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Development of High-speed Data Acquisition System of Negative Ion Source Breakdown

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Due to a number of factors, long pulse experiments conducted under Negative ion source based Netutral Beam Injection (NNBI) are not always stable. The occurrence of breakdown can lead to damage of the ion source device. Currently, low-speed data acquisition (DAQ) systems operating in NNBI have low sampling rates, which make it difficult to accurately characterize the changes of each key electrical signal at that moment. Therefore, it is not conducive for researchers to analyze the causes based on the sampling data. To solve this problem, a high-speed DAQ system based on random trigger method, pre-trigger method, multi-threading and MDSplus database is proposed, especially for acquiring the instantaneous electrical signals before and after the time axis of the system in the fault state. In terms of signal anti-interference processing, this system adopts high-speed voltage-to-frequency (VF) and frequency-to-voltage (FV) conversion technologies to achieve isolated transmission of field signals. In terms of software, this system is developed based on C# to realize each module, mainly including data acquisition, data playback, and data storage. In addition, multi-threading techniques are employed to achieve unification of high-speed and low-speed DAQ systems on the time axis. The current sampling rate of the system can reach up to 2M Sa/s, which can realize high-precision data acquisition of key experimental parameters such as the current and voltage data generated during NNBI experiment, so it can provide data support for researchers to precisely analyze the possible causes of system failures, and also establish corresponding data samples for fault prediction implemented based on artificial intelligence or some other research directions. At present, current and voltage signals of acceleration grid power supply and extraction grid power supply have been connected to this system. According to experimental needs, more signals will be added to this system subsequently to provide reliable data sources for physical analysis of NNBI.

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