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Development of integrated superconducting Quadrupole Doublet Modules for operation in the SIS100 Accelerator

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The FAIR project evolves and builds an international accelerator and experimental facility for basic research activities in various fields of modern physics. Within the course of this project, integrated Quadrupole Doublet Modules (QDMs) are in development. The QDMs provide two superconducting main quadrupoles (focusing and defocusing), corrector magnets, cryogenic collimators and beam position monitors as integrated sets of ion-optical components. Furthermore LHe cooled beam pipes and vacuum cold warm transitions are used as ultra-high vacuum components for beam transportation. Superconducting bus bars are used for the 13 kA current supply of the main quadrupole magnets. All components are integrated as one common cold mass in one cryostat. HTSC local current leads will be applied for the low current supply of the corrector magnets. The QDMs will be operated in the SIS100 heavy ion accelerator, the core component of the FAIR project. First versions of corrector magnets are already manufactured at JINR in Dubna / Russia and are now ready for testing. The ion-optical lattice structure of SIS100 requires multiple configurations of named components. Eleven different configurations, organized in four families, provide the required QDM setups. The high integration level of multiple ion-optical, mechanical and cryogenic functions, based on the requirements on operation safety, is leading towards sophisticated mechanical structures and cooling solutions, to satisfy the demanding requirements on position preservation during thermal cycling. The cryogenic and mechanical design solutions will be discussed and the planning for the complex manufacturing and testing processes will be presented.

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