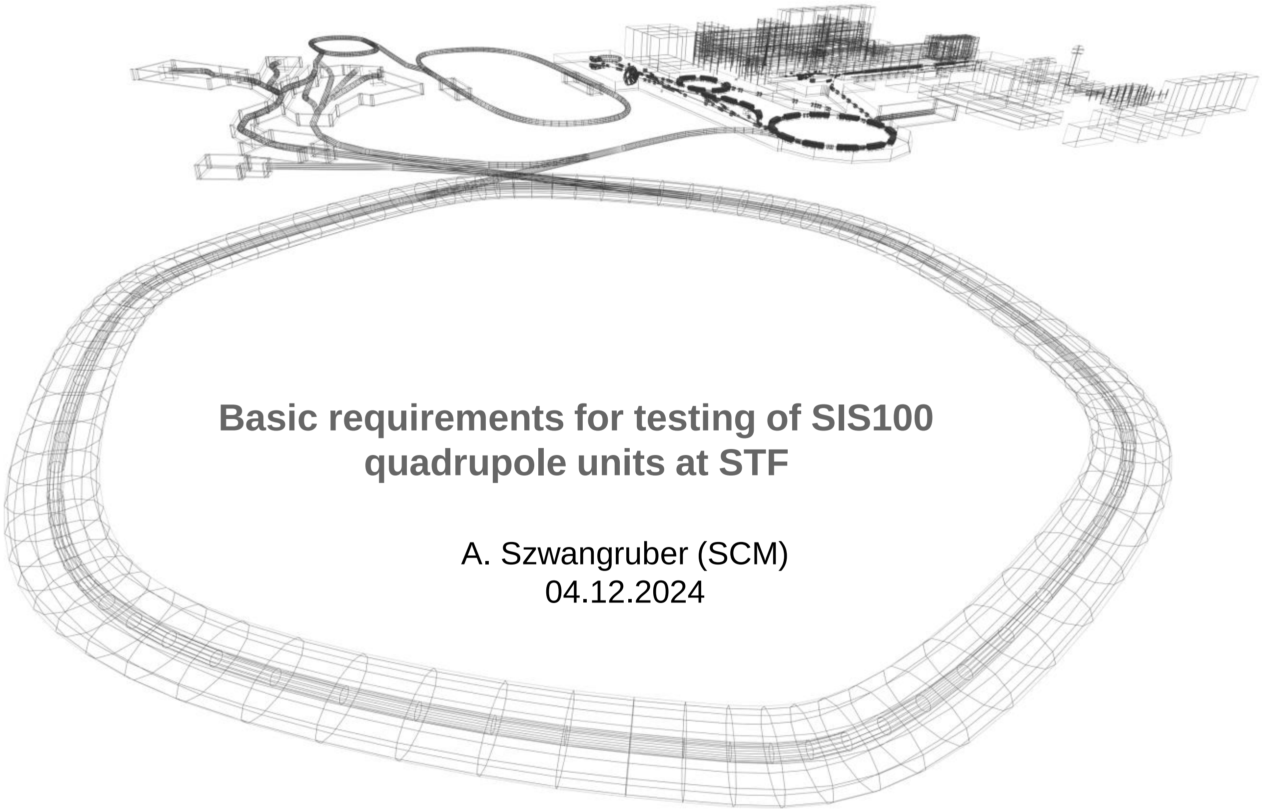
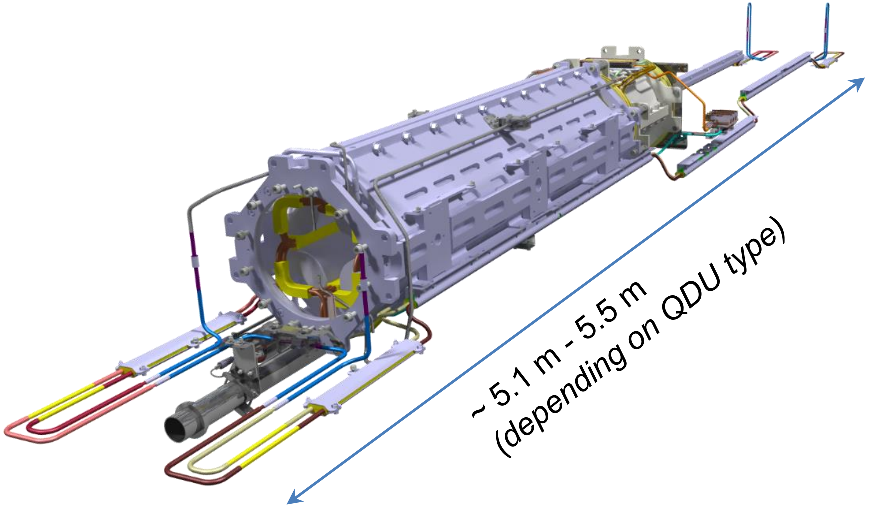


Basic requirements for testing of SIS100 quadrupole units at STF

A. Szwangruber (SCM)
04.12.2024

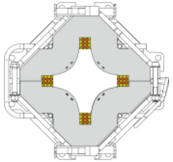
Magnetic measurement subjects - Quadrupole Units

SIS100 ring contains 166 Quadrupole Units (QDU) of 18 different types

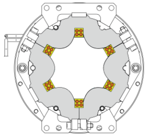


QDU of SF2 type: quadrupole,
steering magnet

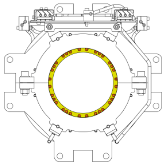
QDU consist of a main quadrupole magnet, together with up to two corrector magnets



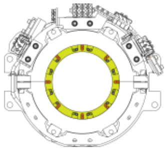
main quadrupole – superferric with sc-coil



chromaticity sextupole – superferric with sc-coil



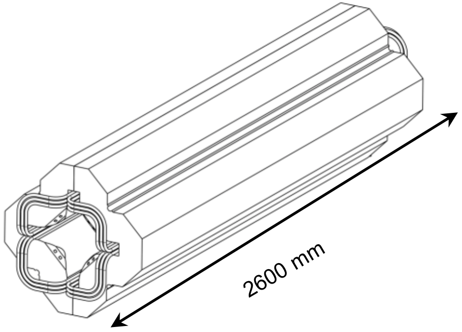
steerer – cosθ nested

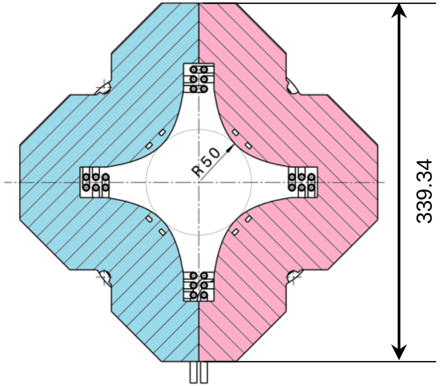


multipole corrector – cosθ nested (B2, A3, B4)

SIS100 quadrupole magnet design

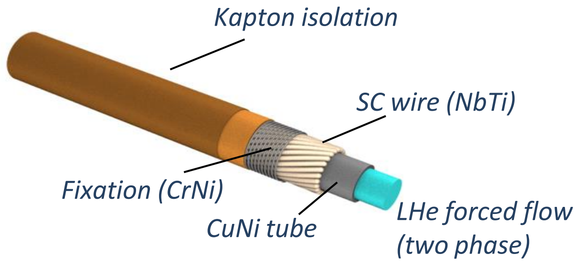
- Superferric magnet with a coil made of the Nuclotron type cable





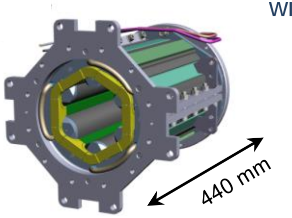
B_2(max. at magnet centre)	T/m	27.77
Ramp rate	(T/m)/s	58
Effective magnetic length L_{eff}	m	1.264
Magnet aperture (radius)	mm	50

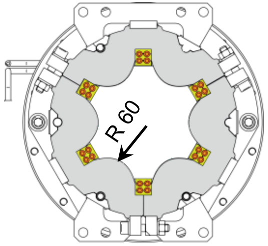
Nuclotron type cable



SIS100 corrector magnets

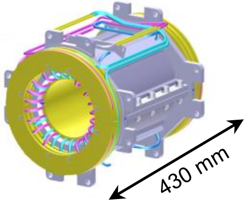
chromaticity sextupole – superferric with sc-coil

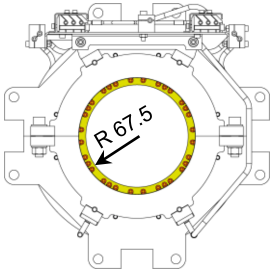




B_3(max. at magnet centre)	T/m^2	232
Ramp rate	$(T/m^2)/s$	1325
Effective magnetic length L_{eff}	m	0.383
Magnet aperture (pole tip radius)	mm	60

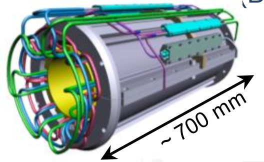
steerer – cosθ nested

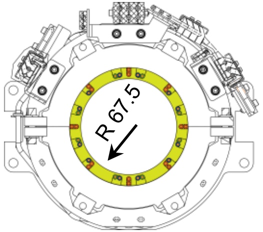




B_1(max. at magnet centre)	T	H: 0.372; V: 0.366
Ramp rate	T/s	1.86
Effective magnetic length L_{eff}	m	H: 0.403; V: 0.410
Magnet aperture (radius)	mm	67.5

multipole corrector – cosθ nested (B2, A3, B4)

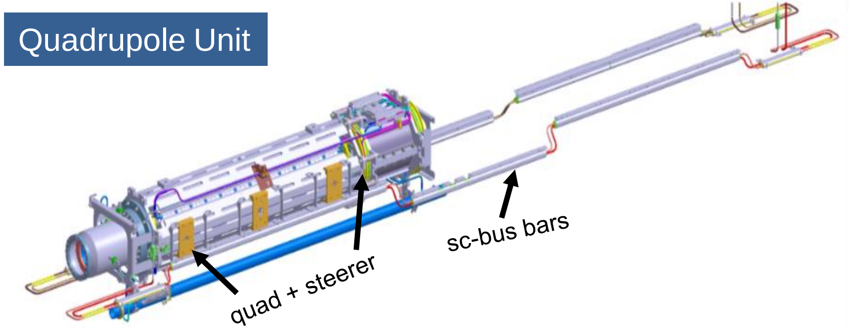




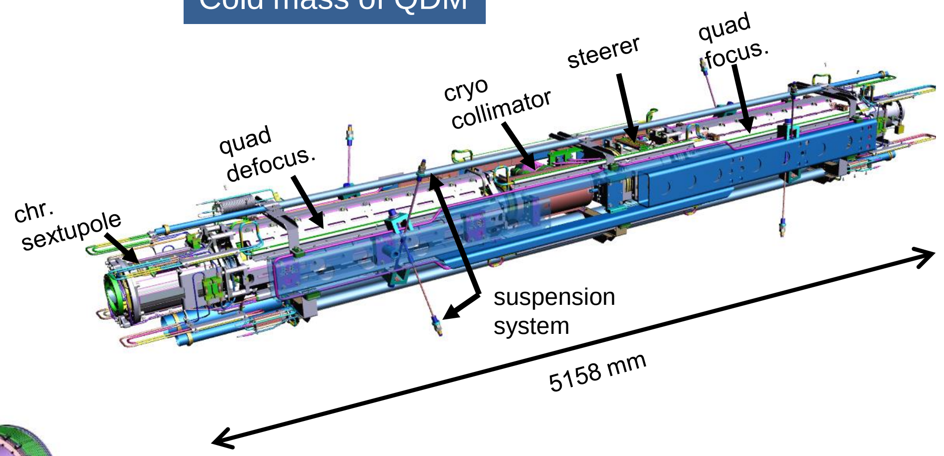
B (max. at magnet centre)	$T/m^{(n-1)}$	B_2 0.94; A_3 32.13; B_4 449
Ramp time	s	0.2
Effective magnetic length L_{eff}	m	B_2 0.59; A_3 0.62; B_4 0.56
Magnet aperture (radius)	mm	67.5

Quadrupole Doublet Modules (QDM) for SIS100

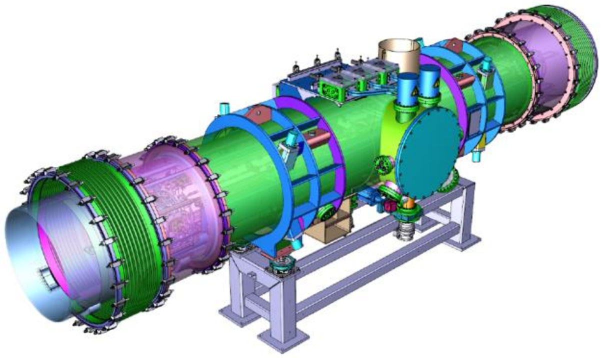
Quadrupole Unit



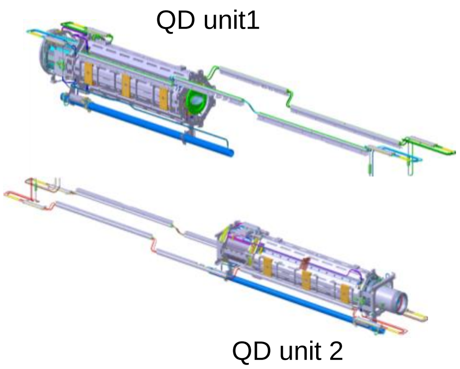
Cold mass of QDM



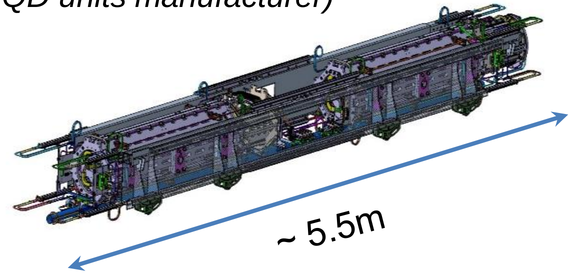
QDM



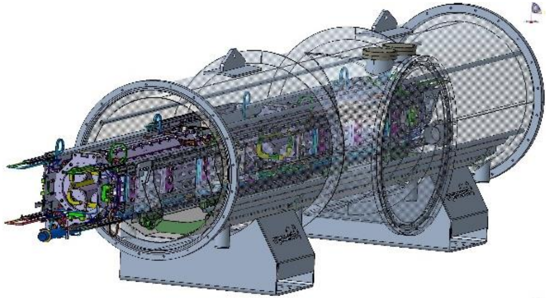
Configuration for testing of QD units during SAT



QD-Units are assembled pair wise on a testing girder *(to be done at the QD units manufacturer)*



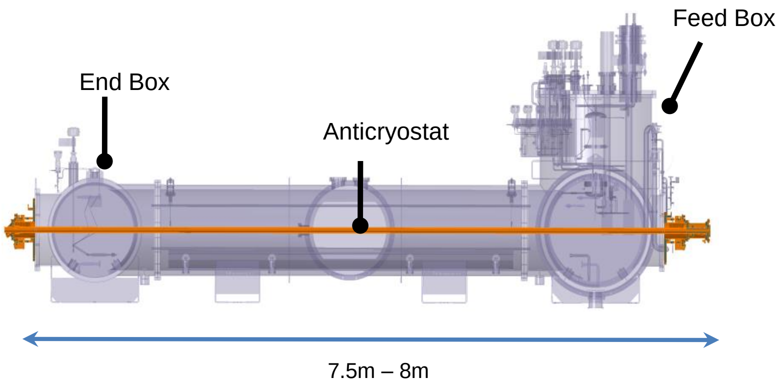
and installed into a test cryostat *(to be done at GSI test facility STF)*



Main motivation for testing of the QD units in described configuration – enabling of required testing rate 4 Units per month to fulfil the fixed deadline within FAIR project

Configuration for testing of QD units during SAT

An assembly of two units in the test cryostat will be attached to the Feed and end box providing cooling an power link required for the power tests at 4K



Tests @ 4K for validation of prototypes and series units

Quality assurance aspects:

- He piping
  - pressure and leak tightness,
  - hydraulic resistance @ 4K
- instrumentation check
- electrical integrity
  - HV, LV
  - turn-to-turn insulation (quad. coil)
- quench performance
- inductance
- static heat load and AC losses

Parameters for machine control:

- integral *B*-field
- harmonics
- magnetic axis of main quadrupoles

Anticryostat

An anticryostat is required to enable magnetic field measurements @4K with warm measurement systems (SSW, rotating coil probe)

- warm bore - atmospheric pressure, room temperature, free aperture for a rotating coil probe with ⌀77- 80 mm
- cold bore:
  - insulation vacuum 10^{-6} mbar (in case of He-leak in the system max pressure within the cryostat ~ 1,1 bar)
  - temperatures: 6K for the parts located inside of magnet yokes, up to 120 K for the parts located outside of the magnet yoke in the extremities of the feed and end boxes (if no thermal anchoring to the 60K installed)
  - no contact with any cooling medium
  - not a pressurised vessel
  - support – point wise contact to the pole tips of the main quadrupole magnets by mean of support feet. Free aperture within the main quadrupole ⌀100 mm