Cryocooler-based cryogenic systems are an attractive alternative for LTS detector magnets. Such a solution requires a design oriented towards a significant reduction of heat input to the cold mass. Current leads are one of the main heat sources for the cold mass. Hence, efforts are being made to design conduction-cooled HTS current leads together with an associated cryogenic circuit which intercepts heat at an intermediate temperature of 50 K.

**Goal**

- Design and optimisation of HTS-based current leads featuring an operating current of 3 kA
- Design of a remote cooling loop for the CLs operating with helium gas @50 K
- Design the heat exchangers constituting thermal interfaces between helium and the leads
- Interconnection, assembly and test of the demonstrator

**Thermal interface between cryocooler and helium gas**

**Main components of the loop:**
- Single-stage Gifford-McMahon cryocooler AL600
- Double-stage PT420
- Active thermal shields @50K
- Cryocooler-to-helium gas heat exchanger
- 2 x 3 kA current leads with integrated heat exchangers
- Cold circulator
- Measuring apparatus

**Characteristics of the cooling circuit**

- Working fluid: helium gas
- Operating pressure: 5 bara
- Operating temperature: 50 K
- Cooling capacity @50K: 340 W

**Design and optimisation of the current leads**

- Material: Brass
- Current: 3 kA
- Dissipation: 15.1 W
- Outer diameter: 51/65 mm
- Mass flow: 2 g/s

**Heat transfer characteristics:**
- Steady state is considered
- Mass flow of 2 g/s
- Operating static pressure of 5 bara
- Flow velocity of 1.22 m/s
- Laminar flow, Re=1030
- Linear pressure drop of 4.7 mbar
- Inlet temperature of 60 K
- Outlet temperature of 43 K

**Conclusion & Acknowledgement**

- Design of the HTS current lead cooling system was done
- Thermal interface between cryocooler and helium gas was designed and manufactured, to be tested soon
- Optimized design of the 2 x 3 kA HTS current lead prepared
- Preparations for the test campaign are underway

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**References**

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