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Experiments for machine protection: from consequences of beyond-design failures to damage limits of sc. magnets

HiRadMat is an unique facility to experimentally verify the consequences of beam impact on accelerator equipment. These experiments are essential for machine protection to validate simulation results and confirm the consequences of beam failure cases in the LHC and future accelerators. In the early years of HiRadMat, a dedicated experiment could prove the existence of the so-called hydrodynamic tunnelling effect, which leads to a significantly increased penetration depth of the beam in accelerator equipment in case of a direct impact of the LHC beam. During Run 2, the damage limits of superconducting magnet components have been studied in HiRadMat at room temperature and at 4.2 K.
This presentation reviews the major results achieved through the different HiRadMat experiments performed in the scope of LHC machine protection and gives an outlook on outstanding topics and future follow-up experiments.

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