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Dynamic vacuum and temperature predictions for informed anomaly detection at the CERN-SPS

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High intensity beams, through electron cloud and impedance based mechanisms, cause an increase in vacuum pressure in the SPS kicker magnets. These magnets are pulsed at high voltage in order to quickly deflect the beam. However, if the vacuum inside their aperture deteriorates, it can lead to an electrical breakdown and potential damage to the kicker itself.

Conversely, a breakdown in a kicker that is not initiated by beam behaviour exhibits a very similar signature - a rapid increase in pressure. Additionally, both an electrical breakdown and rapid increase in dynamic vacuum can occur simultaneously, making it challenging to detect sparks in the magnet and automate the process. The rarity of breakdown events further complicates matters, as simple classification of vacuum signatures cannot be applied.

To address this issue, we propose a data-driven model that predicts vacuum and temperature behavior and distinguishes between normal and anomalous activities.

Primary Keyword

failure prediction

Secondary Keyword

anomaly detection

Tertiary Keyword

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