

PLR Sensor Production

31 October 2024

Claudia Gemme (INFN Genova)

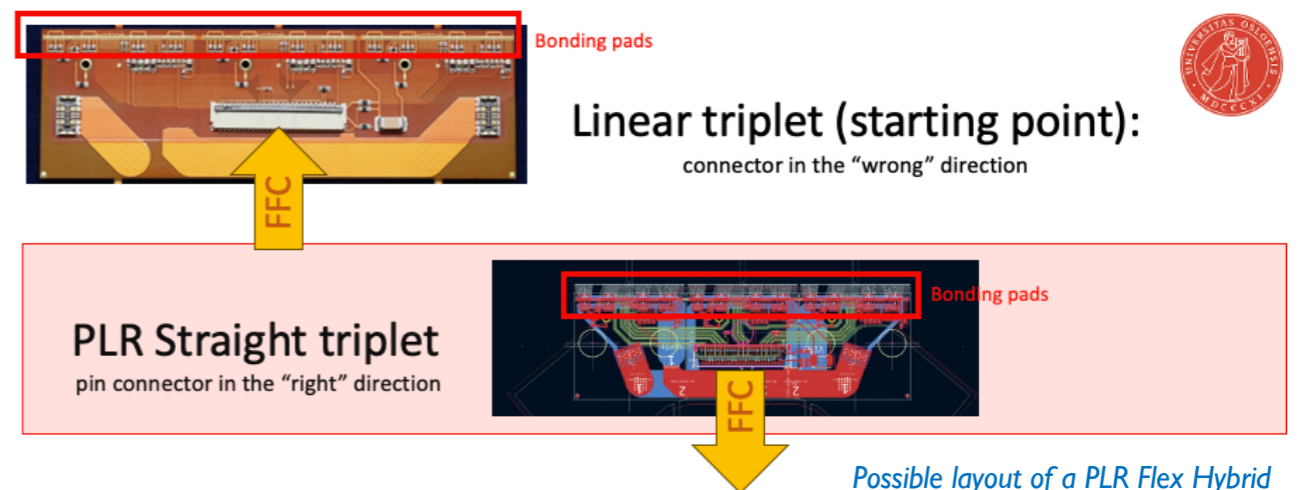
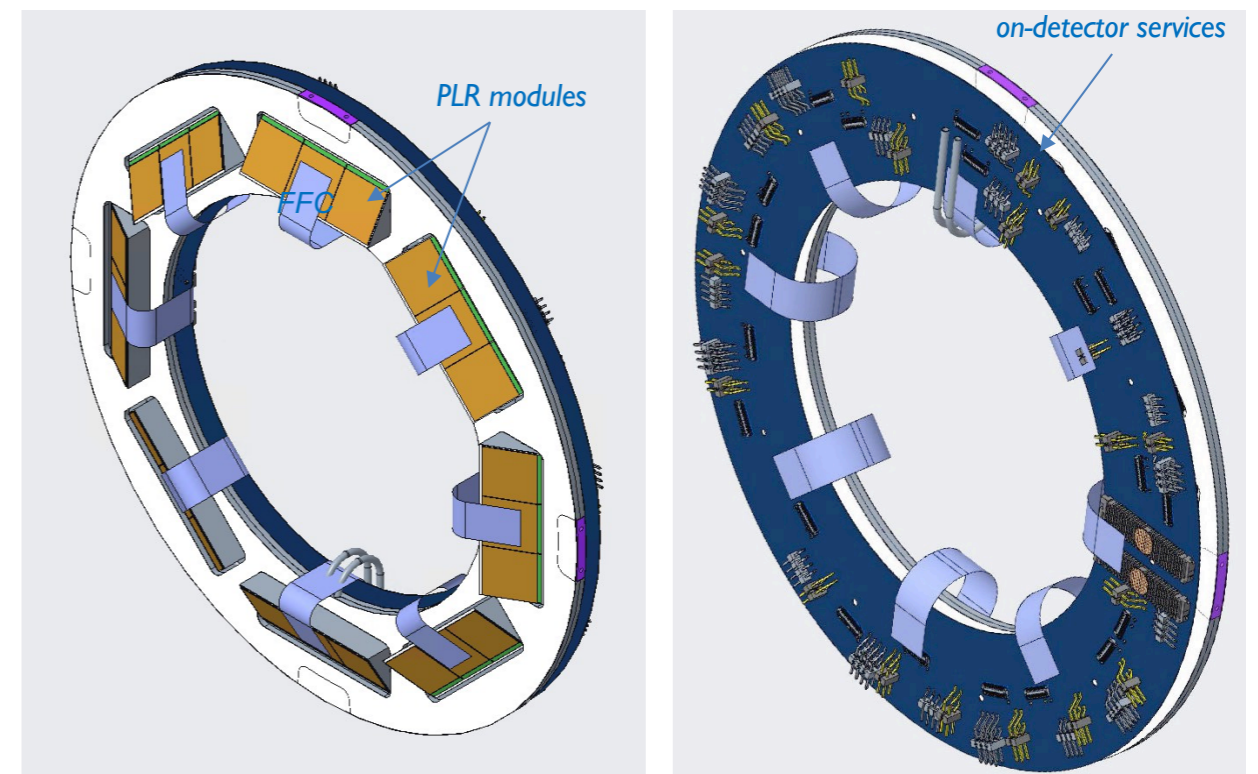
Pixel Luminosity Ring (PLR)

On each ring, eight **Layer-0 barrel triplet pixel modules** are loaded.

Main differences between Pixel and

PLR are:

- Would use a **readout chain** independent from TDAQ, and the maximum readout speed allowed by the RD53 ASIC, around 8 MHz for empty events, possibly 2 MHz for full events.
- **3D 25x100 μm^2** pixel cell as in ITk, sensors **tilted 30° towards the IP**, to get longer cluster for better S/B using shape information.
- **Flex Hybrid** to be designed starting from the linear modules of the L0 barrel: the data connector is tilted due to the endcap geometry.
- **Local support surface** modified to dissipate heat.
- **All the rest, sensors, ASICs, electrical and mechanical services, including mechanical jig for assembly, is the same as Pixel.**



3D Sensors in Pixel

Use the same as Pixel. In L0 we have 3D modules installed:

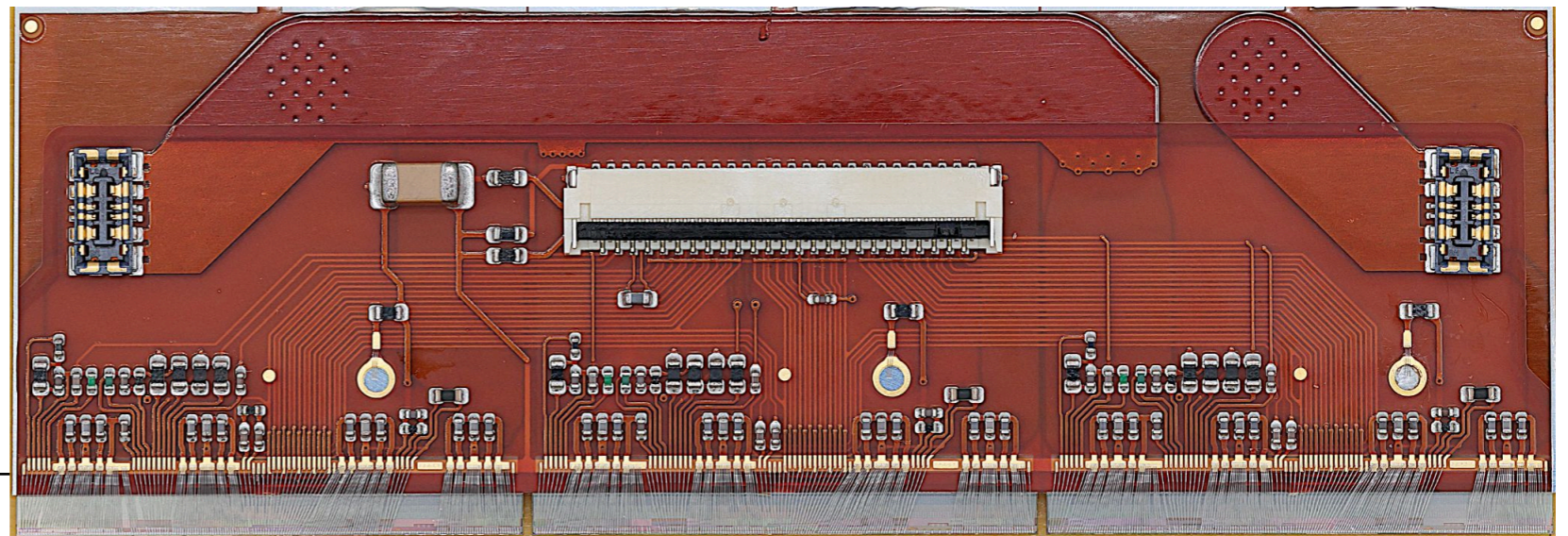
- 96 L0 Modules 25x100 μm^2
- 180 R0 Modules 50x50 μm^2
- 120 R05 Modules 50x50 μm^2

Sensors are produced by

- FBK 25x100 μm^2 and 50x50 μm^2 (PRR passed)
- Sintef 50x50 μm^2 (preparation for PRR ongoing)

3D FBK 25x100 μm^2 used in the barrel, currently modules assembled by Barcelona.

- 96 “triplets” modules installed \rightarrow 288 3D sensors installed, including Yield model 478 needed.



Sensors Production

Status of Pixel Production:

- 67 sensors delivered in pre-production
- Full production order is 500 sensors (vs 478 required)
 - first batch of 250 production sensors delivered in March 2024.
 - some of these sensors have been or will be used for pre-production → The sensors used for pre-production from this batch will need to be compensated with a new order – no left over in FBK
 - Next batch is expected to be other 250 sensors and it will arrive in Dec/January → probably not many spares from this batch (i.e. if the yield is good max 50 more sensors in house at FBK to purchase on top of the 250)

PLR

- For the PLR, 48 sensors installed → maybe 70-80 needed
 - ~20 can come from 500-478 (i.e. extra from pixel production)
 - Maybe ~50 from Batch 2????
- → it would be conservative to place another order to cover ~50 more sensors for the PLR on top of the production ones used for pre-production tasks.
- If a new batch was needed: From when they start producing, FBK will need 6-8 months to complete a new batch
 - If we wait to see the yield of the batch delivered in December we will get new sensors by July-September 2025

Indicative date		FBK 25x100	
		Plan	delivered
November 2022			
December 2022	Start production		
January 2023	1 month		
February 2023	2 months		
March 2023	3 months		
April 2023	4 months		
May 2023	5 months		
June 2023	6 months		
July 2023	7 months		
August 2023	8 months		
September 2023	9 months		
October 2023	10 months		
November 2023	11 months	PRR	
December 2023	12 months	Order	
January 2024	13 months		
February 2024	14 months		
March 2024	15 months	250	250
April 2024	16 months		
May 2024	17 months		
June 2024	18 months		
July 2024	19 months		
August 2024	20 months		
September 2024	21 months	Order?	
October 2024	22 months		
November 2024	23 months		
December 2024	24 months	250	
January 2025	25 months		
February 2025	26 months		
March 2025	27 months		
April 2025	28 months	250?	
May 2025	29 months		
June 2025	30 months		
July 2025	31 months		
August 2025	32 months		
September 2025	33 months		
October 2025	34 months		

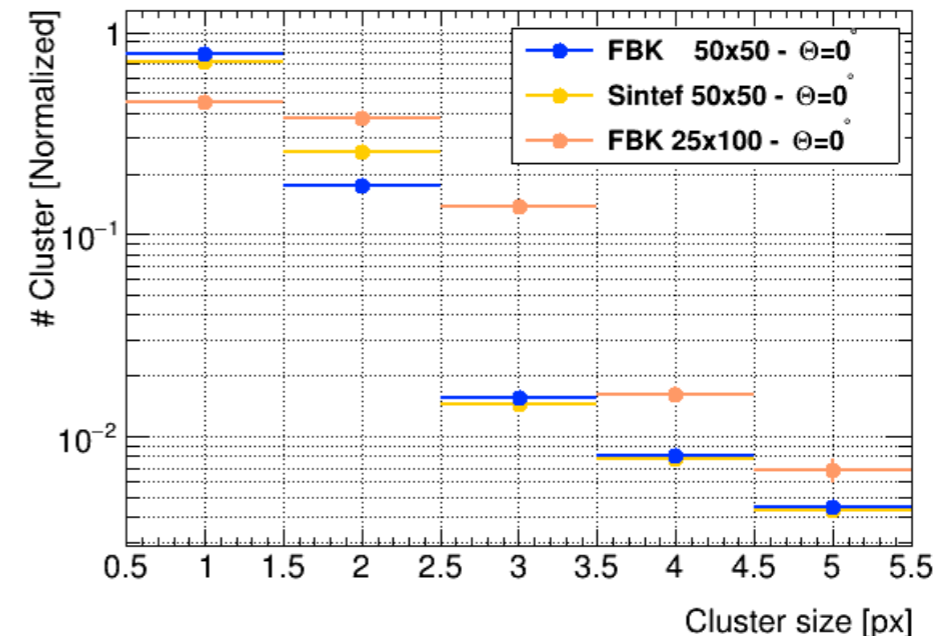
Italian Interest

- **Italy** has an important role **both in Luminosity (LUCID) and Pixel3D** , therefore PLR represents a perfect match in our interests.
- At this stage, **we can't take more commitments**, however we appreciate as this small project is very interesting and relevant for ATLAS.
- To let a door open for future involvements, we have asked our FA to **contribute to the PLR sensor procurement**, with a relatively modest contribution of **24 kChF**, and **their performance** evaluation. This commitment would slightly extend our current engagement on this topic.
- Instead, although very interesting, today **we can't commit** in the TDAQ part of the project, given the duties in Lucid/BMA.
- On the long term, we hope to get involved in the tracking/luminosity measurements given the expertise in the groups, but we cannot subscribe now (not needed in the MoU).

Italian Interest

- Sensors are **exactly the same as the ITk Pixel L0 Barrel** (3D FBK 25x100 μm^2 , now in production) which are under our responsibility (production, test in lab and test beam, before /after irradiation). We have already collected data at 30 degrees inclination (data analysis ongoing).

ATLAS Working in progress , TB 2023, Gemme, Ravera, Ressegotti et al



- The L0 barrel **must be perfect** : it is at 3.4 cm radius, the next innermost L1 is at 9.9 cm. Any L0 inefficiency will have a highly disruptive impact on the tracking performance.
 - L0 modules **may have a yield lower than originally planned**: If one Bare module fails after triplet assembly, **two good ones are lost** as well: no reworking is possible!
 - Pixel is considering to produce more 25x100 barrel sensors to get the production perfect modules we need \rightarrow injecting more money in FBK
- 25x100 may be seen **as covering PLR or an extra cost in L0**
 - Lower quality modules [**to be identified prior the assembly in triplets, may be tricky!**] may be used for PLR?