SVT fiber harnesses some initial considerations

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Considerations for SVT fiber harnesses

- SVT readout is based on VTRx+ (CD-3B) with short “pig-tails” of ~6 cm length, necessitating a transition to fiber bundles / fiber harnesses internal to the SVT envelope,
- Over Summer, we inventoried services exiting/entering the SVT envelope with the assumption of 144-fiber bundles,

- Fiber bundles contribute a relatively small fraction of ~2% to the overall cross-section entering and exiting the SVT envelope,
- Among the fiber bundles, data-out dominates over controls by a factor ~5,

- So far, we spent (too) little time on the fiber harnesses needed within the SVT envelope,
- Help sought! This really needs someone(s) to engage with this topic.

SVT barrel and disk power and readout architecture

ePIC SVT - disk and barrel power and readout architecture
Sichtermann, Glover, Silber

Rev	Date	Author	Description
v1	2025-10-09	Joe Silber (LBNL)	imported original diagram from Ernst, added details on sizes, counts, and connection interfaces
v2	2025-10-15	Joe Silber (LBNL)	visual cleanup, approx dims on furcation tubes, power wire pairs, and CB-FIB ribbon
v3	2025-10-16	Joe Silber (LBNL)	incorporated comments from Nikki on barrel vs disk variations; made MFPC and bridge connections more visually clear
vx			in-progress – added ref links

Nomenclature

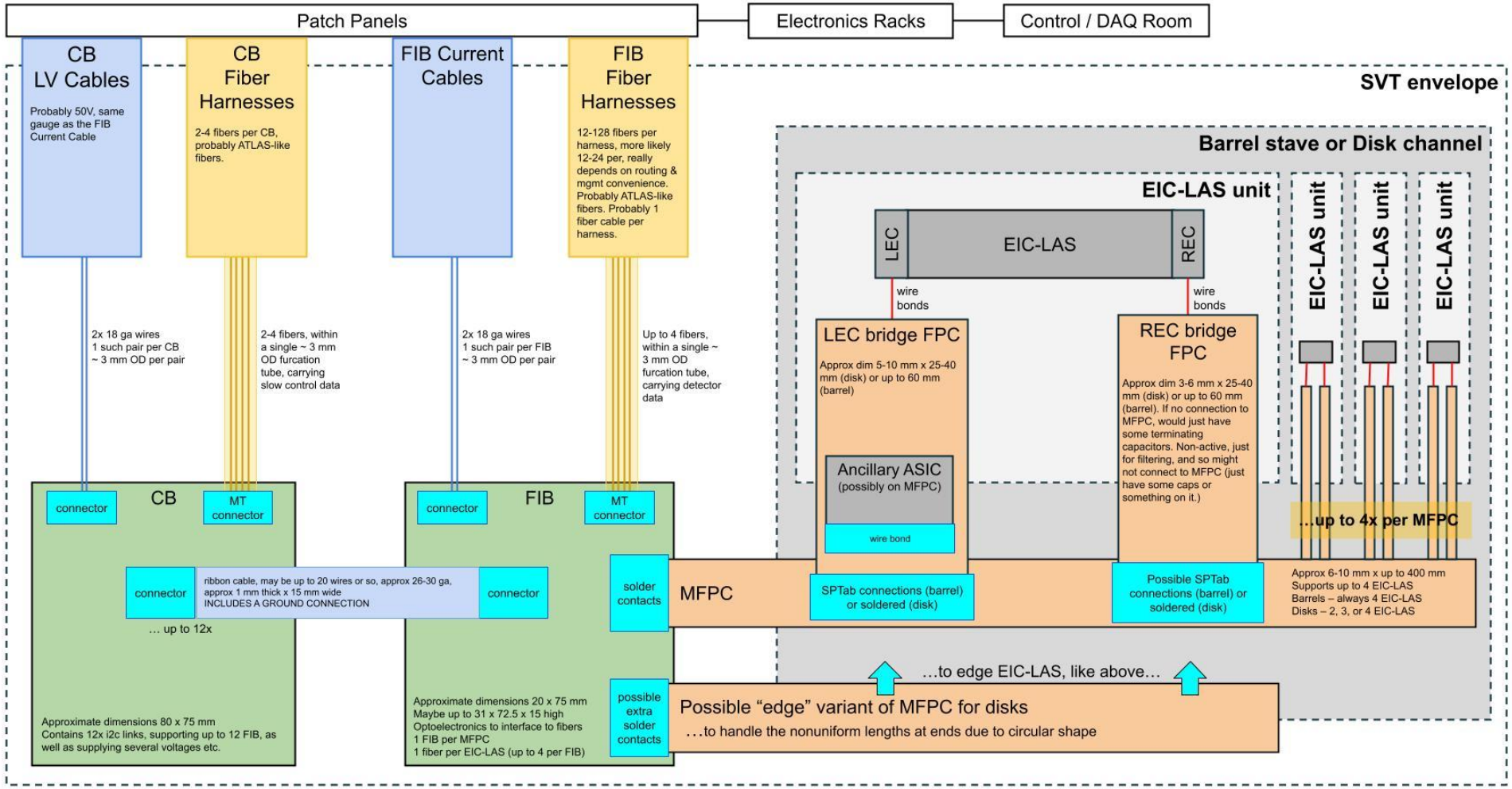
FPC … Flexible Printed Circuit
CB … Control Board
FIB … FPC Interface Board
LV … Low Voltage
MFPC … Main FPC
BFPC … Bridge FPC
SPTab … bonded overlapping Al/Kapton

Notes

1. Not to scale.
2. Color-coding consistency not guaranteed.

References

1. module drawing from Nikki 2025-08-22



SVT electron-side services entering/exiting SVT envelope

Subsytem	Type	Item	Material	Cable Specifics	Quantity	Diameter (cm)	Cross Area (cm^2)	Notes
Inner Barrel	Power	LV	Multi-Conductor Cable	4 Al conductors, 18AWG	16	0.9	NA	All on the hadron side; none on the electron side
	Signal	Data	144 Fiber Cable		4	0.89	NA	All on the hadron side; none on the electron side;harnesses TBD
	Cooling	cooling	Air		2	2.54	NA	All on the hadron side; none on the electron side
	Cooling	Exhaust	Air				40.54	Preliminary estimate, **not subject to packing & misc.**
Outer Barrel	Power	LV	Multi-Conductor Cable	4 Al conductors, 18AWG	93	0.9	59.16	
	Signal	Data	144 Fiber Cable		6	0.89	3.73	
	Cooling	cooling	Air		8	2.54	40.54	
	Cooling	Exhaust	Air				162.15	Preliminary estimate, **not subject to packing & misc.**
Disks	Power	LV	Multi-Conductor Cable	4 Al conductors, 18AWG	185	0.9	117.69	
	Signal	Data	144 Fiber Cable		12	0.89	7.47	
	Cooling	Cooling	Air		10	2.54	50.65	
	Cooling	Exhaust	Air				202.60	Preliminary estimate, **not subject to packing & misc.**
Outer Barrel / Disks FIB	Signal	Read out Fibers			NA	NA	NA	part of the fiber counts above (OB, disks) insofar external
	Power	Ext Current Source			NA	NA	NA	powered by CB (i.e. internal services, but not external)
	Cooling	cooling	Air / convection		NA	NA	NA	VTRx+ can be cooled convectively per its manual
Outer Barrel / Disks CB	Signal	Slow Control Fibers FIB	144 Fiber Cable		1	0.89	0.62	
	Signal	Slow Control Fibers FPC	144 Fiber Cable		1	0.89	0.62	
	Power	Ext Voltage Source		4 Al conductors, 18AWG	26	0.9	16.54	16 OB control boards, 36 disk control boards
	Cooling	Cooling	Water		28	0.63	8.73	Approx. 1.3 kW to be cooled
Inner Barrel SCB	Signal	Control Fibers	144 Fiber Cable		1	0.89	NA	All on the hadron side; none on the electron side;harnesses TBD
	Cooling	Cooling	Water		4	0.63	NA	All on the hadron side; none on the electron side
Inner Barrel DPB	Signal	Control Fiber	144 Fiber Cable		1	0.89	NA	All on the hadron side; none on the electron side;harnesses TBD
	Power	Bulk Power	Multi-Conductor Cable	4 Al conductors, 18AWG	16	0.9	NA	All on the hadron side; none on the electron side
	Cooling	Cooling	Water		4	0.63	NA	All on the hadron side; none on the electron side
Ground(s)							0.70	Preliminary estimate
Interlocks							4.00	Preliminary estimate; more of a "space allocation"
Environmental sensors							4.00	Preliminary estimate; more of a "space allocation"

- Values listed are for the electron side of the SVT

- Only services leaving the SVT Envelope are shown

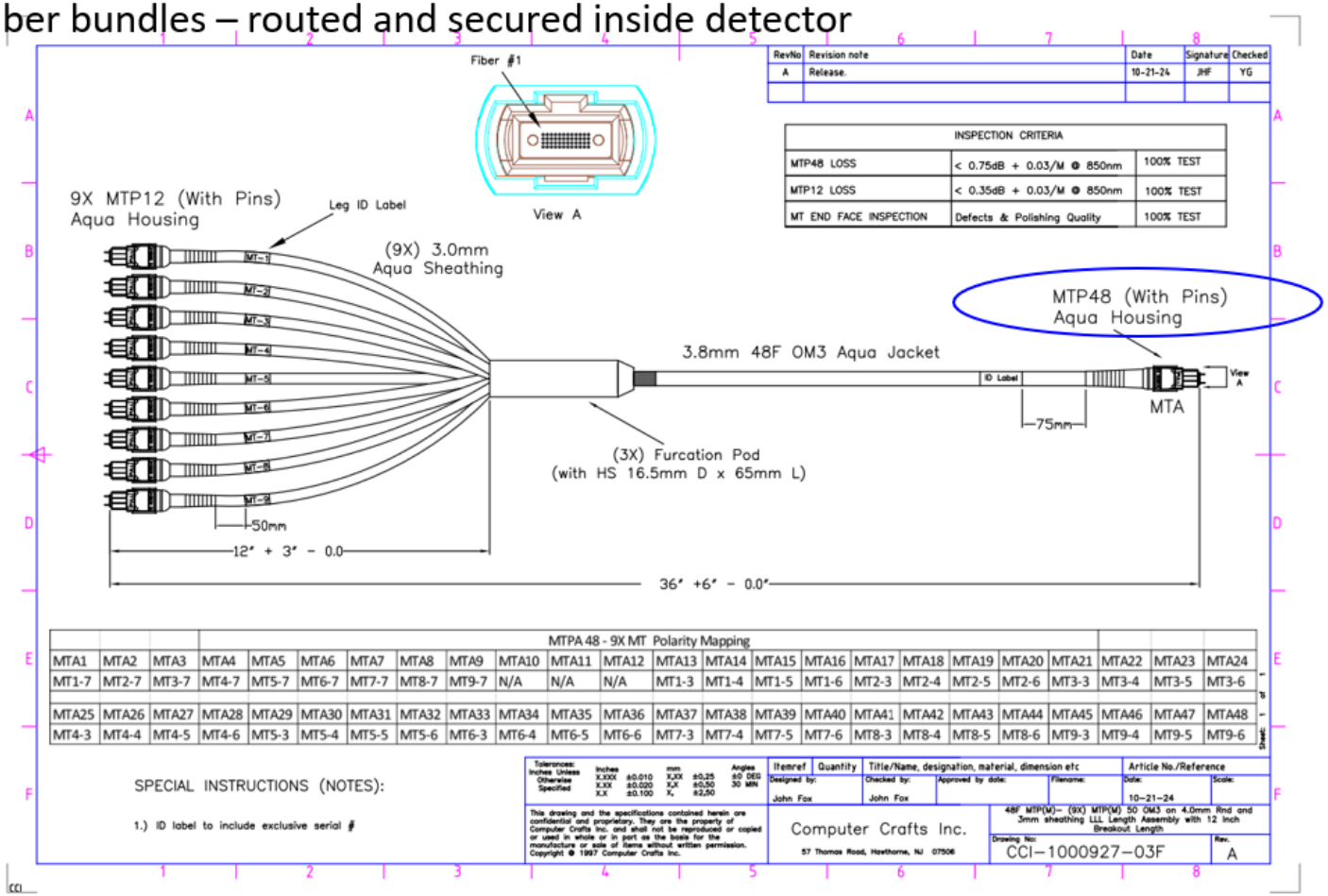
“Generic” ePIC fiber harness (?)

Fernando Barbosa (Jlab)
Electronics and DAQ WG meeting
September 11, 2025

Further notes on VTRX+ and Aggregation

- ❑ Custom fiber bundles – routed and secured inside detector

From
9 VTRX+
(45 Fibers)



At detector
patch
disconnect
(multiple)

To
RDOs/DAQ

“Generic” ePIC fiber harness (?)

- Bundles nine VTRx+ fiber bundles – 1 RX and 4 TX – into a single 48-fiber bundle with 3 dark fibers,

- Generic, in that it would accommodate the 4 TX SVT data-out fibers from each FIB, as well as the 2 x (1 RX + 1 TX) fibers to/from the FIB control boards,

- Solution is in use in the sPHENIX experiment, I (ES) believe.

“Generic” ePIC fiber harness (?)

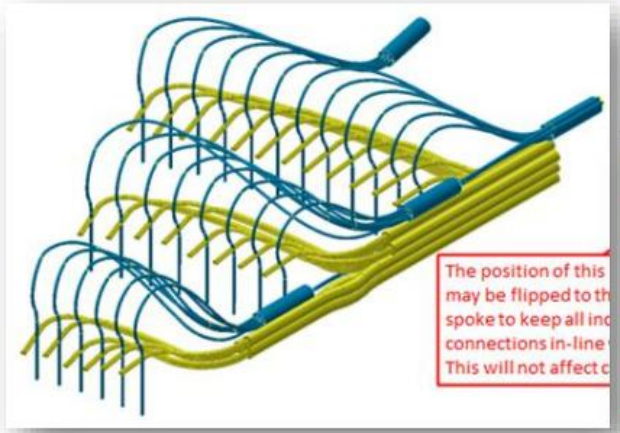
- Bundles nine VTRx+ fiber bundles – 1 RX and 4 TX – into a single 48-fiber bundle (MTP) with 3 dark fibers,
- Not very efficient use of fibers for our purpose – 12/48 dark fibers from 9 FIBs; 30+/48 from 4+ FIB-CBs – with limited possibilities to improve,
- Nine seems not such a natural divider for the OB and disks, potentially further degrading the fraction of lit fibers,
- 48 isn’t 144 either, but recall that fiber services external to the SVT are a small percentage of the total cross sectional area needed,
- Fairly bulky, it seems – Q (ES): do we need/benefit from fiber for (part or all of) FIB-CB ?

Misc.

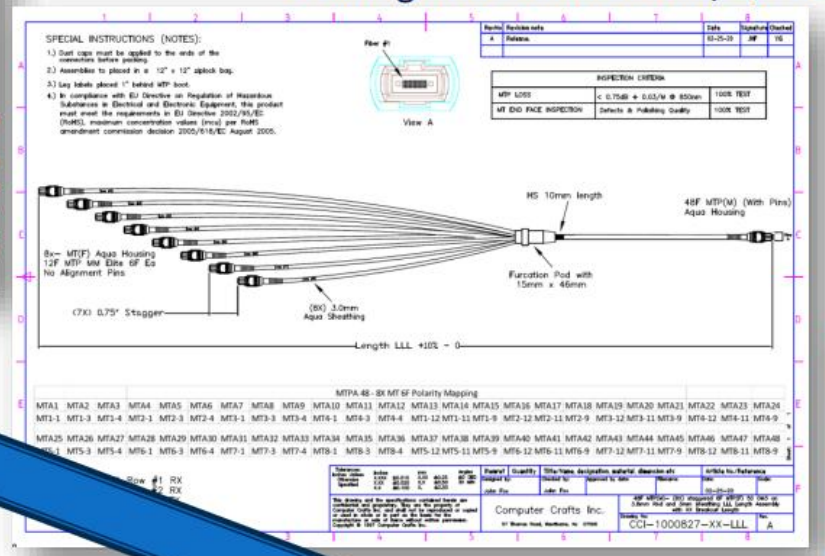
Jin Huang (BNL)
Streaming readout WG meeting
October 24, 2023

Custom MTP-48 to MTP-12 breakout

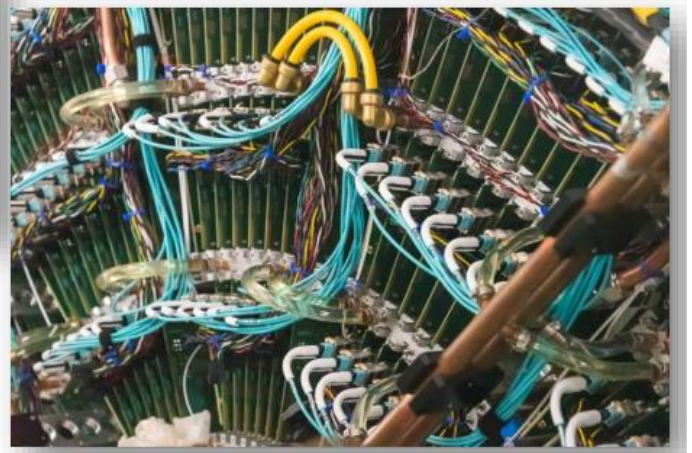
Mechanical and channel-mapping design at BNL



Drawing and manufacture/QA at CCI: ~$500 + 4wk LT



Installation at sPHENIX



Considerations for SVT fiber harnesses

- SVT readout is based on VTRx+ (CD-3B) with short “pig-tails” of ~6 cm length, necessitating a transition to fiber bundles / fiber harnesses internal to the SVT envelope
  - Although VTRx+ is compact, we will incur “bulk” from the fiber connectors and harnesses,
- Over Summer, we inventoried services exiting/entering the SVT envelope with the assumption of 144-fiber bundles,
  - 48-fiber bundles, as a possible alternative, would be a relatively small impact on overall service cross-section,
- Generic ePIC fiber harness would seem inefficient,
  - 9 x VTRx+ to 1 x MTP would leave quite a few fibers “dark” in our application,
  - 9 is also not particularly natural divider in our application (# staves, # rows),
- A possible alternative 12 x VTRx+ to 1 x MTP will likely work better,
- Inner Barrel not considered here; Jo Schambach discussed possibilities recently and may do so later in this meeting,
- Bottom line: help sought! This really needs someone(s) to engage with this topic.