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Towards a conceptual design for FCC cryogenics

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Following the update of the European strategy in particle physics, CERN has undertaken an international study of possible future circular colliders beyond the LHC. The study considers several options for very high-energy hadron-hadron, electron-positron and hadron-electron colliders.
From the cryogenics point of view, the most challenging option is the hadron-hadron collider (FCC-hh) for which the conceptual design of the cryogenic system is progressing. The FCC-hh cryogenic system will have to produce up to 120 kW at 1.8 K for the superconducting magnet cooling, 6 MW between 40 and 60 K for the beam-screen and thermal-shield cooling as well as 850 g/s between 40 and 300 K for the HTS current-lead cooling. The corresponding total entropic load represents about 1 MW equivalent at 4.5 K and this cryogenic system will be by far the largest ever designed. In addition, the total mass to be cooled down is about 250'000 t and an innovative cool-down process must be proposed.
The cryogenic system of the electron-positron collider (FCC-ee) will have to produce up to 184 kW at 4.5 K for the cooling of superconducting RF cavities.
This paper will present the proposed cryogenic layout and architecture, the cooling principles of the main components, the corresponding cooling schemes, as well as the cryogenic plant arrangement and proposed process cycles. The corresponding required development plan for such challenging cryogenic system will be highlighted.

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