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C1Po1F-10 [43]: Thermal engineering of optical mirrors for use at cryogenic temperature inside a LHC cryostat

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In the frame of the HL-LHC project, innovative technical solutions are sought to measure accurately the position of the magnet cold mass inside the cryostat. To this end, a system based on laser-interferometry is being designed to monitor the displacement of the cold mass through dedicated openings in the new HL-LHC cryostats.
In order to test such a system on a full-scale setup in representative operating conditions, a LHC dipole cryostat was modified to integrate the system optical lines of sight and the reflective mirrors were mounted onto the magnet helium vessel.
Upon the first cool down of the magnet helium vessel to 80K, severe ice-like condensation started forming on the reflective surface of the mirrors hence making the system unusable at cold. This was attributed to the condensation of the residual gas remaining in the cryostat insulation vacuum on the mirror surface. In this configuration the mirrors acted as local "cold spots"since they were purposefully sticking out of the multi-layer insulation (MLI) that is otherwise covering the magnet helium vessel.
In order to cope with this condensation issue, a dedicated study was carried out to design and manufacture a passive temperature regulation system based on a thermal insulating support and a thermal radiation intercept in order to keep the mirrors just above the expected freezing temperature in operational conditions.
This paper details the thermal engineering study leading to the design of the insulated mirrors and presents the technical solution retained as well as the latest test results.

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