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Quench Detection and Voltage Spikes Analysis of the FECR Half-scale Nb3Sn Superconducting Magnet

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Institute of Modern Physics is developing the Fourth-generation of Electron Cyclotron Resonance source, also known as FECR. In order to fulfill the requirements of higher beam intensity and quality, the FECR needs a Nb3Sn superconducting magnet with high performance and complex structure. Therefore, a half-scale prototype is produced for the technical research, it was wound by a 1.3mm diameter Nb3Sn wire and consists of six racetrack dipoles and two solenoids. For the Nb3Sn magnet, it has obvious thermo-magnetic instabilities, so-called “flux jumps”, which means large voltage transients will occur frequently during the magnet training. The voltage spikes can lead to misjudgment of the Quench Detection System (QDS), that’ s very harmful to the normal operation of the magnet. Especially, for this FECR prototype with a composite structure, the situation of flux jump is more complicated. In an effort to better characterize and understand these voltage spikes, as well as to make the quench detection faster and more accurate, we have done several experiments on the half-scale prototype and obtained a large amount of data. Through the analysis of these data, we have optimized the quench detection algorithm. In this paper, the analysis results of voltage spikes and strategy of quench detection are presented.

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