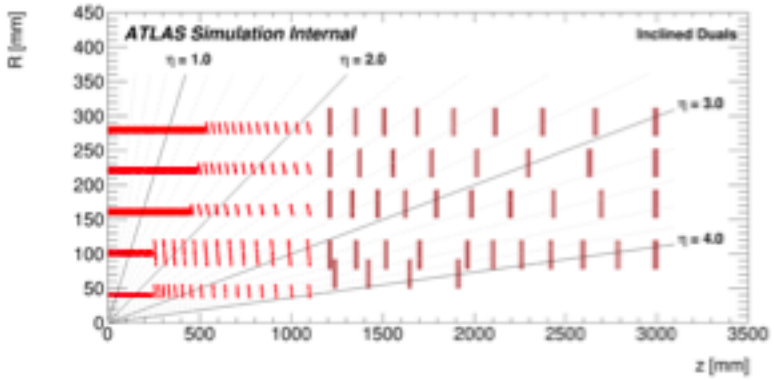
Glue overview

July 8, 2018

Overview

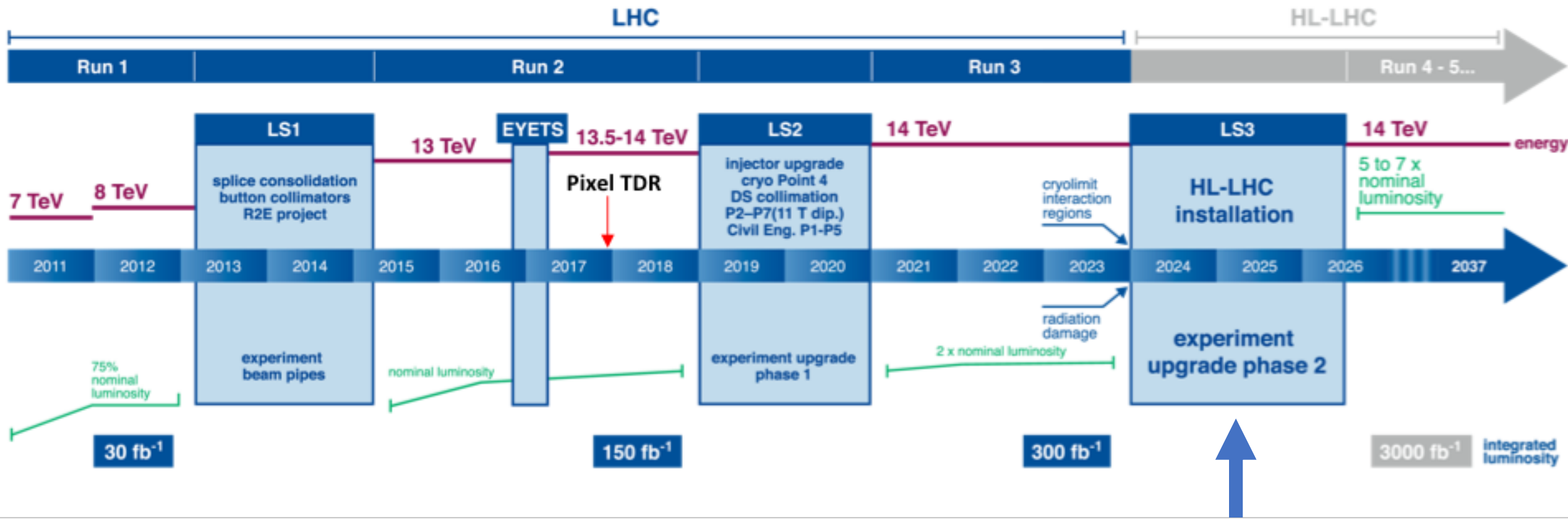
- Adhesive will connect silicon sensor modules to carbon fiber cores in the inner-most pixel layer
- See Pixel TDR **8.3 Pixel Module Assembly and Quality Control**
  - “Adhesive attachment of flex hybrid to bare module”

Red lines show the barrel pixel I believe



Schedule

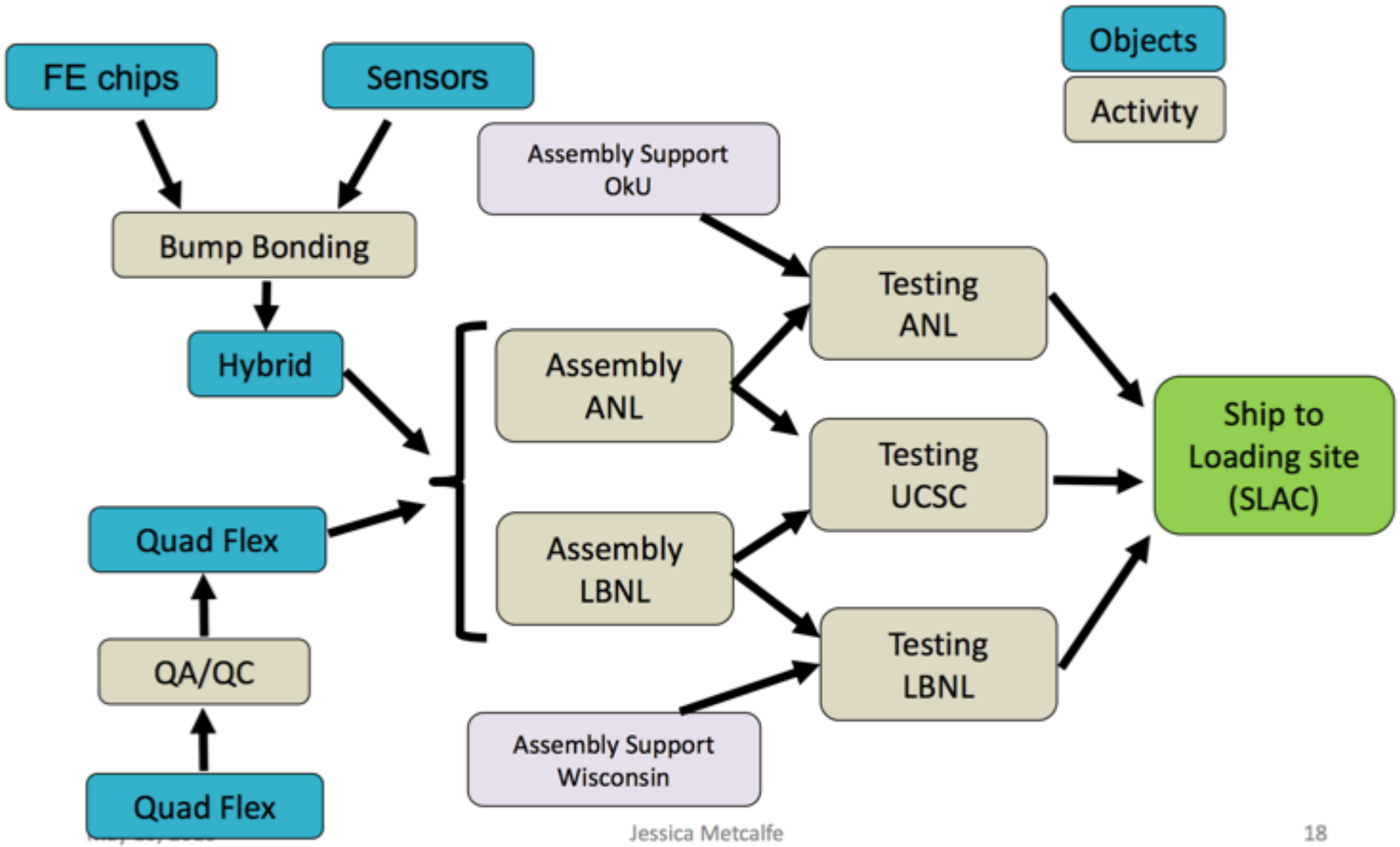
LHC / HL-LHC Plan



Installation of upgraded pixel

Expected pile up for HL-LHC is mu = 200

Module Assembly



Radiation dose

- Quoted Radiation hardness of pixel sensors: **500Mrad at -15 C**
- TDR: 0-layer of pixels will be replaced half way through Run 4. TDR says “Layer 0 must be radiation tolerant up to a dose of 900 Mrad.”
- (Overall “Requested radiation hardness”: 2x10^{16} n_{eq}/cm^2 x 20. Full Run4)

Table 2.9: The maximal 1 MeV neutron equivalent fluences and total ionising dose for different parts of the Pixel Detector, for the baseline replacement scenario for the inner section. A safety factor of 1.5 is taken into account.

luminosity	location	R (cm)	z (cm)	fluence (10^{14} n_{eq}/cm^2)	dose (MGy)
2000 fb^{-1}	barrel layer 0, flat	3.9	0.0	131	-
		4.0	24.3	-	7.2
	barrel layer 0, inclined	3.7	25.9	123	-
		3.7	110.0	-	9.9
	end-cap layer 0	5.1	123.8	68	6.3
	barrel layer 1, flat	9.9	24.3	27	1.5
	barrel layer 1, inclined	8.1	110.0	35	2.9
	end-cap layer 1	7.9	299.2	38	3.2
4000 fb^{-1}	outer barrel, flat	16.0	44.6	28	1.6
	outer barrel, inclined	15.6	110.0	30	2.0
	outer end-cap	15.3	299.2	38	3.5

Our list of Glues

- This Table https://confluence.slac.stanford.edu/display/Atlas/Glue+Table

lists the properties of the glues we are interested in. The properties we focused on are:

Viscosity, Thermal Conductivity, Electrical Resistivity, and Radiation Hardness. We also note if the glue is being used/ has been used by other experiments.

  - The glue should have low viscosity so that the pressure needed to push the silicon and carbon fiber together is low.
  - Thermal conductivity should be high to allow for effective cooling between the sensor and the cooling pipe.
  - Electrical resistivity should be high so that electrical signal is not passed through the glue.
  - Radiation Hardness must pass the specified HL inner pixel requirements.

- Manufacturers generally provide all of these properties except radiation hardness
- To test the radiation hardness we can apply the glue and send it to CERN to be irradiated and tested. Also, CERN is conducting these tests on a set of adhesives for use by all LHC experiments (see next page). These glues are listed in blue in the table.

List of glues being tested by CERN

Currently in	
Polytec TC418	2-parts epoxy
Epotek T7109	2-parts epoxy
Dymax 9-20801	UV cure TIM
Epolite FH-5313	2-parts epoxy
Polaris PF7006A	2-parts epoxy
Tra-Bond F112	2-parts adhesive
SE4445	2-parts adhesive
EG7655	2-parts epoxy
EG7658	2-parts epoxy
3M VHB5909	Tape
Araldite 2020	2-parts epoxy
Araldite 2011	2-parts epoxy
Tesafix 4962	Tape
UHU Endfest 300	2-parts epoxy
Dymax 9001	Encapsulant
Dymax 9001 v3.7	Encapsulant
Dymax 9101	Encapsulant
Sylgard 186	Encapsulant

In the next batch	
Epoxyhars L + Verharder W300	2-parts epoxy
Poly-Pox THV 500 + Harder 355	2-parts epoxy
Loctite Hysol EA 9396	2-parts epoxy
PCE-HT 3350/57	-
PCE-FILM-SA80	-
PCE-HTC-1800	-

Useful references

- Link to ATLAS Itk Pixel **Module Building Workshop (May 2018)**
- https://indico.cern.ch/event/718423/
- See especially this talk:
- https://indico.cern.ch/event/718423/contributions/3002853/attachments/1650032/2638799/20180515_MaterialQualification.pdf
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