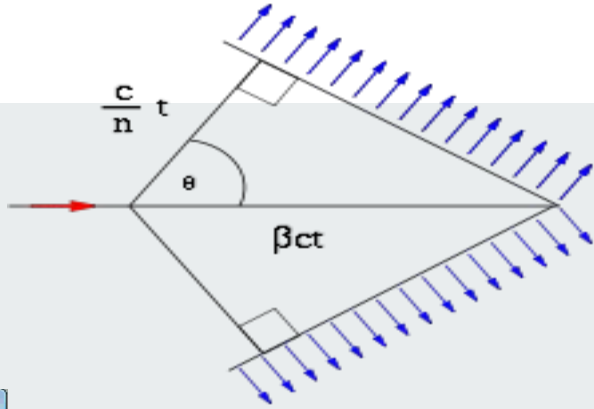
We All Fix the iFix

Updating the Slow Controls System at FTBF

Eha Srivastava, James Kennedy



Test_beam/MTEST_Beam_Cer_1_upstream.grf

6/25/2018
10:33:26 AM

Return to Main Page | MTEST BCKOV 2 (Downstream) | Login/ofl

MTEST BCKOV 1 (Upstream)

38.4 psig
PT-US18-G
49.8 psia

Gas Supply From Gas Shed

EV-US14-G Fast Slow
EV-US13-G

EV-US11-V Fast Slow
EV-US12-V

Use for P > 1 Torr PT-US15A-V: 0.5 Torr
Use for P < 1 Torr PT-US15B-V: 445.4 Microns

Anti-suckback valve

Dry vacuum pump

Total pump hours: 4498.7

Note: Green indicates pump on, red indicates pump off.
Green indicates valve open, red indicates valve closed.
Pump rebuild should be considered at 16,000 hrs.

Vessel ultimate ~15 microns

Note: Selecting the gas changes the density calculation. It does not open and close valves to change the gas delivered to the ckov.

Note: Maximum pressure system will fill to is 21.5 psia.
Relief valve set point 8 psig ~

P > 1 Torr PT-US16A-V: 4.8 Torr
P < 1 Torr PT-US16B-V: 1046.4 Microns
Note: 1 psi = 51.71 Torr, 1000 microns = 1 Torr

Temp.: 23.38 °C TE-US17-G
Abs. Pres.: 0.1128 psia PT-US17-G
Computed Density: 0.00059 lbm/ft^3

Select Gas: N2 | CO2 | C4F10

Desired Density: 0.00050 lbm/ft^3
In auto mode, enter desired density in above box

Est. Press. for Setpt.: 0.1022 psia
Difference: -0.0106 psi

Density Error: 0.000094 lbm/ft^3

CKOV Volume ~ 46 ft^3

BCKOV1 HEAD

Beam

Titanium Window #2

BCKOV 2
Abs. Pres.:
1.5790
psia

Density Deviation: 0.0004 lbm/ft^3

Auto | Evacuate

Note: Vacuum pump shuts off after 1 hr of valve inactivity in Auto and Manual Modes. Please minimize pump hrs in vacuum mode!

Manual

EV-US14-G Gas Fill Slow	Open / Close
EV-US13-G Gas Fill Fast	Open / Close
EV-US12-V Vacum Slow	Open / Close
EV-US11-V Vacum Fast	Open / Close
DS-VAC-PMP Vacum Pump	Turn On / Turn Off

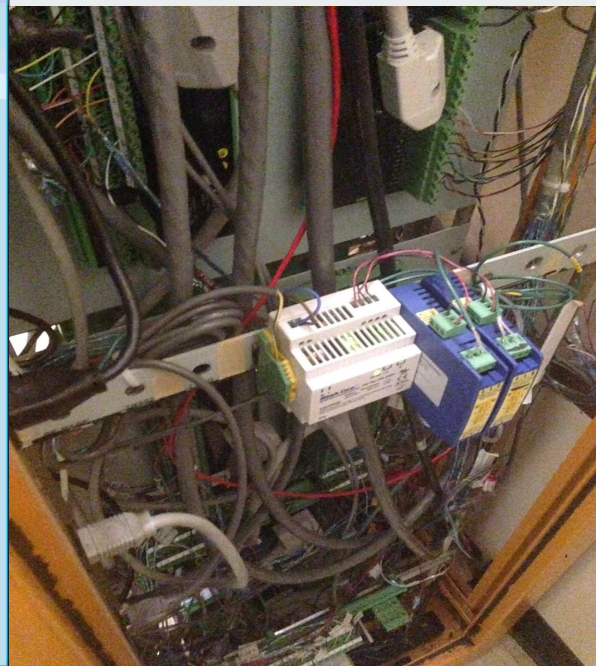
total # of Ti window #2 reversals: 14
# of Ti window #2 reversals remaining: 36

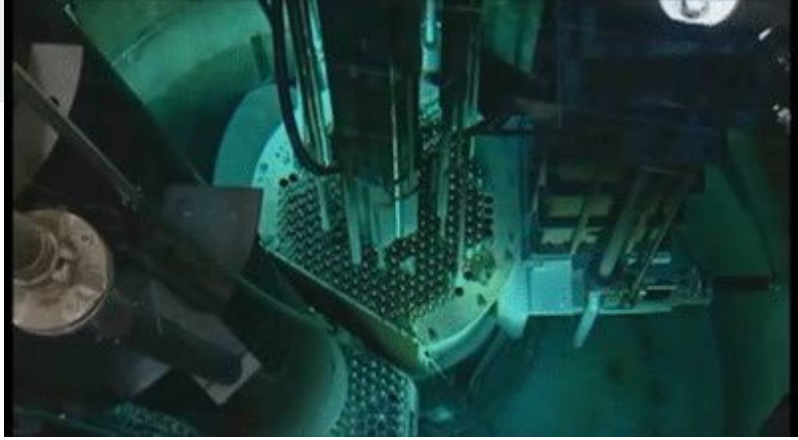
Density Estimator
If desired pressure is known, calculates density to enter as Desired Density in Auto mode.

Enter Pressure: 0.1000 psia
Corresponding Density: 0.00049 lbm/ft^3

Note: Manual mode valve and pump buttons will only actuate valves and pump if all interlocks are satisfied. If pump is off, a vacuum valve open request will turn on the pump and the valve will open 20 sec later. If the pump is running, Turn On may have to be clicked before Turn Off to turn off the pump.

Window cycle plot: PLOT | Historical analog data: PLOT | Historical discrete data: PLOT





What is Cerenkov Radiation?

- Charged particle travels through a medium faster than light in that medium
- Causes emission of photons which can be detected
- Like a sonic boom, but with light

How do the Detectors Work?

- Beam enters counter
- Cerenkov radiation reflects off concave mirror M1
- Focused into ring of light
  - Radius = Cerenkov angle * focal length
- Slit in plane mirror M2 allows some light to enter inner PMT
- Light reflects into outer PMT

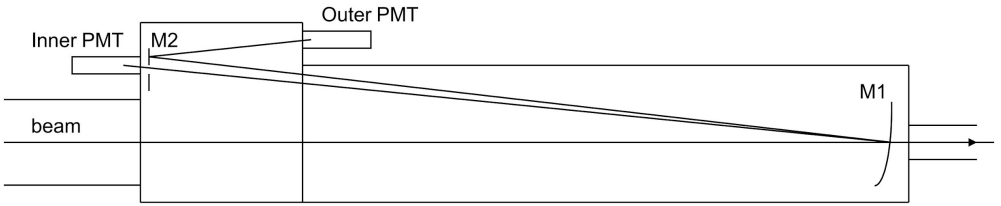
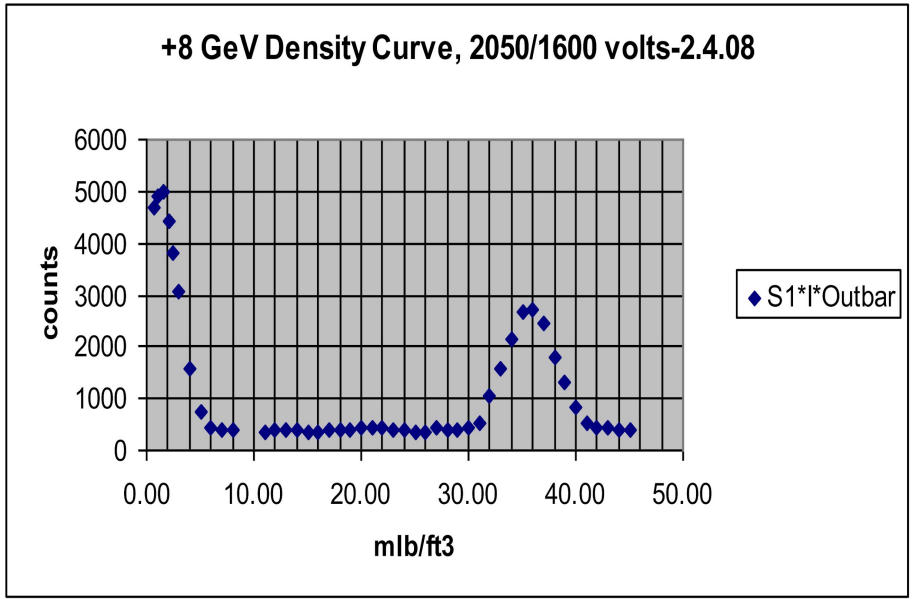


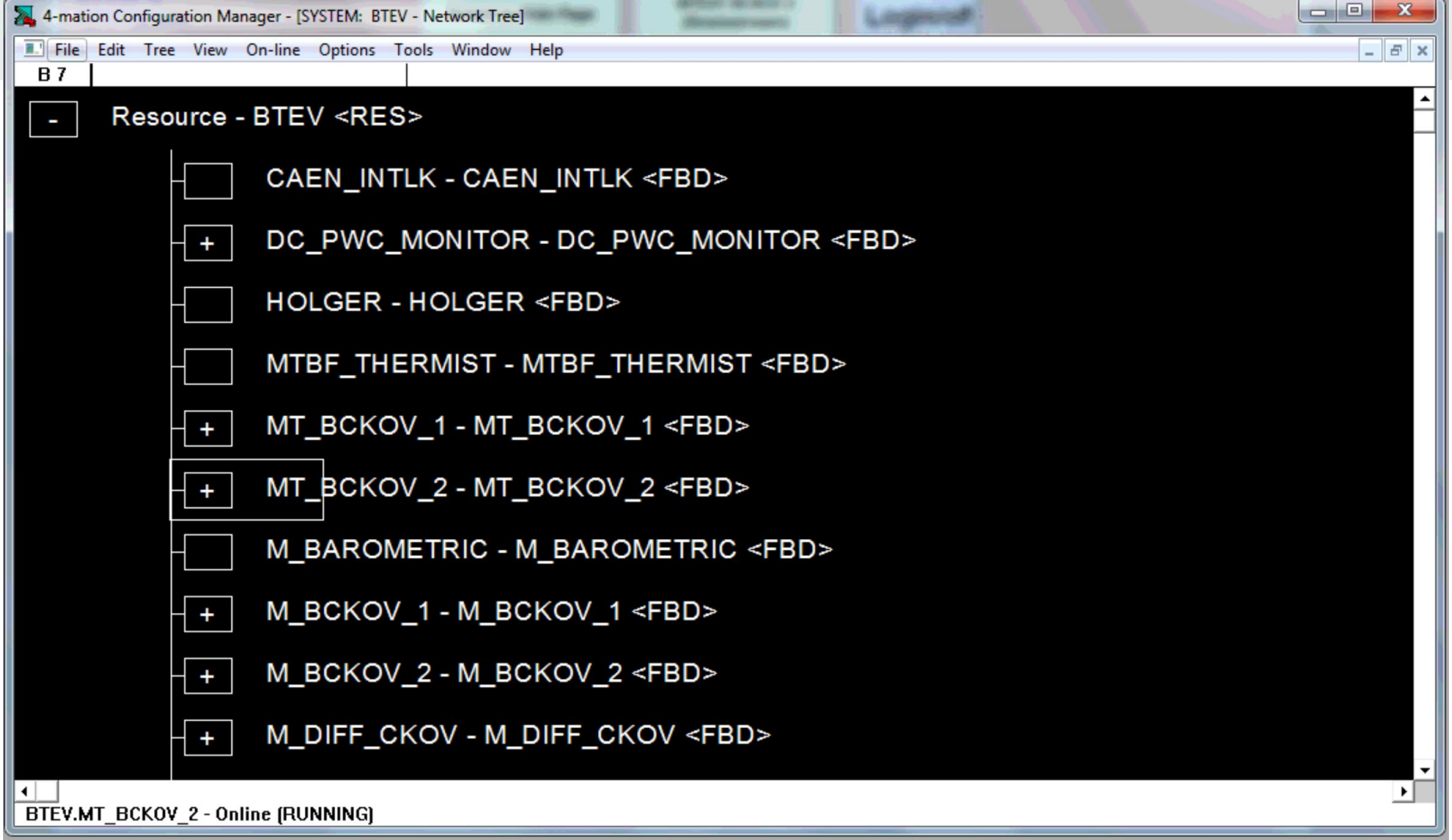
Fig. 1: Differential Cherenkov Counter Optics

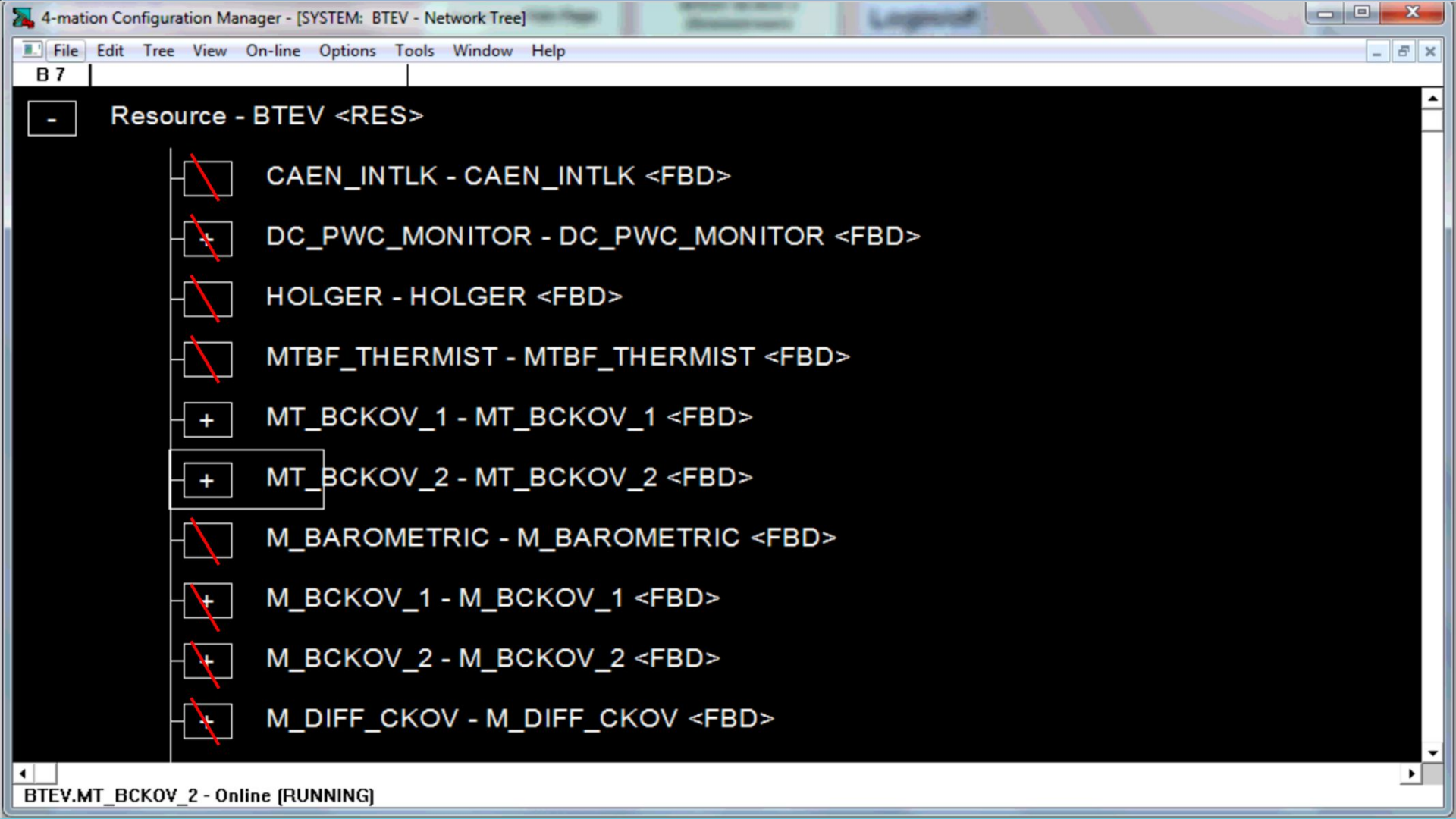
What are the detectors used for?

$$\beta = v/c \qquad \theta_C = \cos^{-1}\left(\frac{1}{\beta n}\right)$$

- Particle identification
- Given constant momentum beam, particles of different mass have different beta values
- To appear in large frequencies at a given angle, particles of different mass require different n




4-mation Configuration Manager - [SYSTEM: BTEV - Network Tree]
File Edit Tree View On-line Options Tools Window Help
B 7
- Resource - BTEV <RES>
CAEN_INTLK - CAEN_INTLK <FBD>
+ DC_PWC_MONITOR - DC_PWC_MONITOR <FBD>
HOLGER - HOLGER <FBD>
MTBF_THERMIST - MTBF_THERMIST <FBD>
+ MT_BCKOV_1 - MT_BCKOV_1 <FBD>
+ MT_BCKOV_2 - MT_BCKOV_2 <FBD>
M_BAROMETRIC - M_BAROMETRIC <FBD>
+ M_BCKOV_1 - M_BCKOV_1 <FBD>
+ M_BCKOV_2 - M_BCKOV_2 <FBD>
+ M_DIFF_CKOV - M_DIFF_CKOV <FBD>
BTEV.MT_BCKOV_2 - Online (RUNNING)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CAEN_INTLK - CAEN_INTLK <FBD>
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HOLGER - HOLGER <FBD>
MTBF_THERMIST - MTBF_THERMIST <FBD>
MT_BCKOV_1 - MT_BCKOV_1 <FBD>
MT_BCKOV_2 - MT_BCKOV_2 <FBD>
M_BAROMETRIC - M_BAROMETRIC <FBD>
M_BCKOV_1 - M_BCKOV_1 <FBD>
M_BCKOV_2 - M_BCKOV_2 <FBD>
M_DIFF_CKOV - M_DIFF_CKOV <FBD>
BTEV.MT_BCKOV_2 - Online (RUNNING)

What is our goal?

- Replace APACS system, iFIX console, 4-mation software with new hardware and software
- Transfer necessary wires, modules, connections of old system to new system
- Improve documentation
- Expand to include all systems at Test Beam Facility

What is the Pr

- Verify existing co
- Identify which mo
  connections are n
  - Remove mod
    not useful / fu

Downstream 15 pair cable to APACS color	Downstream 15 pair cable to APACS pair #	APACS channel or ps terminal	Labels to place on cables at APACS end
BLK	1	R01S10 SDM+ CH8	EV-DS1-V
RED		Common terminal	
BLK	2	R01S10 SDM+ CH9	EV-DS2-V
WHT		Common terminal	
BLK	3	R01S10 SDM+ CH17	EV-DS3-G
GRN		Common terminal	
BLK	4	R01S10 SDM+ CH18	EV-DS4-G
BLU		Common terminal	
BLK	5	R01S10 SDM+ CH19	DS-VAC-PMP
YEL		Common terminal	
no connection	-	-	-
no connection	-	-	-
no connection	-	-	-
no connection	-	-	-

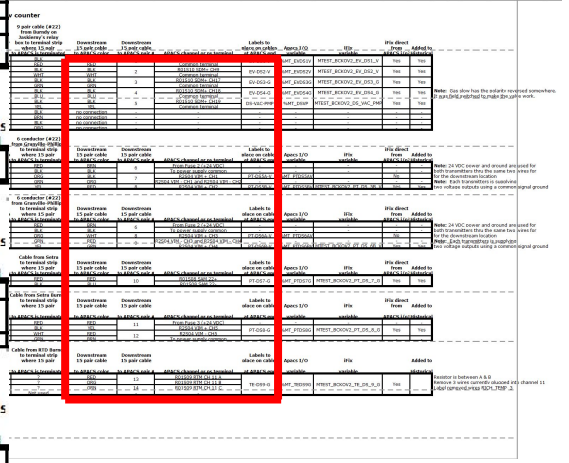
Downstream 15 pair cable to APACS color	Downstream 15 pair cable to APACS pair #	APACS channel or ps terminal	Labels to place on cables at APACS end
BRN	6	From Fuse 2 (+24 VDC)	-
BLK		To power supply common	-
BLK	7	R2S04 VIM + CH1	PT-DS5A-V
ORG		R2S04 VIM - CH1 and R2S04 VIM - CH2	-
RED	8	R2S04 VIM + CH2	PT-DS5B-V

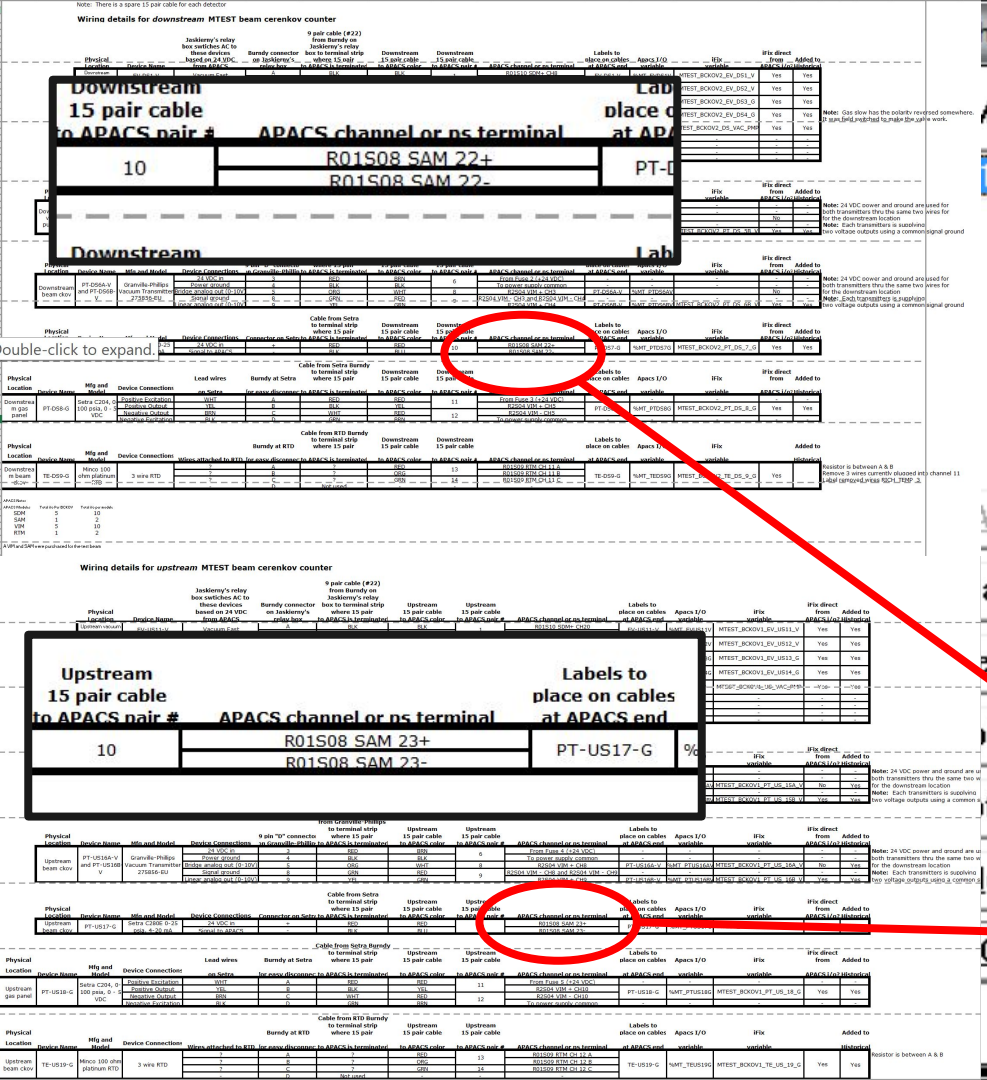
Downstream 15 pair cable to APACS color	Downstream 15 pair cable to APACS pair #	APACS channel or ps terminal	Labels to place on cables at APACS end
BRN	6	From Fuse 2 (+24 VDC)	-
BLK		To power supply common	-
WHT	8	R2S04 VIM + CH3	PT-DS6A-V
RED	9	R2S04 VIM - CH3 and R2S04 VIM - CH4	-
GRN		R2S04 VIM + CH4	PT-DS6B-V

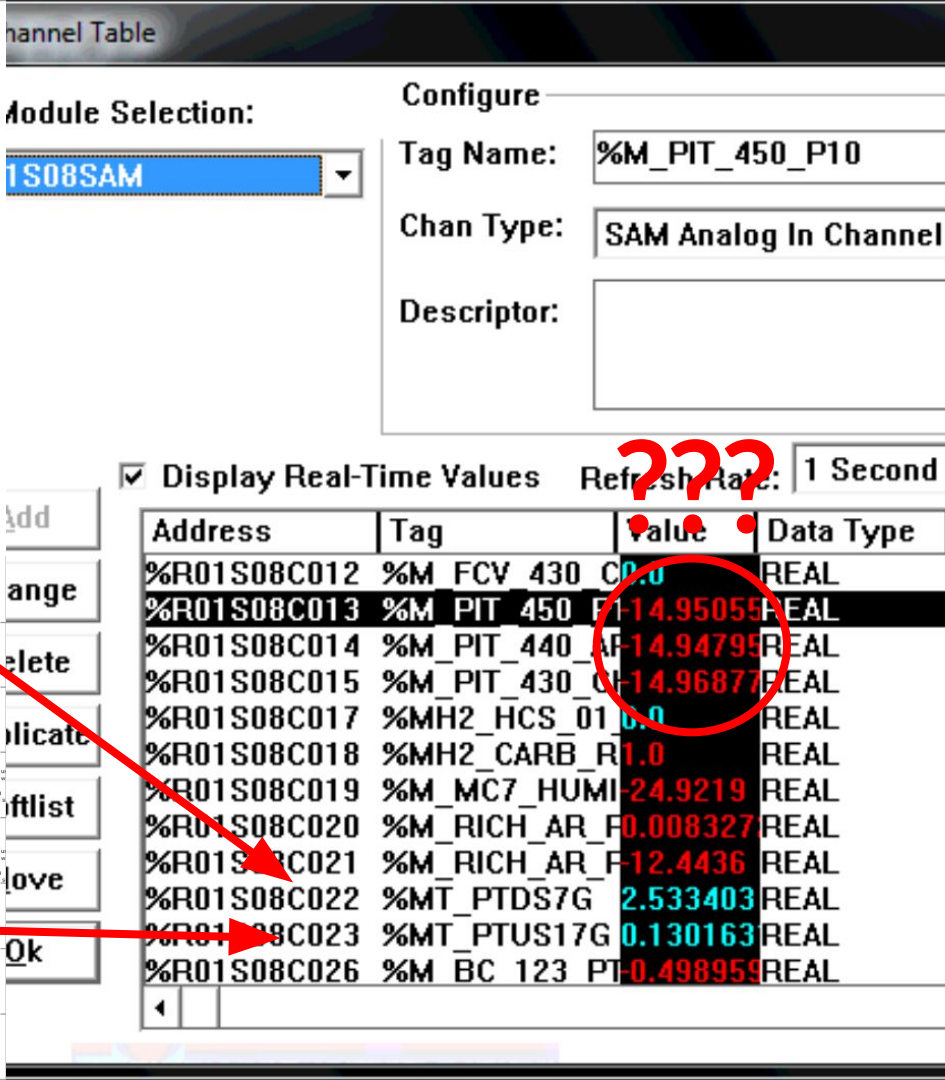
Downstream 15 pair cable to APACS color	Downstream 15 pair cable to APACS pair #	APACS channel or ps terminal	Labels to place on cables at APACS end
RED	10	R01S08 SAM 22+	PT-DS7-G
BLU		R01S08 SAM 22-	

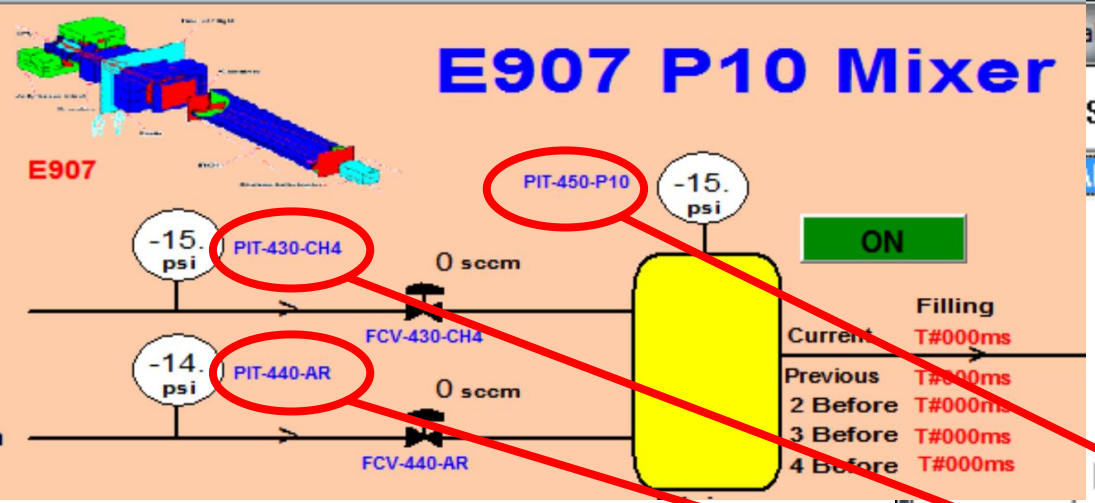
Downstream 15 pair cable to APACS color	Downstream 15 pair cable to APACS pair #	APACS channel or ps terminal	Labels to place on cables at APACS end
RED	11	From Fuse 3 (+24 VDC)	-
YEL		R2S04 VIM + CH5	PT-DS8-G
RED	12	R2S04 VIM - CH5	
BRN		To power supply common	-

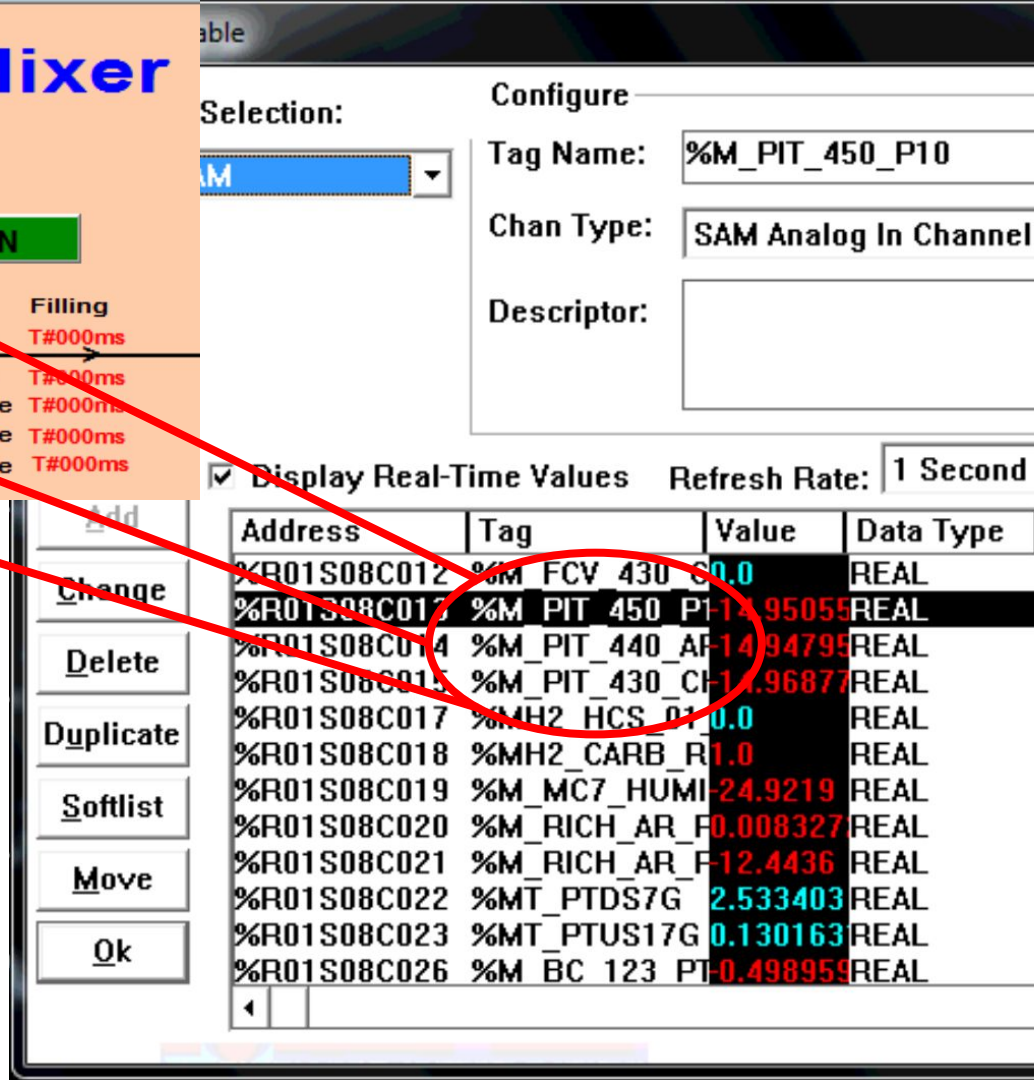
Downstream 15 pair cable to APACS color	Downstream 15 pair cable to APACS pair #	APACS channel or ps terminal	Labels to place on cables at APACS end
RED	13	R01S09 RTM CH 11 A	TE-DS9-G
ORG		R01S09 RTM CH 11 B	
GRN	14	R01S09 RTM CH 11 C	



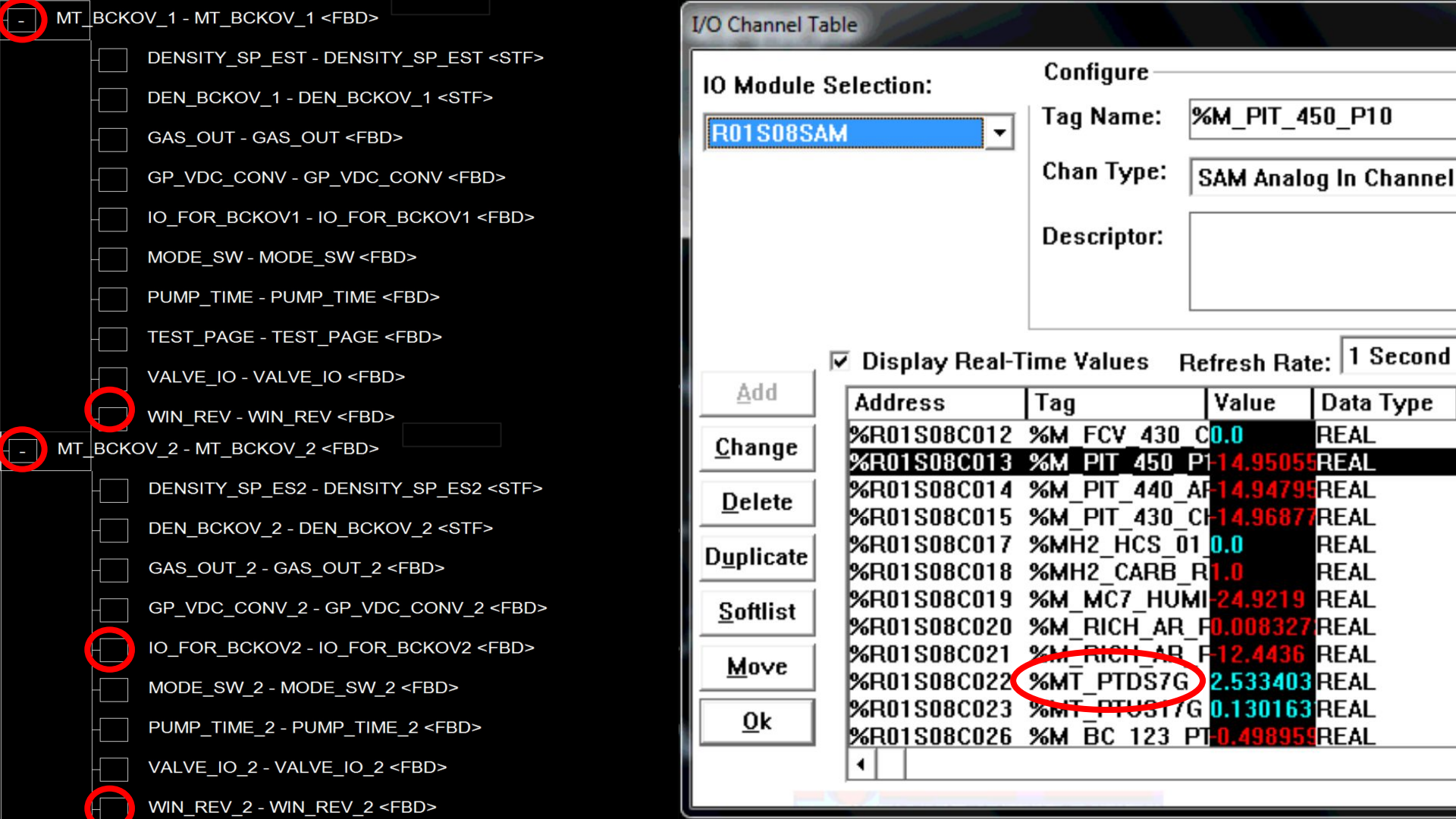

Wiring details for downstream MTEST beam cerenkov counter
Downstream
15 pair cable
to APACS pair #
APACS channel or ps terminal
Labels to
place on cables
at APACS end
10
R01S08 SAM 22+
R01S08 SAM 22-
PT-US17-G
Wiring details for upstream MTEST beam cerenkov counter
Upstream
15 pair cable
to APACS pair #
APACS channel or ps terminal
Labels to
place on cables
at APACS end
10
R01S08 SAM 23+
R01S08 SAM 23-
PT-US17-G


Module Selection:
1S08SAM
Configure
Tag Name:
%M_PIT_450_P10
Chan Type:
SAM Analog In Channel
Descriptor:
Display Real-Time Values
Refresh Rate:
1 Second
???
Address
Tag
Value
Data Type
%R01S08C012 %M_FCV_430_C 0.0 REAL
%R01S08C013 %M_PIT_450_P -14.95055 REAL
%R01S08C014 %M_PIT_440_A -14.94795 REAL
%R01S08C015 %M_PIT_430_C -14.96877 REAL
%R01S08C017 %MH2_HCS_01_ 0.0 REAL
%R01S08C018 %MH2_CARB_R 1.0 REAL
%R01S08C019 %M_MC7_HUMI -24.9219 REAL
%R01S08C020 %M_RICH_AR_P 0.008327 REAL
%R01S08C021 %M_RICH_AR_P -12.4436 REAL
%R01S08C022 %MT_PTDS7G 2.533403 REAL
%R01S08C023 %MT_PTUS17G 0.130163 REAL
%R01S08C026 %M_BC_123_PT -0.498959 REAL





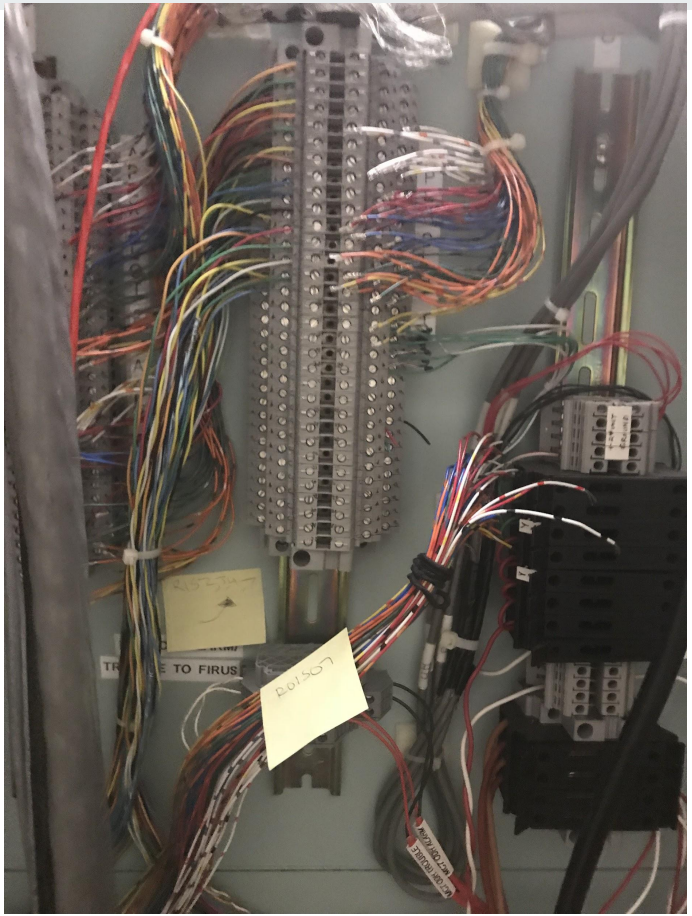
- E907 Detectors are no longer in use
- PIT-430, PIT-440, PIT-450 are no longer important to monitor
- C013, C014, C015 can be unplugged


MT_BCKOV_1 - MT_BCKOV_1 <FBD>
DENSITY_SP_EST - DENSITY_SP_EST <STF>
DEN_BCKOV_1 - DEN_BCKOV_1 <STF>
GAS_OUT - GAS_OUT <FBD>
GP_VDC_CONV - GP_VDC_CONV <FBD>
IO_FOR_BCKOV1 - IO_FOR_BCKOV1 <FBD>
MODE_SW - MODE_SW <FBD>
PUMP_TIME - PUMP_TIME <FBD>
TEST_PAGE - TEST_PAGE <FBD>
VALVE_IO - VALVE_IO <FBD>
WIN_REV - WIN_REV <FBD>
MT_BCKOV_2 - MT_BCKOV_2 <FBD>
DENSITY_SP_ES2 - DENSITY_SP_ES2 <STF>
DEN_BCKOV_2 - DEN_BCKOV_2 <STF>
GAS_OUT_2 - GAS_OUT_2 <FBD>
GP_VDC_CONV_2 - GP_VDC_CONV_2 <FBD>
IO_FOR_BCKOV2 - IO_FOR_BCKOV2 <FBD>
MODE_SW_2 - MODE_SW_2 <FBD>
PUMP_TIME_2 - PUMP_TIME_2 <FBD>
VALVE_IO_2 - VALVE_IO_2 <FBD>
WIN_REV_2 - WIN_REV_2 <FBD>
I/O Channel Table
IO Module Selection:
R01S08SAM
Configure
Tag Name:
%M_PIT_450_P10
Chan Type:
SAM Analog In Channel
Descriptor:
Display Real-Time Values
Refresh Rate:
1 Second
Add
Change
Delete
Duplicate
Softlist
Move
Ok
Address
Tag
Value
Data Type
%R01S08C012 %M_FCV_430_C 0.0 REAL
%R01S08C013 %M_PIT_450_P -14.95055 REAL
%R01S08C014 %M_PIT_440_AF -14.94795 REAL
%R01S08C015 %M_PIT_430_CI -14.96877 REAL
%R01S08C017 %MH2_HCS_01_ 0.0 REAL
%R01S08C018 %MH2_CARB_R 1.0 REAL
%R01S08C019 %M_MC7_HUMI -24.9219 REAL
%R01S08C020 %M_RICH_AR_F 0.008327 REAL
%R01S08C021 %M_RICH_AR_F -12.4436 REAL
%R01S08C022 %MT_PTDS7G 2.533403 REAL
%R01S08C023 %MT_PTUS17G 0.130163 REAL
%R01S08C026 %M_BC_123_PT -0.498959 REAL

IO Module Address	Channel Number	Is it dead?
R01S02 (UNPLUGGED)	24	No
	25	No
	26	No
	27	No
R01S03 (UNPLUGGED)	ALL	Yes
R01S04 (UNPLUGGED)	8	No
	9	No
	10	No
	11	No
	12	No
	13	No
	16	No
R01S05 (UNPLUGGED)	ALL	Yes
R01S06 (IN FLUX)	ALL	No
R01S07 (UNPLUGGED)	ALL	Yes
R01S08 (SOLVED)	13	No
	14	No
	15	No
	18	No
	22	No
	23	No
R01S09 (SOLVED)	11	No
	12	No
R01S10 (PENDING CONF. 16)	8	Yes
	9	Yes
	17	Yes
	18	Yes

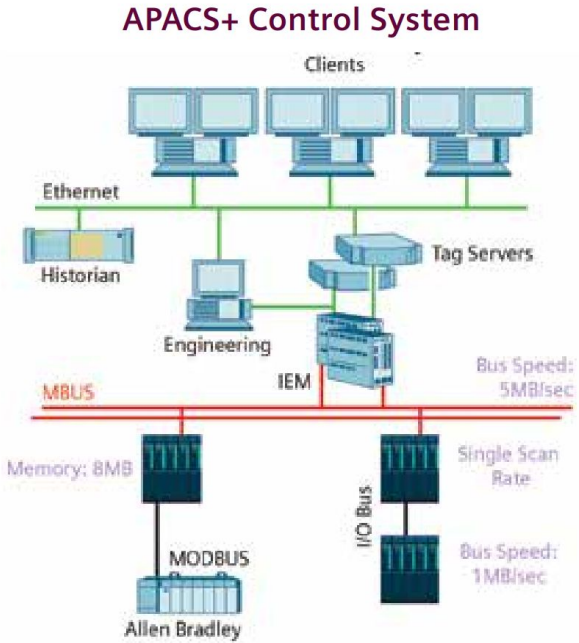
Tag	iFIX Network	iFIX Block	Channel Type	ep? (Y/N)
%MT_PTDS7G	MT_BCKOV_1 - MT_BCKOV_1	WIN_REV - WIN_REV	Analog In	
	MT_BCKOV_2 - MT_BCKOV_2			
	MT_BCKOV_2 - MT_BCKOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2		
	MT_BCKOV_2 - MT_BCKOV_2	WIN_REV_2 - WIN_REV_2		
%MT_PTUS17G	MT_BCKOV_1 - MT_BCKOV_1		Analog In	
	MT_BCKOV_1 - MT_BCKOV_1	IO_FOR_BCKOV1 - IO_FOR_BCKOV1		
	MT_BCKOV_1 - MT_BCKOV_1	WIN_REV - WIN_REV		
%MT_TEDS9G	MT_BCKOV_2 - MT_BCKOV_2		RTD In	
	MT_BCKOV_2 - MT_BCKOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2		
%MT_TEUS19G	MT_BCKOV_1 - MT_BCKOV_1		RTD In	
	MT_BCKOV_1 - MT_BCKOV_1	IO_FOR_BCKOV1 - IO_FOR_BCKOV1		
%MT_EVDS1V	MT_BCKOV_2 - MT_BCKOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2	Discrete Out	
	MT_BCKOV_2 - MT_BCKOV_2	VALVE_IO_2 - VALVE_IO_2		
%MT_EVDS2V	MT_BCKOV_2 - MT_BCKOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2	Discrete Out	
	MT_BCKOV_2 - MT_BCKOV_2	VALVE_IO_2 - VALVE_IO_2		
%MT_EVDS3G	MT_BCKOV_2 - MT_BCKOV_2	GAS_OUT_2 - GAS_OUT_2	Discrete Out	
	MT_BCKOV_2 - MT_BCKOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2		
	MT_BCKOV_2 - MT_BCKOV_2	VALVE_IO_2 - VALVE_IO_2		
%MT_EVDS4G	MT_BCKOV_2 - MT_BCKOV_2	GAS_OUT_2 - GAS_OUT_2	Discrete Out	
	MT_BCKOV_2 - MT_BCKOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2		
	MT_BCKOV_2 - MT_BCKOV_2	VALVE_IO_2 - VALVE_IO_2		

	iFIX Block	Channel Type
KOV_1	WIN_REV - WIN_REV	Analog In
KOV_2		
KOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2	
KOV_2	WIN_REV_2 - WIN_REV_2	
KOV_1		Analog In
KOV_1	IO_FOR_BCKOV1 - IO_FOR_BCKOV1	
KOV_1	WIN_REV - WIN_REV	
KOV_2		RTD In
KOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2	
KOV_1		RTD In
KOV_1	IO_FOR_BCKOV1 - IO_FOR_BCKOV1	
KOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2	Discrete Out
KOV_2	VALVE_IO_2 - VALVE_IO_2	
KOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2	Discrete Out
KOV_2	VALVE_IO_2 - VALVE_IO_2	
KOV_2	GAS_OUT_2 - GAS_OUT_2	Discrete Out
KOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2	
KOV_2	VALVE_IO_2 - VALVE_IO_2	
KOV_2	GAS_OUT_2 - GAS_OUT_2	Discrete Out
KOV_2	IO_FOR_BCKOV2 - IO_FOR_BCKOV2	
KOV_2	VALVE_IO_2 - VALVE_IO_2	



What are our hardware needs?

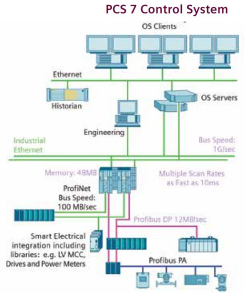
- Integrated HMI + PLC
- I/O Modules with room for future expansion
  - 2 analog inputs
  - 2 RTD inputs
  - 10 discrete outputs
  - 15 voltage inputs
  - Expandability
- Website interface OR Modbus



Upgrade Options

SIEMENS

- PCS 7
- Natural upgrade option
- But would keep the iFix network which we don't want



Maple Systems INC.

- HMC 7000
- Comes with software called Mapware 7000 which also offers the ability for web based remote access

HMC7070A-M

UNITRONICS®

- Unistream Modular and Built-In
- Offers Unilogic software which lets you make webpages to access remotely

What are our hardware needs?

- Integrated HMI + PLC

7.0" HMI + PLC

CLASS I, DIVISION 2 · c UL us LISTED · CE · RoHS Compliant

HMC7070A-M

Product Highlights

- Touchscreen
- 800 X 480 Pixel Resolution TFT
- Ethernet
- 5 I/O Expansion Ports
- 2 Serial Ports
- List Price: $700

What are our hardware needs?

- I/O Modules with room for future expansion
  - 2 analog inputs
  - 2 RTD inputs
  - 10 discrete outputs (sourcing)
  - 15 voltage inputs

HMC7-MIO-08

HMC7-MI-03

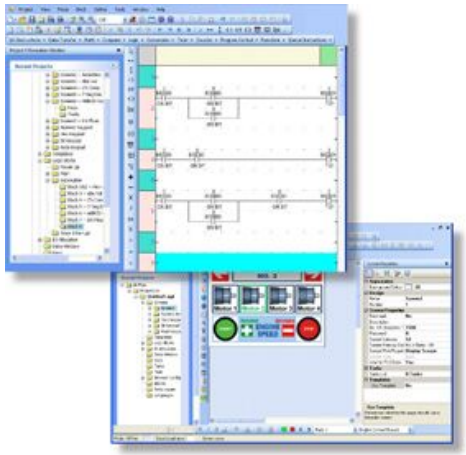
HMC7-MO-03

What are our hardware needs?

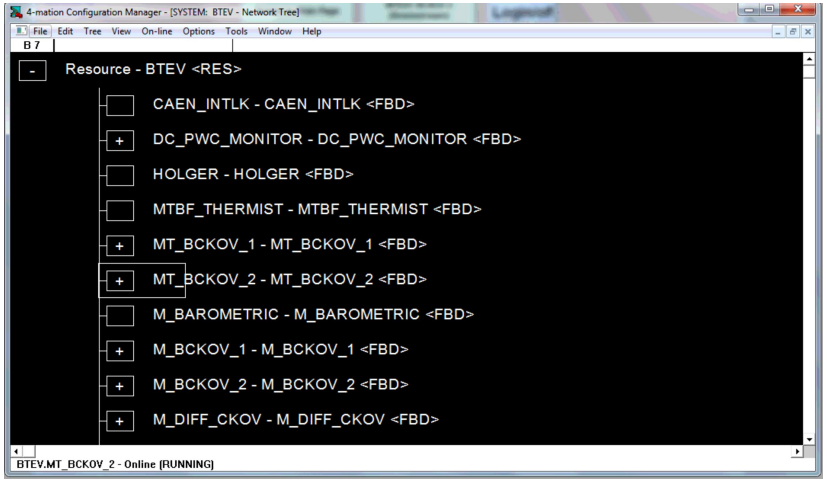
- Expandability
  - Via Mapware-7000 and Ethernet, MLC3-E is capable of communicating with existing HMC
  - +16 I/O Modules in addition to 5 already in use

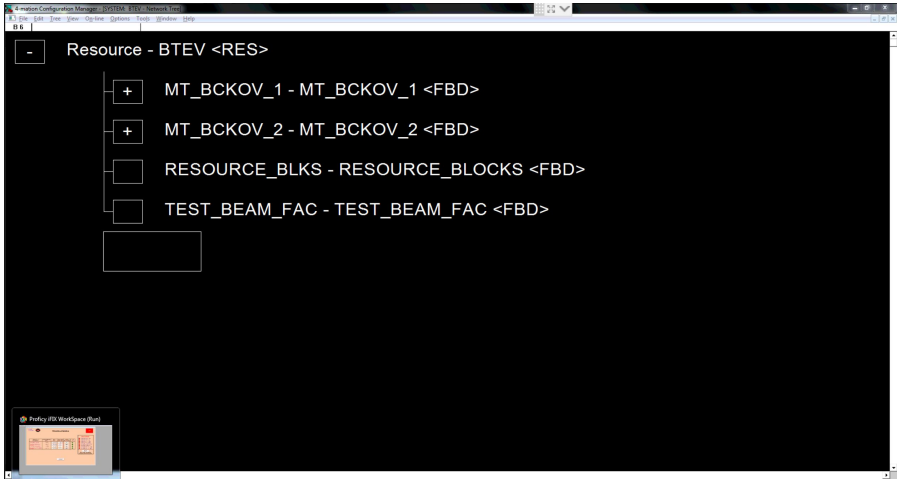
What are our hardware needs?

- Website interface OR Modbus
- Mapware-7000
- This software allows us to build web screens that let the user to access the controls remotely



Deleting Code



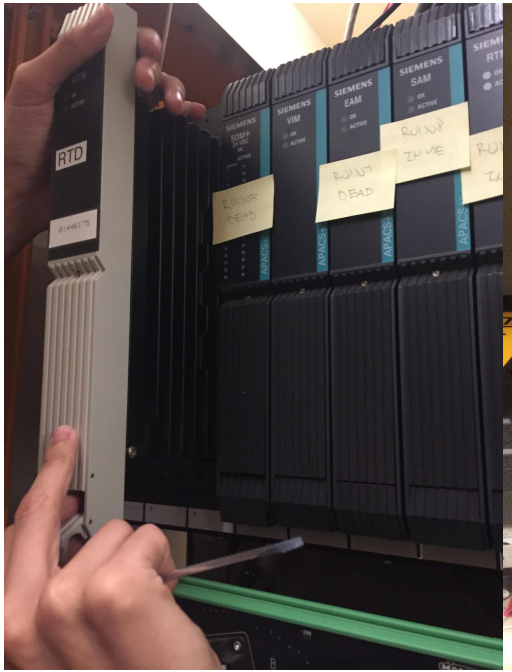


BEFORE

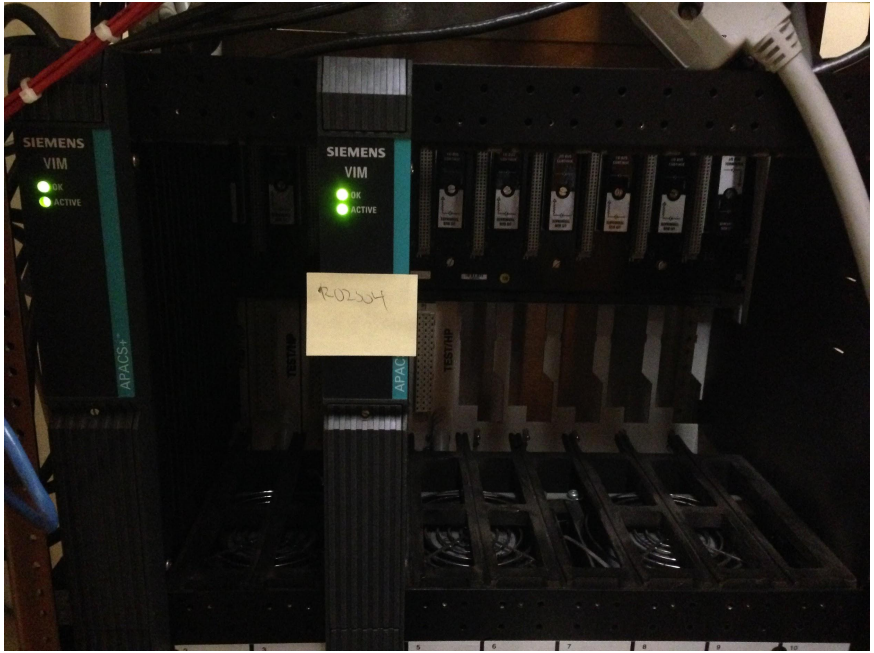
AFTER

Removing Modules

- Power off the slow controls system, shut down iFIX
- Use screwdriver to remove unnecessary consoles
- Safely store modules
- Reboot iFIX console




SIEMENS
ACM+
SIEMENS
SAM
SIEMENS
RTM
SIEMENS
SDM+
APACS+


SIEMENS
VIM
SIEMENS
VIM
OK
ACTIVE
APACS+

Next Steps

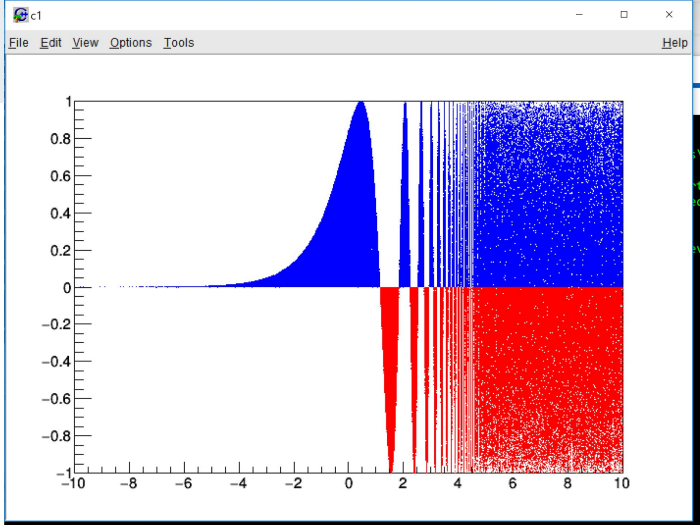
- Order and install Maple hardware
- Smooth transition from APACS to Maple
- Using Mapware 7000, program new console to replace iFIX
- Incorporate gas shed, motion tables into Maple system

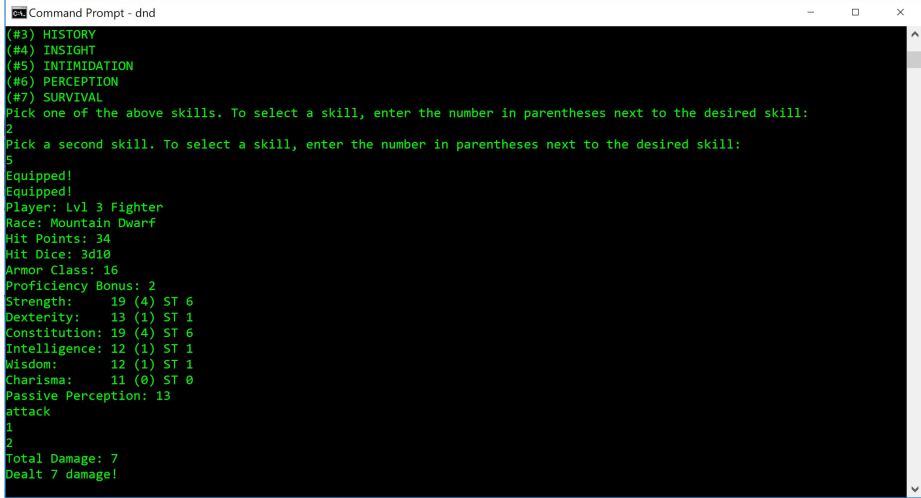
SEE EXCEL SHEET:
https://drive.google.com/open?id=1xkOZvX7l5xMHwCq34nliRn-sy6vC2h9O

- VERIFIED INFO
  - Downstream 15 pair cable to APACS color (all devices)
  - Downstream 15 pair cable to APACS pair # (all devices)
  - APACS channel or ps terminal (all devices)
  - Labels to place on cables at APACS end (all devices)
  - All other columns were not verified
- NOTES
  - For all* devices, APACS channel or ps terminal is numbered as +/- CH(#)
    - e.g., +CH4, -CH5, 22+, etc.
  - Channel number is consistent with 4-mation address, but inconsistent with I/O module port number
    - e.g., R01S08 SAM 22+ corresponds to address R01S08C22 in 4-mation, but plugs into port 43 on the I/O module itself
    - If +CH(#N), port number is 2N - 1
    - If -CH(#N), port number is 2N
  - *EXCEPTIONS: EV-DS1-V, EV-DS2-V, EV-DS3-G, EV-DS4-G, DS-VAC-PMP, EV-US11-V, EV-US12-V, EV-US13-G, EV-US14-G, US-VAC-PMP
    - For these devices, channel number is consistent with both 4-mation address and I/O module port number

During Spare Time

- Learning other important skills
  - Object oriented programming
  - Git and Github
  - Data analysis and the use of ROOT
  - Learning more about particles, neutrinos, etc.





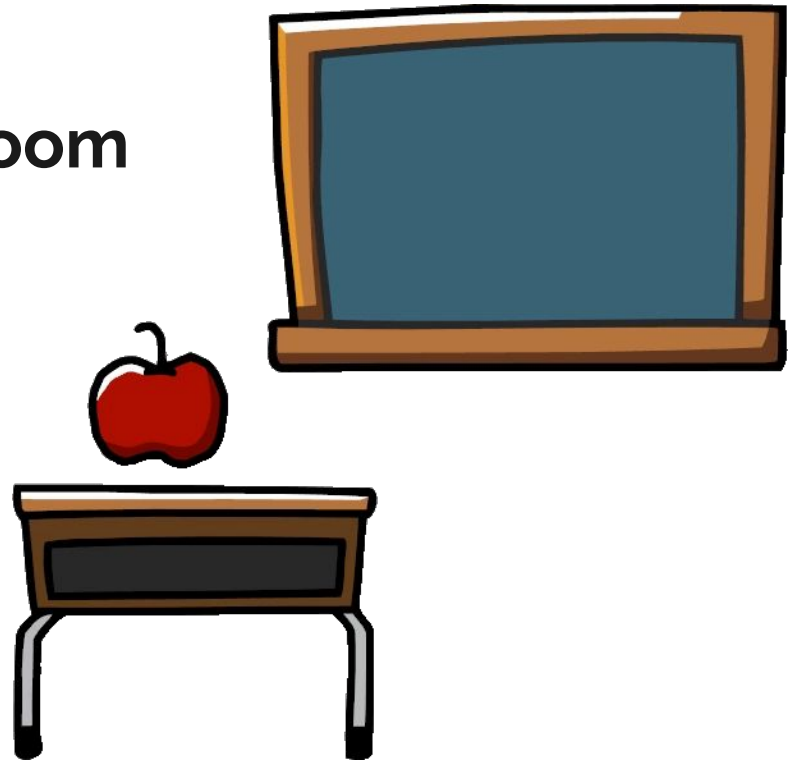
Lectures and Colloquiums

- Undergraduate Lecture Series
  - We learned more about current topics in the field
- Quantum computing
- Neutrinos
- Particle physics of detectors
- Gravitational Waves
- Mechanical and electrical engineering

Harrison Prosper *Florida State University*	Particle physics	Compressed slides (13MB) Original Slides (71MB) Photos
Bo Jayatilaka *Fermilab Scientific Computing Division (SCD) / Data Movement and Storage*	Scientific computing at Fermilab	Slides (44MB) Photos
Linda Valerio *Fermilab Accelerator Division / SRF Test Facilities Ops*	Mechanical Engineering of accelerators	Slides Photos
Anne Schukraft	Introduction to neutrino	Original Slides (110MB) Compressed

Takeaways for the Classroom

- Not all science is numbers and data
- Document the process
  - Science is a multiple group effort
  - Effective communication of ideas is key
- Make progress in steps
- Always learn more



Acknowledgements

- Mandy Rominsky
- Jerry Zimmerman
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- Peter Cipriano

To access our documentation, click here.