

Some thoughts on the concept of the Stave for the bTOF detector

Rachid N., Itaru Nakagawa, and Dan Cacace
Many Thanks to:
David Lynn and Carl Haber

Motivation

These are some thoughts based on our expertise on designing, building and testing staves at BNL:

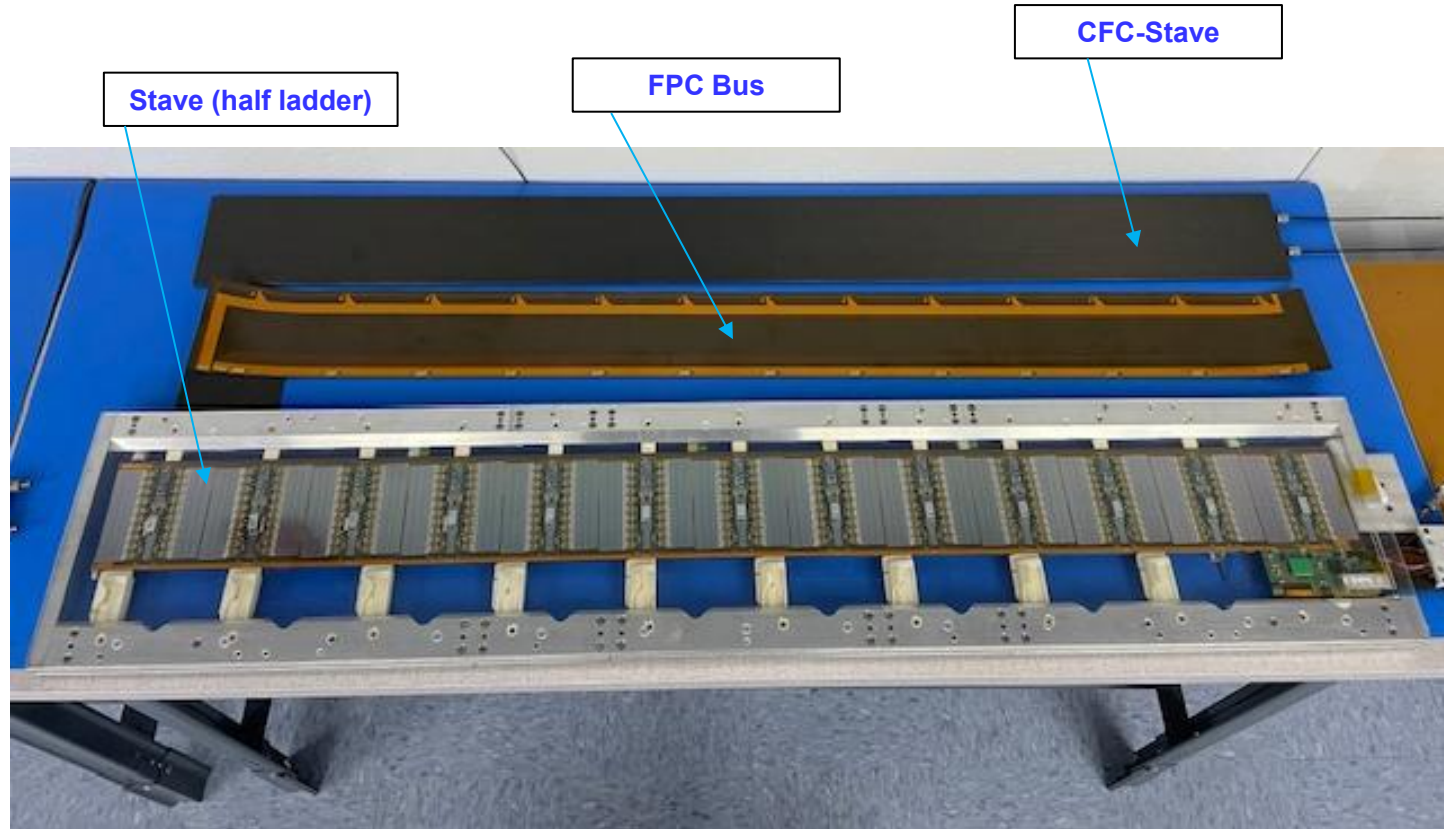
- Silicon modules, staves/ladders, barrel layers, and integration:

PHOBOS, VTX/PHENIX, INTT/sPHENIX, and ATLAS

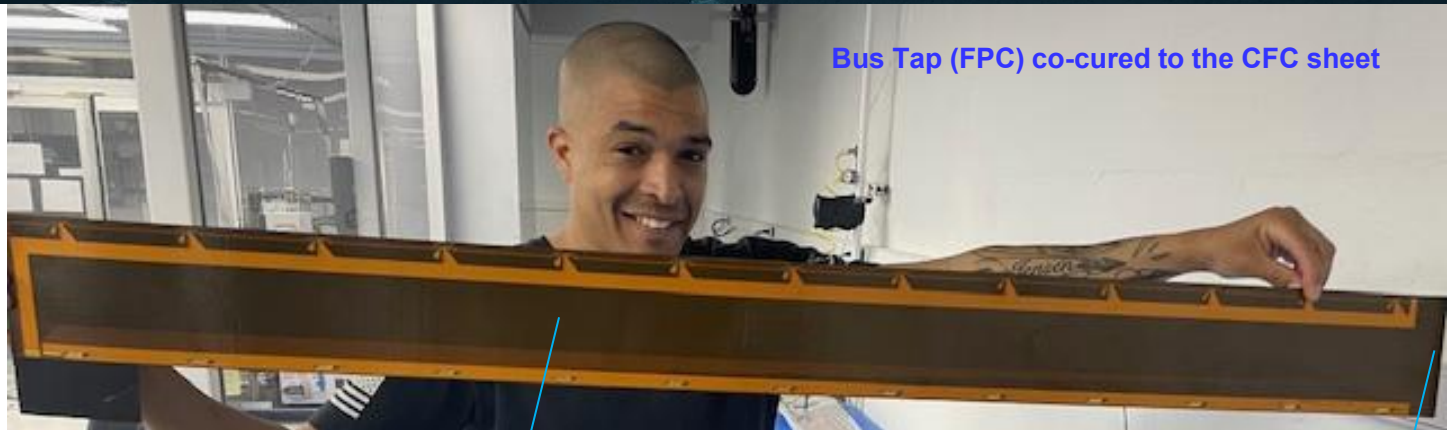
- Working with CFC companies:

Asuka, Workshape, and LBNL

ATLAS Stave



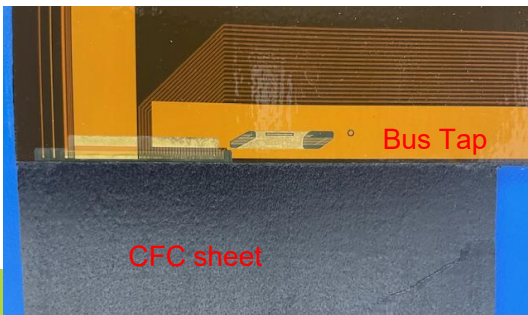
ATLAS Stave



Bus Tap (FPC) co-cured to the CFC sheet

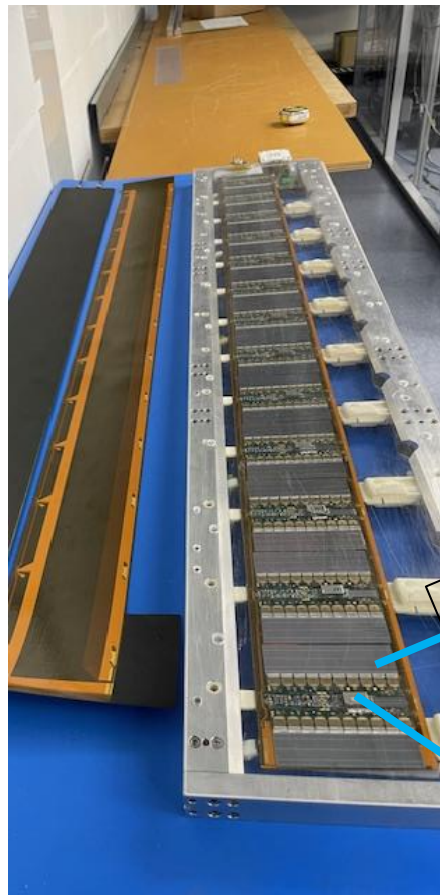
Back view: we see Bus Tap (FPC)

Back view: we see CFC sheet

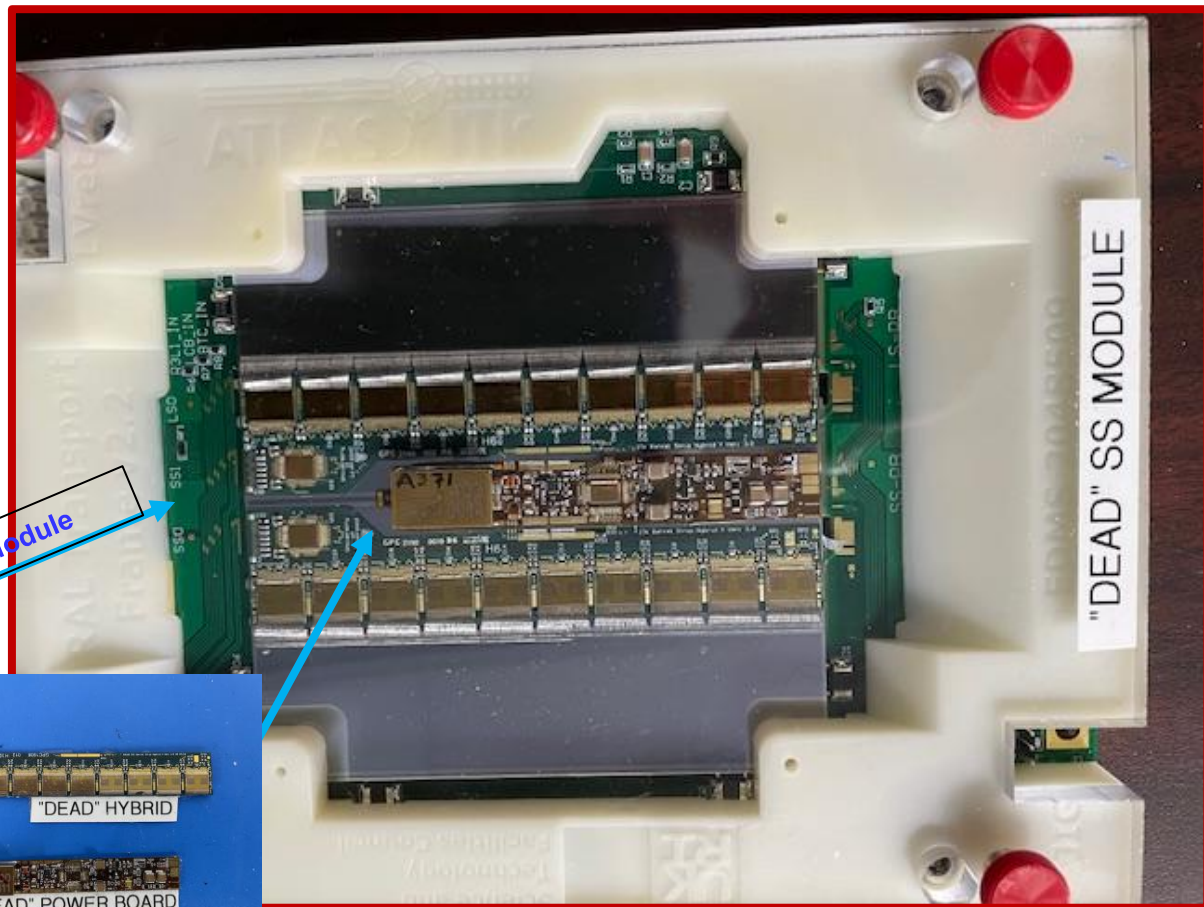
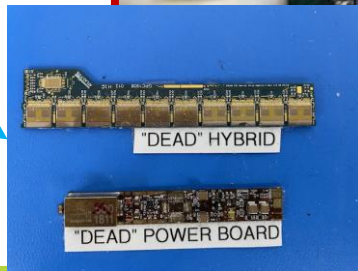


Zoom view

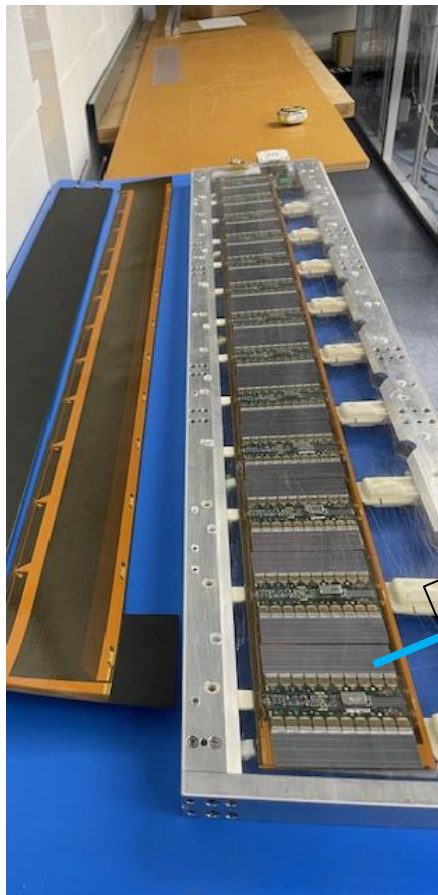
Silicon Module connected to the testing board in a Box



Silicon Module



ATLAS Silicon Module

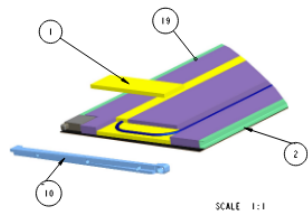


Silicon Module ready to be glued on the Bus Tap

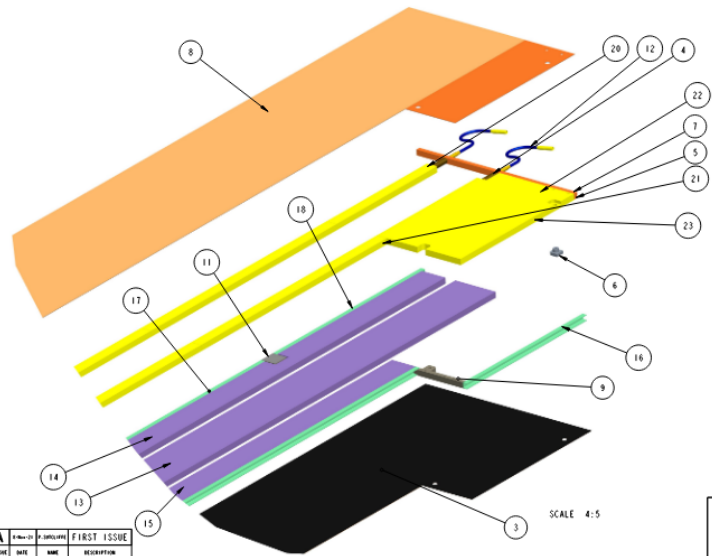


Silicon Module

What is the composition of the ATLAS CFC stave?



ITEM	PART/CAD No	DWG TITLE	MATERIAL	MAT SPEC	REMARK	QTY
1	NP49-01-125	ALLCOMP COOLING STRIP - 2:0	ALLCOMP K9 FOAM	SM43 OR SM56	-	2
2	NP49-01-210	EDGE CHANNEL SHORT - 14 MODULE STAVE	CFRP	-	-	1
3	NP49-01-245	STAVE CO-CURED BOTTOM FACESHEET - LONG STRIP	SEE PARTS	SEE PARTS	CO-CURED FACESHEET WITH L5 RNS BUS TAPE	1
4	NP49-01-101-01	KAPTON WRAP	KAPTON	-	-	2
5	NP49-01-206	END CLOSURE Z:1, 4 SLAVE (BOTTOM)-14 MOD STAVE	PEI	ULTEM 1000	-	1
6	NP49-01-226	M3 EOS CARD INSERT	PEI	ULTEM 1000	-	1
7	NP49-01-219	END CLOSURE EOS MASTER SIDE - 14 MODULE STAVE	PEI	ULTEM1000	-	1
8	NP49-01-243	STAVE CO-CURED TOP FACESHEET - LONG STRIP	SEE PARTS	SEE PARTS	CO-CURED FACESHEET WITH L5 RNS BUS TAPE	1
9	NP49-01-236	EOS LOW Z CLOSURE/INSERT	PEI	ULTEM 1000	OXFORD DRAWING	1
10	NP49-01-232	END CLOSURE Z:0	ULTEM	ULTEM 1000	OXFORD DRAWING	1
11	NP49-01-235	LOCKING POINT HOUSING	PEI	ULTEM 1000	OXFORD PART	5
12	NP49-01-224	STAVE COOLING TUBE ASST-A SIDE	SEE PARTS	SEE PARTS	SEE PARTS	1
13	NP49-01-215	STAVE HONEYCOMB CORE - CENTRE - 14 MOD STAVE	CFRP HONEYCOMB	UCF-320-114-3.0	ULTRACORE	1
14	NP49-01-214	STAVE HONEYCOMB CORE - EDGE - 14 MODULE STAVE	CFRP HONEYCOMB	UCF-320-114-3.0	ULTRACORE	1
15	NP49-01-140	STAVE HONEYCOMB CORE 2	CFRP HONEYCOMB	UCF-320-114-3.0	ULTRACORE	1
16	NP49-01-217	EDGE CHANNEL - E:SS LONG - 14 MODULE STAVE	CFRP	-	-	1
17	NP49-01-227	EDGE CHANNEL L/POINT LONG-14 MOD STAVE	CFRP	-	-	3
18	NP49-01-209	EDGE CHANNEL L/POINT SHORT-14 MOD STAVE	CFRP	-	-	1
19	NP49-01-228	EDGE CHANNEL L/POINT Z:0-14 MOD STAVE	CFRP	-	-	1
20	NP49-01-142	ALLCOMP COOLING STRIP - SHORT	ALLCOMP K9 FOAM	SM43 OR SM56	LOW DENSITY (LDB) FOAM	2
21	NP49-01-208	ALLCOMP COOLING STRIP - 14 MODULE STAVE	ALLCOMP K9 FOAM	SM43 OR SM56	LOW DENSITY (LDB) FOAM	18
22	NP49-01-155	ALLCOMP COOLING STRIP-2,6	ALLCOMP K9 FOAM	SM43 OR SM56	LOW DENSITY (LDB) FOAM	1
23	NP49-01-141	ALLCOMP EOS BLOCK-2,0	ALLCOMP K9 FOAM	SM43 OR SM56	LOW DENSITY (LDB) FOAM	1



NOTE
ITEMS 2, 4, 5, 7, 12, 20, 21, 22, 23
ARE PRE ASSEMBLED AS PER DRAWING
NP49-01-201-01

A	REV	BY	DATE	DESCRIPTION
				FIRST ISSUE

INDICATORS

UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS IN MILLIMETRES SURFACE FINISH UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input checked="" type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED REMOVE BURRS AND BREAK SHARP EDGES DO NOT SCALE	REFERENCE DIMENSIONS TO BE SHOWN ON ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input checked="" type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED	DIMENSIONS TO BE SHOWN ON ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input checked="" type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED	DIMENSIONS TO BE SHOWN ON ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input checked="" type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED	DIMENSIONS TO BE SHOWN ON ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input checked="" type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED DIMENSIONS TO BE <input type="checkbox"/> UNLESS OTHERWISE SPECIFIED
--	---	---	---	---

THE UNIVERSITY OF LIVERPOOL
DEPARTMENT OF PHYSICS

PROJECT: S-LHC

TITLE: STAVE-LONG STRIP-A SIDE

DRAWING NUMBER: **NP49-01-241**

DATE: 0-NOV-21

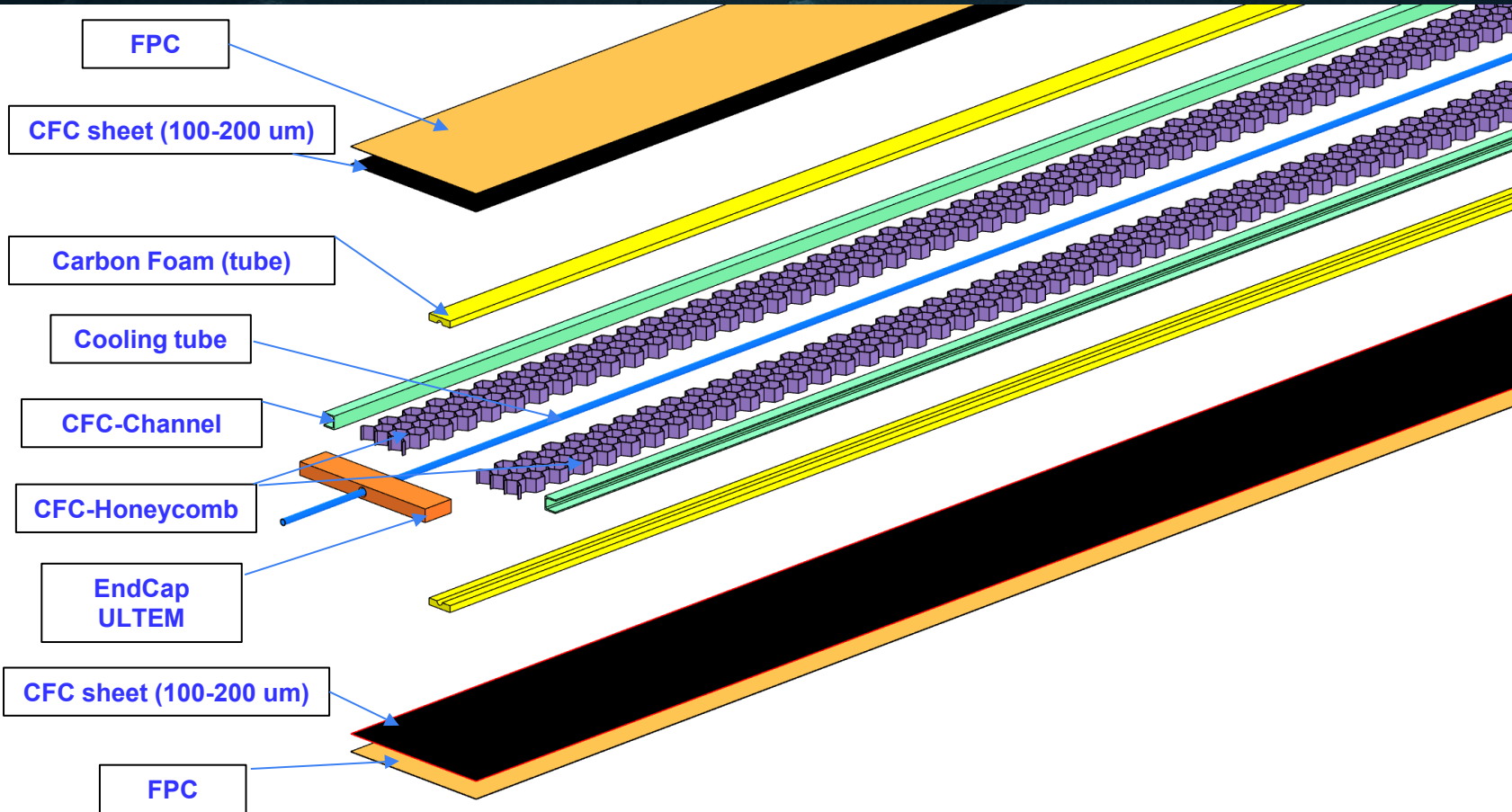
DESIGNED BY: PS

CHECKED BY: PS

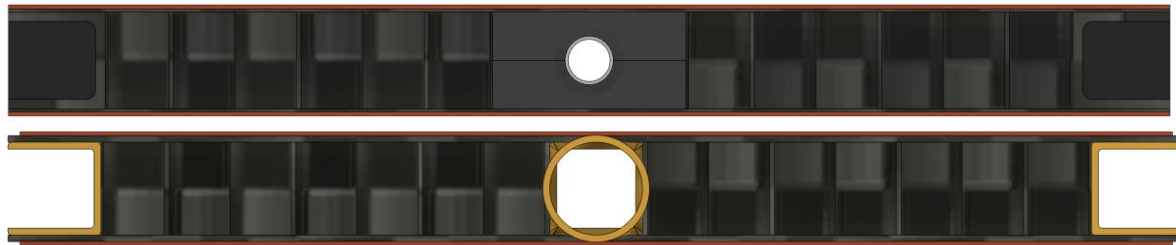
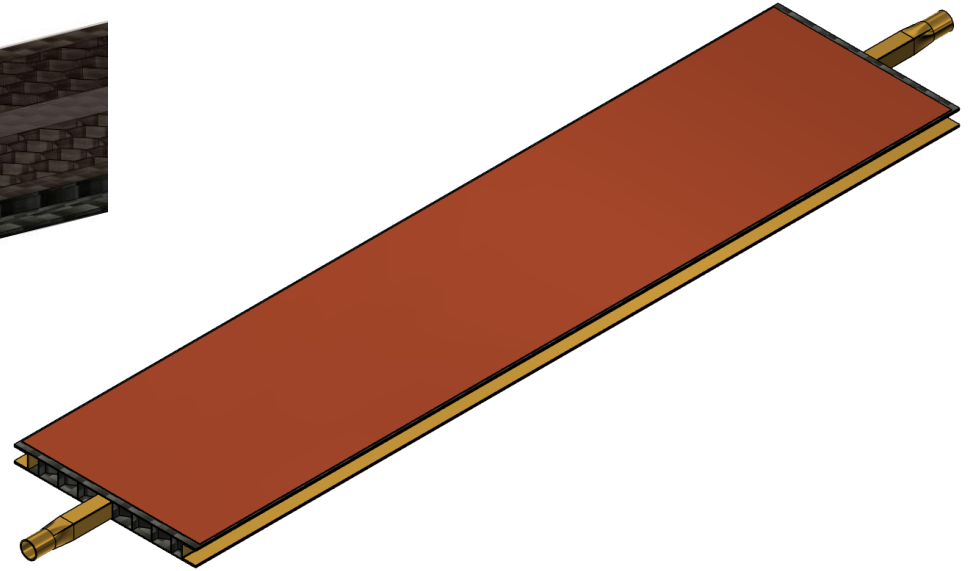
APPROVED BY: PS

SHEET 1 OF 4 SHEETS SCALE: 1:1

Proposal for the bTOF CFC-Stave



Short CFC-Stave for Prototyping



Roadmap Proposal for bTOF Stave

- **Stave Design Steps**

- Silicon sensor design
- Physical footprint of ASCII chips
- Module design
- FPC design
- Power dissipation
- Stave mechanical design and FEA

- **Prototyping a short stave to confirm FEA analysis results and co-curing FPC to CFC-sheet**

- **Prototype full stave**

- Asuka Company
- Workshape
- LBNL

Itaru visited Asuka Company
(Autoclave oven)



On 2/19/26 14:17, WorkShape wrote:

Co-curing: Rachid in contact with Workshape Company 2/19/2026

This Message Is From an Untrusted Sender
You have not previously corresponded with this sender.

Dear Rachid,

Of course i remember you and the project!

It's great to have some news from you.

Well, yes, co curing shouldn't be a problem, but if you can provide me with some more infos about which thermoplastic is used for the FPC, that could be great. If we use the good formula between temperature and pressure, it should work (or we'll make it work...).

Cheers,

Simon.

Si-Lab -1: Assembly Cleanroom: Overview

Hybrid
Test/Burn-In
Station

Stave
Assembly
Station

Hybrid/Module
Assembly
Station 1



Class 10,000
Clean Room with
independent
ACs, vacuum
systems, etc.

10 chamber
Desiccator
Storage

Hybrid/Module
Assembly
Station 2

Si-Lab -1: Assembly Cleanroom: Stave Assembly Station (one of two globally)

Accurate XYZ stages (~5um)

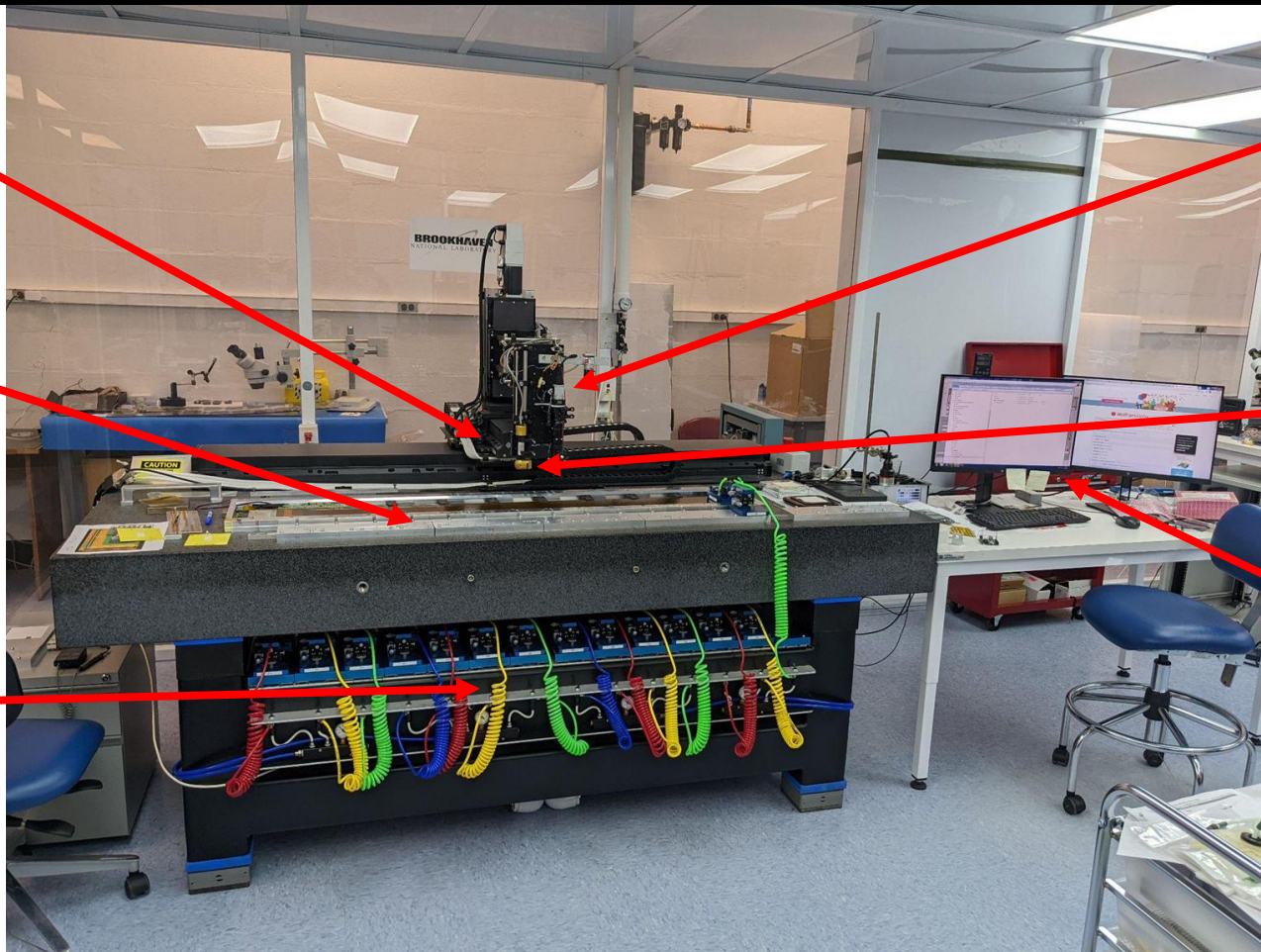
Stave under construction

Module vacuum pickup and alignment tools

Long range focus microscope for metrology

Volumetric glue dispenser

Computer Control



Si-Lab -1: Assembly Cleanroom: Wire Bonding Station 1

Wire bond pull tester to test quality of wire bonds

Table to enable wire bonding of complete stage



Hesse BJ820 automatic wire bonder

About 3 wire bonds per second in production mode

Si-Lab -1: Assembly Cleanroom: Hybrid Test and Burn-In Station (we will have two soon)

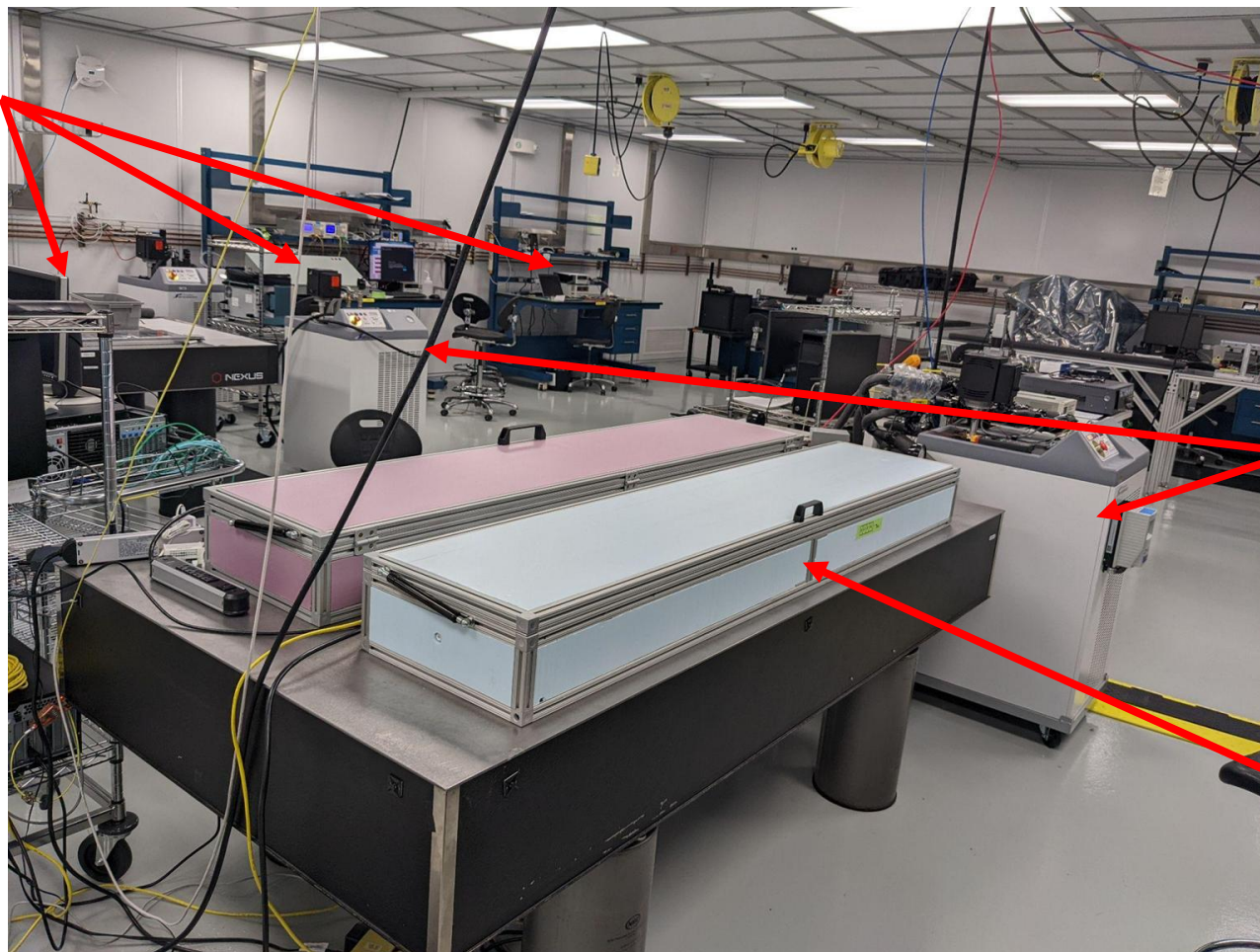


Hybrid Burn-In
Crate capable of
testing 36 hybrids
in parallel and
burning them in
for about 100
hours at 40 degC

In production
mode this
station will be
fully automatic

Si-Lab -1: Testing Cleanroom: Overview

Two module testing stations to test modules at nominal cryogenic temperatures and to thermal cycling them
One reception cold box to test modules received from LBNL and SCIPP at room temperature



Class 10,000 Clean Room with its own AC system, vacuum systems etc.

Special chillers capable of cooling down to -50 degC
In production we will have 5

Two independent cold boxes for testing of fully assembled staves at nominal cryogenic temperature