

Noise Level of the HDice NMR Field Sweep

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This note presents the result of the noise level measurement of a typical NMR field sweep; such field sweeps are used to scan for and pick up the polarization signal from the HDice target.

The NMR field sweep is used to scan for and pick up the polarization signal from the HDice target. The standard deviation σ of each field sweep setting (calculated after the field value has been set and read back several times) is a measure of the noise level at that field setting.

For the test, the current of the Oxford power supply (configured in the shorted mode) was measured by the CAENels current transducer box, which triggered the lock-in amplifier. The NMR program calculated \mathbf{B} from the measured current using a formula associated with PD1 (Production Dewar #1).

The NMR program set the current of the power supply such that the calculated \mathbf{B} was swept from 3150 G \rightarrow 2850 G \rightarrow 3150 G, Fig. 1, and acquired readback data. For the test, the sweep was repeated one thousand times (1,000 cycles). In a cycle there are $\sim 16,000$ events (set and readback acquisitions), determined by the maximum buffer depth of the lock-in amplifier.

The NMR program also sets the initial, final, and holding \mathbf{B} fields, ramp-down and ramp-up rates, dwell times, and the overall period of the sweep.

Fig. 1 shows the \mathbf{B} -field sweep. The starting \mathbf{B} -field value is 3150 G; then the field is dropped to 2850 G over $\sim 7,500$ events, where it is held for about 500 events. The field is then increased over $\sim 7,500$ events to its starting value of 3150 G, where it is held for about 500 events, which completes the cycle. For the sweep shown in Fig.1, the cycle period is about three minutes.

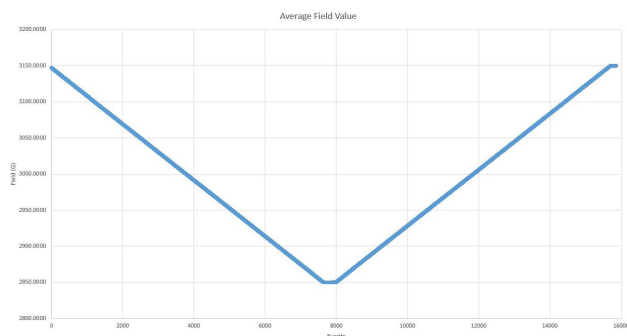


FIG. 1. Average field value readings for 1,000 cycles.

Figure 2 shows the σ 's of the average field values of events 3700–3760, for 1,000 cycles.

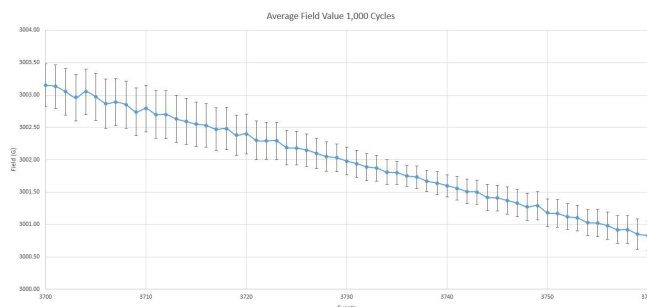


FIG. 2. Average field value and standard deviation of 1,000 cycles.

To conclude, σ measured at each field setting for the 1,000 cycles run over the range 2850 G to 3150 G varies from ~ 0.4 G to ~ 0.7 G.