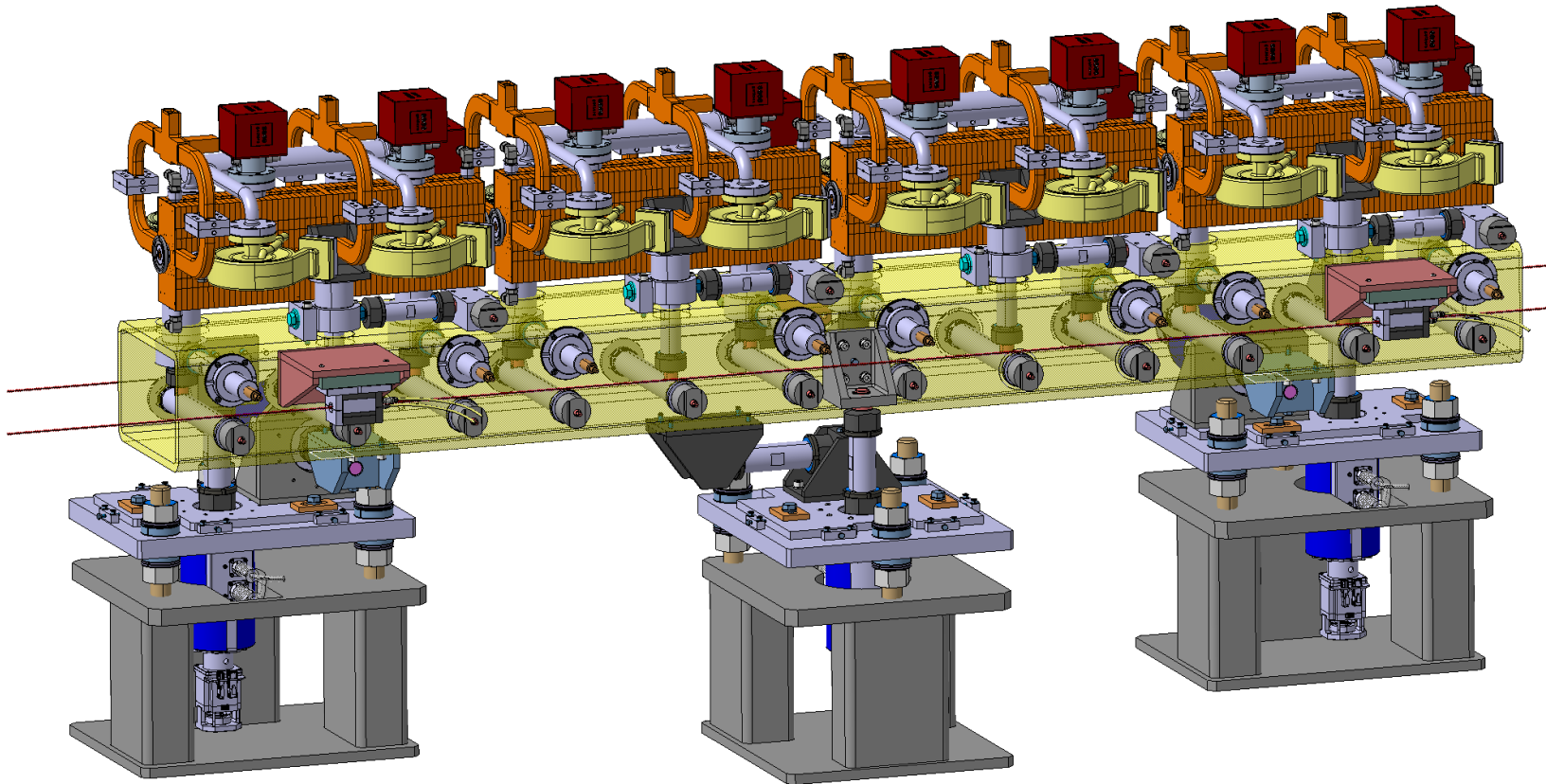


# Module Prototyping & Testing Programme 2022

Matthew Capstick

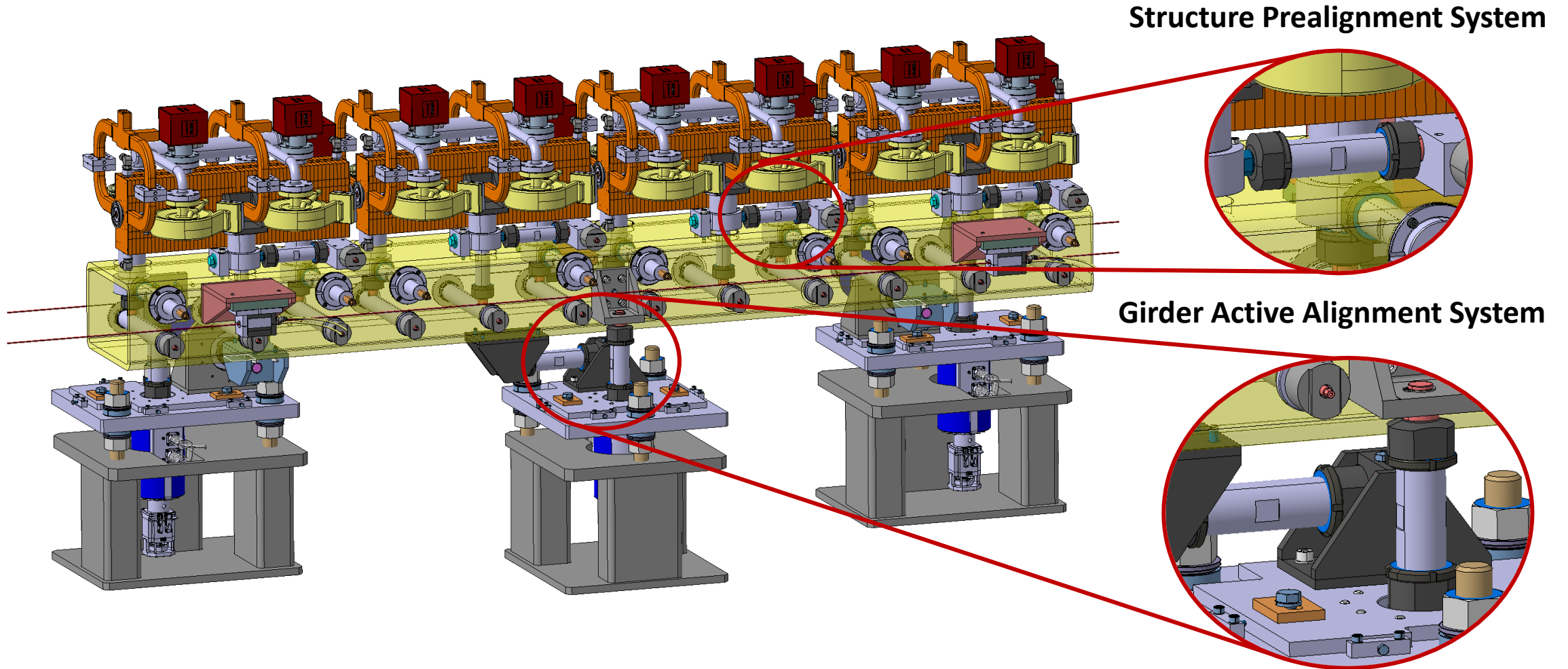
02/02/2022

# Current Module Design



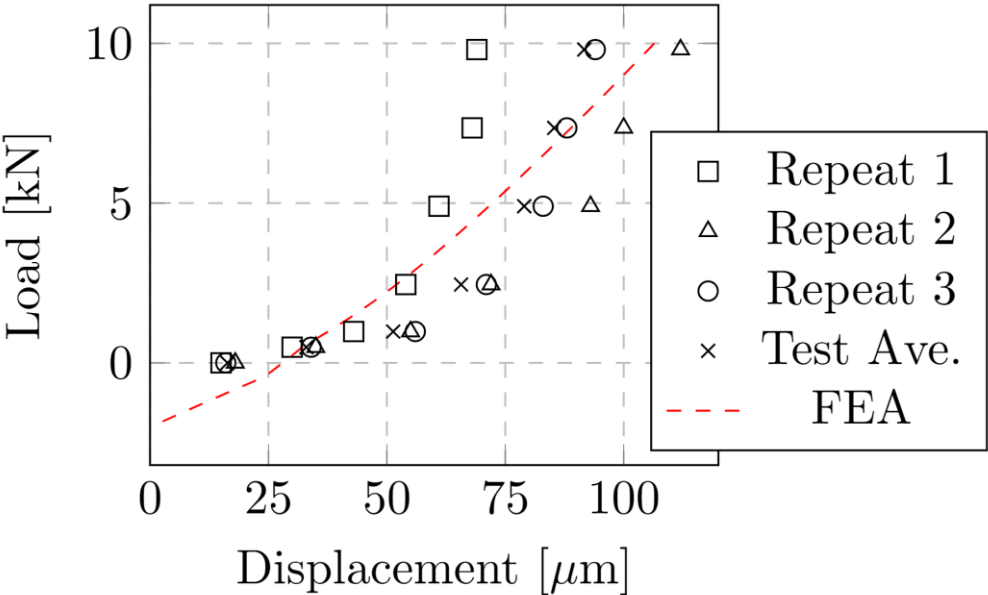
- The current main beam supporting system design
- Based around 'universal joints'
  - Both the structure prealignment and the active girder alignment
- The girder adjustment system is based around 5 of the existing (vertical/large variant) linear actuators
  - No longitudinal adjustment
- **We intend to manufacture and test some prototype systems to verify the design this year**

# Universal Joints



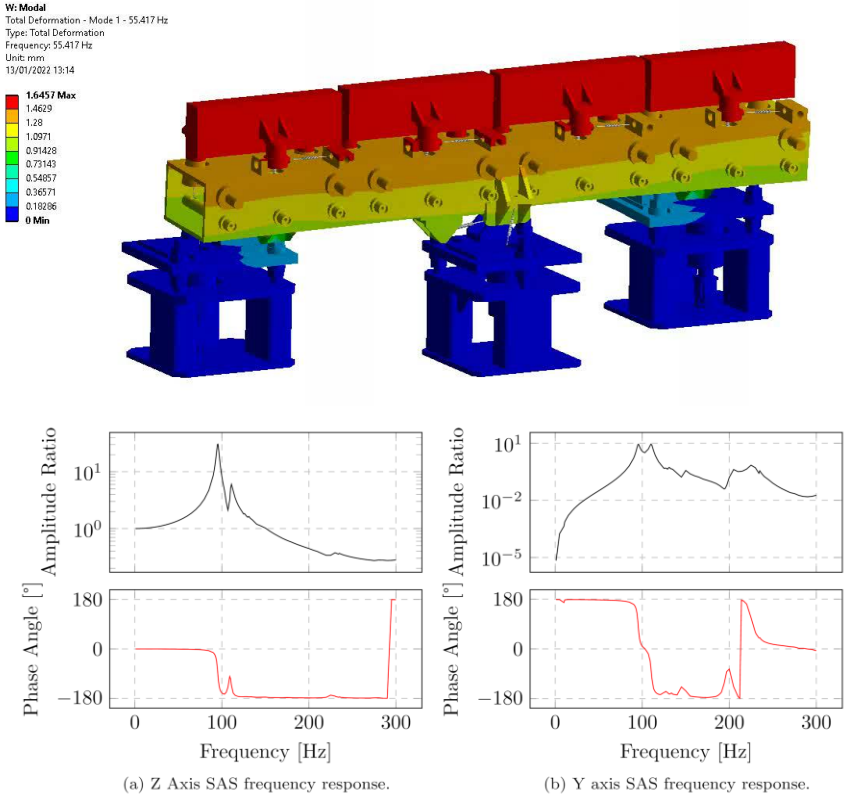
# Universal Joint Stiffness

## Predicted Stiffness



Above: The results of compressive testing of a 22mm Diameter bearing prototype universal joint compared to the equivalent axisymmetric FEA.

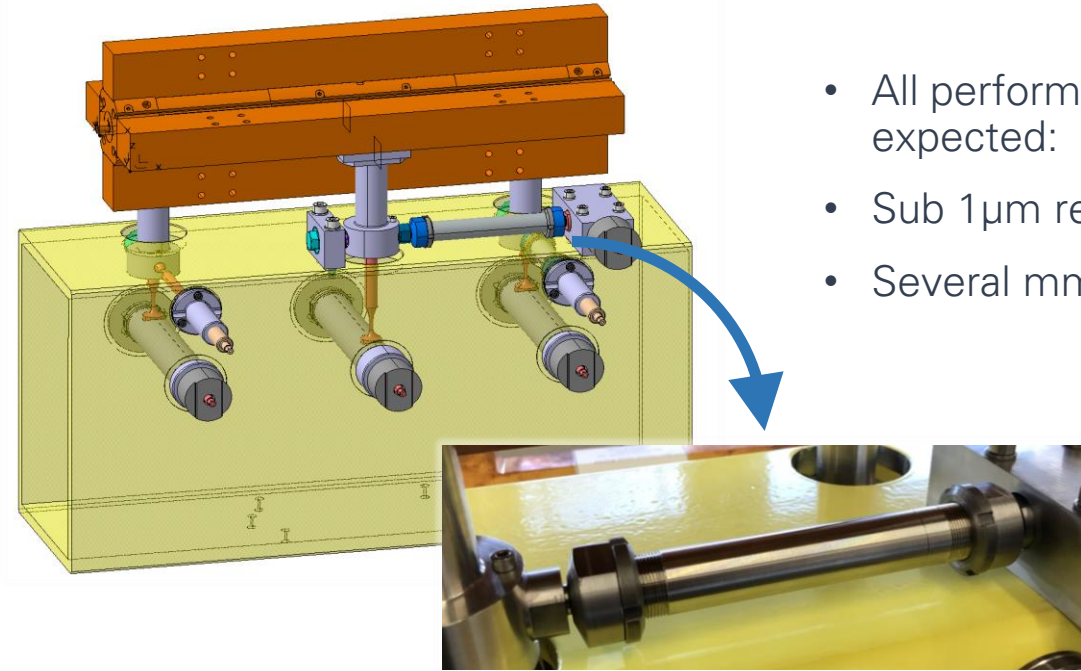
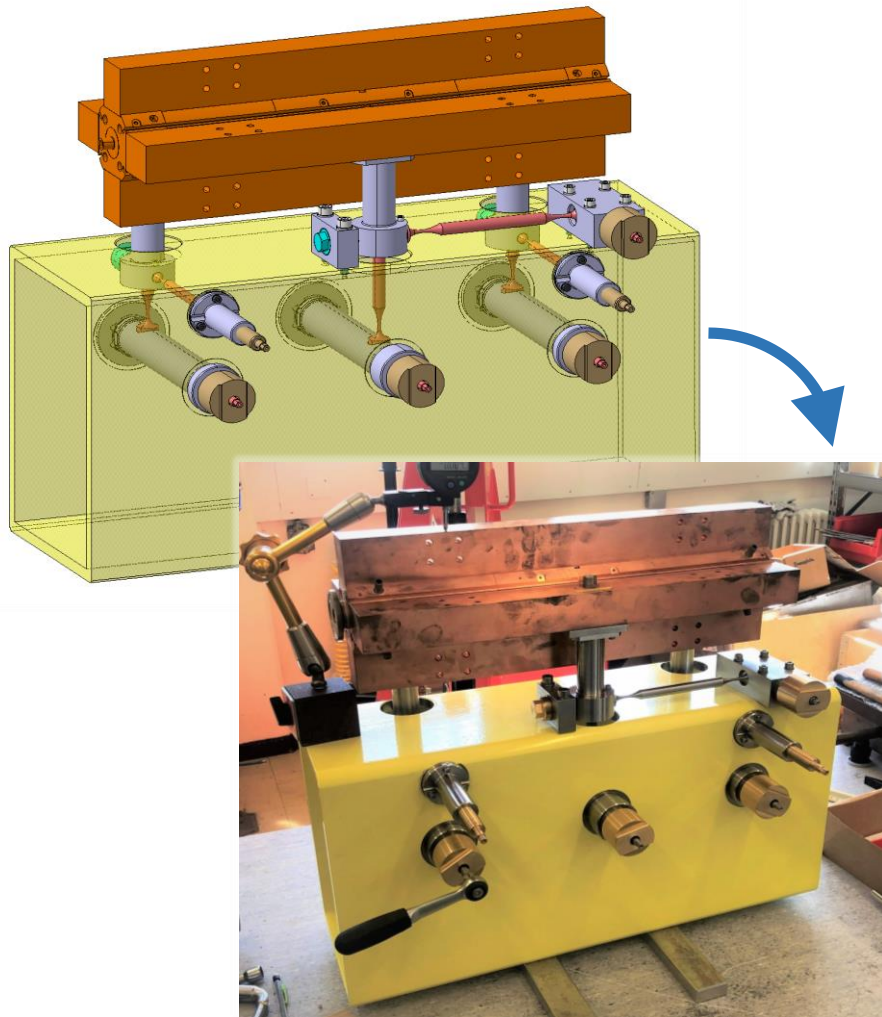
## Harmonic Response



Left: The primary (55Hz) harmonic mode of a recent CLIC module design

Left: The Z (vertical) and Y (transverse) axis frequency response for a module design, exposed to an in-phase vertical base oscillation

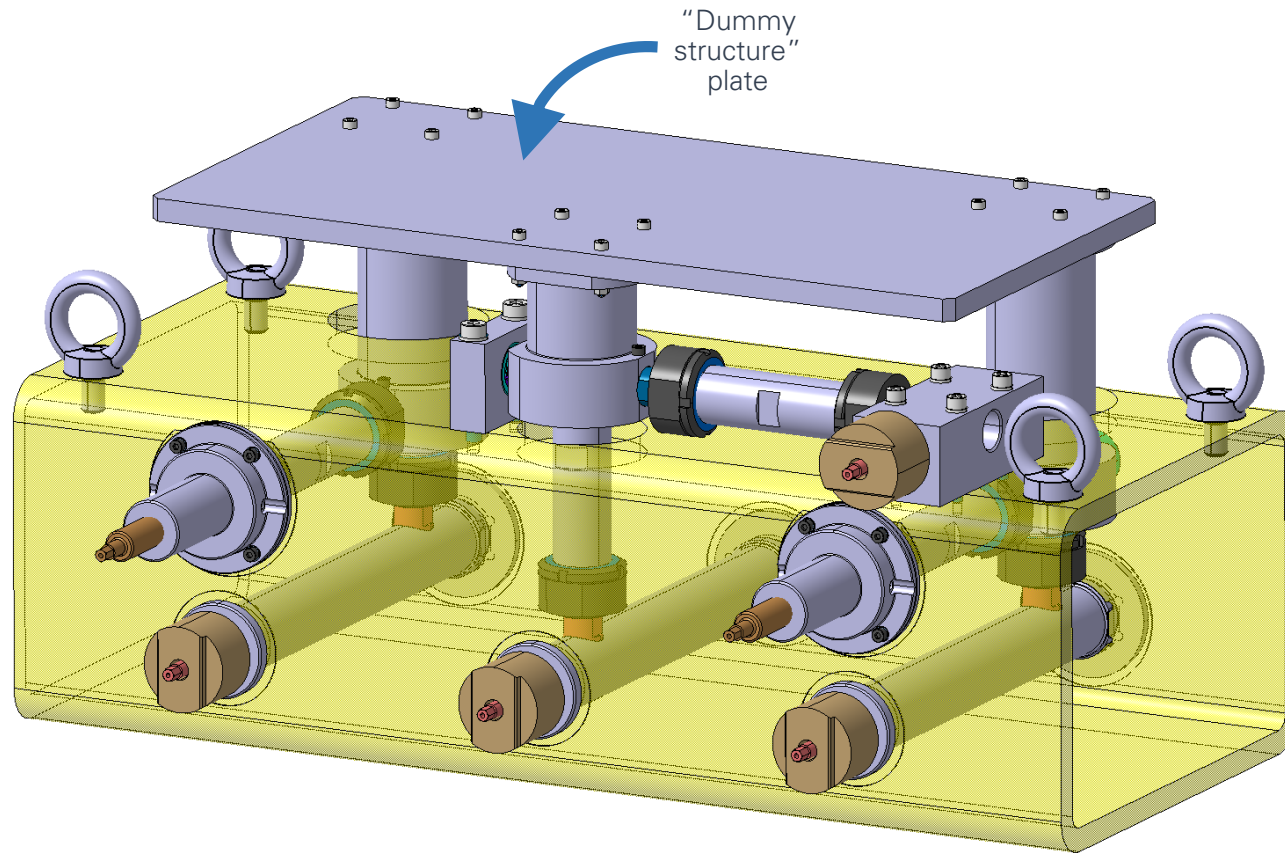
# Prototype Structure Alignment Platforms



- All performed as expected:
- Sub  $1\mu\text{m}$  resolution
- Several mm range

- Version 3 of the SAS alignment platform
  - Flexure based
- Version 3.5 of the SAS alignment platform
  - Used a single universal joint to verify kinematics etc.

# Future Prototype Platform

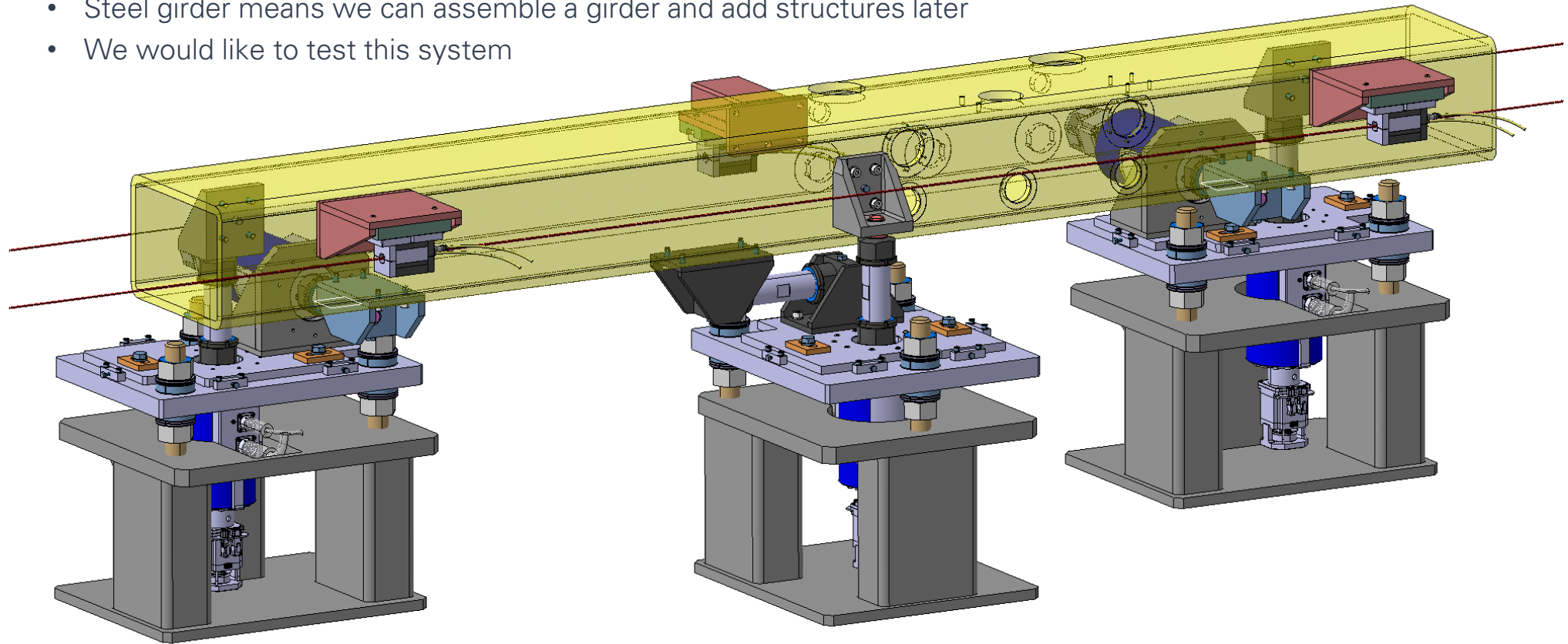


Above: the design of a new generation accelerating structure positioning prototype based around universal joints

- We have a design for new prototype of the structure alignment system (V4)
  - Based around joints
  - Updated girder dimensions
  - Updated materials etc.
- Currently in manufacture
- We will test similarly to the previous prototypes
  - Range/resolution
- Also possible to add weight to the plate and carry out further testing
  - EMA Experimental Modal Analysis etc.

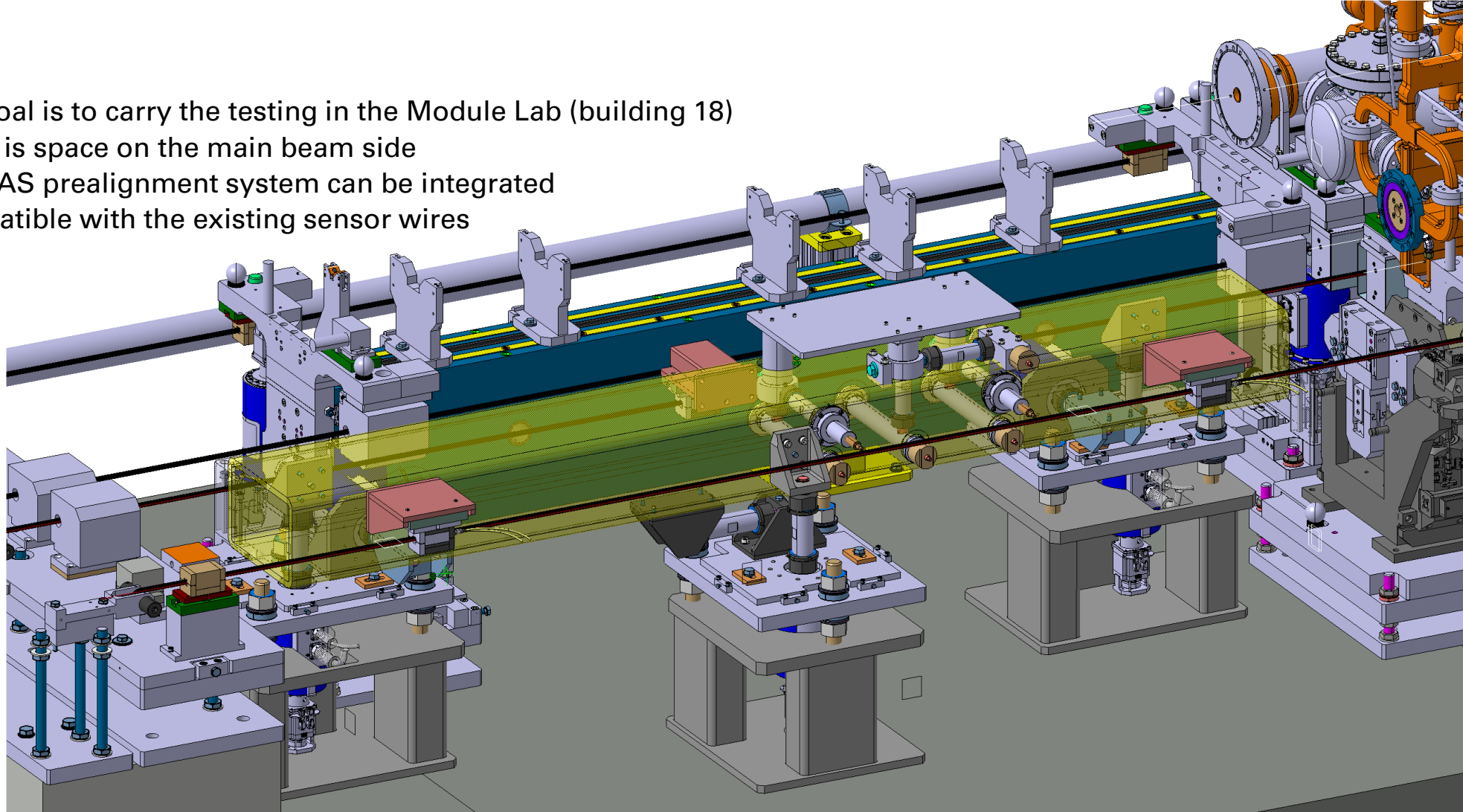
# Future Prototype Module

- We have a design for new prototype of the girder alignment system
  - Similarly uses joints, in this case driven by the large linear actuators
  - Steel girder means we can assemble a girder and add structures later
  - We would like to test this system



# Within the Module Lab

- The goal is to carry the testing in the Module Lab (building 18)
- There is space on the main beam side
- The SAS prealignment system can be integrated
- Compatible with the existing sensor wires

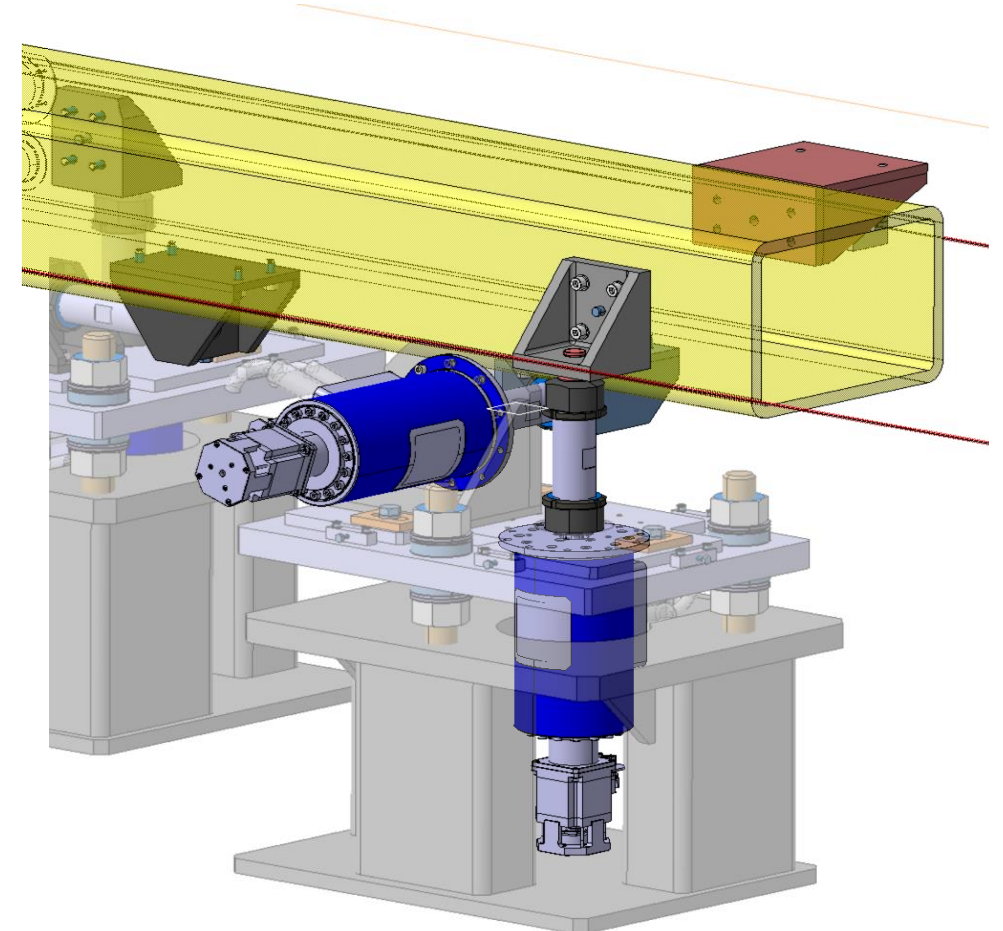




# Testing

- We are interested in testing this system. This testing could be relatively simple or more comprehensive.
- The level of detail somewhat depends on the level of input from BE-GM
- **Simplest testing:**
  - Adjusting individual actuators and physically/manually measuring the result, or using the WPS
  - Using the existing equipment within the module lab (bld 18)
    - Could potentially be done by myself and or a technical or summer student
    - Would be significantly easier if someone who is familiar with the equipment from GM could spare a few hours to get us started
- **Comprehensive testing:**
  - Implementing an automatic feedback system using the actuators and the WPS sensors
    - A girder position could be entered and moved to, compensating for parasitic motion etc.
    - Would probably require significant input from Geodetic Metrology
- **Somewhere in between?**
  - Depending on the availability and interest of BE-GM

End support showing vertical and lateral actuators



# Summary

- We are manufacturing prototypes of the structure prealignment and active girder positioning systems
- We intend to test the girder positioning system within the module test lab. The exact testing we do, and how quickly we can do it, depends on the input from BE-GM:
  - We can move individual actuators, and measure the response of the girder.
    - This would be much easier if someone is able to spare a few hours one day to demonstrate the actuator control system which is already installed within the module lab.
  - We can implement a more complete system, using the wire position sensors and the actuators to move the girder to a specific point in space
    - Would probably require significant input from Geodetic Metrology to implement an automatic feedback loop with the actuators and the WPS sensors
  - We can do something in-between, depending on the availability and interest of BE-GM
- How interested are the Geodetic Metrology Group in being involved?

