Task

The future FAIR machine consists partly of super conducting magnets (especially for SIS100 and S-FRS). These magnets were designed without any view ports. The design process is closed, therefore no additional changes are possible. Nevertheless, it is desired to monitor the position of the cold mass with respect to the stable cryostat in cold condition, especially with regard to lateral shifts and rotation around beam axis. Therefore it is planned to do optical measurements at cryogenic condition (vacuum 10⁻⁶mbar; temperature 4K) without any view ports. We are in the process of developing a measurement method using the Absolute Multiline System from ETALON (group of HEXAGON). This fibre optical system measures interferometric distances (1D) between a collimator and a reflector with an accuracy of about 0.5µm.

First tests

A comparison between the Absolute Multiline System (AMS) and laser tracker measurements was done for verification of the performance of the concept. Cold mass was observed with laser tracker on three points. The Absolute Multiline System is installed with three line of sights (LOS). All points and lines were installed in one vertical plane. Approximate coordinates of the collimators and targets were determined with laser tracker in advance. They represent the direction of the LOS. Afterwards the measured changes in the distances (gaining from AMS) were adapted polar to the approximate target position.

In a first approach, using the three target positions for each system (AMS and laser tracker), the transformation parameters (Tx, Ty and Rx) were computed between several epochs and compared against each other.

In advance the measurement setup and mathematical evaluation of the data were checked under normal condition. The Absolute Multiline System was installed with three line of sights (LOS). All points and lines were installed in one vertical plane. Approximate coordinates of the collimators and targets were determined with laser tracker in advance. They represent the direction of the LOS. Afterwards the measured changes in the distances (gaining from AMS) were adapted polar to the approximate target position.

On a test bench for magnets, view ports were installed for one direction. Information due to the minimal 1D configuration.

Approximate coordinates. Furthermore there is a loss of results of both measurements fit with an accuracy of about 0.15 mm.

Evaluation of the data were checked under normal condition the measurement setup and mathematical evaluation of the data were checked under normal condition. The Absolute Multiline System was installed with three line of sights (LOS). All points and lines were installed in one vertical plane. Approximate coordinates of the collimators and targets were determined with laser tracker in advance. They represent the direction of the LOS. Afterwards the measured changes in the distances (gaining from AMS) were adapted polar to the approximate target position.

In a first approach, using the three target positions for each system (AMS and laser tracker), the transformation parameters (Tx, Ty and Rx) were computed between several epochs and compared against each other.

4. Usage of reflecting foil as target

Further investigations

1. Checking the stability of the cryostat and the mounting of the magnet with cold down.
2. Improving approximate coordinates.
3. Behaviour of fibre optical cables and collimators under cold condition.
4. Usage of reflecting foil as target.
5. Using more line of sights for a more realistic determination of the movement (especially by shrinkage of the object).