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Fri-Mo-Po.06-02: Effects of Cryogenic Irradiation on Optical Fiber Sensors based on Brillouin Scattering and Type-II Bragg Gratings for Fusion Magnet Monitoring

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Optical fiber sensors are gaining attention as a promising technology for magnet monitoring and quench detection in fusion reactors. These sensors enable precise measurement of strain and temperature profiles within superconducting magnets and their integration into superconducting wires and cables has been demonstrated as viable. However, when embedded into fusion magnet systems, these sensors will be subjected to ionizing radiation, potentially degrading their performance or altering the sensing signals, especially under cryogenic conditions. Understanding these effects is essential for harnessing the benefits of optical fiber sensors in such extreme environments.

This study investigates the impact of cryogenic (77 K) gamma irradiation on light transmission and several types of optical fiber sensors. Specifically, we evaluated:

- The effects of ionizing radiation at cryogenic temperatures on light transmission in optical fibers of various material compositions.
- The influence of cryogenic gamma irradiation on Brillouin scattering-based distributed sensing and a comparison with room-temperature irradiation effects.
- The response of type II fiber Bragg gratings (FBGs) to cryogenic gamma irradiation and their behavior relative to room-temperature conditions.

Overall, the results of this study indicate that under the tested conditions, cryogenic irradiation is unlikely to prevent the application of these sensors to fusion magnets. Current technical challenges that require further research are presented.

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