

HPS Detector Status/Plans

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SVT

- L1-2 Modules: silicon won't withstand another run, only one spare
- L5-7 Modules: damage occurring between 2019 and 2021 runs left hole in L5, no spares.
- FEBs: only two perfect spares. Latent design error could make them susceptible to failure.
- Data Flange: ran with the spare in 2021, original no longer reliably operates full detector.

DAQ

- TI PCIe Card: development work on new cards not completed, no spares of old version. [Completion of TI PCIe library is also needed for CLAS12, so will be attended to after current run is complete.](#)

ECal (Nathan)

- HV issues: frequent trips of HV PS. [Will investigate and decide on action in spring.](#)
- Chiller issues: chiller reliability issues. [Will have spare chiller serviced.](#)

Hodoscope (Rafo)

- [minor damage occurring during run already repaired. No other action needed in the near term.](#)

[We had sufficient contingency to address surprises, but no time in which to do the work.](#)

[In most cases, starting now leverages fresh knowledge and experience](#)

SVT L1-2 Modules

Slim edge sensors obtained for 2021 were significant improvement on 2019 design

- Very few ($\ll 1\%$) bad channels (pinholes in AC coupling capacitors)
- Extremely precise (within 1 μm) positioning of cleaved edge w.r.t. active region (one exception)
- No issues with surface charge buildup / surface leakage during operation with beam

However, the new processing left metallization on the cleaving line: Schottky contact generates leakage.

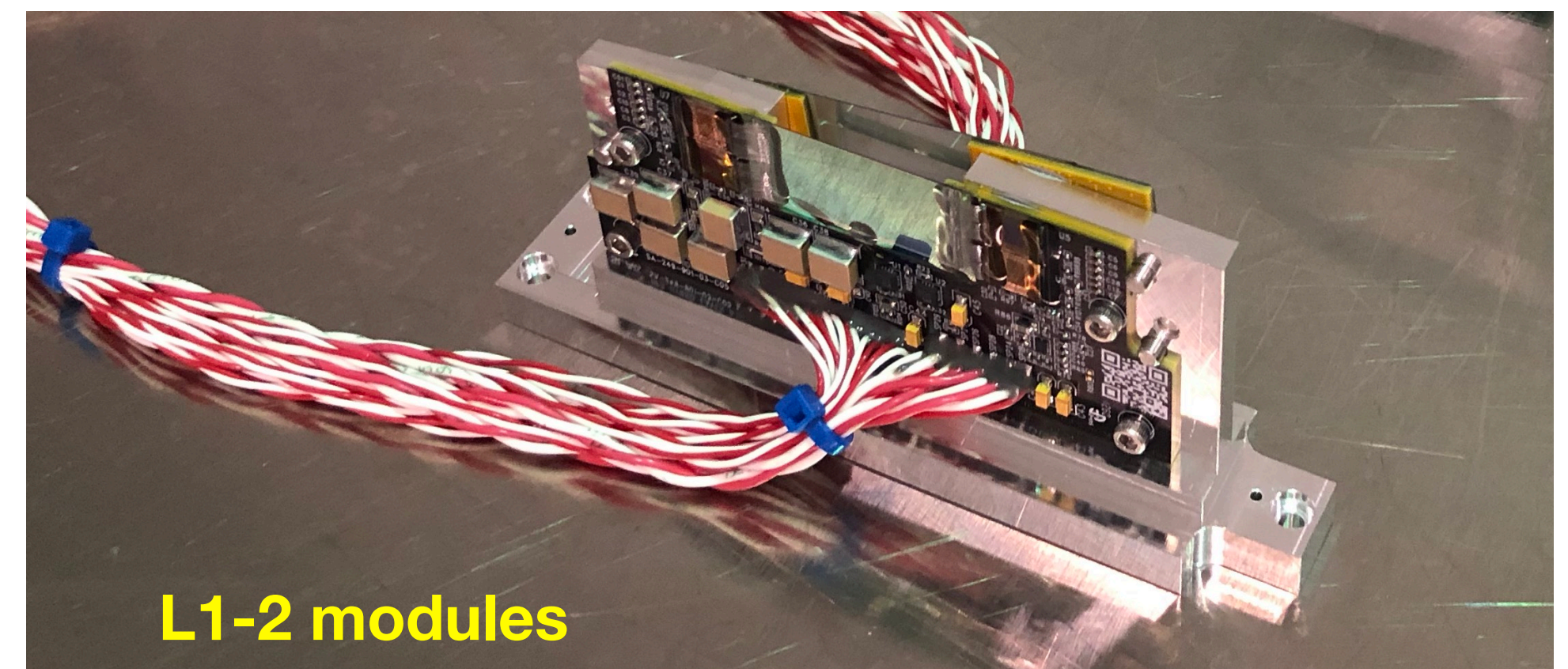
- Sensors have relatively low breakdown voltages that limit operation to high electron fluences

Realizing this we held back most of our hybrids, building only modules we needed to run.

Plan: order new sensors from CNM to build the rest of the modules

Status:

- Agreed on design changes with CNM to eliminate metallization, fabricate on lower resistivity silicon
- SLAC currently processing the order for 30 new sensors
- Wafers ordered by CNM before the holidays
- Hope to have sensors before end of CY2022



When sensors arrive, will plan out assembly and testing of the rest of half-modules with UCSC.

SVT L5-7 Modules

Long modules used in L5-7 were anticipated to be a low-risk item

- Built with knowledge and experience from test-run modules
- Far from target and beam plane, low radiation and risk of beam accidents
- 20 half-modules built (18 good), 12 needed for the detector

Instead, these modules have suffered mysterious problems during non-operational periods

- wirebond damage to half-modules facing downstream (now also seen in short modules in L2-3)
- new problem: partial shorts between some power rails and ground

There are no more spares

Plan: build as many additional half-modules as we can

Status:

- The required tooling has been located and set up at SLAC
- Enough parts at SLAC to build 8 more half-modules, limited by carbon fiber
- Ron Lipton confirms plenty of sensors still at FNAL. Will discuss if more carbon fiber also possible.

Before we order and build more hybrids, we need to understand the mysterious shorts

Sarah Gaiser is investigating this and will report status next.

After radiation damage to FEB5V regulator during 2019 run, we undertook a redesign for 2021

- 20 new FEBs were built (10 needed) with more radiation tolerant regulator and better board material
- Components discontinued since first run of boards required significant changes to the design
- One of these changes exposed a latent error in the original design in the specification of a *different* regulator
- This error caused damage to the new boards when first powered: several boards were lost to this. 12 good.
- We had no choice but to (slightly) overdrive these regulators on the remaining boards.

It would be wise to fix this problem now: if we wait, it could again trigger significant design changes.

Plan: Correct design error and order more FEBs

Status:

- Work underway on schematic changes. Expect to use same regulator as replacement for 5V regulator.
- Beginning to order BOM to lock in supplies and guard against possible discontinued components.

When we have the new design complete, we will place another turnkey order for 20 FEBs. Given current FPGA availability, we anticipate this will be a very long lead time (a year?)

SVT Data Flange

SVT data flange converts FEB control+data on copper to optical connected to RCE back end.

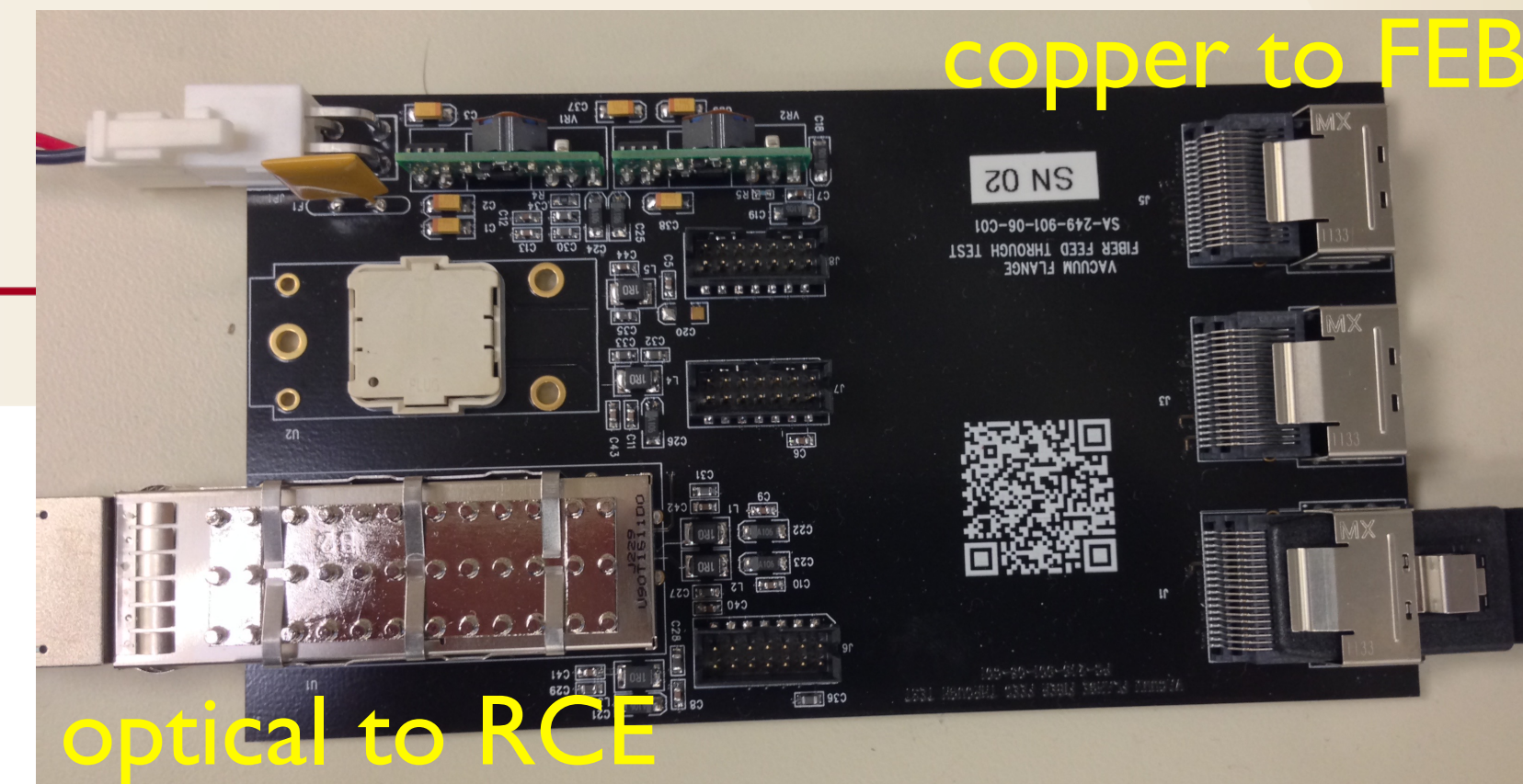
- Four boards with 3 channels each (12 links total)
- Boards are potted through 6" vacuum flange on positron side of upstream vacuum box.
- Two flanges were built: the first no longer has 10 reliably working channels. Spare was used in 2021.

Plan: build another data flange

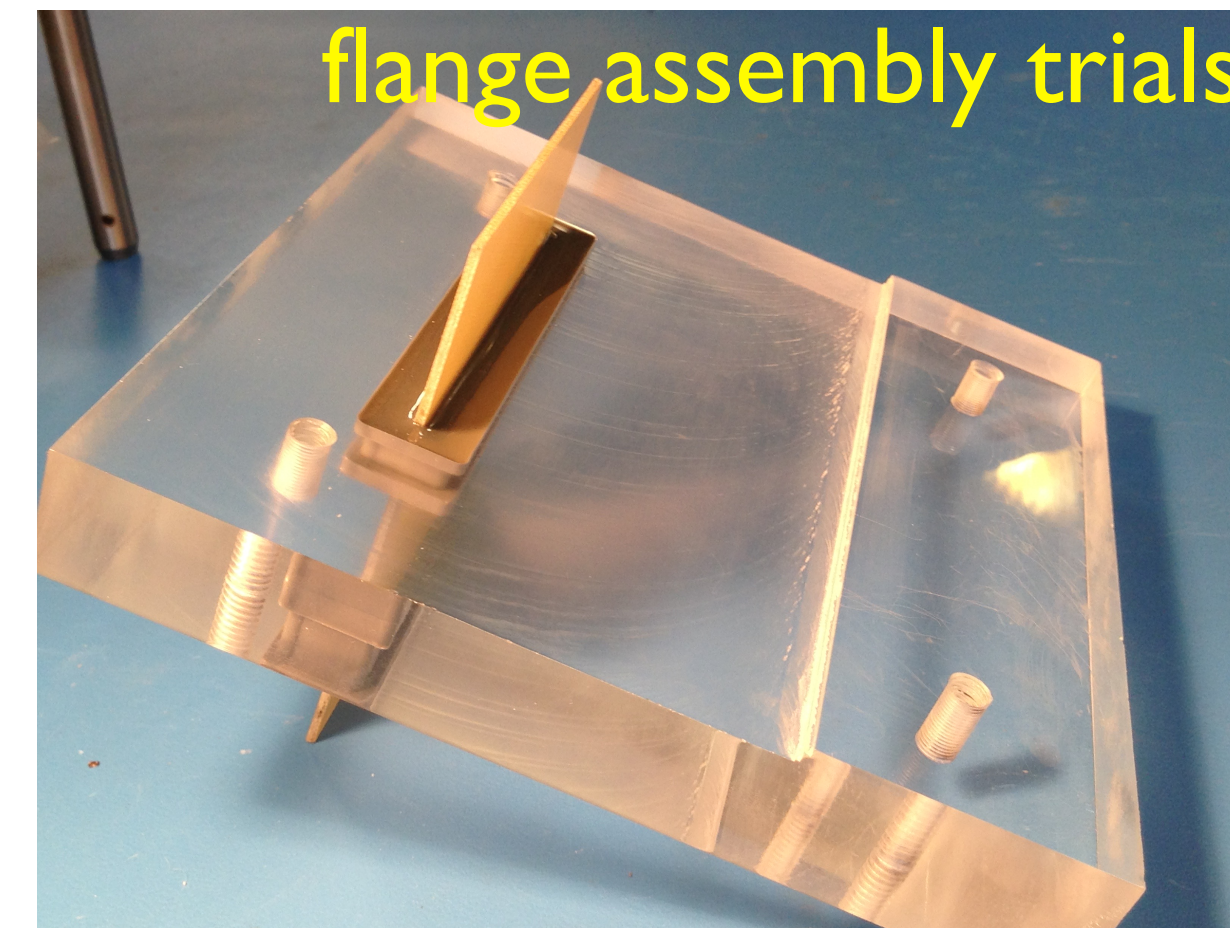
Status:

- Checking component availability for flange boards
- Plan small changes to make more flexible in operating with new FEBs
- Will order at least 6-8 more boards, expect long lead
- Matt McCulloch has located assembly tooling: estimates 60 hours/flange.

Will perform assembly once boards/flange in hand.



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Budget and Schedule

We have some contingency left after the run, funds that would have addressed SVT issues beforehand if time had allowed.

OHEP has supplied additional FY22 funding to complete the plan.

Given supply chain issues, especially with electronics, these projects need 2 years to comfortably complete.

First major milestone will be trip to JLab before summer to extract the SVT and store in the EEL (freezer with N₂ purge)

Starting now will allow this to be done at relaxed pace and without disrupting priority work on physics analysis, provides a lot of great projects for students.