GSI/FAIR Collaborations with CERN in the Area of Technologies relevant for the Subproject SIS100/SIS18

P. Spiller

SIS100 TFS System

System Operation	multi-sampling per bunch (damping of intra-bunch oscillations)
Bandwidth: low border (-1 dB)	15 kHz
Bandwidth: upper border (-1 dB)	32 MHz
Pick-Up signal implementations	• 2 pick-ups • 1 pick-up • n turns combined • normalized / unnormalized
Sampling Rate	• fixed-f_S: 16 ns (62.5 Msps) or • $f_S = 240 f_0$: 26.7 ns–15 ns (37.4 Msps–66 Msps)
Total Signal Jitter	max. 1 ns
Low-Pass Filter	32 MHz, 50 dB
Notch Filter	50 dB at $(n f_0 \pm 0.05 f_0)$
Kicker Power	kick per turn $\Delta\theta = 16\,\mu$rad
BTF functionality	
Remotely Adjustable	• lattice settings; variable along the cycle • kick phase (antidamping, reactive) • pick-up signal implementations • kicker gain; variable along the cycle • low-pass filter • pick-up amplifier gain • fast switch

- Document of physical (beam dynamics) requirements for SIS100 completed.
- Draft technical specification, based on SIS18 TFS system available.
- Very similar requirements to TFS System of CERN PS.
- Therefore, in order to save time and effort for completing the technical specification, the subproject SIS100/SIS18 would have a great interest in technical consultancy by the CERN BE-RF dpt. and provision of the PS technical specification.
- Next steps:
  -Technical meeting on the SIS100 TFS system in Q1 2021. Exchange of requirements and technical information.
  -Completion of technical specification for SIS100 by GSI
  -Consideration of more detailed technical collaboration in the frame of engineering design.

ARD
Accelerator Research and Development

- In the frame of the HFG Topic „M&T Matter and Technology“, Subtopic „ARD Accelerator and Technology“, GSI continues with R&D in the area of fast ramped s.c. magnets.
  The work of GSI in the area of fast ramped s.c. magnets, has explcitly supported by the committee in the international evaluation of the content of funding period POV IV.

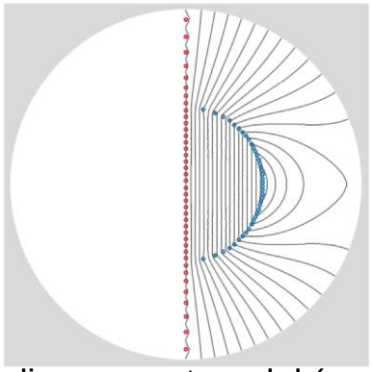
- GSI has contributed to the FCC design study and has presented the work on s.c. septa at various FCC annual meetings (next slide).

- In view of the high work load of the FAIR project and in order to minimize the use of GSI resources, most of the work is done via industrial design contracts (e.g. two design studies with Bilfinger Noell supervised by GSI).

- Since s.c. septa are also of interest for future accelerators at GSI/FAIR, GSI would like to continue to contribute to FCC by means of considering synergies and CERN/FCC interests in future industrial design studies.

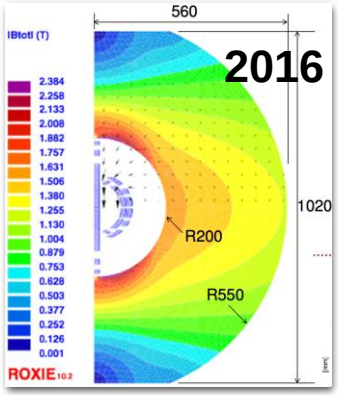
Superconducting Septum Magnet

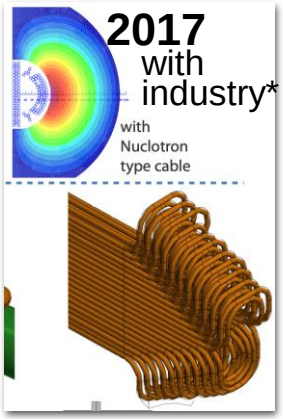
truncated cosine-theta sc magnet, generating > 2T
common interest
GSI: SIS300/400?, CERN: FCC
Target ~ 4T
GSI patent granted

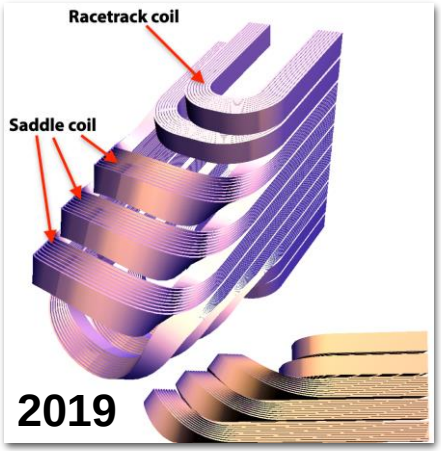


line current model (analytical)

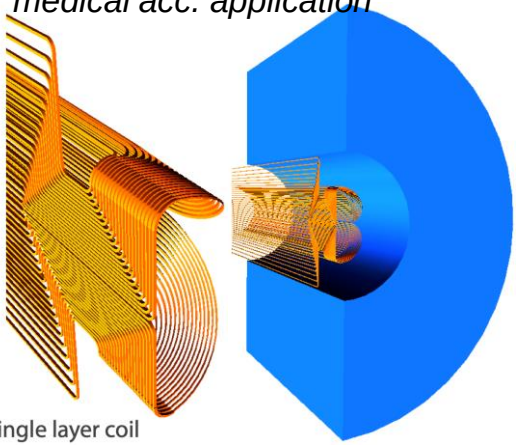
Contribution to FCC week 2015-2019







medical acc. application

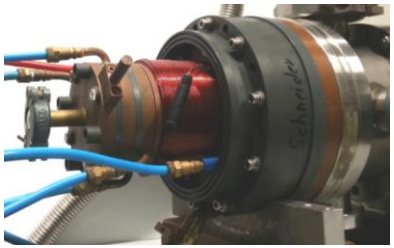


*budget from Helmholtz association, ARD program

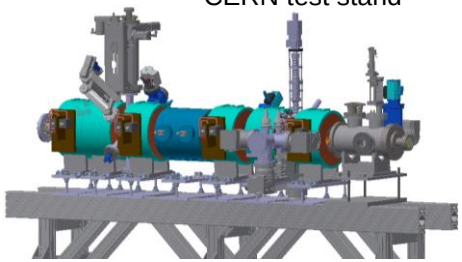
ARIES Electron Gun for E-Lens

SCC Gun Requirements	
Beam size (h/v)	35 mm/20 mm
Cathode radius	26.5 mm
Extraction voltage	30 kV
Peak current	10 A
Grid voltage	3 kV
Grid capacitance	75 pF
Modulation frequency	0.4 to 1 MHz
Modulation bandwidth	10 MHz
Gun solenoid field	0.6 T

Electron gun at IAP



CERN test stand



- ARIES WP16 JRA
  “Intense RF-Modulated Electron Beams” (IRME)
  05/2017 – ~~05/2021~~ 10/2021 (extension due to Covid-19)

- Goal: Manufacturing and testing of an e-gun for an e-lens for space charge compensation in hadron synchrotrons

- Partners and Tasks
  - GSI: coordination, e-lens layout (16.1, 16.2)
  - IAP: manufacturing and commissioning of e-gun (16.3)
  - RTU: manufacturing of RF power modulator (16.3)
  - CERN: preparation of test stand and testing (16.4)

- Status:
  - e-gun and modulator manufactured, first tests done
  - CERN test stand ready, operated with CERN HEL-gun

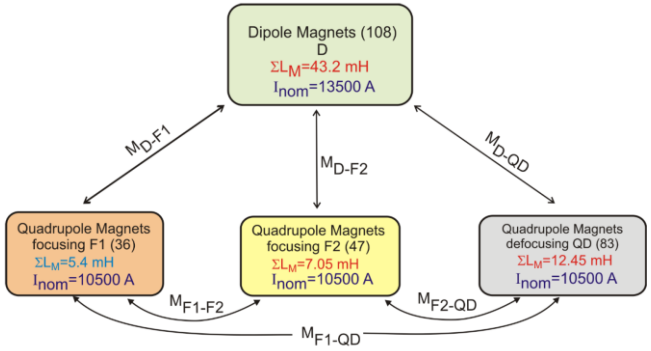
- Next steps for testing at CERN:
  - Manufacturing of modified e-gun (IAP, delayed Covid-19)
  - Technical integration of e-gun and modulator
  - Actual testing and test report

Simulations of Transient Effects

Addendum #13 to CERN collaboration contract 4

Full Title: Simulation of Transient Effects in the SIS100 Superconducting Magnet and Busbar Systems

CERN has hired a fellow (funded by GSI) conducting the simulations in the STEAM group (contact: Arjan Verweij)



Content:

- Electrical model of the main SIS100 superconducting magnet and busbar circuits within the STEAM framework. This includes all circuit elements, magnets, busbars, extraction systems, power converters, and QDS (cabling, electronics), etc.
- Model for the transfer function of the superconducting dipole magnets, validated by means of experimental results, to be used in the model of the magnet powering circuit.
- List of fault scenarios based on operational experience from other accelerators, e.g. failure of opening an energy extraction switch, short-to-ground, etc. Voltage across quench detectors for fast ramps, considering possible impact from other circuits.Table of voltage / current transients during normal operation and for fault scenarios.
- Proposal for mitigation of undesired effects, such as high voltage, cross-talk between circuits, voltage waves, etc. Estimation of mutual coupling between circuits.
- Influence of the parasitic capacitance and leakage currents on the superconducting magnet systems.