The most critical CLIC RF components need to be pre-aligned within 14 µm rms with respect to a straight reference line along a sliding window of 200 m.

A system based on supporting structures (girders and cradles) connected in “snake”-type configuration and equipped with linear actuators is being tested. A special test mock-up was built at CERN to demonstrate, the feasibility of remote active pre-alignment within tight tolerances.

**CERN CLIC mock-up**

**Articulation point**

The SLAVE cradle is driven by the MASTER cradle thanks to a flexural ‘Articulation point’.

**Adjustable articulation point**

First generation of MASTER-SLAVE cradle flexural inter connection did not meet the alignment requirements. A new, adjustable solution was developed

**Mock-up validation and encountered issues**

**Cradle-girder material compatibility**

The temperature variations caused cradle-girder misalignment due to their materials (Al, SiC) thermal expansion coefficients differences. A temporary solution of thermally stable artificial cradle was applied.

**Alignment of the components on the girder**

The RF components should be machined in way to provide their proper alignment on the girder V-supports.

Power Extraction and Transfer Structures (PETS) positions always in tolerance → maximum 80µm misalignment observed w.r.t. ±100 µm tolerance.

Accelerating Structures (AS) need to improve their production technology. In the best case, the AS misalignment w.r.t. V-support’s (girder) mean axis is 60 µm w.r.t. ± 14 µm tolerance.

**Active alignment tests**

Tests were performed on the “snake”-structure of three Drive Beam girders DB2 - DB4. The girders were misaligned in random directions with a maximum position error of 0.3 – 0.8mm. The roll (Ry) of the girders was set in range of -0.4 mrad to 1.6 mrad

For the tested regulation algorithm, the 10 µm tolerance zone was reached after 4 iterations, showing perfect convergence. The typical stabilizing time of position for single iteration was ~10s allowing for big errors corrections even within 1 minute.

The trajectory of MASTER cradles was slightly non linear for the first algorithm iteration due to big actuators shifts requested.

**Case of Main Beam Quadrupole Alignment**

The Main Beam Quadrupole (MBQ) alignment control algorithm tests were performed on a parallel test stand at CERN. The mock-up including the girder, mounted on CAM movers (CM) and equipped in WPS sensors was used.

All positioning algorithms managed to reach all sequence targets within tolerances. The movement time of Synchronous PTP algorithm (60 – 90s) is significantly longer than that of the others (30 – 40s).

**Conclusions**

Closed loop adjustment of “snake”-like girders string shows that absolute active alignment of supporting structures is feasible within the specified accuracy. Concerning the alignment of MBQ, the CLIC positioning requirements can be met in one movement by using feedback directly from alignment sensors. There are still issues linked with RF structures alignment on the girders.