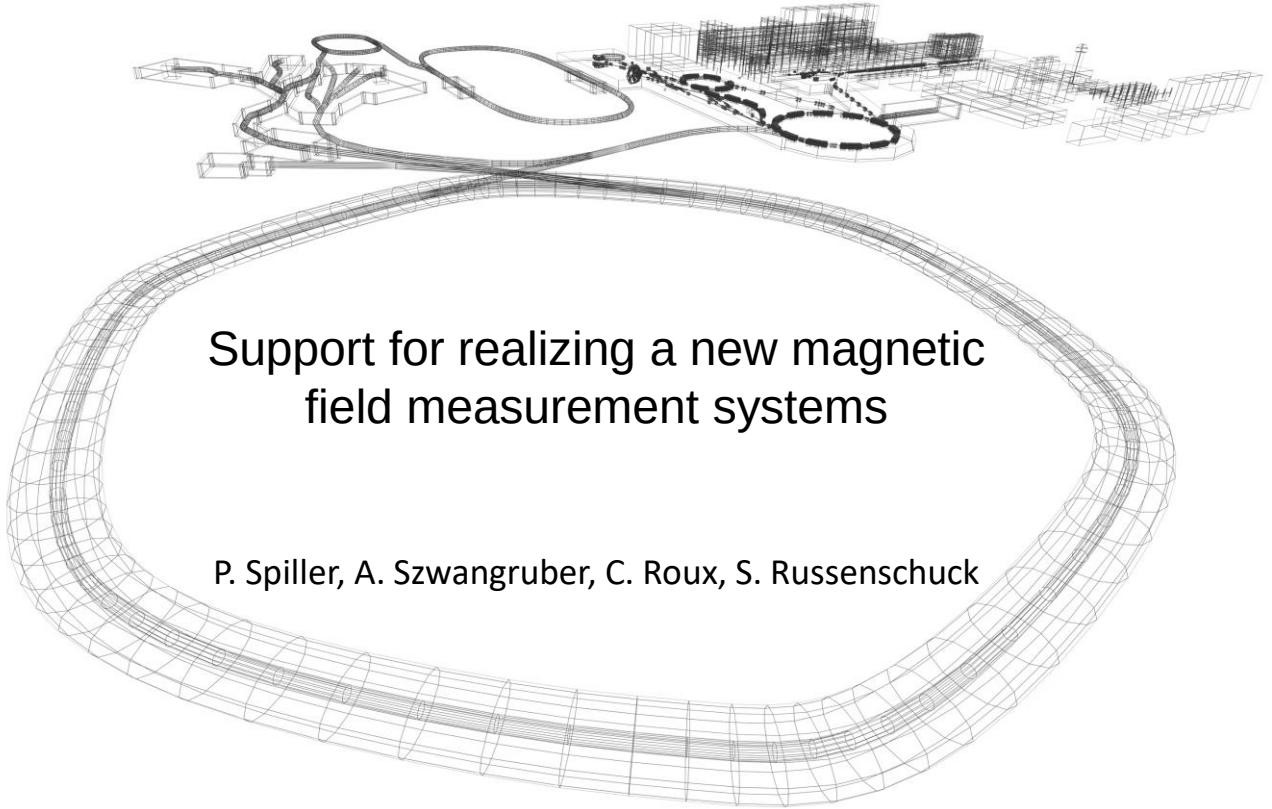

# Support for realizing a new magnetic field measurement systems

P. Spiller, A. Szwangruber, C. Roux, S. Russenschuck

# S.C. Quadrupole Units for FAIR SIS100

- The s.c. quadrupole units is a Russian contribution to FAIR.
- The collaboration has been interrupted with the start of the Ukraine crisis in March 2022.
- Considering the fact that FAIR and JINR are both international organizations, the collaboration has been re-established in December 2023 after the approval of the German export control, ministries and authorities.
- Production and cold testing of the s.c. Quadrupole Units are carried out by JINR, Dubna → critical path for SIS100

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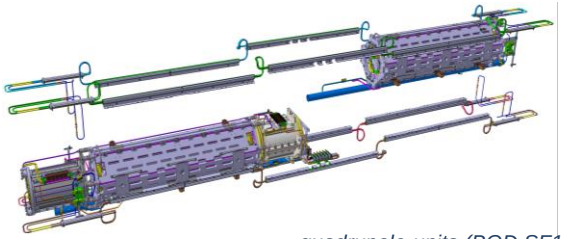
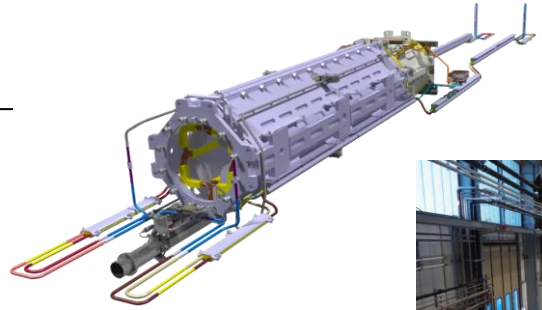
- A plan B has been developed and established with contracting of four prototype units with Bilfinger, including the manufacturing of all tooling required for a potential series production.
- The FAT and SAT are assumed to be completed until end (latest) of 2025.
- Qualification (SAT) of quadrupole units from industrial production will be carried out at the GSI series test facility (STF).
- The testing equipment (rotating coil probes, stretched wire system, control and data acquisition systems) to be developed and set-up shall serve a potential series production in industry.



*quadrupole units (BQD,SF1H)*

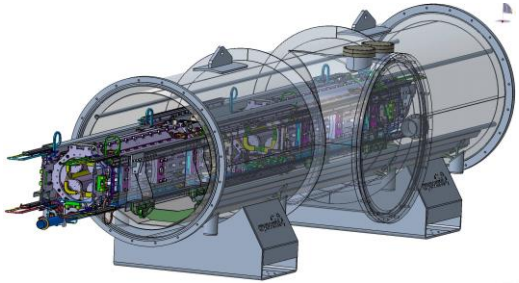


*Series test facility (STF) at GSI*

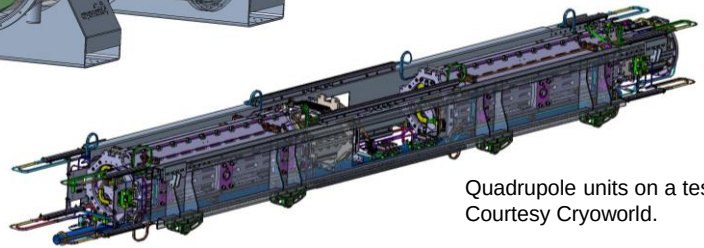
# Steps towards Quadrupole Unit Testing at GSI

## Required upgrade of the existing series test facility (STF):

- test cryostats for QD-units
- bench and tooling for a fast mounting of the cold mass into the test cryostat (preparation towards series testing)
- systems for magnetic field measurements
- anti-cryostat for magnetic field measurements
- optimisation of the existing testing infrastructure



Test cryostat with quadrupole units on a test girder. Design study at Cryoworld. Courtesy Cryoworld.



Quadrupole units on a test girder. Courtesy Cryoworld.

## Procurement strategy:

- Test cryostats and installation benches - design and production in industry
- **Systems for magnetic field measurements - design and procurement and implementation with support from CERN.**
- Components for the infrastructure upgrade – GSI (SCM, CRY)

Stretched wire system SSW6, magnetic axis measurements FAIR Super-FRS multiplets. Courtesy P.Kosek

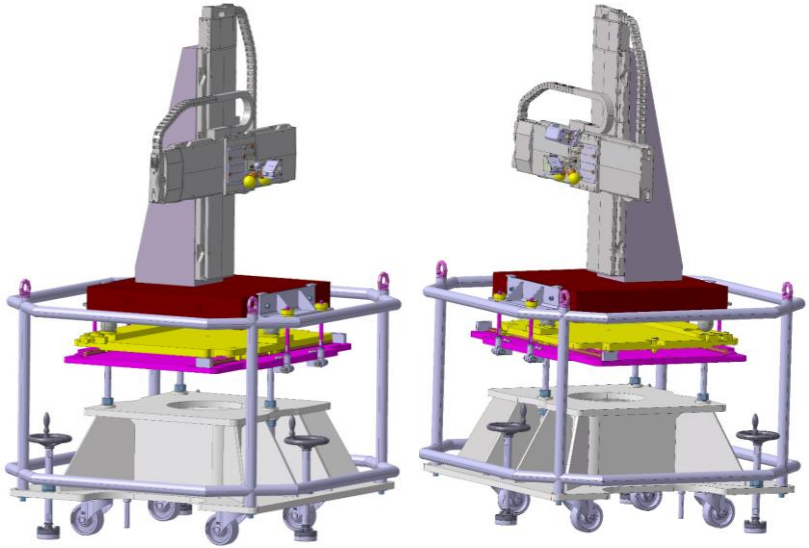
# CERN Support for Realization of a new magnetic field measurement systems

## Single Stretched Wire (SSW) measurement system:

- Position of the magnetic axis
- Integral field gradient
- Applicable for SIS100 units and doublets

## Scope and contributions:

| GSI | CERN |
|---|---|
| System development (in particular for the FFMM software (controls, DAQ) based on the CERN-SSW5 design | |
| Hardware procurement<br>~ 170.000 €<br>(if integrators are available) | Training of GSI personnel |
| Final assembly and commissioning of the system | |
| 1 FTE (working at CERN magnet laboratory) + 0.5 FTE | 0.4 FTE |



Model of a stretched wire system SSW6, magnetic axis measurements FAIR Super-FRS multiplets. Courtesy P.Kosek

Expected readiness for QU testing equipment – middle 2025

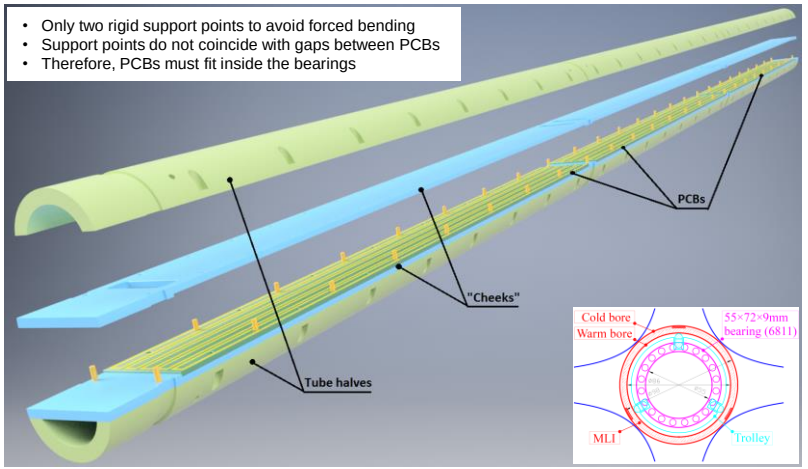
# CERN Support for Realization of a new magnetic field measurement systems

## Rotating coil system:

- Field homogeneity
- Integral field gradient for main quadrupole
- Integral field strength for corrector magnets
- Applicable for SIS100 quadrupole units

## Collaboration scope and contributions:

| GSI | CERN |
|---|---|
| Development of the measuring system based on PCB coils | |
| Mechanical design and electrical layout for the PCB | PCB manufacturing and calibration |
| Procurement and assembly of components for measuring heads and motor units | Calibration of the PCBs (in dipole) and measuring heads (in quadrupole) |
| Assembly of motor units (BEA) | |
| Adjustment of the control and data acquisition software for operation at GSI | |
| 2.5 FTE | 0.4 FTE |
| ~ 120.000 € | |




Tentative magnetometer design. Courtesy V. Marusov

Expected readiness for QU testing equipment – Q3/Q4 2025

# To Do

SSW system: Motor controller type not commercially available anymore. Qualification of a new supplier for the precision stages may be required (count 12 months). CERN can make available drawings of the auxiliaries.

Rotating-coil magnetometer: Qualification of other suppliers (shells and PCB) would be welcome. Shaft calibration at CERN is limited to 100 mm in diameter and 1.2 m in length. Also possible: In situ calibration with SSW at GSI.

Electronic rack: The electronic rack could be made compatible for the two measurement systems. If fast digital integrators need to be replaced, new integrators or commercially available DAQ systems must be developed.

Software (FFMM): A license agreement (black box versus open source) needs to be drafted. Both new systems require software updates (could be assigned to a TECH student at CERN) and licenses for the operating systems.

On the CERN side, resources of different competencies are required for system development, assembly, calibration, and testing. GSI to make available (or hire) an experienced measurement engineer.

Consider 24 months for completion of tasks; so $t_0$ is now. Decisions to be taken as soon as possible.