WBS 6.1: Pixel Phase-II Upgrade

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Bump Bonding in the US

- Requested (approved) an RBT to launch a first run of bump bonding at RTI.
- Two FE-I4 wafers + 2 Planar sensors purchased in the UK.
- Bare modules will be glued to module flex prototypes, provided by Bonn, at UCSC and SLAC: test/check of bump bonding process and start learning about the module assembly.
- ~2 months to get the sensor wafers. Modules in hands before end of 2015.

Pixel (Itk) Layout

- Overall layout still under discussion.
- Eta coverage: 2.7, 3.2, 4?
- N Pixel layers: 4,5,6.
- Pixel envelop? PST at 345mm or 395mm.

Layout	Cost
4 Layers – η = 2.7 – PST 34 cm	27.4 MCHF
4 Layers – η = 3.2 – PST 34 cm	31.3 MCHF
4 Layers – η = 4 – PST 34 cm	32.2 MCHF
5 Layers – η = 2.7 – PST 39 cm	36.1 MCHF
5 Layers – η = 3.2 – PST 39 cm	42.0 MCHF
5 Layers – η = 4 – PST 39 cm	44.3 MCHF
4 Layers – η = 4 – PST 39 cm	36.3 MCHF

6660 modules, 9.7 m^2

11500modules, 16.8 m^2

Cost of Components

- Hybridization: 27.7%.
- Sensors (Planar): 20.1%.
- Local supports: 14.0%.
- PP2: 10.5%.
- On-det readout + DCS: 9.3%.
- FE Chip: 8.0%.
- Power Supplies: 5.6%.

- Barrel versus Rings: 60%/35% (27 MCHF) – 57%/40% (44 MCHF).

- UK: committed to build one end-cap.

Cost Profile: Example

Cost profile

4 Layers – η = 3.2

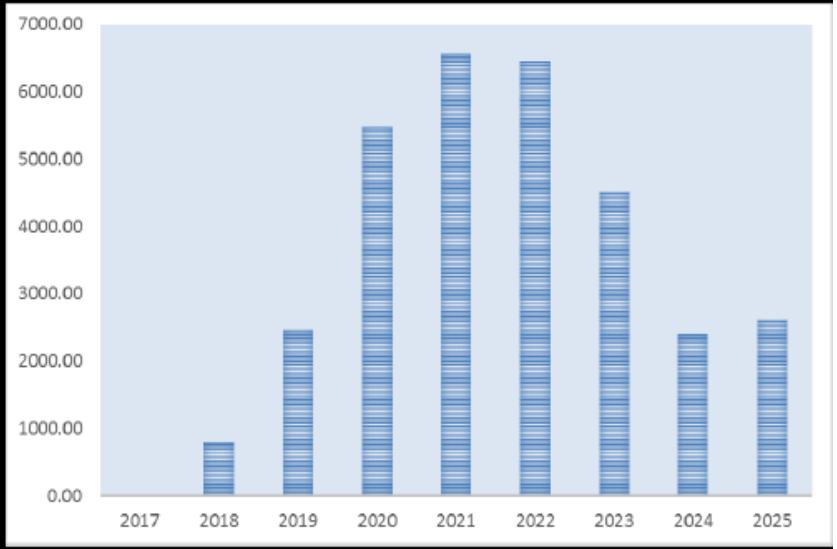
2017 : FE chip masks

2018 : pre-production

2019-2021 : module production

2021-2024 : integration and test

2025 : installation



Item	Cost	2017	2018	2019	2020	2021	2022	2023	2024	2025
Sensors	6802.97			10	30	30	20	10		
FE-chip	2647.64		30	20	20	20	10			
Bump-bonding	8338.90			15	25	25	25	10		
Local support	4043.77				10	20	30	30	10	
On-detector electornics	4207.14				10	20	30	30	10	
LV/HV	1689.90					5	5	10	30	50
Cables/Fibers	3541.22					5	5	10	30	50
Total	31271.54	0.00	794.29	2460.66	5480.23	6566.88	6446.91	4512.57	2394.43	2615.56

PM - Pixel Detector Cost Update 1/7/2015 21

ITk Common Items

- WBS L2 for ITk Common Items. Contains:
- Mechanics: everything that is not stave.
- Electronics: readout, ITk specific developments.

ATLAS WBS

WBS	L3	L4
2.1.1	Sensors	
2.1.2	Module	
2.1.2.1		FE Chip
2.1.2.2		Bump Bonding
2.1.3	Further Electronics	
2.1.3.1		On-det readout
2.1.3.2		On-det DCS
2.1.3.3		Type 0 cables
2.1.3.4		Service Panels
2.1.4	Off Detector Electronics	
2.1.4.1		PP2
2.1.4.2		Type-2 cables
2.1.4.3		Fibers
2.1.4.4		HV+LV power supplies
2.1.5	Mechanics – Local Support	

US-ATLAS WBS

6.1.1	**Local Supports**
6.1.1.1	**LST_LBNL**
6.1.1.1.1	Barrel I-Beams mechanics
LST3010	Design
	Prototype
	Production
6.1.1.1.2	Barrel local support electrical components
	Design
	Prototype
	Production
6.1.1.1.3	Barrel stave system testing
	Design
	Prototype
	Production
6.1.1.2	**LST_SLAC**
6.1.1.2.1	Barrel stave system loading and testing
	Design
	Prototype
	Production

2.1.5 Local Supports

6.1.2	**Readout FE Chip**
6.1.2.1	**ROC_LBNL**
	Design
	Prototype
	Production
6.1.2.2	**ROC_UWA**
	Design
	Prototype
	Production

2.1.2 Module

US-ATLAS WBS

6.1.3	**Sensors**
6.1.3.1	**3D_SLAC**
	Design
	Prototype
	Production
6.1.3.2	**CMOS-Pixel_SLAC**
	Design
	Prototype
	Production
6.1.3.3	**CMOS-Strips_SLAC**
	Design
	Prototype
	Production
6.1.3.2	**CMOS-Strips_UCSC**
	Design
	Prototype
	Production

2.1.1 Sensors

6.1.4	**Modules**
6.1.4.1	**RTI Bump Bonding atSLAC**
	Design
	Prototype
	Production
6.1.4.2	Module Assy/Testing
6.1.4.2.1	**Module Assy/Testing_ANL**
	Design
	Prototype
	Production
6.1.4.2.2	**Module Assy/Testing_LBNL**
	Design
	Prototype
	Production
6.1.4.2.3	**Module Assy/Testing_SLAC**

2.1.2 Module (Assembly)

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6.1.4.2.4	**Module Assy/Testing_UCSC**
	Design
	Prototype
	Production
6.1.4.2.5	**Module Testing_UNM**
	Design
	Prototype
	Production
6.1.5	**Services**
6.1.5.1	**Twinax_SLAC**
	Design
	Prototype
	Production
6.1.5.2	**TwistedPairs_UCSC**
	Design
	Prototype
	Production
6.1.5.3	**RADHardFlex_UNM**
	Design
	Prototype
	Production
6.1.5.3	**RADHardFlex_OkS**
	Design
	Prototype
	Production
6.1.5.4	**SerialPowering_OkU**
	Design
	Prototype
	Production
6.1.5.4	**SerialPowering_OkS**
	Design
	Prototype
	Production
6.1.5.6	**Opto Boards_OSU**
	Design
	Prototype
	Production

2.1.3 Further Electronics

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6.1.6	**Test setups**
6.1.6.1	**TDAQ_OkS**
	Design
	Prototype
	Production
6.1.6.2	**TDAQ_SLAC**
	Design
	Prototype
	Production
6.1.6.3	**TDAQ_STONY**
	Design
	Prototype
	Production
6.1.6.4	**TDAQ_UWA**
	Design
	Prototype
	Production
6.1.6.5	**TDAQ_ANL**
	Design
	Prototype
	Production

6.1.7	**Testbeam and Irradiations**
6.1.7.1	TestBeam_SLAC
	TestBeam_SLAC
6.1.7.2	Irradiations_UNM

US-ATLAS WBS

- Plans: make US-ATLAS WBS like ATLAS.
- Need to understand some details.
- Main L3 items are identical.
- A few more L3 items in US-ATLAS.

US-ATLAS scope/deliverables ?

- FE-Chip.
- I-Beam (local support) for inner layers, possibly outer layers: fabrication, services, test.
- Module Assembly: 20%.
- Serial Powering.
- High Speed Electrical: on-stave flex, twinax and twisted pairs.
- High speed Optical: Optical transmission?

- Stave loading.

Stave loading in the US

Preliminary thoughts:

- LBNL I-Beams: leading candidate for inner layers, possibly for all layers.
- I-Beams fabricated at LBNL, services installed at LBNL.
- Services tested at SLAC (cooling).
- Load modules at SLAC?
- SLAC has all required experience/expertise/(equipment) to load modules on stave and do the test of the whole chain.
- Inner layers: 30 staves, out of 151, exactly 20% of the barrel staves, ~10-12% of all Pixel.
- Looks like a great opportunity for US-ATLAS for more visible and critical construction role.
- (just like we do in the Strips)