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# Fri-Mo-Po.01-07: Design of Non-insulated HTS Coils for a stellarator demonstration experiment

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Due to the increasing interest in nuclear fusion, basic plasma experiments/small scale devices are good to illustrate plasma physics properties like magnetic surfaces and/or the importance of it. The construction of a table-top stellarator experiment, referred to as Polaris, is envisaged for the Swiss Plasma Center of EPFL. Polaris (major radius ˜40cm and minor radius ˜15cm) consists exclusively of six circular planar coils arranged in an optimal way to generate a large volume of magnetic surfaces and rotational transform in vacuum. The configuration has been optimized following a procedure described in [1]. The main objective is to provide a demonstration of steady-state toroidal plasma confinement without toroidal current, to assess the quality of the magnetic field by experimentally tracing magnetic field lines, and to measure some basic plasma parameters.

There are two sets of coils for Polaris: water-cooled copper coils and non-insulated (NI) HTS coils. With the copper coils, the magnetic field on the plasma axis is around 0.04T. With NI HTS coils a higher magnetic field can be achieved and therefore the confinement is improved.

This works presents the design of the NI HTS coils for Polaris, which have an inner diameter of 21.8cm and are cooled with circulating liquid nitrogen. The operating temperature will be in the range of 65K to 77K. The peak field in the winding pack reaches 0.5T depending on the operating temperature. The design process includes electromagnetic and force calculation of the setup and the layout of the winding pack. In addition, the cryogenic design of the device is illustrated and explained. The current distribution within the NI HTS winding pack is analyzed, considering its impact on the generated magnetic surfaces.

[1] Phys. Plasmas 31, 112501 (2024) https://doi.org/10.1063/5.0226688

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