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Cryogenic refrigeration with neon-helium mixtures: roadmap and first results of TU Dresden study

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Abstract title

At an early stage of the FCC evaluation the heat load caused by synchrotron radiation and the necessity of a beam screen cooling had been identified as a major issue. For a number of reasons and restrictions the beam screens must be kept within between 40 and 60 K. For FCC-hh the heat load including the respective thermal shields piles up to $500 \text{ kW} + 70 \text{ kW} = 570 \text{ kW}$ for each of the 12 sectors. An important aspect is the hydraulic impedance of the beam screen, presently assumed to be equivalent to 230 straight pipes of 5.55 mm inner diameter and 30 m in length per sector. A highly efficient cooling plant is pursued. As a novel approach, the use of a helium-neon mixture as refrigerant was found advantageous. Especially promising is the possible substitution of oil flooded screw compressors by more efficient turbo compressors. This presentation investigates different flow schemes and mixtures compositions with respect to complexity and efficiency. Furthermore, thermodynamic aspects, e.g. whether to use cold or warm secondary cycle compressors are discussed.

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