Leakage magnetic field measurement on April 14, 2026

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April 17, 2026

Abstract

Results of leak field measurement performed on April 14, 2026 at SAMURAI are reported. Focus is placed on the residual field strengths at roughly the PMT positions of various neutron detectors: HIME, HIME+, and NDA.

1 Field measurement

Residual magnetic field, present at the PMT position of the neutron detector, can cause a gain shift of the anode signal. In an attempt to understand the phenomenon quantitatively, the leakage magnetic field was measured at various points downstream of the SAMURAI neutron window. These positions roughly correspond the locations of the PMTs at the front surface of each neutron detector (HIME, HIME+, NDA) installed for the 2026-May SAMURAI campaign. Measurement was performed when the SAMURAI magnet was excited up to 2.9 T.

The SAMURAI magnetic field values quoted in this report are likely to be those calculated from the excitation current, thus they seem to suffer from the effect of hysteresis: magnetic field is different for the same excitation current depending on the direction of the current change (increment or decrement).

2 Method

A Hall probe was place near the lower PMT of a vertical module of HIME, located in the high-momentum side of the SAMURAI exit (see Fig. 1).

At 2.5 T, the probe sense plane was rotated so that the measured field strength reaches the maximum. In this way we intended to measure the absolute value of the field.

A cell phone APP (Physics Toolbox) was also used to measure the field strength. A cell phone can be placed at various points handily, then this was used to extend the measurement points as mentioned above.

3 Results

The results of measurement are shown in Table 1. The measurements from #1 through #5 were done while increasing the magnetic field. The measurements from #6 through #10 were done while decreasing the magnetic field.

Figure 2 depicts the leakage field measured using the Hall probe near the lower PMT position of a HIME module located at the high-momentum side.

Figure 3 depicts the leakage field measured using the cell phone APP (Physics Toolbox) near the lower PMT positions of various neutron detector systems (HIME, HIME+, NDA).

For several HIME channels, a decrease in the PMT pulse height due to stray magnetic fields was recorded (see LogNote and/or expect a separate report).

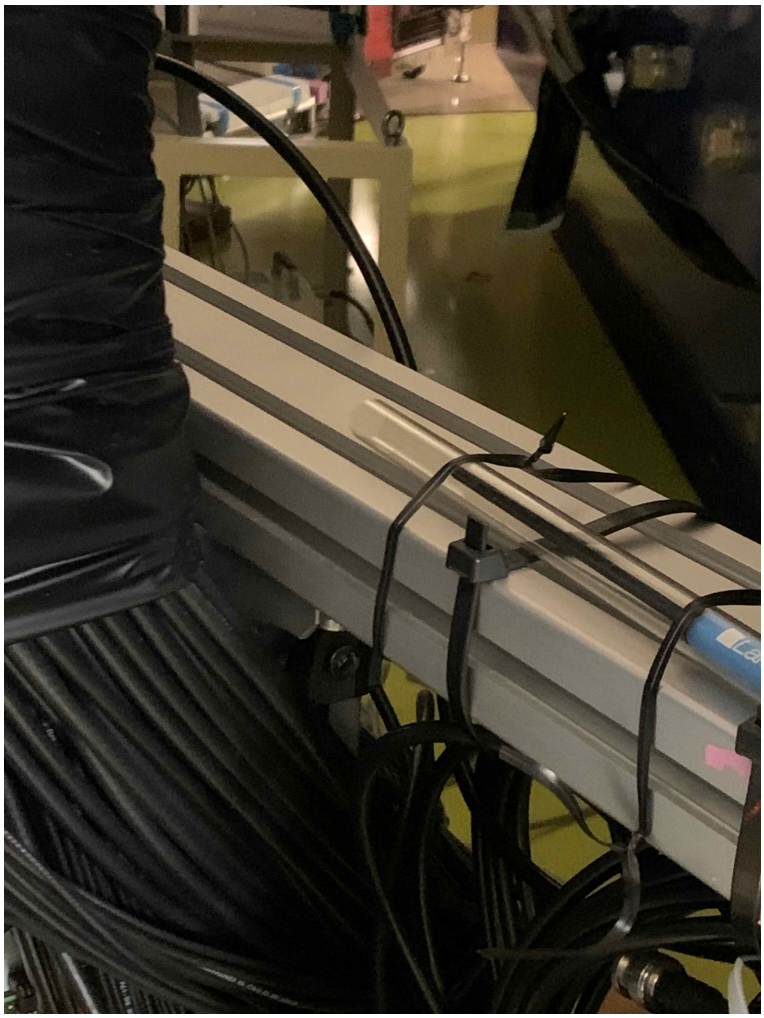

Figure 1: A Hall probe was placed near the lower PMT of a high-momentum-side vertical HIME module.

Table 1: Leakage magnetic fields in [mT] measured at typical locations of the PMTs in each neutron detector. "high" refers to the high-momentum side, "low" refers to the low-momentum side.

#	B[T]	Hall probe	HIME high	HIME low	HIME+ high	HIME+ low	NDA high	NDA low
1	2.5	0.800						
2	2.6	0.949						
3	2.7	1.138						
4	2.8	1.420						
5	2.9	1.858						
6	2.7	0.795	0.88	0.82	0.53	0.53	0.20	0.31
7	2.5	0.449	0.53	0.52	0.34	0.33	0.14	0.17
8	2.1	0.189	0.26	0.29	0.19	0.19	0.07	0.11
9	1.5	0.002	0.12	0.17	0.11	0.11	0.06	0.06
10	0.0	−0.137						

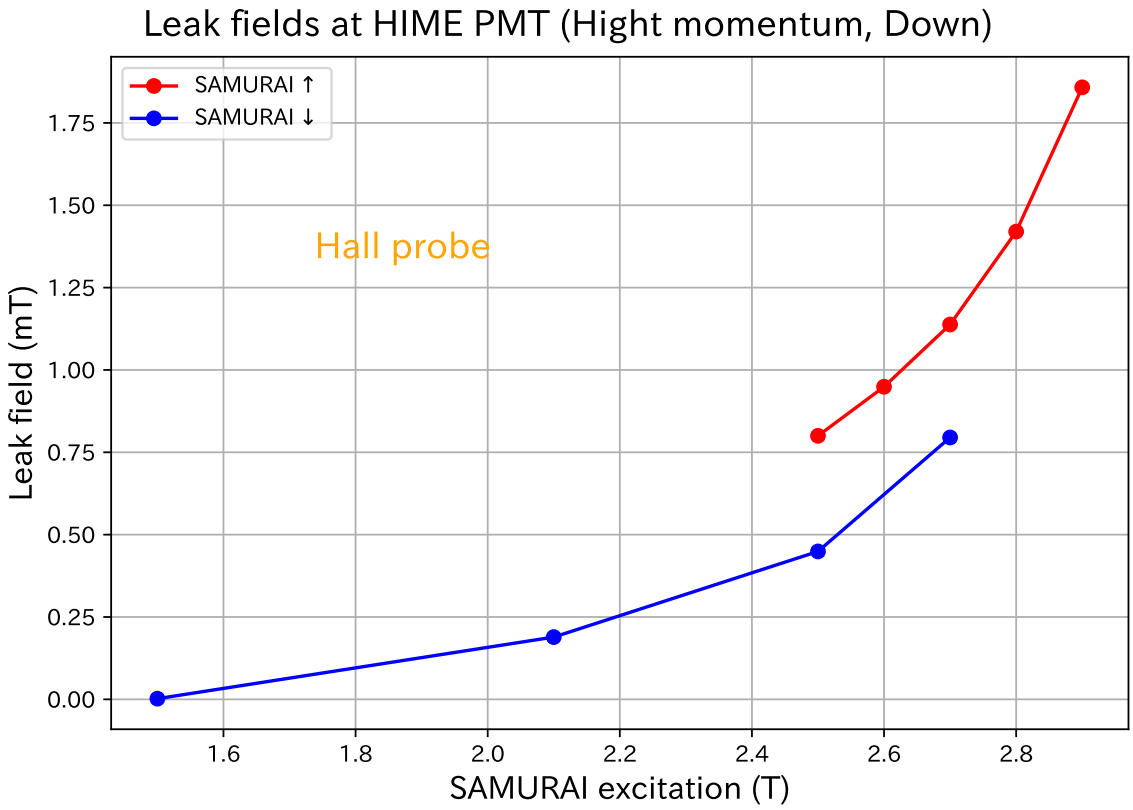

Figure 2: Results of the leakage field measurement done with the Hall probe, placed near the lower PMT of a high-momentum-side vertical HIME module.

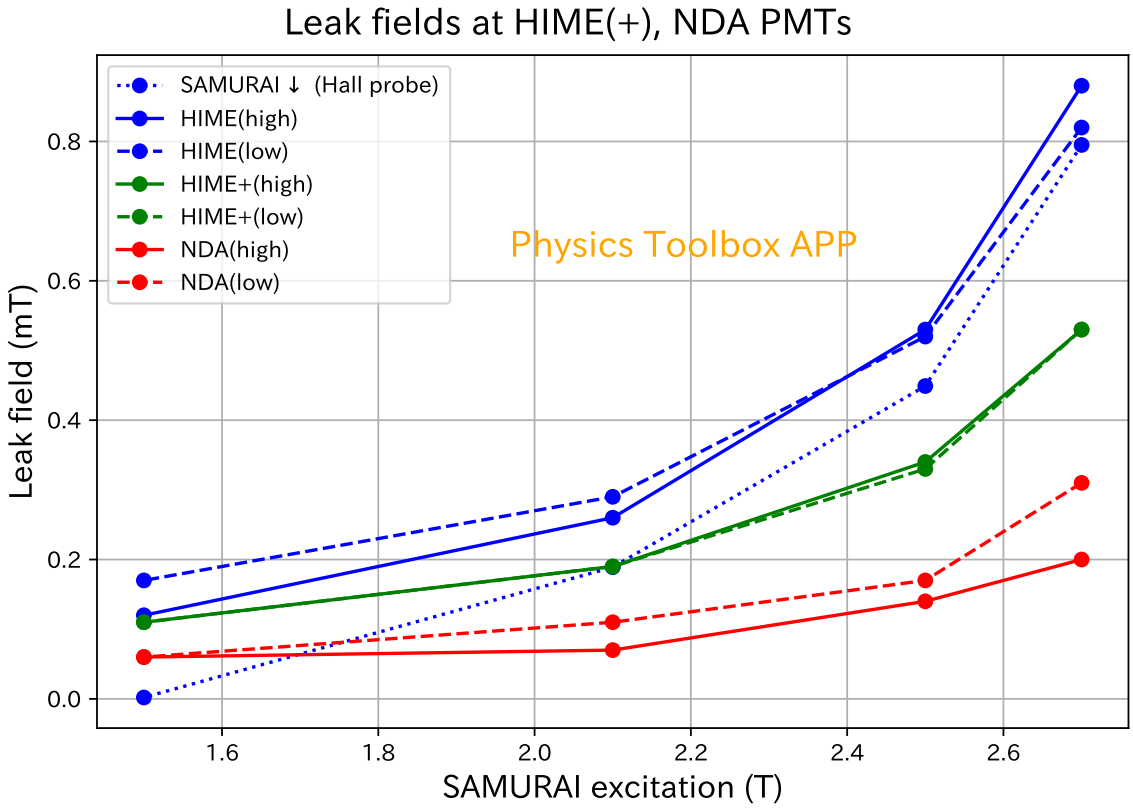

Figure 3: Results of the leakage field measurement done with the cell phone APP (Physics Toolbox), placed near the lower PMTs of HIME, HIME+, and NDA, at both high- and low-momentum sides. Some of the results obtained with the Hall probe (SAMURAI ↓, dotted line) were overplotted for reference. The difference between the Hall probe data and the chell phone APP data might be due to the lack of the absolute precision/calibration in the latter.