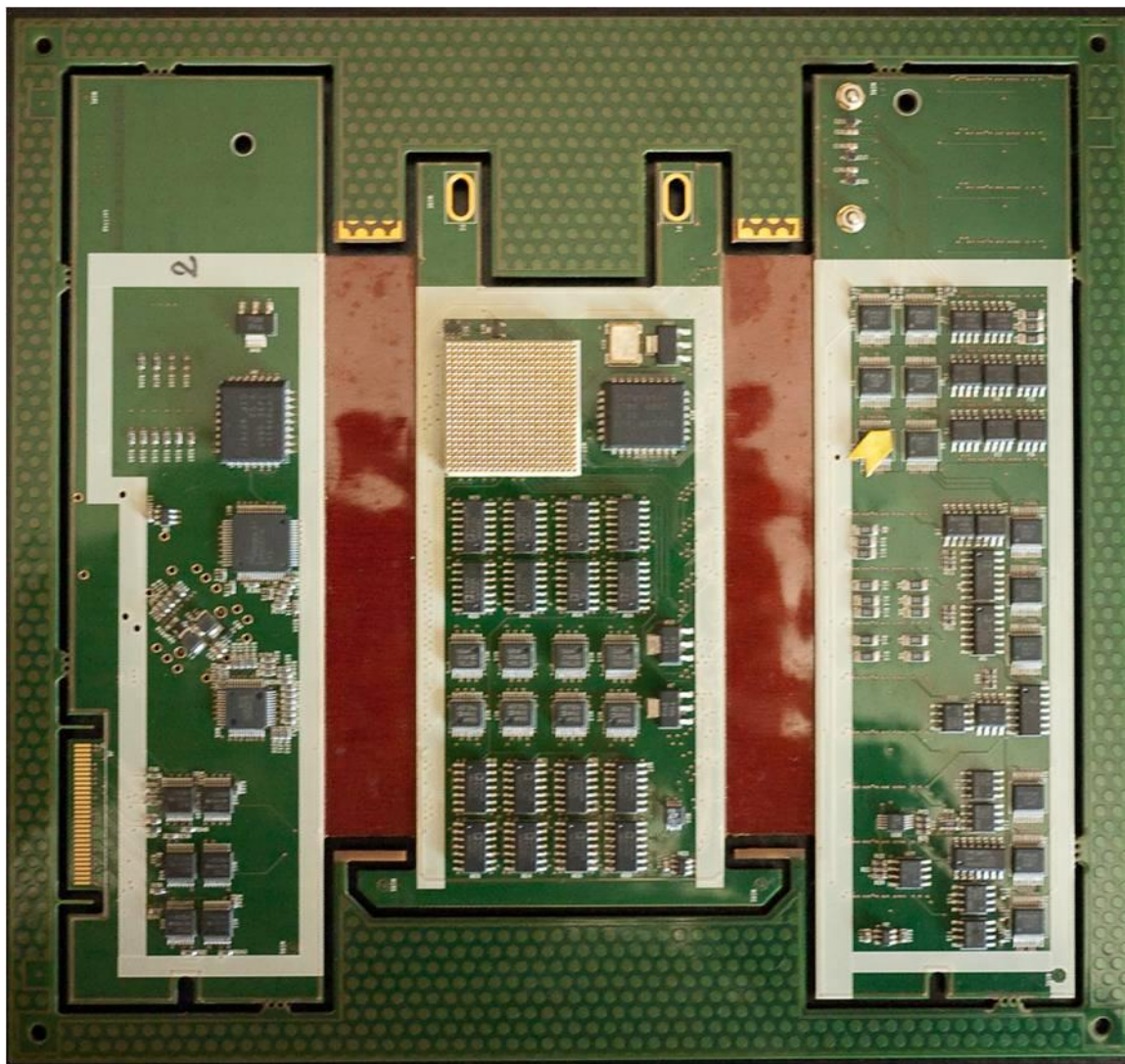


Ladders and Ladder Cards



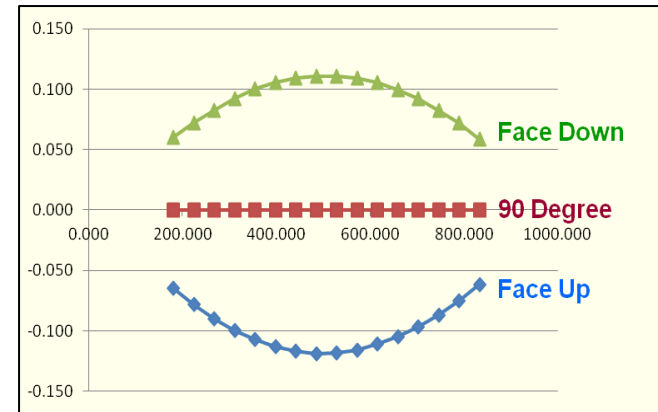
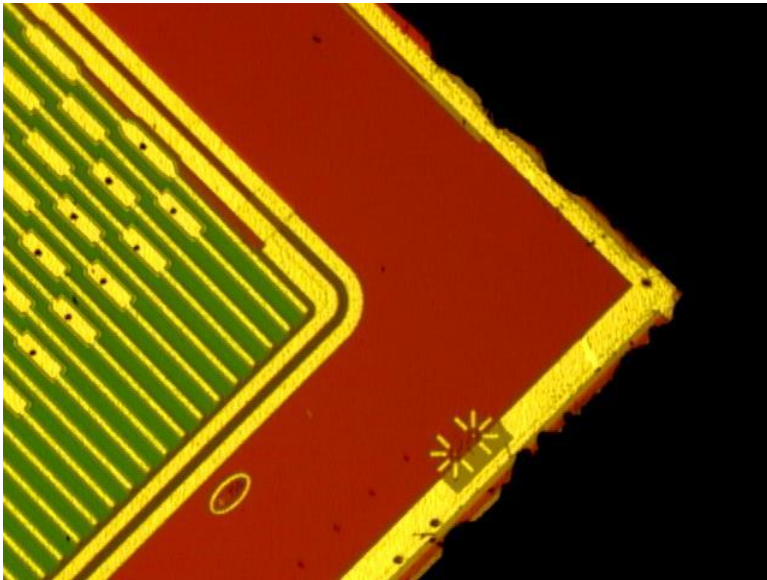
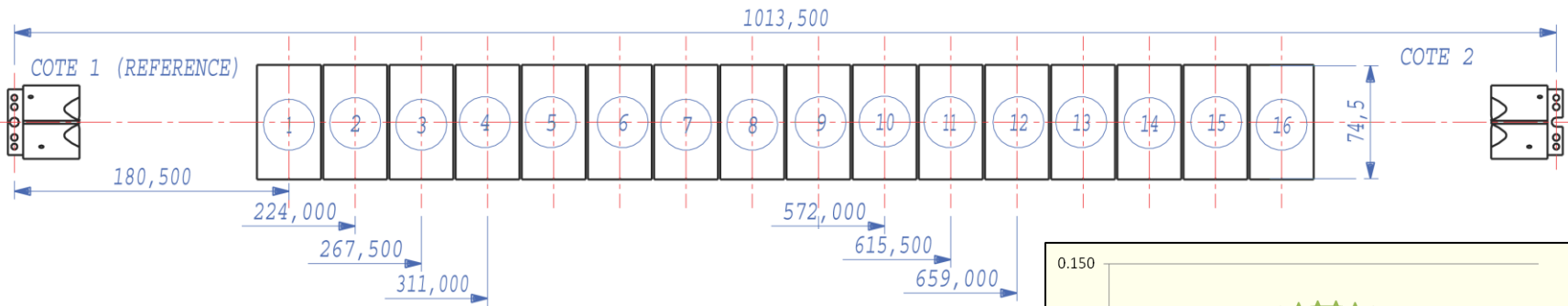
- Foam and Mylar wrap applied to Ladders and Ladder Cards
- Ladders installed and tested
- Analog performance is excellent (analog noise < noise from modules)
- JTAG communications work, T readback OK
- Power consumption is as expected for +5V, +2 V but -2V is a bit high ... may be an issue with power supplies over long lines.

Ladder Cards



- The Ladder Card contains the ADC to read-out each of the Si modules
- On-board FPGA
- Faster, lower noise
 - 1 kHz (16% DT)
 - 10x lower noise

Survey



- Ladders were surveyed to $\sim 10 \mu\text{m}$ precision
- Typically, the wafers are positioned $< 50 \mu\text{m}$ wrt the goal, comparable to our resolution
- A small number of wafers are displaced $\sim 1 \text{ mm}$
- The displacement due to gravity of each ladder has been measured