Laboratory Session Log

Date: 2026-02-06 **Time:** 11:30–3:45 **Notebook:** pp. 1-2 **Session:** #1

OBJECTIVES

The goal of this session was to set up the lab space and get the experimental equipment powered on and functional. This included setting up the TeachSpin Noise Fundamentals apparatus and supporting instruments in the room, connecting power, and beginning to establish the signal chain that will be used to acquire noise voltage time-series $V(t)$ for statistical moment analysis.

SETUP & CONDITIONS

Equipment:

- TeachSpin Noise Fundamentals:
  - Low-Level (LL) Electronics Unit: Contains the pre-amplifier stage and selectable load resistors (switched via front-panel knob).
  - High-Level (HL) Electronics Unit: Contains bandpass filter modules, variable-gain main amplifier, multiplier (squarer) module, and output section.
- SR1 Audio Analyzer
- Oscilloscope: GW-INSTEK GDS-1052-U (provided by Dr. Beyersdorf)

Signal chain (planned):

Selected load resistor (LL box) → Pre-amplifier (LL box) → Bandpass filter (HL box) → Variable-gain amplifier (HL box) → Multiplier/squarer (HL box) → Output (HL box) → Oscilloscope (GDS-1052-U, USB export)

Room temperature: Not recorded. Need to procure a thermometer for future sessions.

PROCEDURE

1. Setup the TeachSpin Noise Fundamentals apparatus (LL and HL units), SR1 Audio Analyzer, and supporting cables in the lab room. Arranged equipment on the bench and connected power cables.
2. Powered on the TeachSpin units. The HL box required locating the correct power cord, which took some time. Verified that both units turned on without obvious issues.
3. Attempted to use the oscilloscope already present in the lab for data export, but discovered it uses a floppy disk drive for saving waveforms. This is not a practical export method, so this scope was set aside.
4. Obtained the GW-INSTEK GDS-1052-U oscilloscope from Dr. Beyersdorf. This unit supports USB export of waveform data, which will be used for all future data acquisition.
5. Read through sections of the Physics 120B Noise Fundamentals lab manual to re-familiarize with the TeachSpin equipment, the module layout, and the signal chain. Took notes (see notebook

pp. 1–2).

6. Briefly explored the SR1 Audio Analyzer's time-sweep acquisition mode (notes on p. 2 of notebook). Per Dr. Beyersdorf's feedback, the SR1 is designed for spectral analysis and is not the appropriate tool for capturing time-domain voltage waveforms $V(t)$.

OBSERVATIONS

Session was primarily spent on logistics: moving equipment, connecting power, and sorting out the data acquisition setup. No noise measurements were taken. Did not have time to select resistor values or configure the signal chain for data collection.

RESULTS

No data collected this session.

Data files (in development):

- `noise_V_R<value>_T<temp>K_<trial>.csv` — Raw time-domain voltage waveform $V(t)$ exported from the oscilloscope via USB. Files are named by resistance in ohms, temperature in kelvin, and zero-padded trial number (e.g., `noise_V_R100_T295K_003.csv`).
- `calc_moments.py` — Computes the first four statistical moments (mean, variance, skewness, kurtosis) of the noise voltage time-series data to characterize the distribution and verify Gaussianity.

INTERPRETATION

No data to interpret. The key takeaway from this session is that the SR1 Audio Analyzer is not suitable for time-domain waveform capture, and the GDS-1052-U oscilloscope with USB export will serve as the primary data acquisition instrument going forward.

OPEN QUESTIONS

? What is the structure of the CSV data exported by the GDS-1052-U via USB? (Number of columns, header format, number of data points per capture.)

? What algorithms need to be developed for computing the first four moments of the noise voltage $V(t)$? This depends on the CSV structure above.

? Should the bandwidth Δf be held fixed across all trials, or varied? Current plan is to cycle through all available load resistor values on the LL box- need to determine if varying bandwidth alongside resistance adds useful information or just complicates things.

? What software is appropriate for creating circuit diagrams of the setup?

NEXT SESSION

Reminders:

- Review the Noise Fundamentals lab manual- focus on the signal chain and module connections

- Read "Understanding Moments" located in the Google Drive in `../Resources/Papers`
- Check the lab for a thermometer; procure one if necessary
- Bring a USB stick for waveform export from the GDS-1052-U
- Log scope settings (V/div, timebase, coupling mode, bandwidth limit) before any USB data collection
- Goal: complete the signal chain, select a resistor value, and capture at least one test waveform

SCRATCH/NOTES

Per Dr. Beyersdorf's feedback, the SR1 Audio Analyzer is not the appropriate instrument for capturing time-domain voltage waveforms $V(t)$. The SR1 is designed for spectral analysis. For direct voltage time-series acquisition, use the oscilloscope (USB-equipped) provided by Dr. Beyersdorf. Data will be exported via USB for statistical analysis in Python.

For notes on the time-sweep acquisition procedure for the SR1, refer to p. 2 in the notebook.

ADVISOR FEEDBACK

[Space for comments if reviewing.]