Phys 3360/AEP 3630
Lecture 42

Detecting signal buried in noise

For poor S/N signal, recovery is often possible

⇒ SNR can be made very large

Signal averaging - example of

\[ SNR_{dB} = 10 \log_{10} \left( \frac{P_s}{P_n} \right) \]

SNR increases 3dB for each
**Lock-in amplification**

- Most signals can be made repetitive

- If signal can be added, made periodic, can use lock-in amp

Phase sensitive detector:

\[ V_{\text{signal}} \propto V_0 \sin(\omega_{\text{signal}} + \varphi) \]

- Switch

\[ \text{Switch} \times V_{\text{signal}} \]

- Output + LP Filter with \( \omega_c << \omega_{\text{signal}} \)

**Lock-in amp**

1) System response signal of interest \( V_0 \)

2) PSD:
3) LP filter after PSD

Application Example

You are measuring a very weak signal, e.g., fluorescence.

Laser light exciting the atoms → sample → detector

Chopper wheel

Laser → Sample → Modulated light at ~kHz freq.

Lock-in amp

Output

Modul. freq. Analog in