NSW Alignment Commissioning

NSW Commissioning & Slice Test (Muon Week)

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ATLAS EXPERIMENT

Outline

I. System Design Overview
   A. Alignment bars
   B. Global alignment system
   C. Proximity alignment system
II. Alignment Bar Commissioning
   A. BCAMs
   B. In-Bar System
III. Chamber Alignment Commissioning
IV. Data Acquisition
V. ARAMyS
VI. Status and Plans

Alignment Bars

Local Alignment: Bars → Chambers

Small and large alignment bars are mounted on the NSW and form a grid in the ATLAS coordinate system.

BCAMs mounted on the proximity lines locate adjacent chambers of the NSW.

BCAMs on BBI and BBE lines of the large bars locate alignment features of the the BIS78 and BEE chambers, respectively.

Global Alignment: Bars → Bars

BCAMs mounted on proximity and azimuthal lines locate adjacent bars of the NSW, establishing our grid and connecting the large and small sectors.

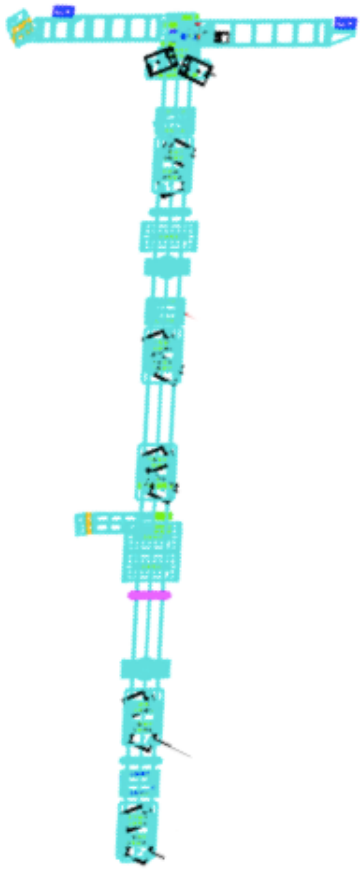
BCAMs mounted on polar lines of the large bars locate the other wheels of the existing muon spectrometer.

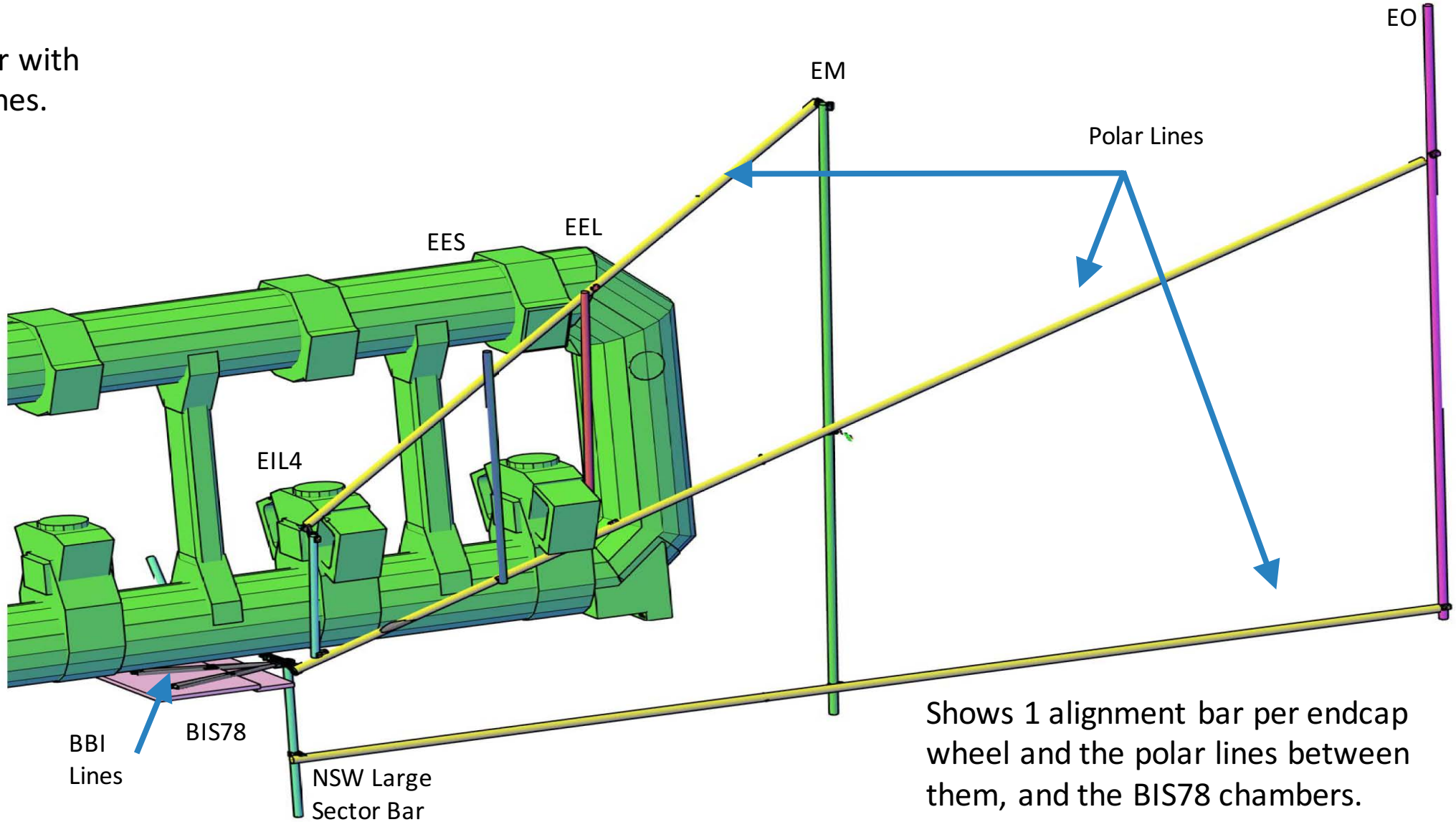
The new BBI/BBE lines, combined with the polar lines, allow us to stitch together the barrel and endcap alignment systems.

8 small and 2 large sector alignment bars mounted on C wheel

Global Alignment System

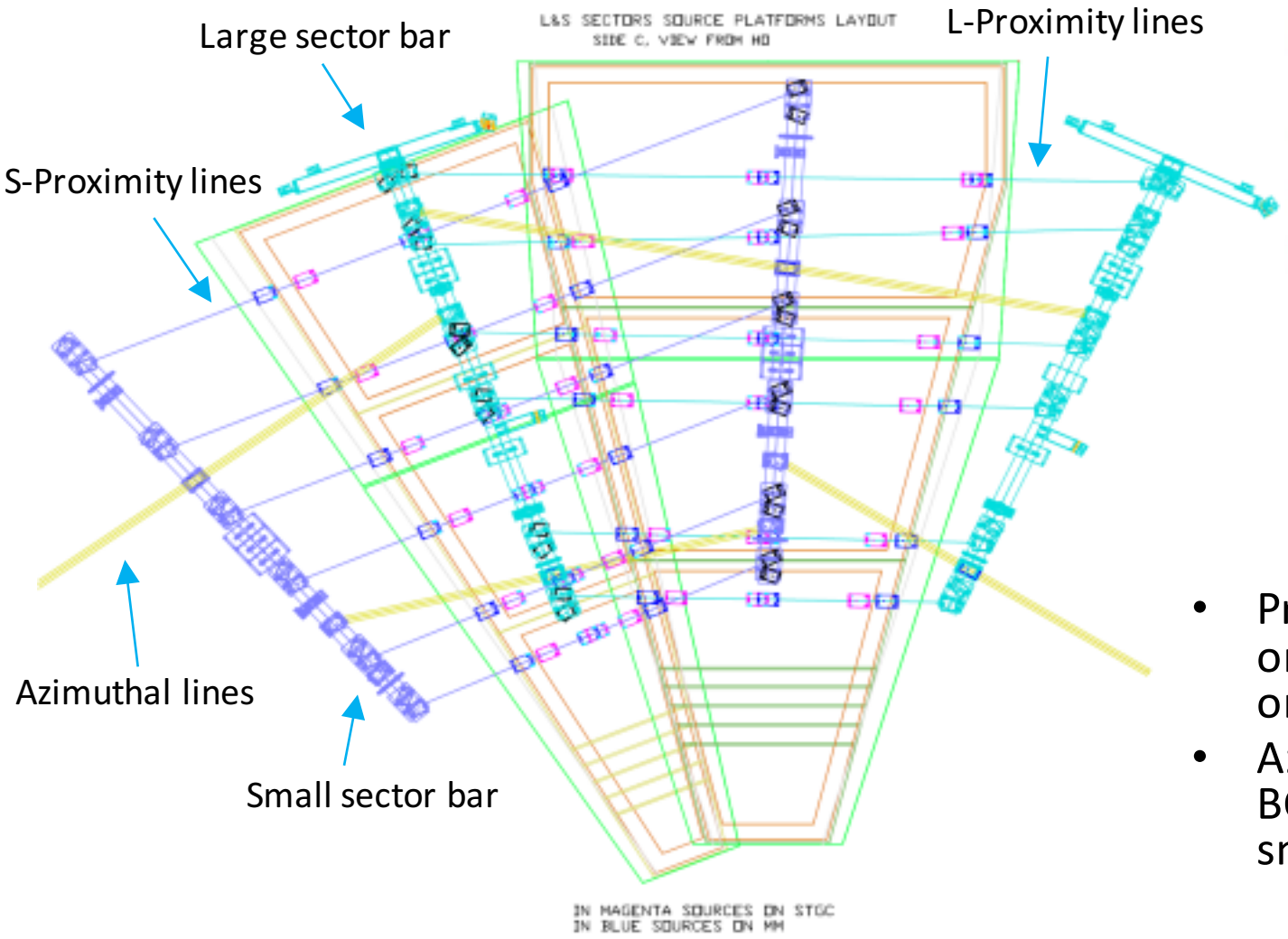
Large alignment bar with "wings" for polar lines.

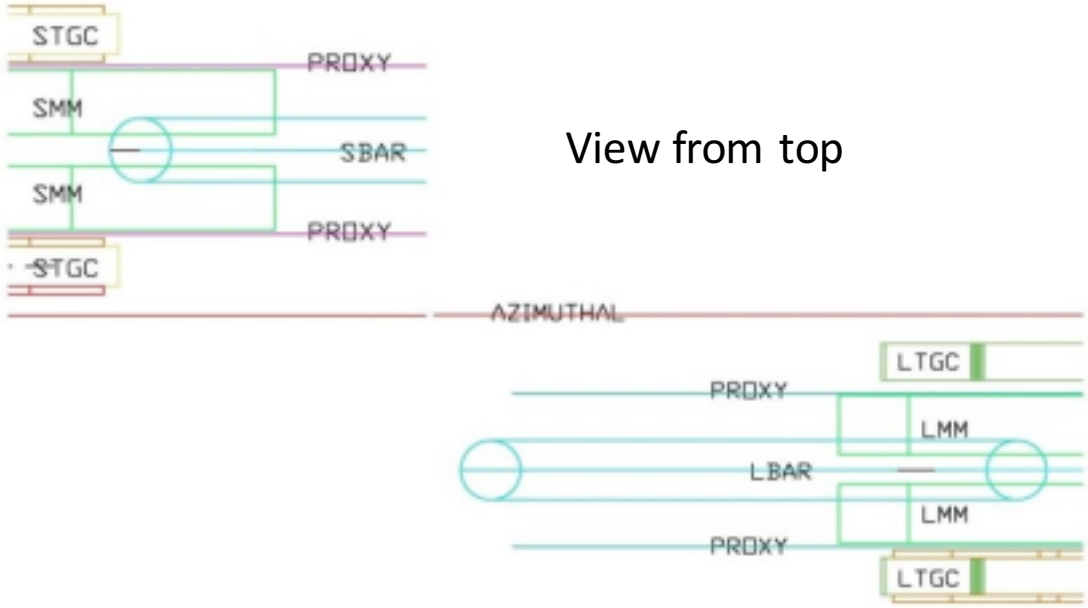




Shows 1 alignment bar per endcap wheel and the polar lines between them, and the BIS78 chambers.

Proximity Alignment System





View from top

- Proximity BCAMs (on bar N) view light sources on chamber surfaces and their partner BCAMs on bar N ± 2.
- Azimuthal BCAMs (on bar N) view their partner BCAMs on bars N ± 1 and N ± 2, connecting the small and large sectors of the NSW.

Alignment Bars - BCAMs

Once the bars are on the wheel…

- We check for BCAM function and view of its partners on the adjacent bars.
- We run a data acquisition script on all bars, and check their relative positions. This can reveal many hidden problems, eg. if a BCAM is mounted improperly, if we recorded the serial number incorrectly, if lines are blocked by cables, etc.
- A survey is performed, which provides us with their absolute positions. We then adjust the bars to their nominal position on the wheel.

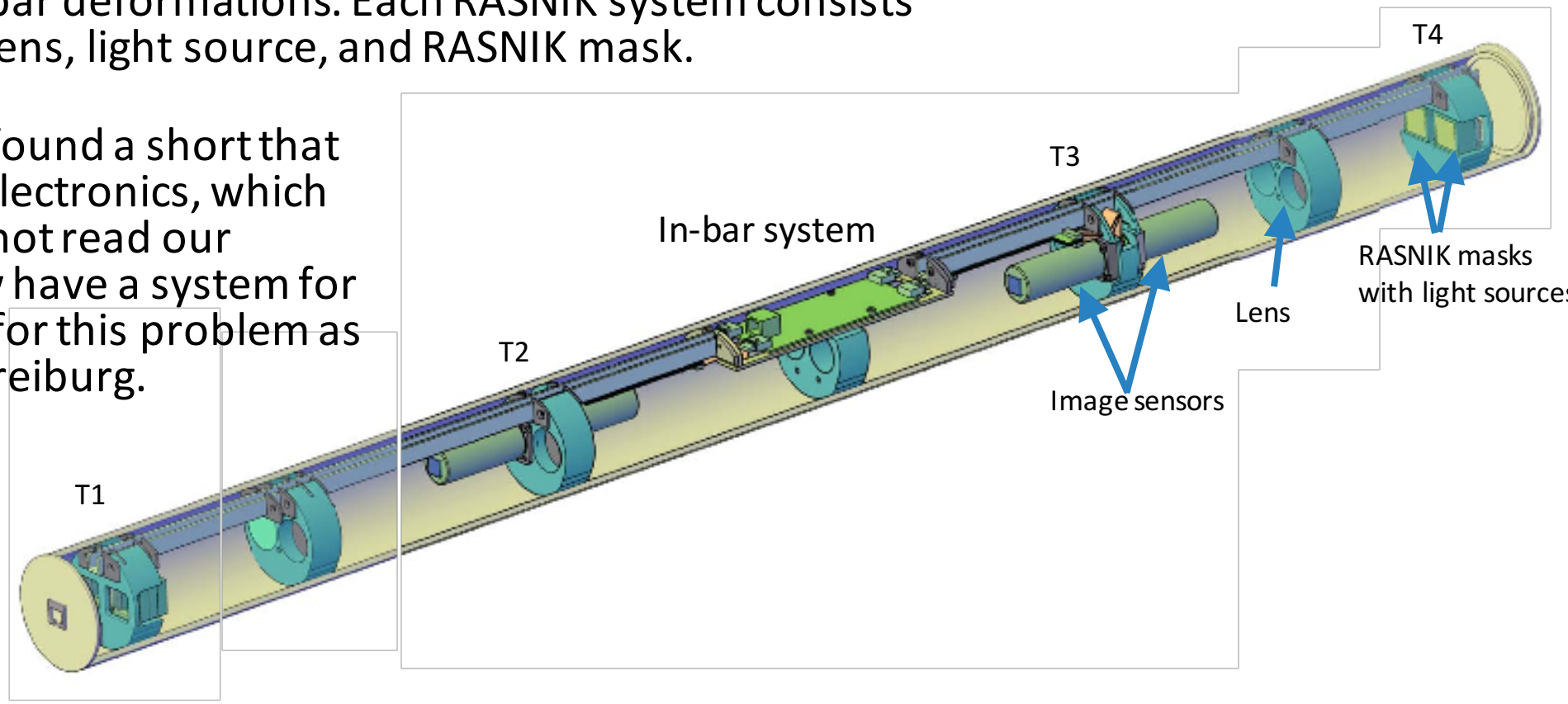
Small sector alignment bars mounted on A and C wheels

Alignment Bars – In-Bar Systems

In-bar System consists of….

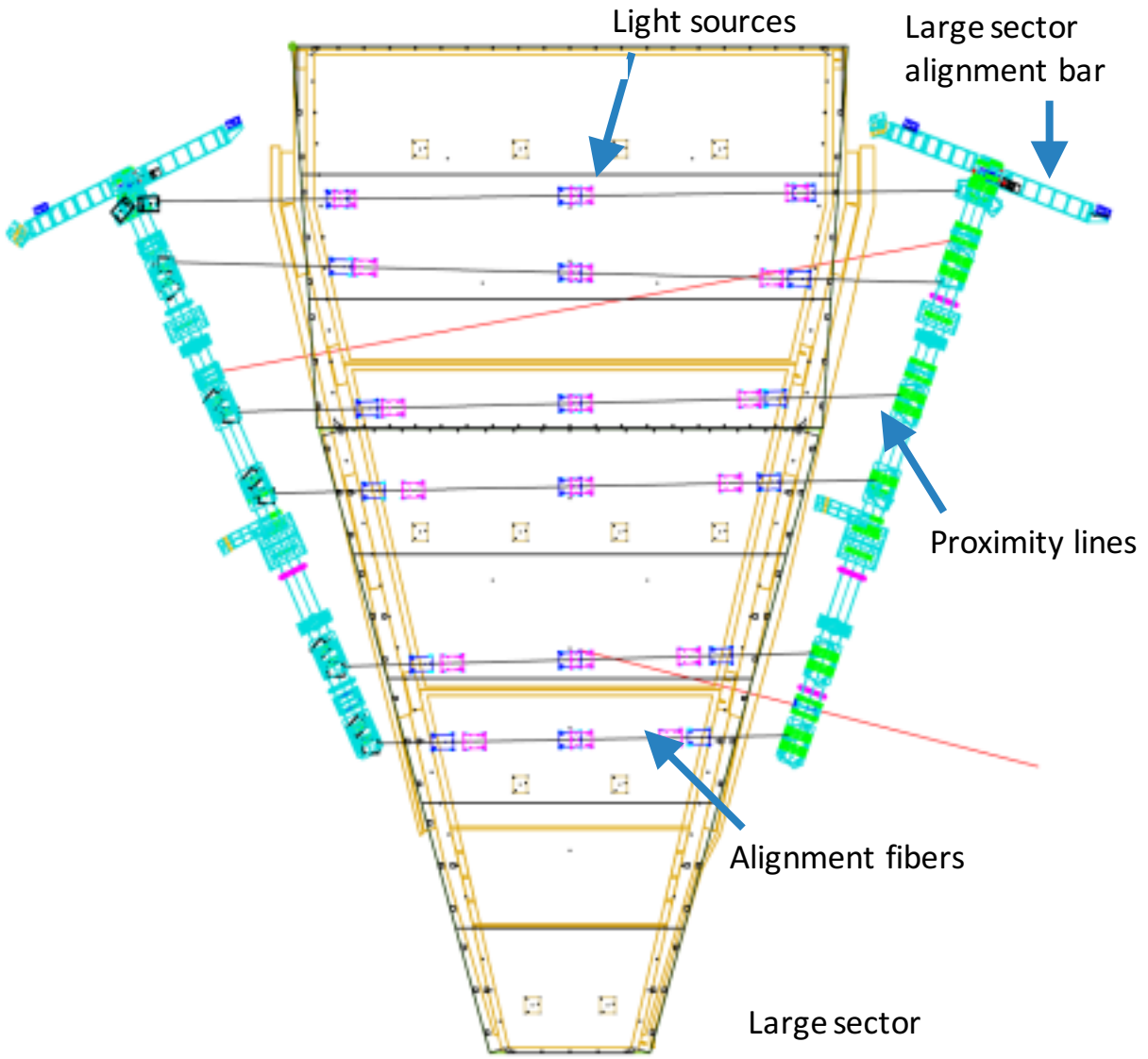
- 4 temperature sensors (T1-T4) to monitor thermal expansion.
- 4 RASNIK systems function as overlapping straight line monitors, allowing us to track bar deformations. Each RASNIK system consists of an image sensor, lens, light source, and RASNIK mask.

With the small bars we found a short that can occur in the in-bar electronics, which makes it so that we cannot read our RASNIK system. We now have a system for checking all future bars for this problem as they are assembled at Freiburg.



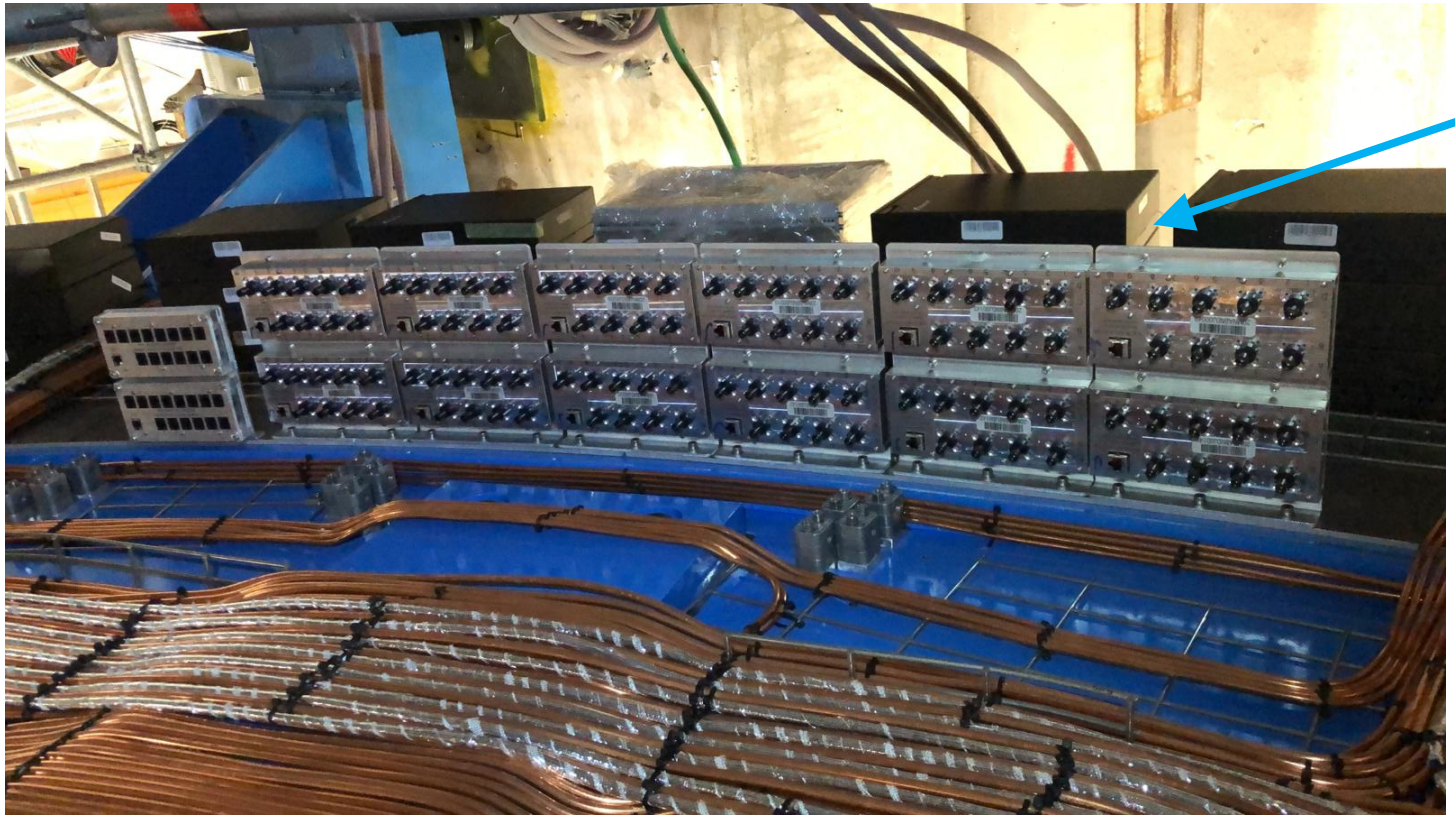
Chamber Alignment System

- The chambers are mounted onto the wheel with calibrated source platforms already installed on the surface, and on-chamber fiber optic cables routed to the source platforms.
- Once on the wheel, the on-chamber fiber harnesses are connected to the off-chamber fiber harnesses, which lead to the light injectors mounted on the NSW.
- Using the NBCAMs on the alignment bars, we check that all the light sources function and are connected to the correct injectors.
- We acquire data from the entire sector and check the positions of the chambers with respect to the alignment bars.

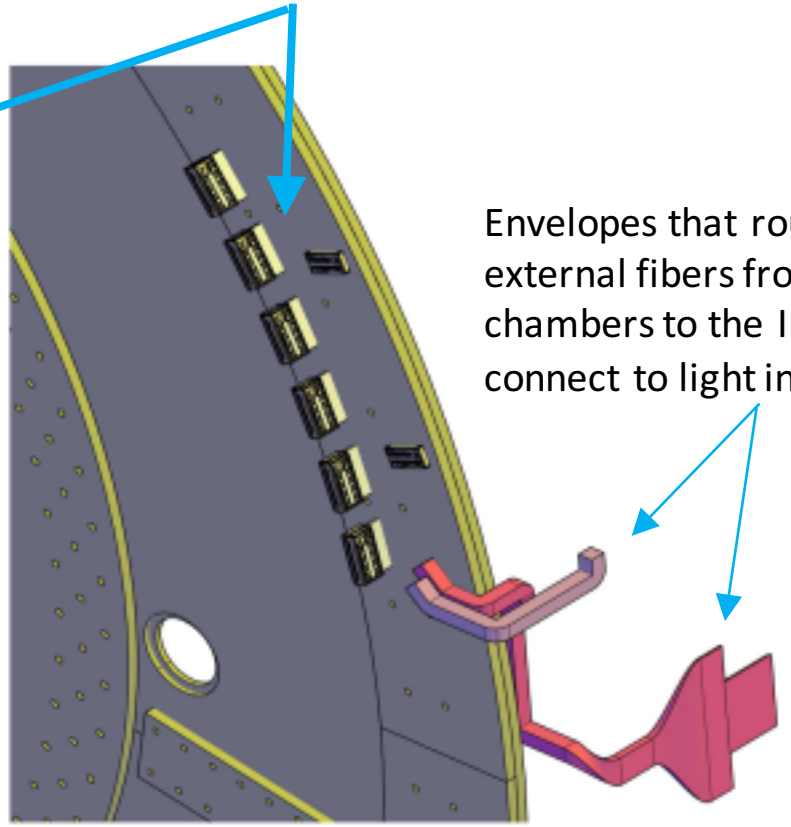


Chamber Alignment System

- Light injectors and multiplexers are currently being mounted on the IP side of the NSW and will be tested soon.
- We are working on a scheme for the designation of fiber connectors on the light injectors.

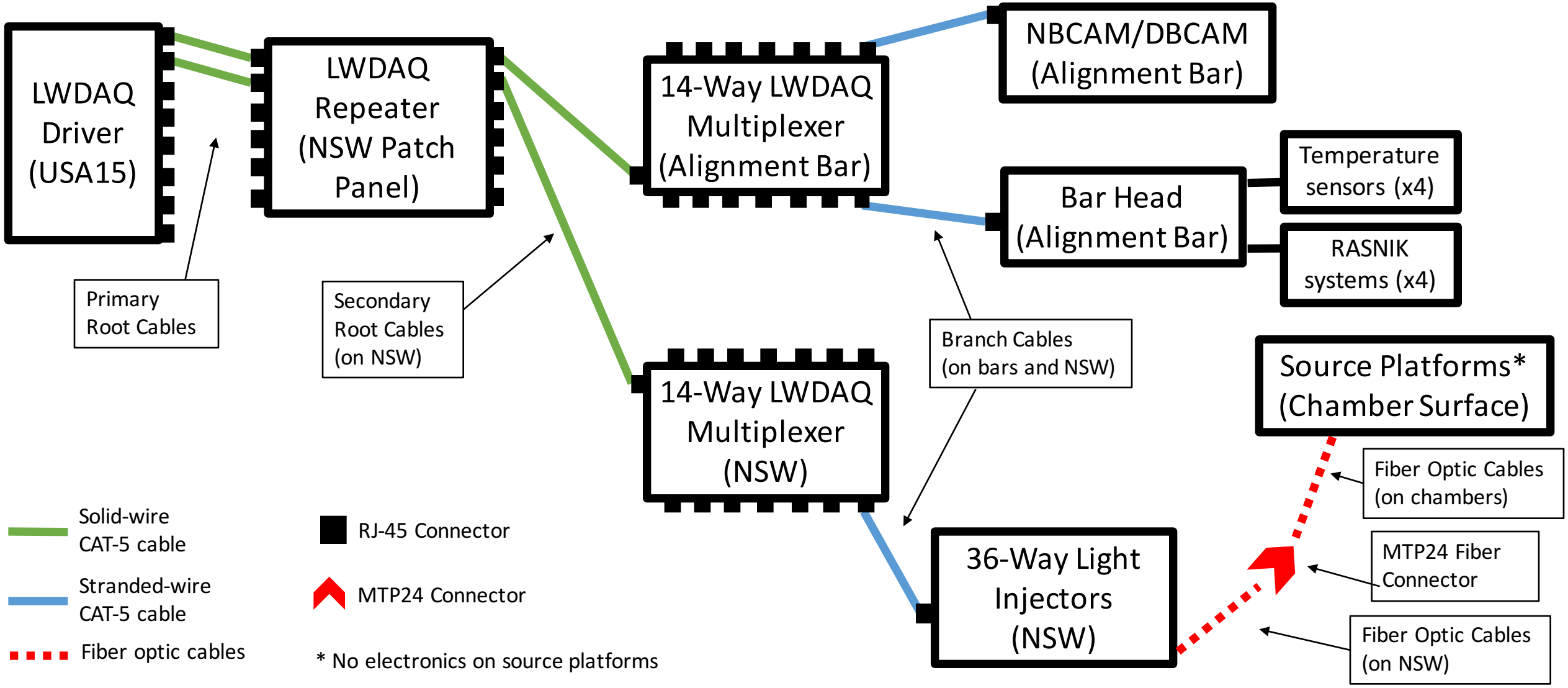


Light injectors and multiplexers on IP side of the JD



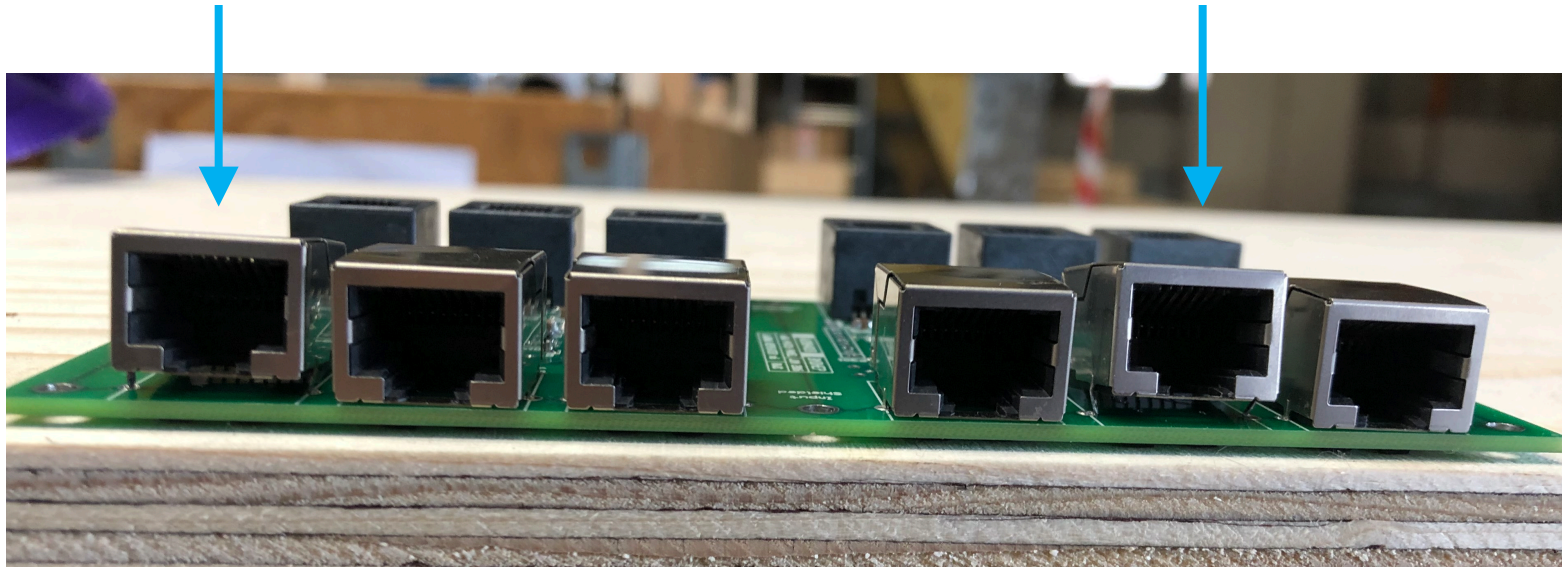
Envelopes that route external fibers from the chambers to the IP side to connect to light injectors

Data Acquisition

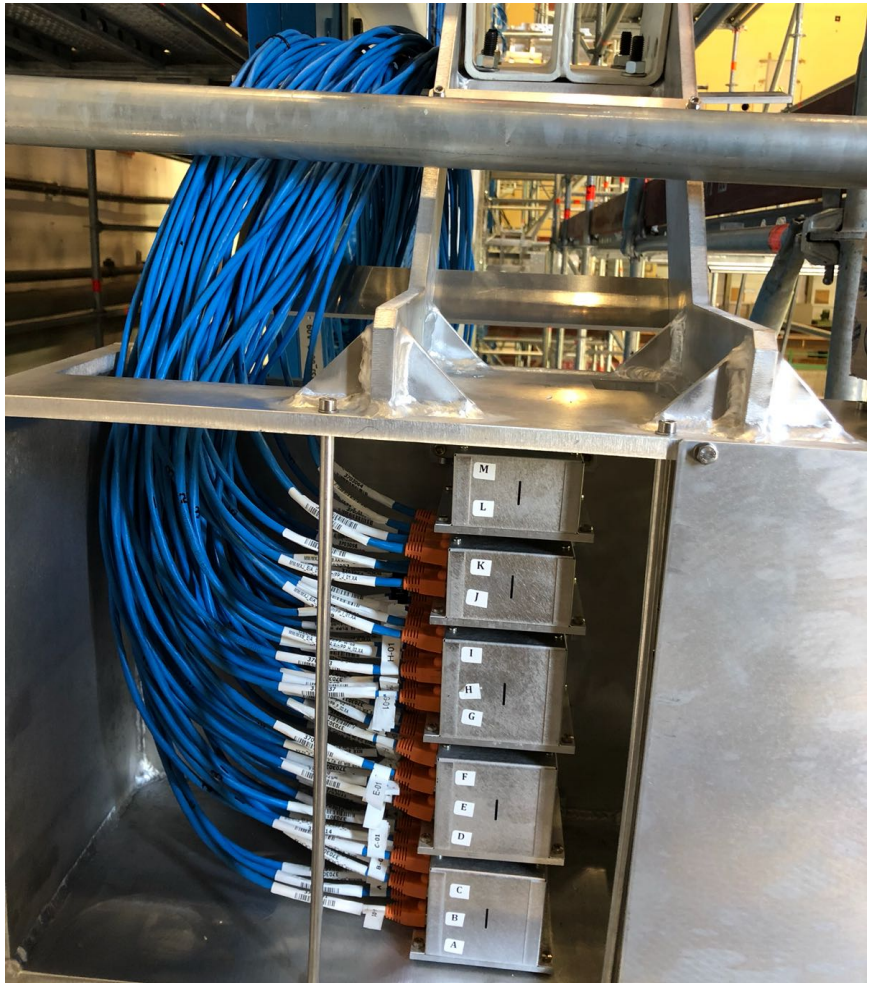


Repeaters

- Problems with repeaters – due to the cramped space in the patch panel, we are damaging our repeater sockets when trying to unplug the cables.
- We are currently working on a redesign of the repeater boxes to allow for more space and accessibility.



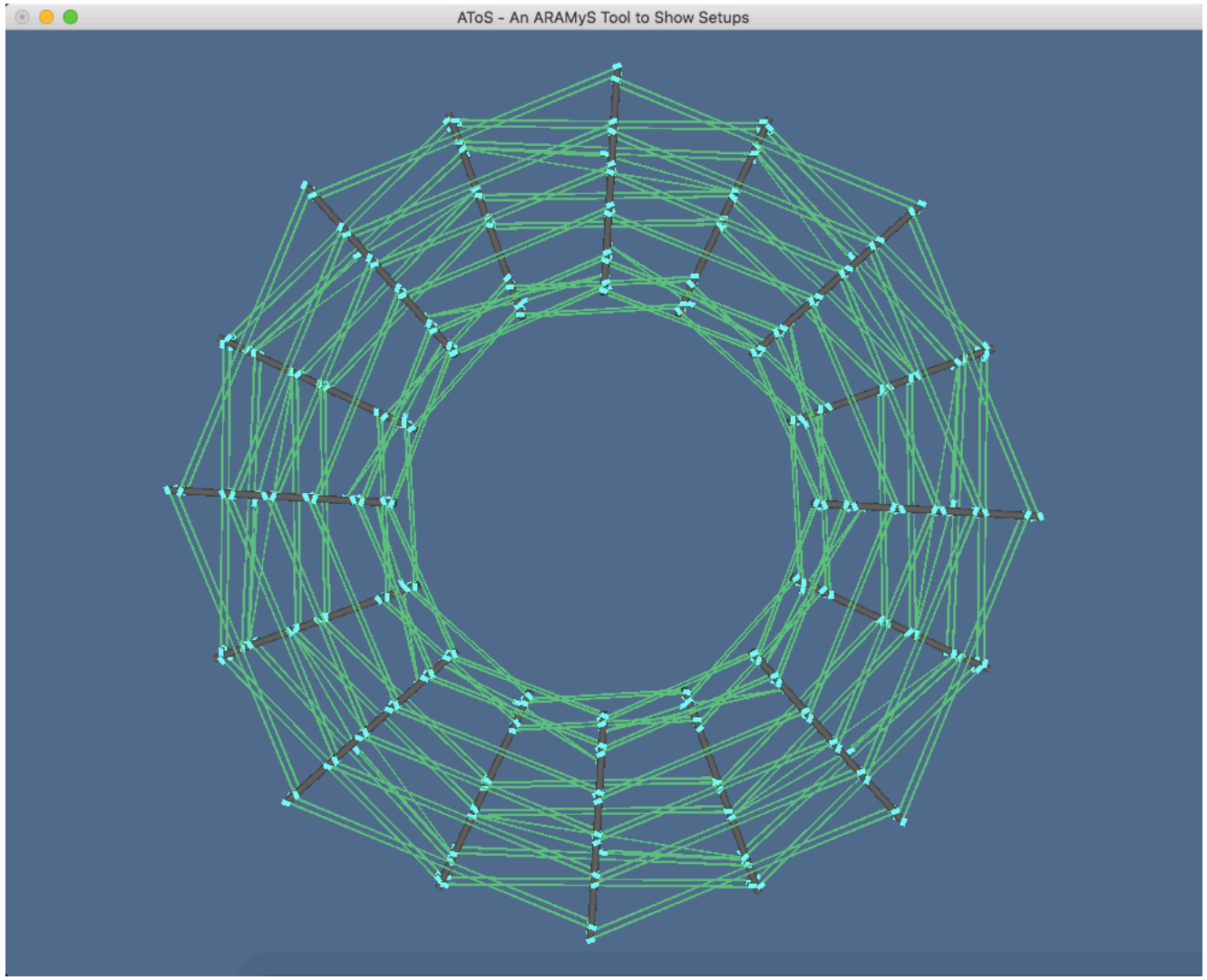
Repeater board with damaged connectors lifted from circuit board



Alignment root cables and repeaters in A-side patch panel

ARAMyS

- We perform an ARAMyS reconstruction using our acquired data, and then check the fit result for consistency.
- The reconstruction accounts for calibration constants, bar and chamber deformations, and surveys performed on the wheel.
- With ARAMyS we will extract displacements and rotations of chambers and bars, adjust all components, acquire data again, analyze, and repeat.



Visualization of the ARAMyS reconstruction of A-side alignment bars.

Status and Plans

Status

- All small alignment bars (A and C wheel) have been mounted on the NSW, tested, and adjusted.
- Large bars (one on A wheel, two on C wheel) have been mounted for preliminary testing prior to sector installation.
- We are in the process of installing injectors and multiplexers to power the light sources of the chambers on the wheel.
- We have a semi-portable LWDAQ VME driver crate set up in b.191 and are starting production of more cables to be able to test all components at once.

Plans

- Complete tests on the large bars mounted on A and C wheel.
- Implement repeater box redesign and test.
- Decide on a scheme for the designation of fiber connectors on the light injectors.
- Begin preparation steps for chamber alignment commissioning (DAQ script, integrate ARAMyS reconstruction).