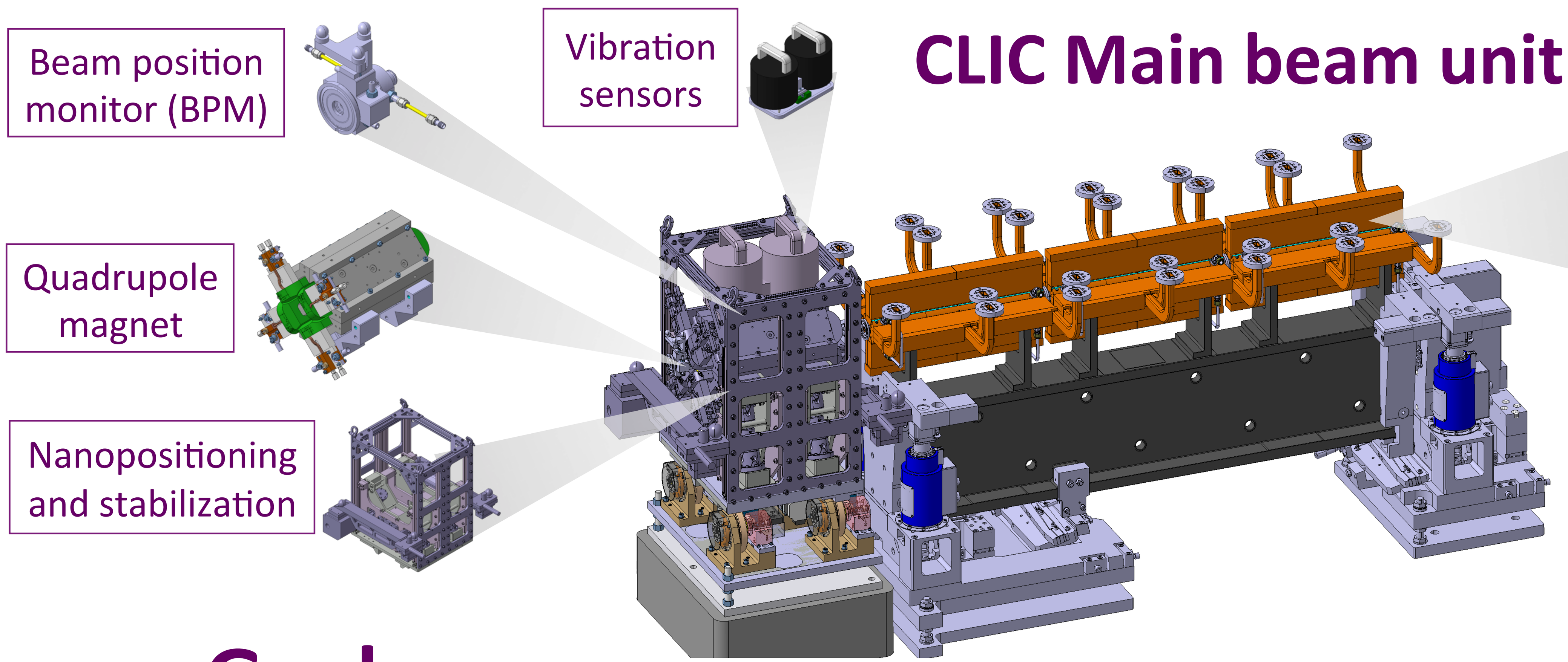
Electromagnetic field pre-alignment of the Compact Linear Collider (CLIC) Accelerating Structure with help of Wakefield Monitor signals.

The **CLIC** accelerator, currently under study at CERN is an electron-positron collider at 3 TeV centre-of-mass energy and luminosity of $2*10^{34}$ $cm^{-2}s^{-1}$. Achieving such luminosity requires a beam vertical dimension of **1 nm** in the vertical plane and high beam stability. The TD24 is a traveling wave structure working at 12 GHz designed to reach **100 MV/m** at constant gradient. It consists of two coupling cells and 24 disks. The RF is coupled from cell to cell though an iris of 5.5 mm. To minimize the occurrence of wakefields and make the emittance growth reached $\Delta\varepsilon_y$ be less than 5%, the **pre-alignment** precision of the electrical centre of the accelerating structure (AS) on its support has to be 7 µm. Later on, the AS is actively aligned with beam using the **wakefield monitor** (WFM) signals, with a resolution of 3.5 µm. A test bench for laboratory measurements has been designed and exploits the asymmetry created in the scattering parameters by an off-centre conductor wire in order to achieve the goals. The results are presented.

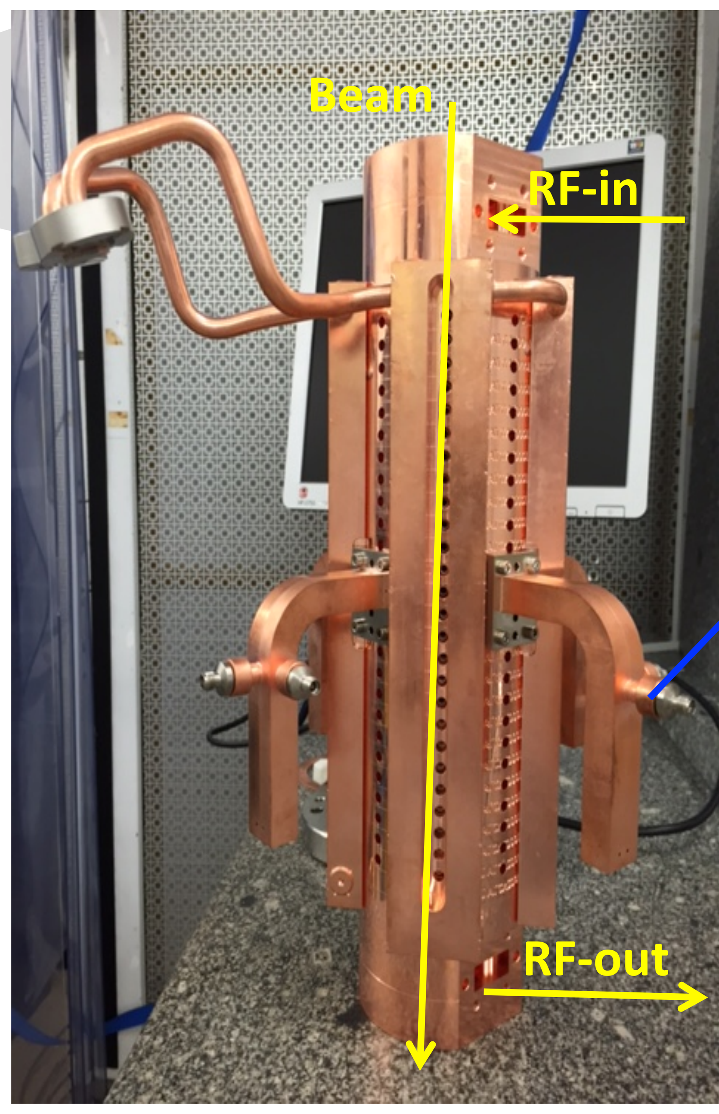
CLIC Main beam unit



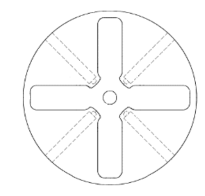
Goals

- **Pre-align** the AS in its support with a precision of **±7 µm.**
- Demonstrate a **3.5 µm resolution** of the WFM in a laboratory environment.
- Propose a method during the assembly of the AS that assures a disk-to-disk **misalignment ≤ 5 µm**.

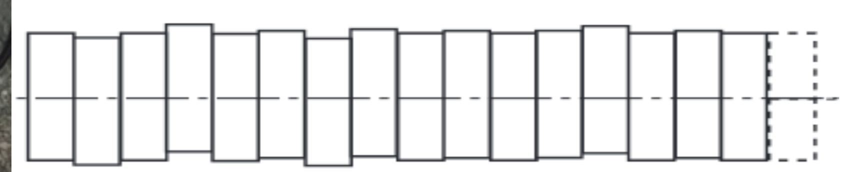
Accelerating Structure (AS)



- Traveling wave structure.
- Accelerating mode at **12GHz**.
- 24 tapered coupled cells.
- Iris mean aperture: **5.5 mm**.
- **100MV/m** constant gradient.
- **Wakefield Monitors (WFM)** to align the AS with beam.

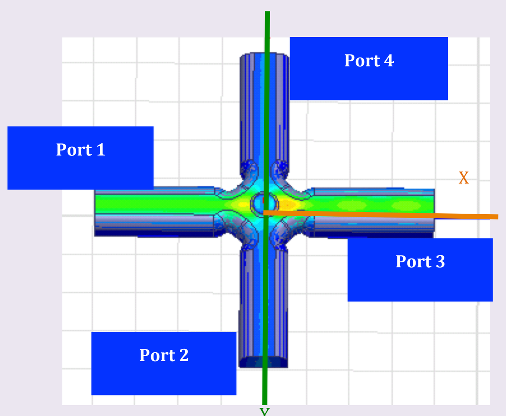


Cross-section of one disk



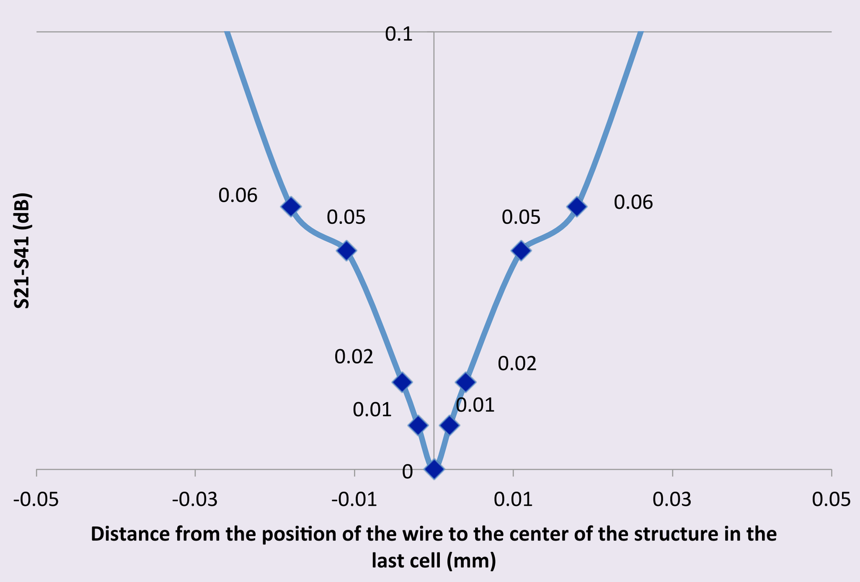
The AS is **bent** and **book-shelving** is observed

Measuring principle



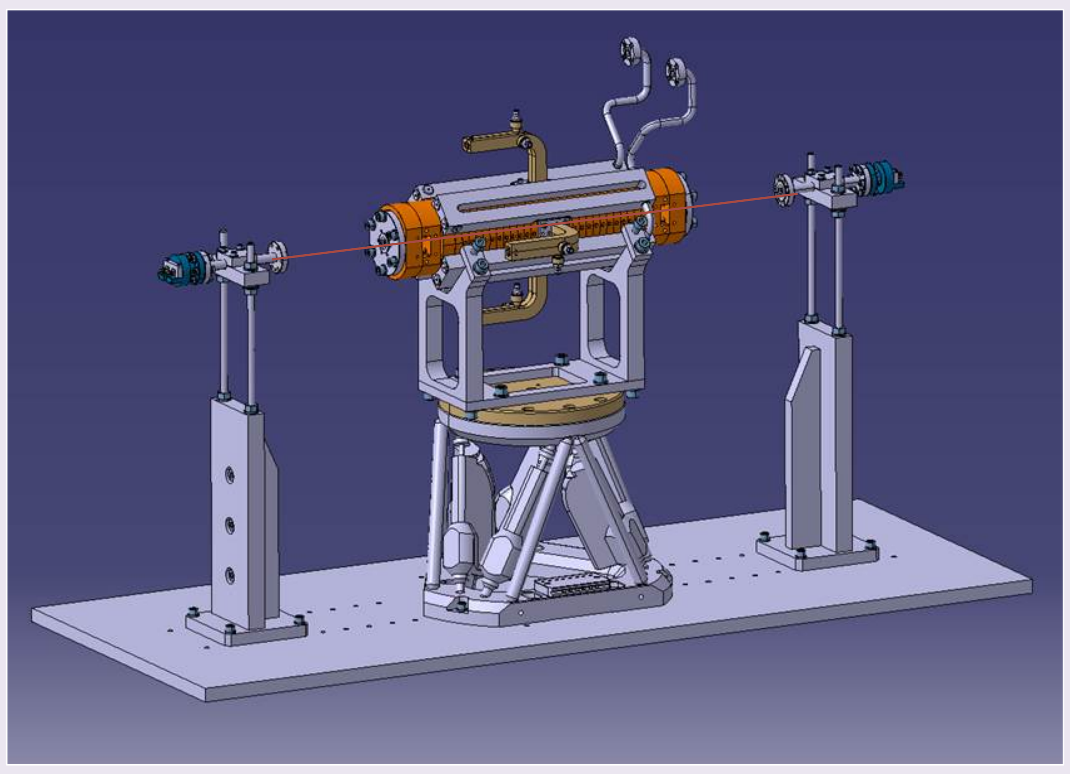
Electromagnetic field pattern when the AS is excited with a dipole mode at **18 GHz**.

This excitation in presence of a conductive wire near the center of the iris will perturb the field and hence alter the transmission between the different ports. If the wire is precisely moved to the electromagnetic center of the iris, this perturbation is minimized.

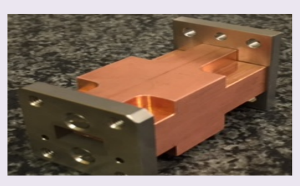


The minimum step found with simulations is **1 µm** taking into account the **0.01 dB** value of uncertainty expected from the VNA.

Test Bench

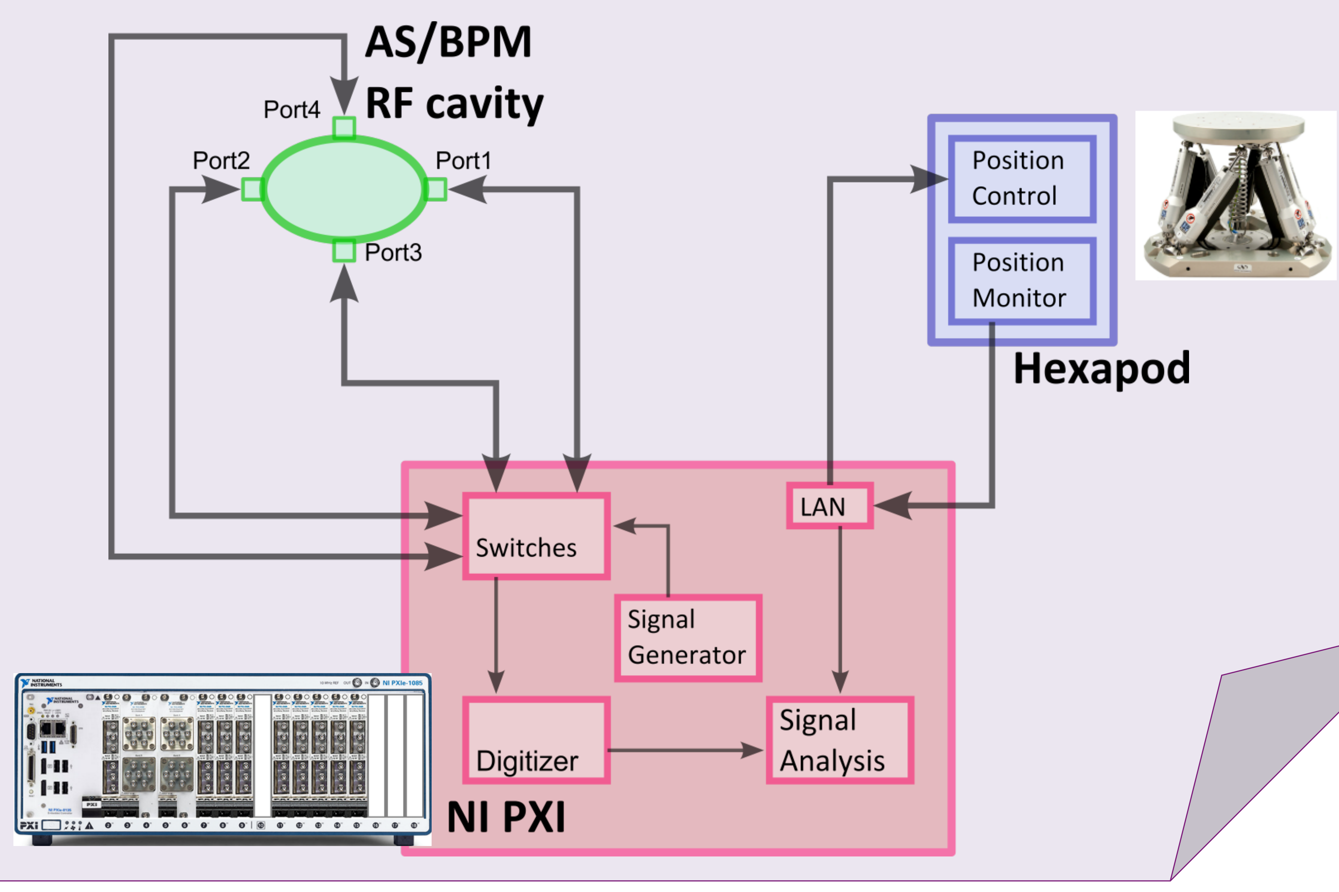


- Active-stabilized **optical table** to reduce vibrations.
- **Hexapod** and remote **controller** to precisely position the AS.
- Two supports that host a fixed and stretched **Be-Cu 0.1 mm Φ wire**
- **VNA** for measurements.
- **PXI** controller running LabVIEW to control the motion of the hexapod and performing automatic measurements with the VNA.

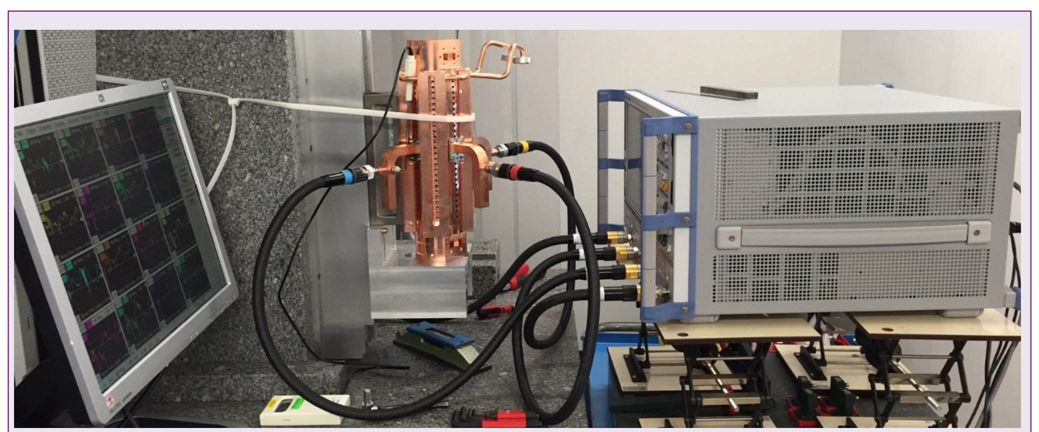


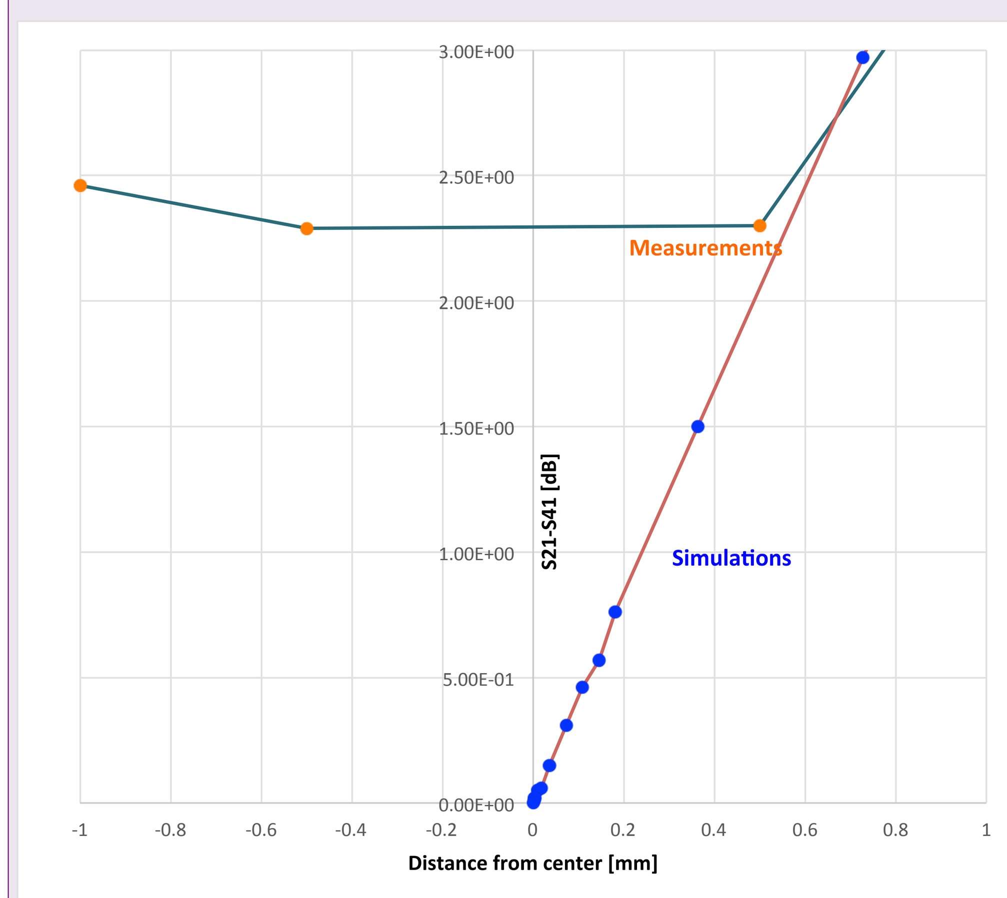
Taper to improve the signal quality measured by the VNA

Feedthrough to analyze the disk-to-disk misalignment



First Results





The difference between measurements and simulations demonstrates the **proof of principle** and validates a sufficient agreement on course wire displacements.

Conclusions

Initial WFM measurements performed on a 12 GHz CLIC AS demonstrate qualitatively the **feasibility** of a stretched-wire method to locate the EM center of the middle cell of the AS.

Still, a long, **challenging** way is ahead to fiducialize the AS with an accuracy of less than 7 µm.

PACMAN

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http://pacman.web.cern.ch/

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