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# Influence of High-Frequency Magnetic Fields on Noise Behavior of CMS 2S Module Prototypes

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For the CMS tracker Phase-2 upgrade new modules with silicon strip sensors are being developed. Each module features a Service Hybrid (SEH) responsible for communication with the tracker back-end and power distribution to the module components. Here, a two stage DC-DC conversion scheme is used for the supply of low voltage. For modules using the latest generation of SEHs an increase in module noise has been observed. A setup for inducing radiative noise with external magnetic fields that are frequency and location dependent will be presented. Resulting measurements suggest that radiative sources are not responsible for the observed noise increase.

## Summary (500 words)

During Long Shutdown 3 the LHC will be upgraded to the High Luminosity LHC with a planned instantaneous luminosity of at least 5*10ˆ34 cm−2s−1. For this purpose, the current strip tracker of the CMS experiment will be entirely replaced by a new system as part of the Phase-2 upgrade. In this context a new type of module, the so-called 2S module, is currently being developed. It is equipped with two silicon strip sensors, two Front End Hybrids (FEH) for binary signal readout, and a Service Hybrid (SEH) for data communication with the tracker back-end and power supply. In particular, a two stage DC-DC conversion scheme is used to provide low voltage to various components.

For modules using the latest generation of SEH and FEH prototypes, an increase in the module noise has been observed compared to earlier generations. Differential measurements of the ground potentials on the two FEHs show significant contributions of harmonics of the DC-DC switching frequencies indicating a coupling of the DC-DC converters and the module ground.

In this contribution a setup is presented to systematically investigate whether this coupling arises from radiative sources and for which frequencies the module is particularly sensitive. It uses a signal generator, a signal amplifier, and a pickup coil to induce magnetic fields. By radiating fields onto the module, a significant increase in common mode noise events can be generated. Frequency scans show the highest response of the module for a range between 10 and 50 MHz matching the frequencies of the harmonics of the DC-DC converters.

Mounting the induction coil to a XY-stage and repeating the frequency scans for various positions of the coil two-dimensional response maps can be recorded. Depending on the location and orientation of the coil, the sensitivity of the module to the external fields differs significantly. However, a replication of these measurements with a module equipped with FEHs and an SEH from a previous generation yields similar maps. This shows that the coupling of external fields into the module did not change across different generations.

After exchanging the pickup coil with an SEH as noise source¬¬¬ no significant difference of common mode events compared to baseline measurements are observed strongly suggesting that radiative sources are unlikely to be responsible for the increased module noise.

In conclusion, this contribution presents a setup to induce radiative noise into a silicon strip module. The measurements provide insights into the response of CMS 2S modules to high-frequency magnetic fields indicating that radiative sources are not contributing to an increased module noise. Finally, it should be noted that this method can also be applied for examining the noise behavior of other types of detector modules.

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