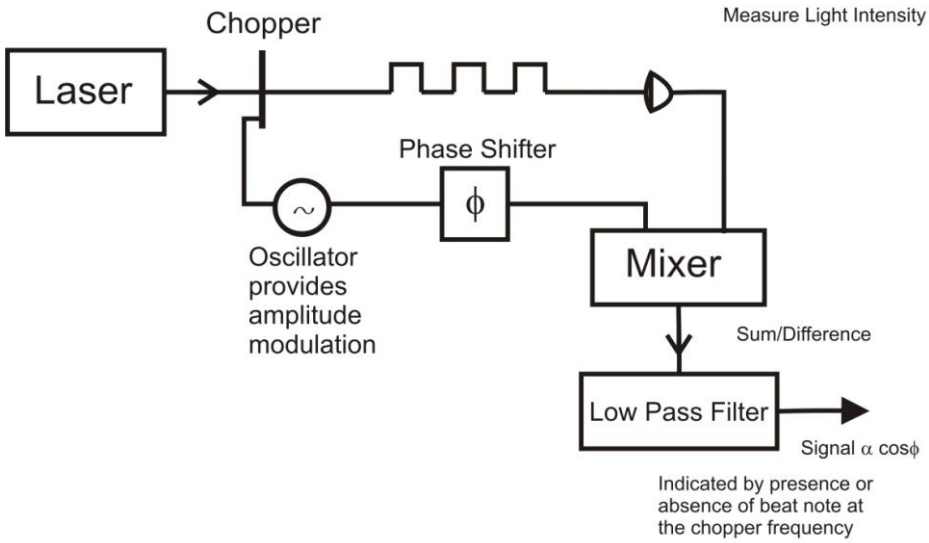
Phys 4061/5061 – Tutorial Four

Details Pertaining to laboratory experiments covered in this tutorial can be found in the lab manual under the following sections

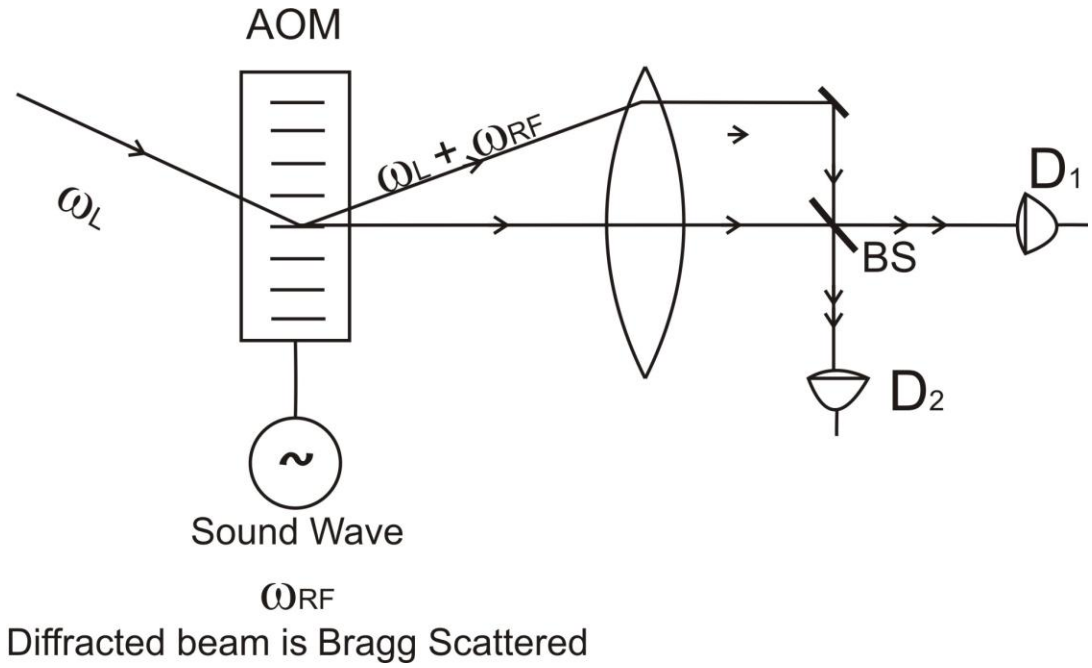
1. Lockin
2. Heterodyne Detection

Overview of Laser Frequency Stabilization – Lockin Amplifier

1. Lockin Detection to detect AM modulated signal



2. Analogy to Heterodyne Detection

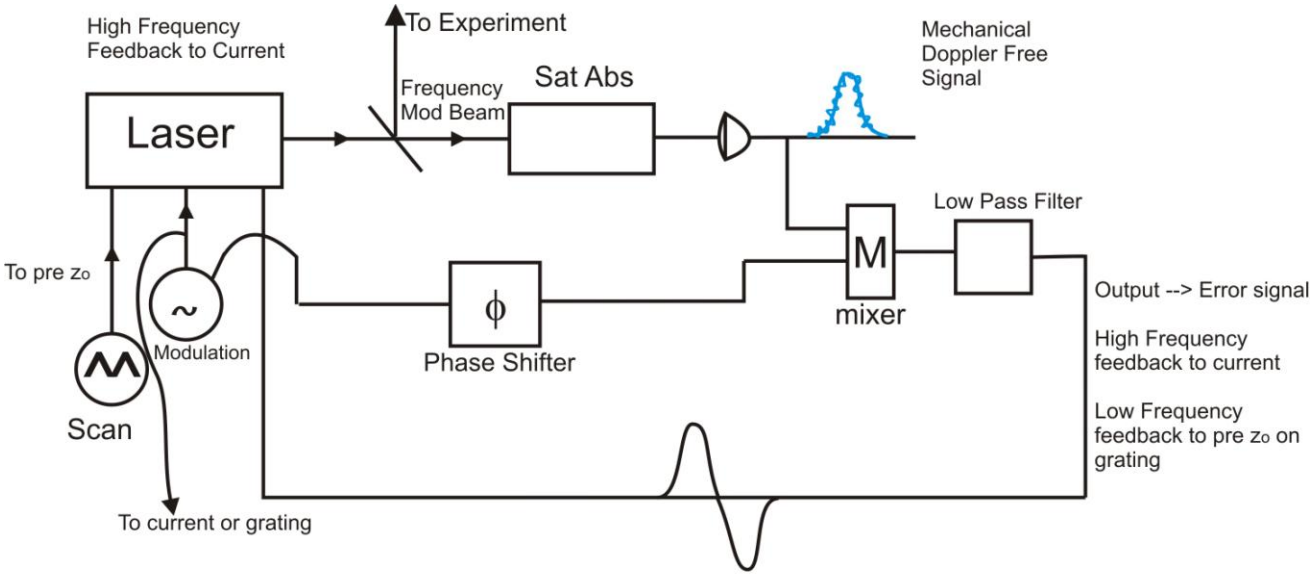


D_1 and D_2 recorded beat note at ν_{RF}

- Signals:
  - $\omega_L + \omega_L + \omega_{RF} = 2\omega_L + \omega_{RF}$
  - $\omega_L - \omega_L + \omega_{RF} = \omega_{RF}$
- only difference in frequency ω_{RF} detected as beat note

3. Contrast with DC/Intensity Detection
   - Heterodyne/Lockin Detection allows detection of signal with high signal to noise in specific frequency range
   - Signal detected by detect presence or absence of beat note
   - choice of modulation frequency is critical

4. Laser Frequency Stabilization with Lockin → detect frequency modulated laser and use signal to lock laser to atomic transition



1. Explain why error signal is positive, zero and negative if laser is below, on and above resonance and how such a signal is useful for feedback

2. Explain why error signal has dispersion shape as a function of laser frequency contrast with signal without scan

3. Explain convent technique to find correct phase setting for locking to atomic transition