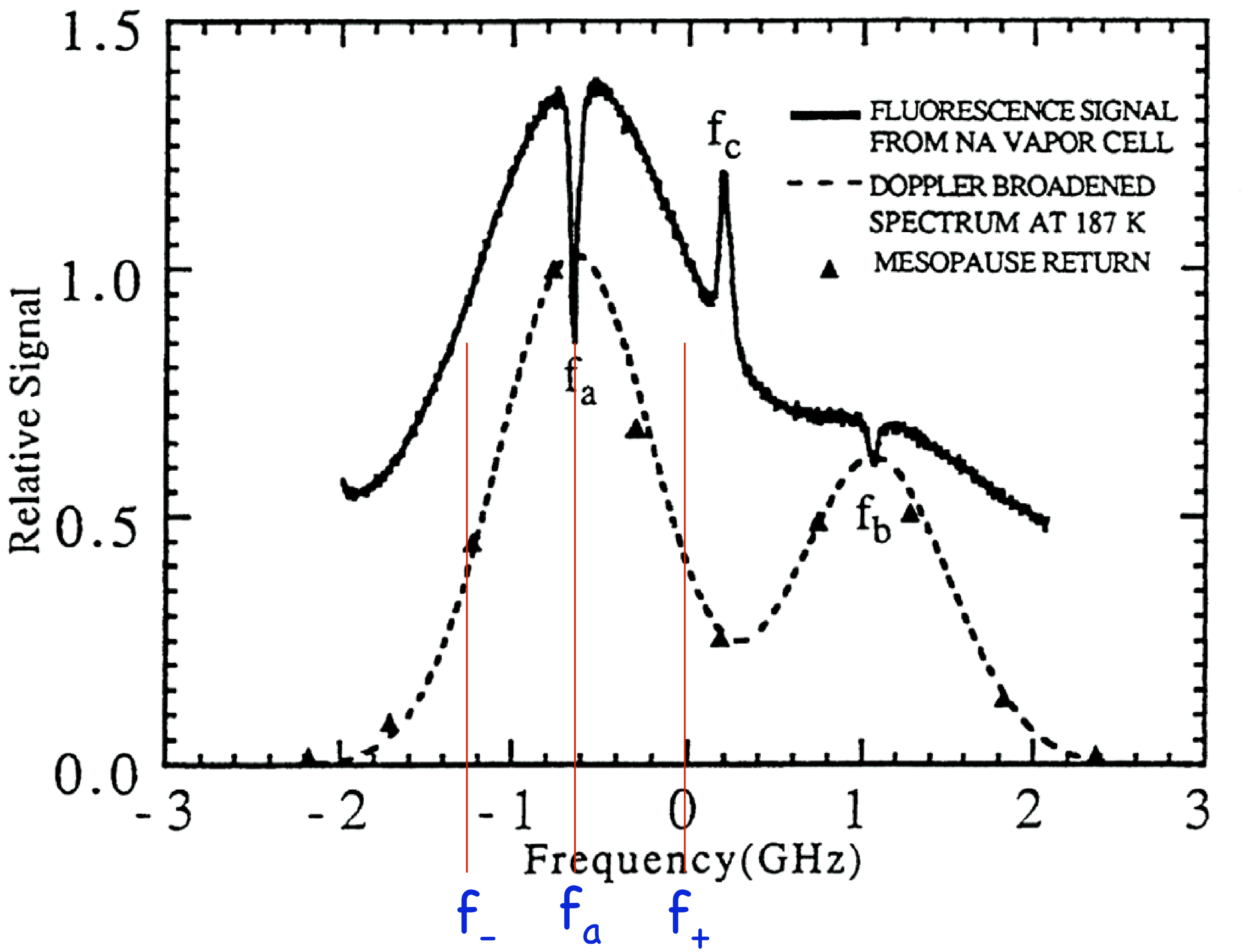
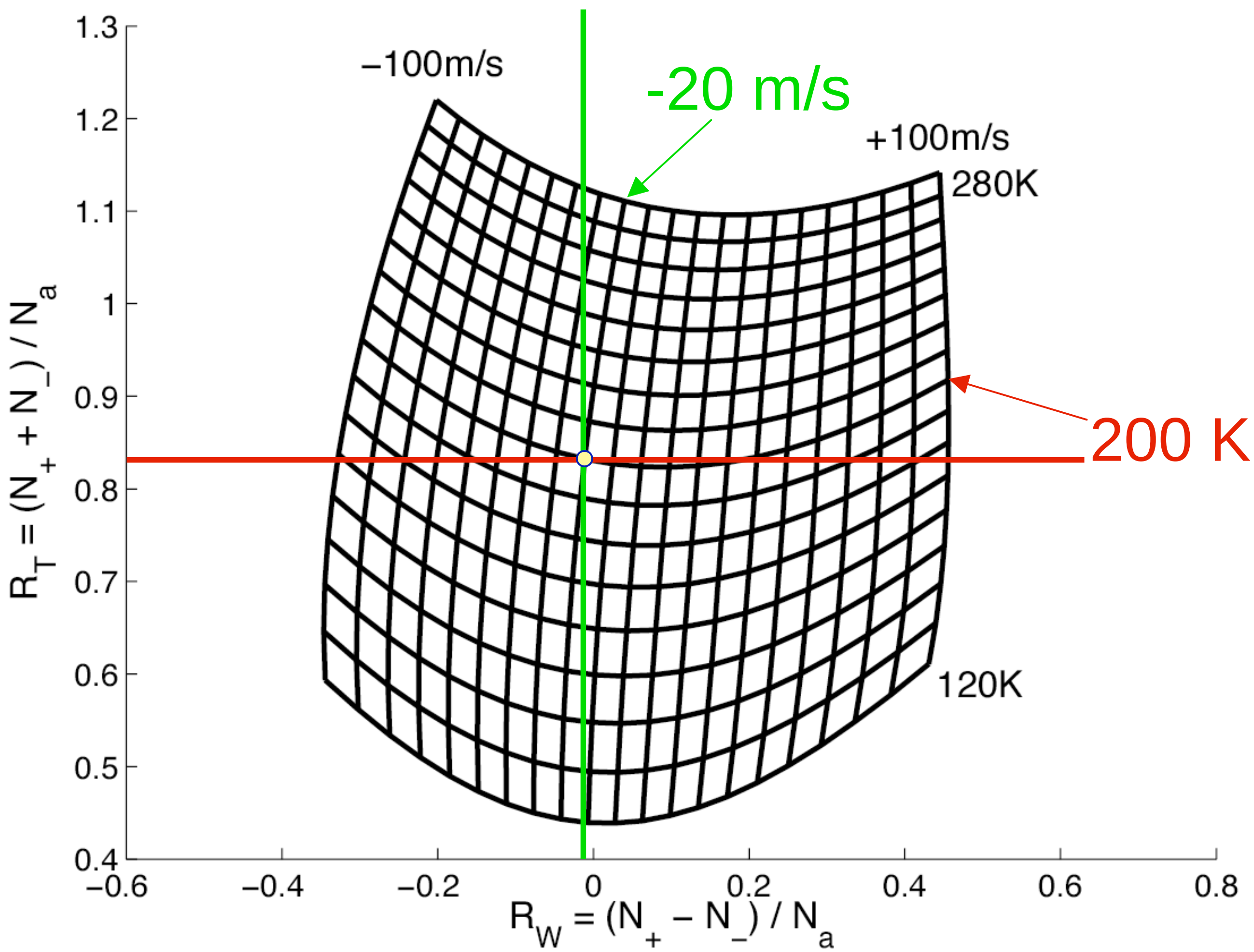
Lecture 12. Temperature Lidar (3)
Na Doppler Lidar Architecture

- Review Doppler ratio technique
- Introduction
- Na Doppler lidar instrumentation
- Na Doppler lidar transmitter
- Na Doppler lidar receiver
- DAQ & control system
- Summary

Review of Doppler Ratio Technique

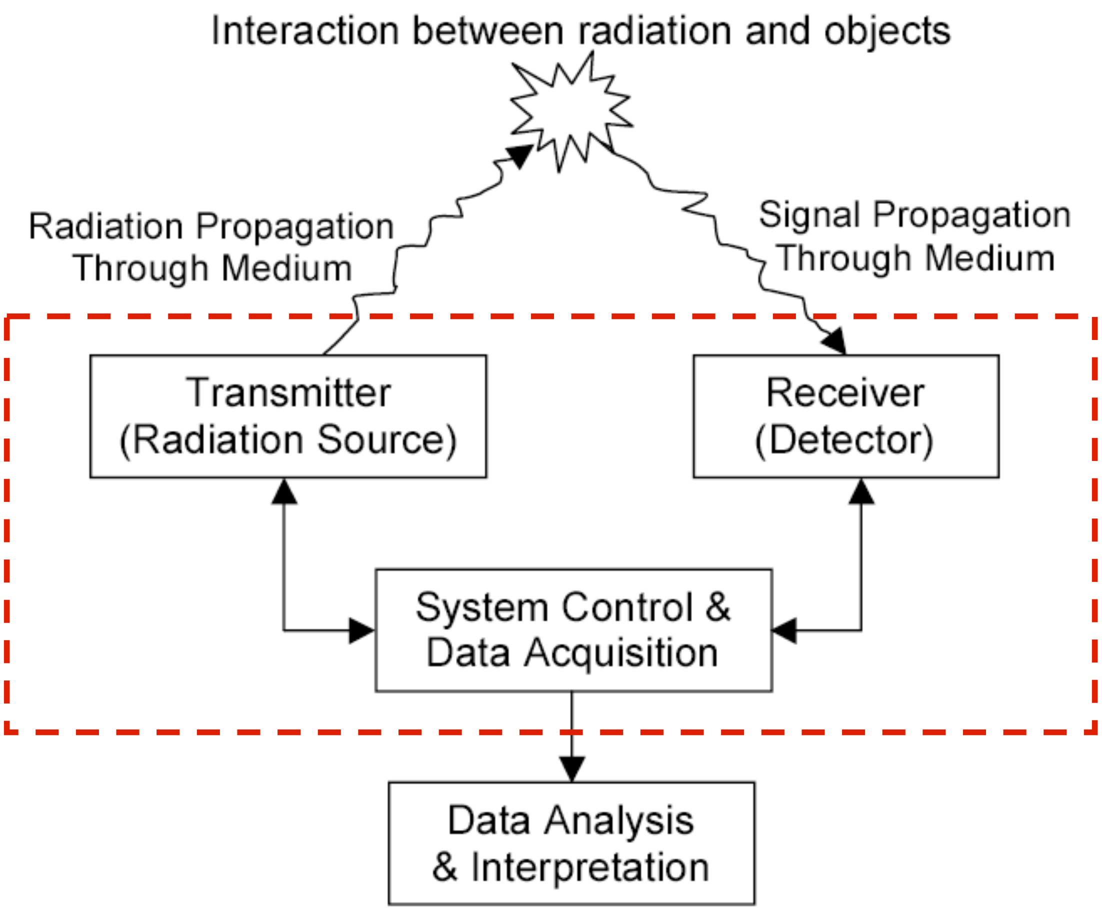


Review of Doppler Ratio Technique

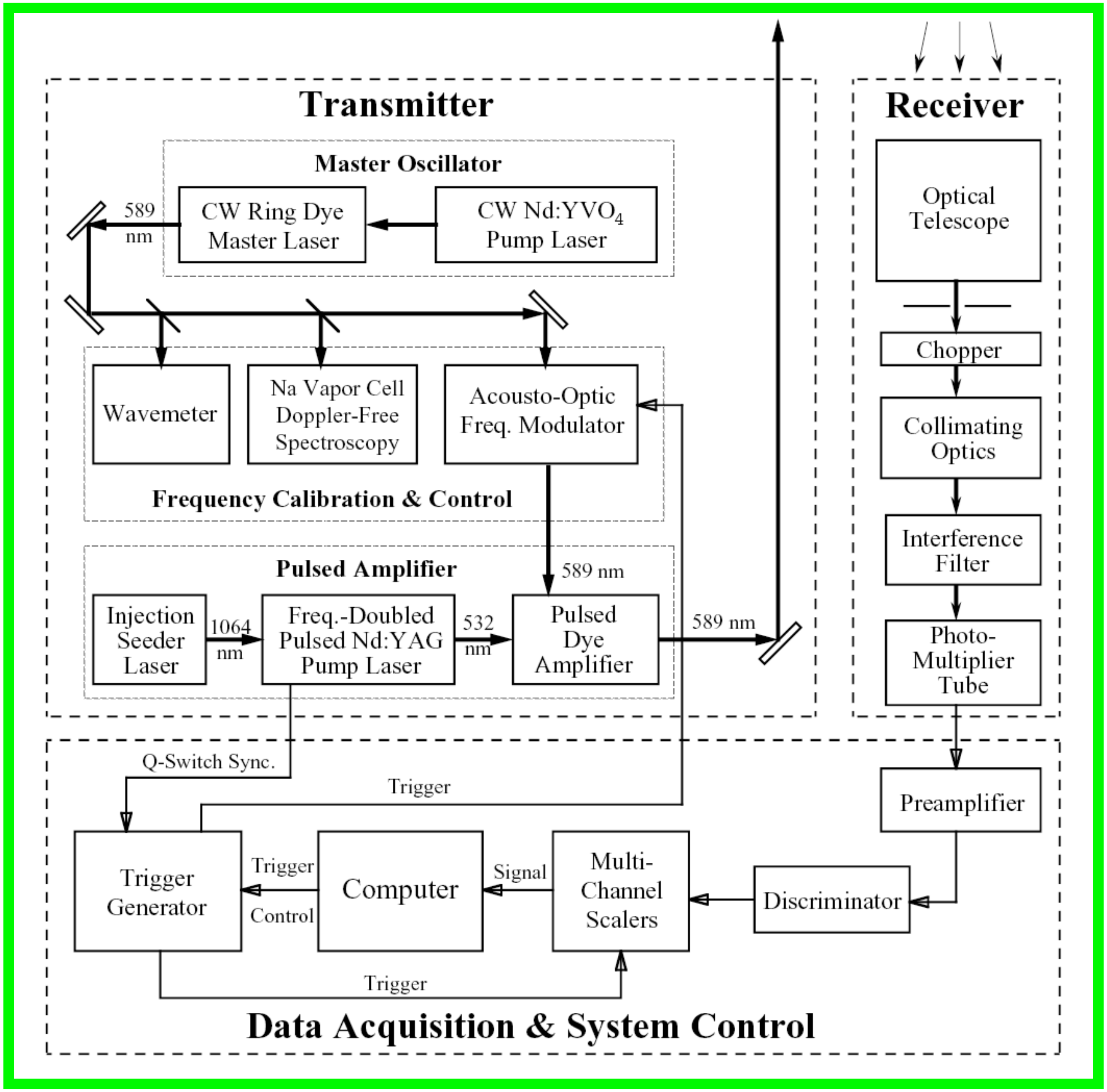


Introduction

- Lidar architecture is the art of lidar system instrumentation (including hardware and software).



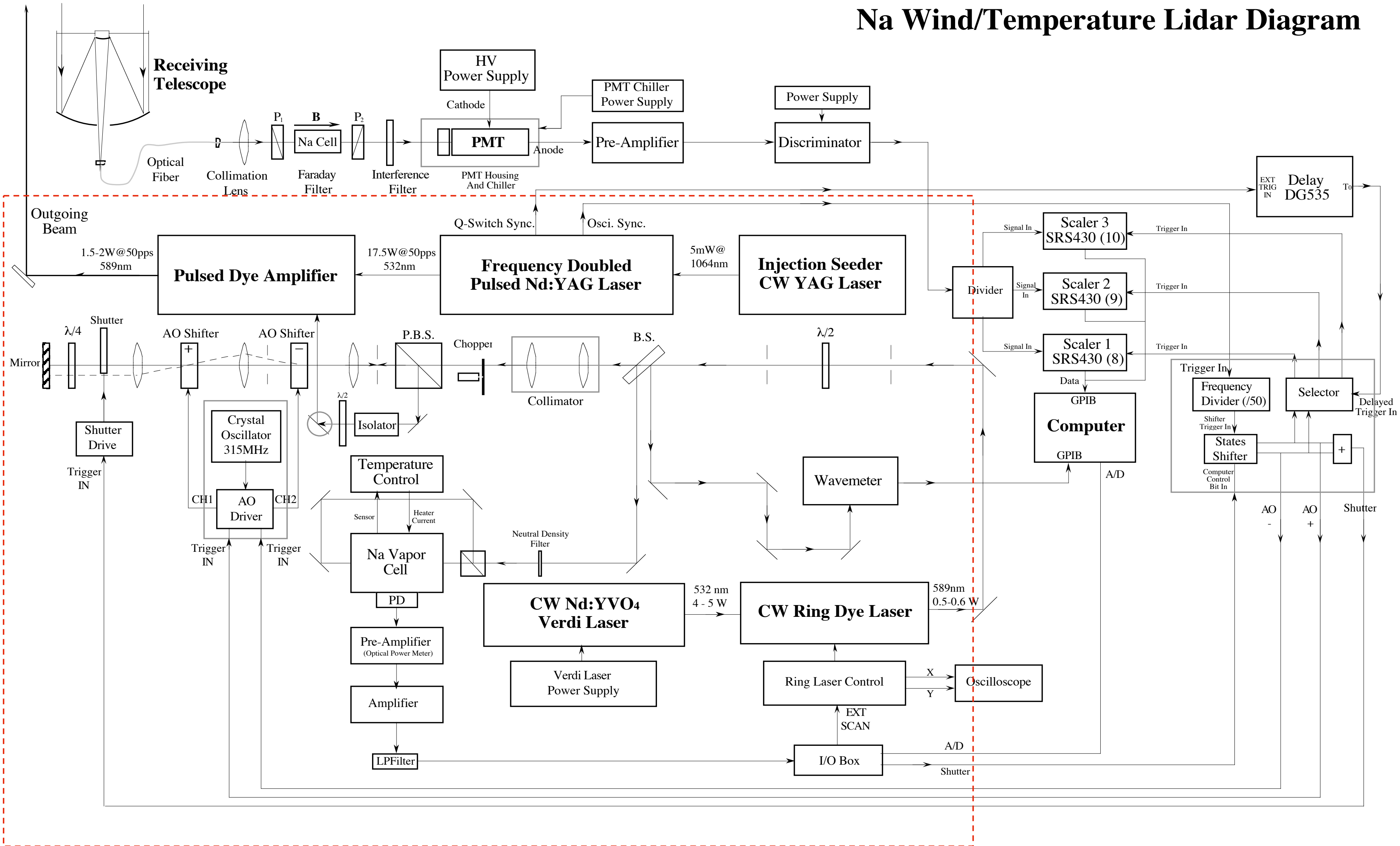
Na Doppler Lidar Schematic



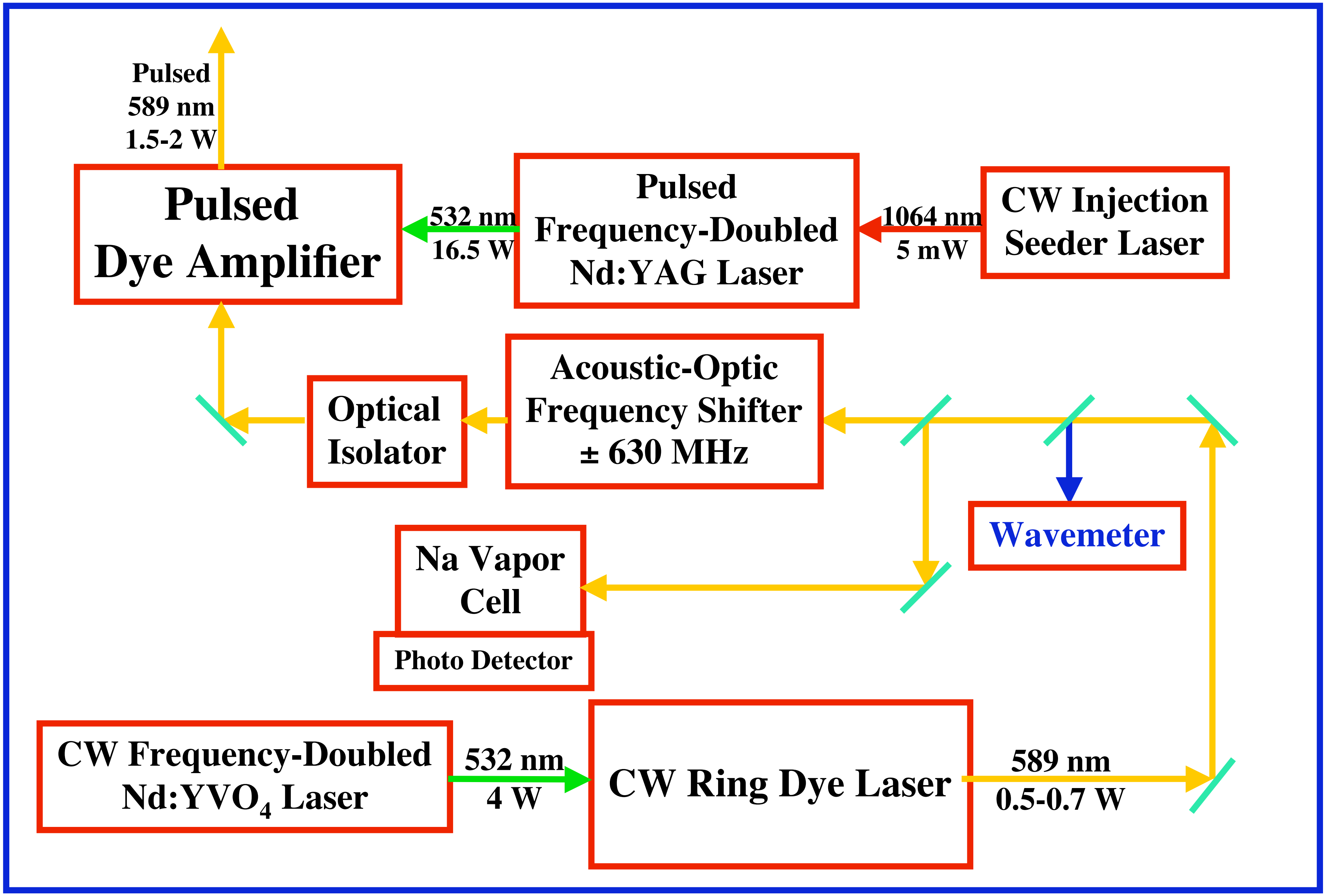
Dye-laser-based Na wind and temperature Lidar

Large-Aperture Na Doppler Lidar

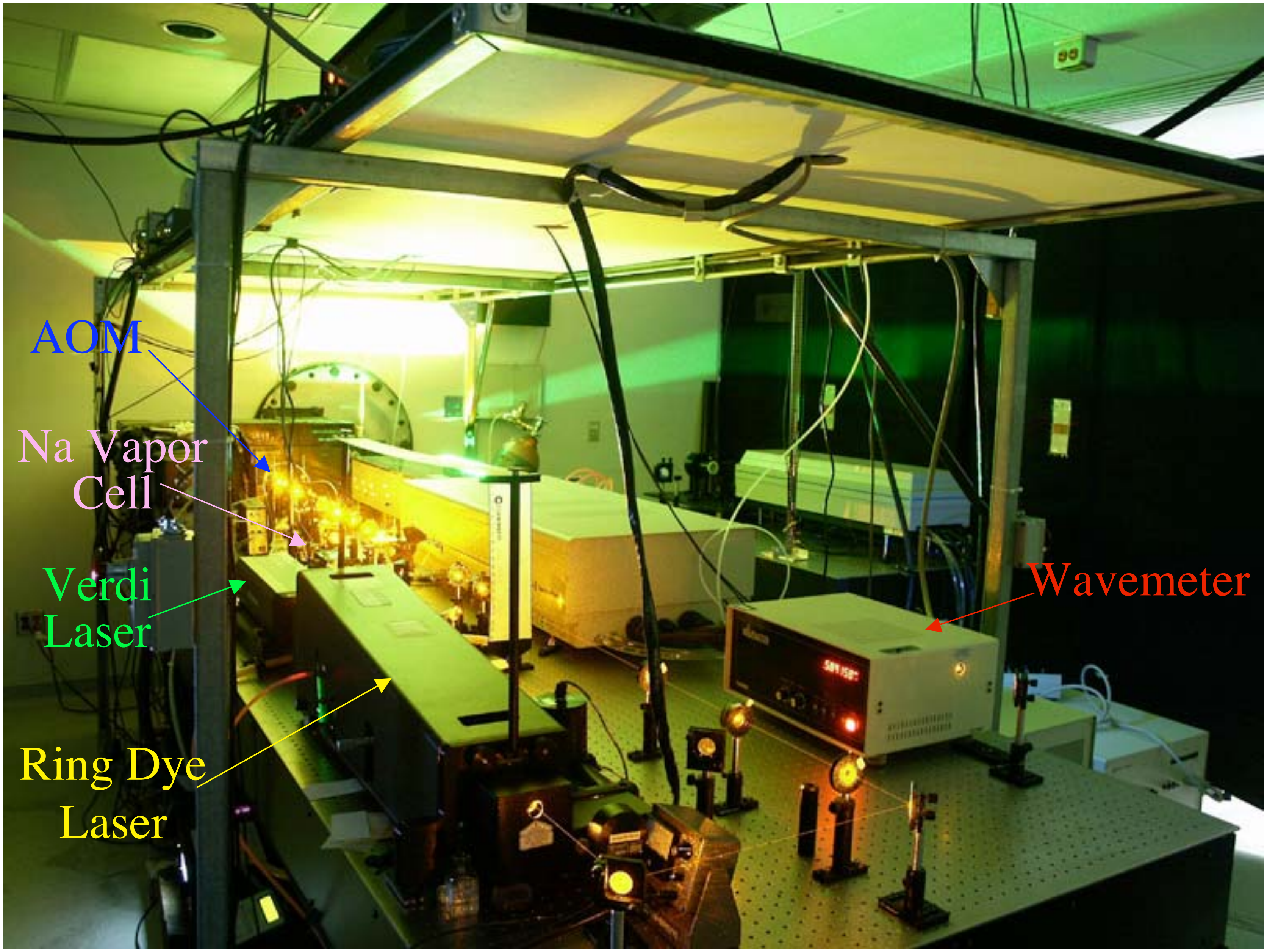
Na Wind and Temperature Lidar



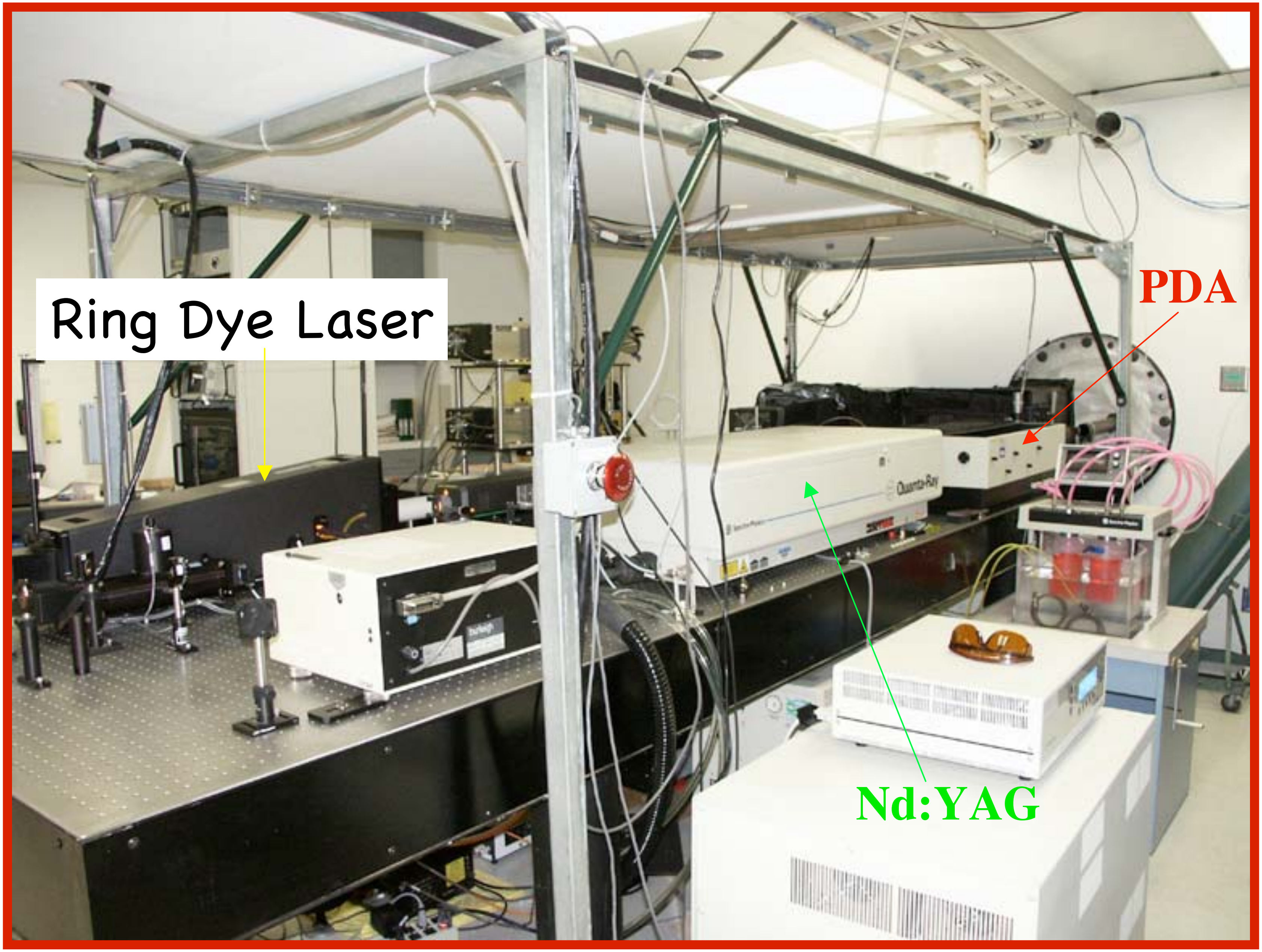
Na Doppler Lidar Transmitter



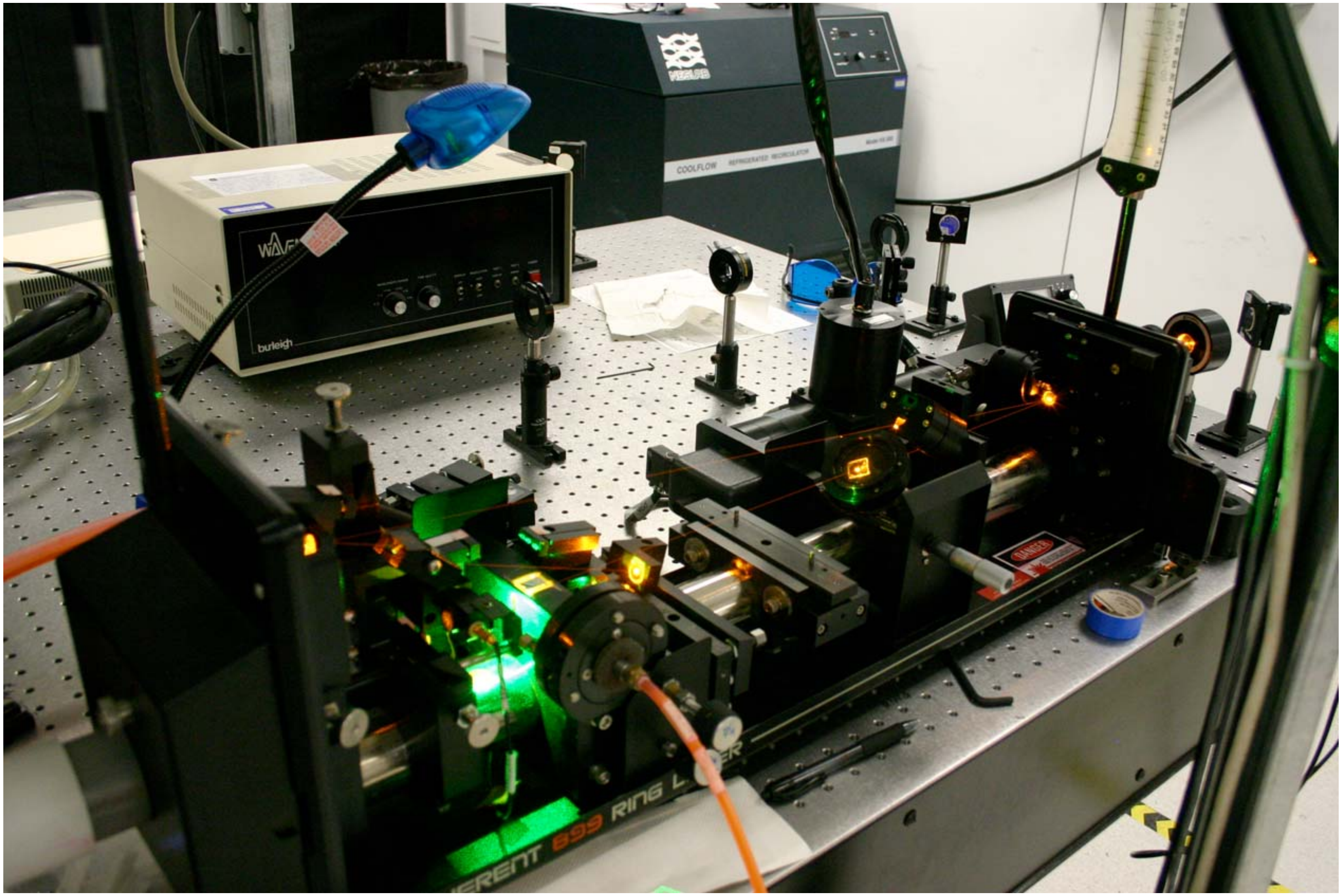
Na Lidar Transmitter



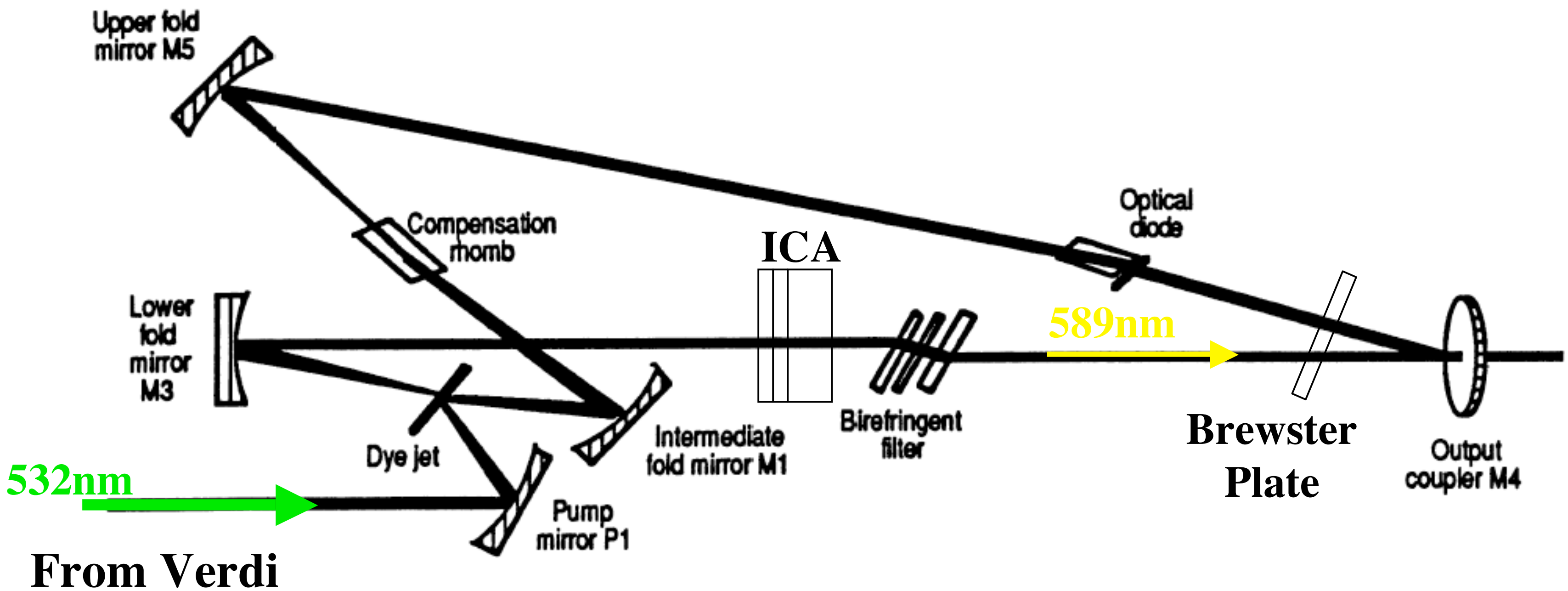
Na Lidar Transmitter



Ring Dye Laser

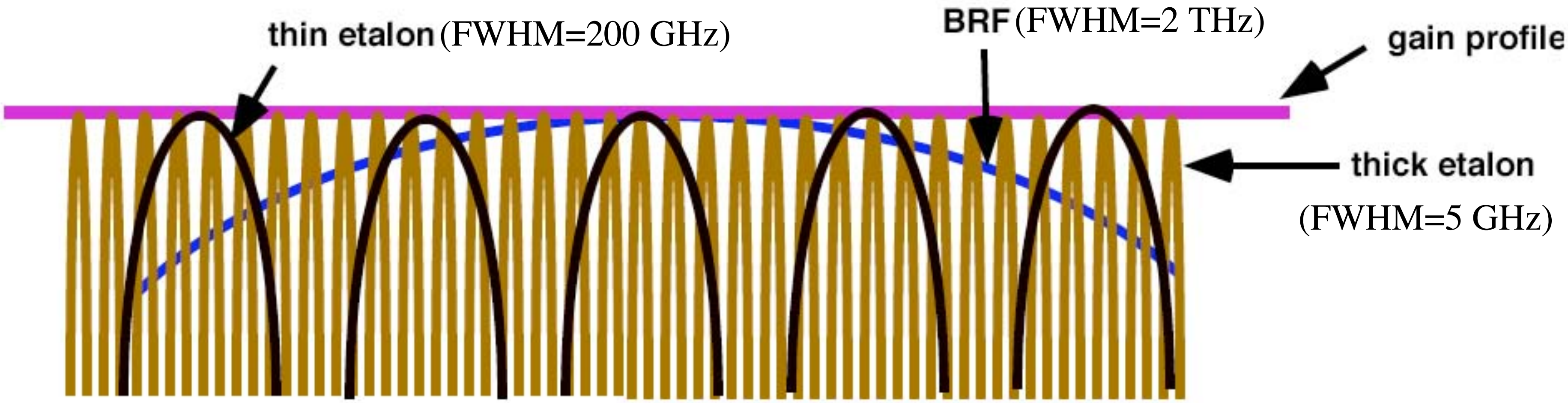


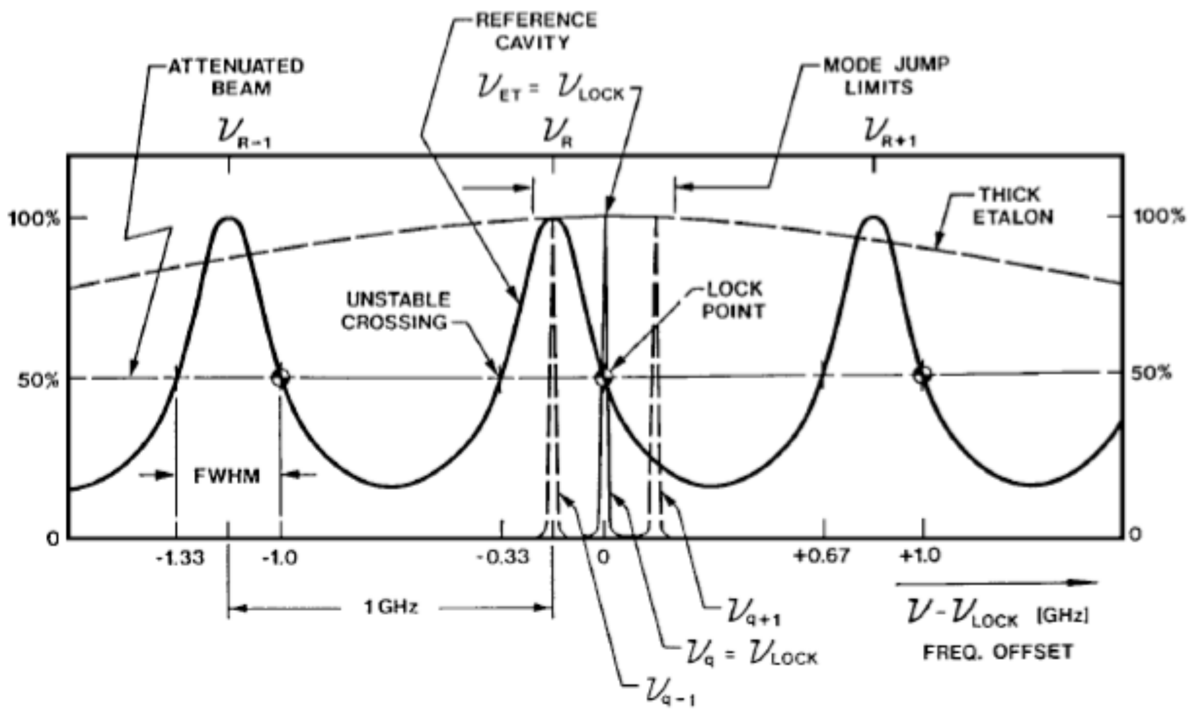
Ring Dye Laser



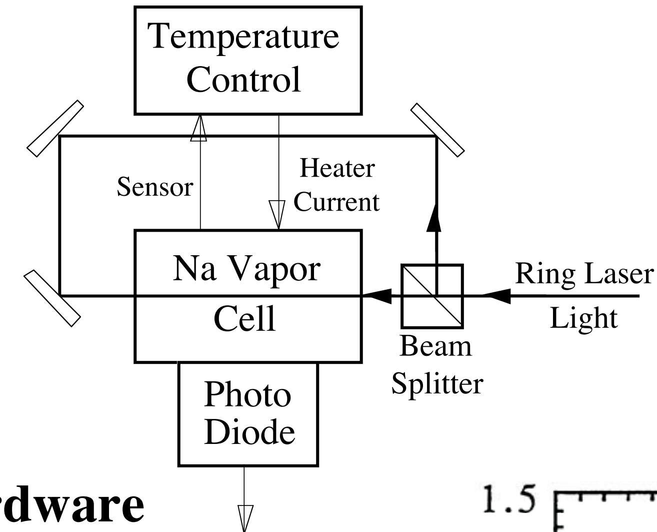
1. **"Four mirror + Dye jet" form the laser resonance cavity.**
2. **Unidirectional lasing prevents spatial hole-burning.**
3. **Rhomb compensates the astigmatism effect.**
4. **Optical diode forces the unidirectional lasing.**
5. **BRF + ICA (etalons) select frequency and narrow bandwidth.**
6. **"Brewster plate + RCA + M3 PZT" actively control frequency.**

Frequency Selection in Ring Laser

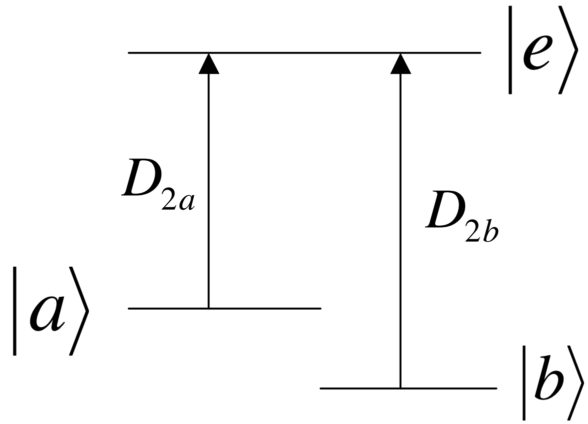


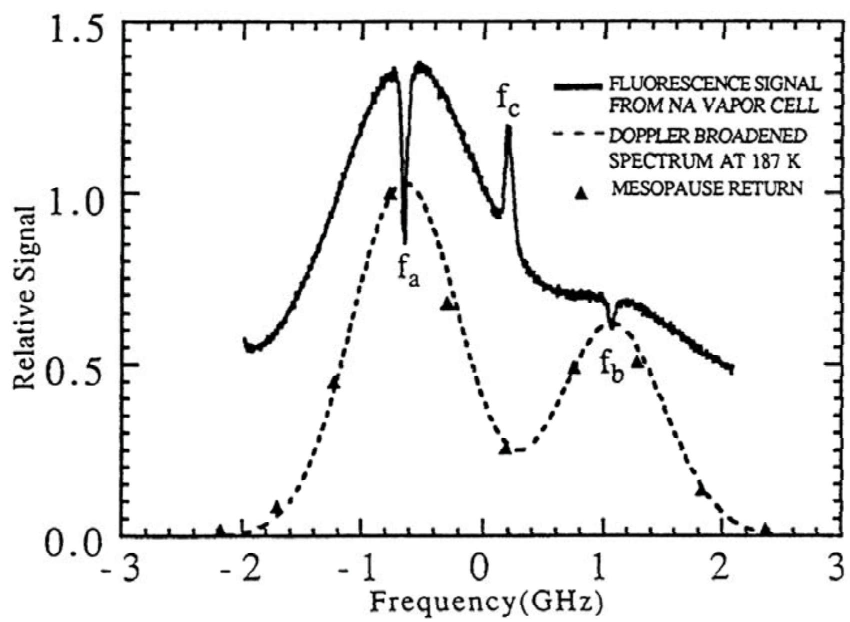


Na Doppler-Free Fluorescence Spectroscopy & Laser Freq Lock



Hardware





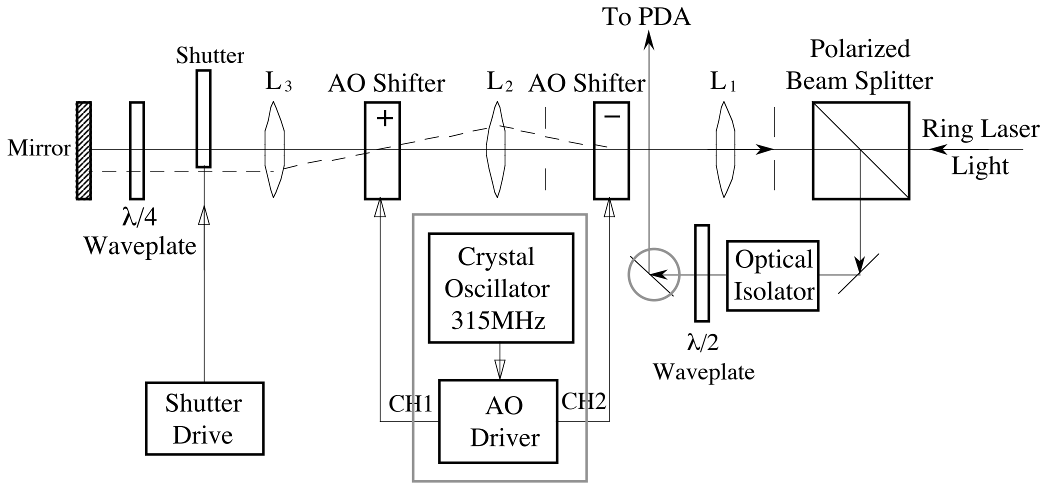
3-Level Explanation

Laser Frequency Scan and Lock

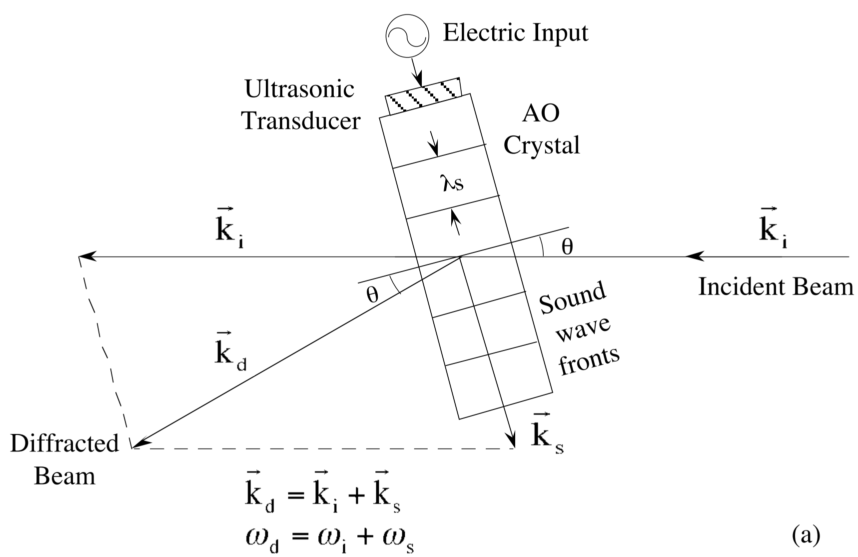
- Use computer to scan laser frequency and lock it to the D_{2a} dip of the Na saturation-absorption spectroscopy.

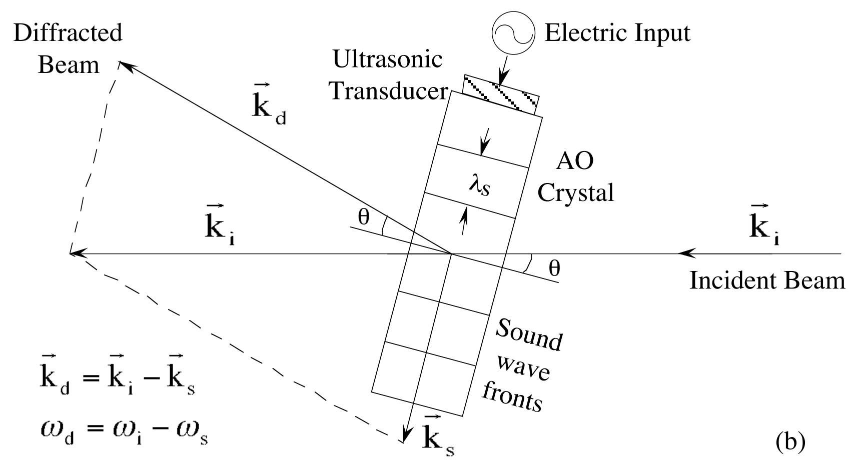
Acousto-Optical Modulator

Hardware

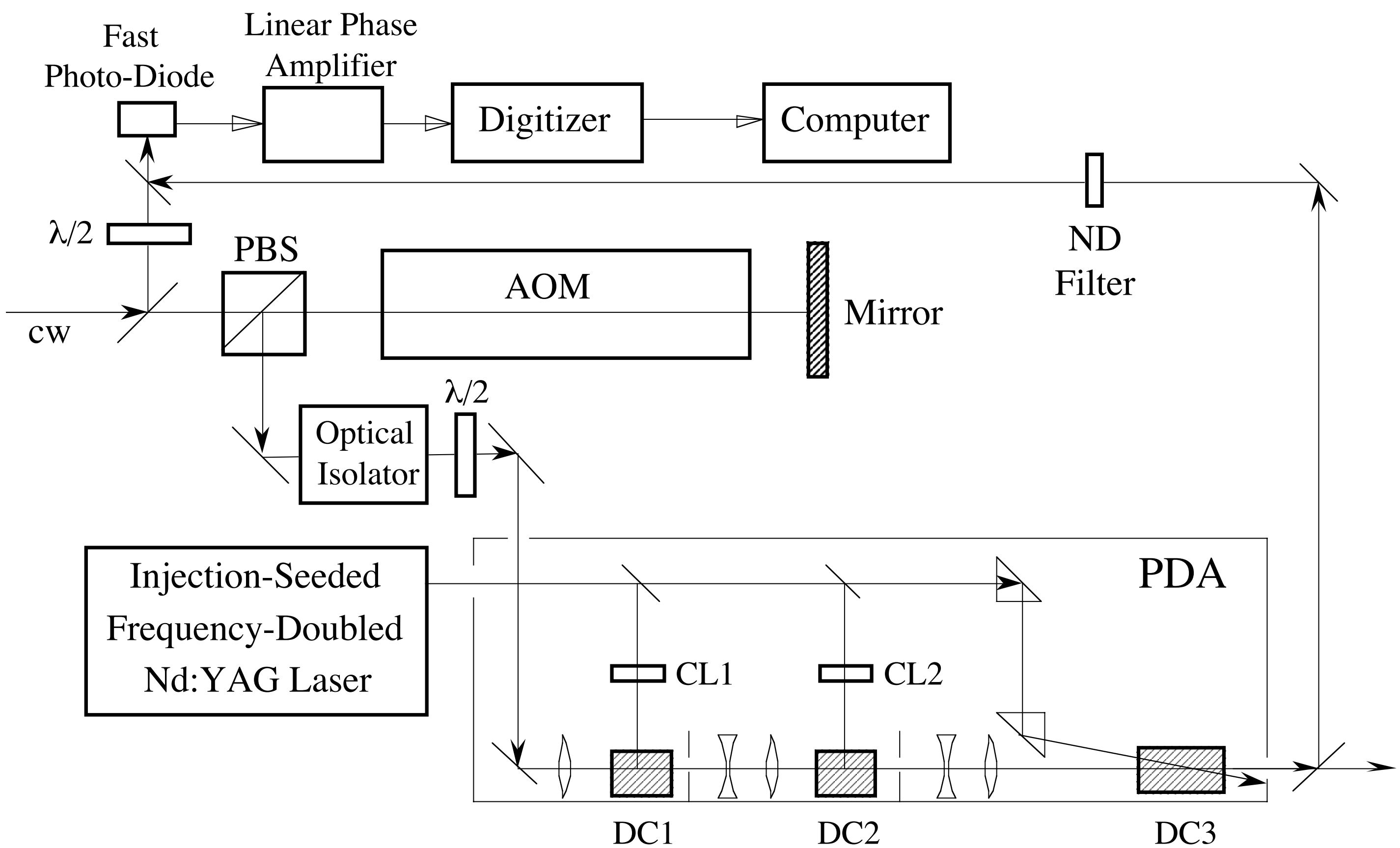


Explanation: Doppler shift or Photon/Phonon Annihilation



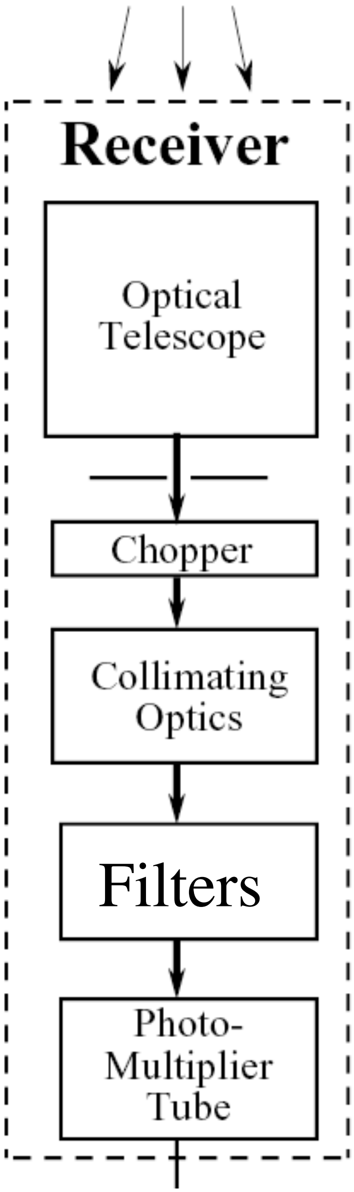


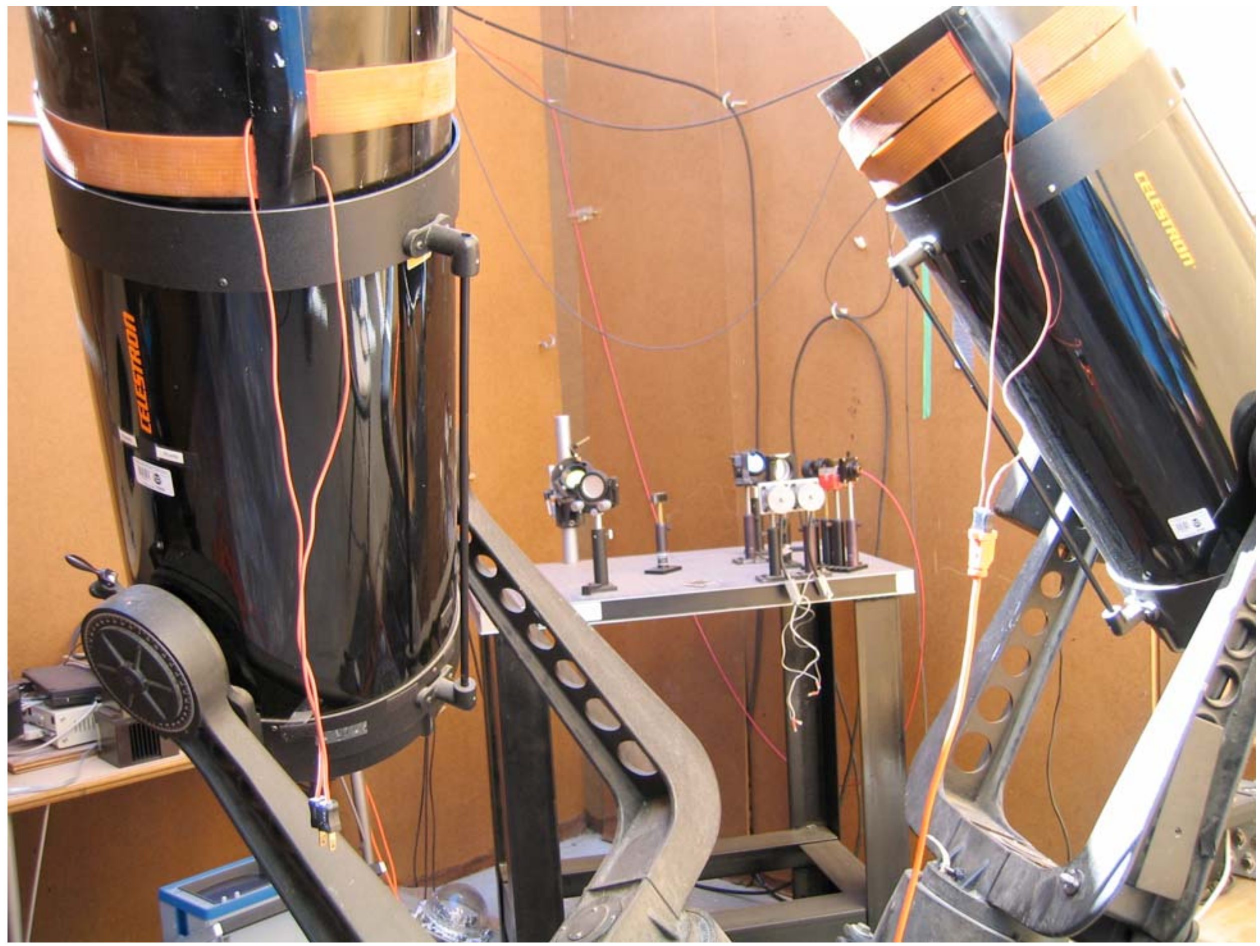
Pulsed Amplification



1. **Amplified Spontaneous Emission (ASE)**
2. **Injection-seeded Nd:YAG laser**
3. **PDA chirp caused by pulsed amplification**

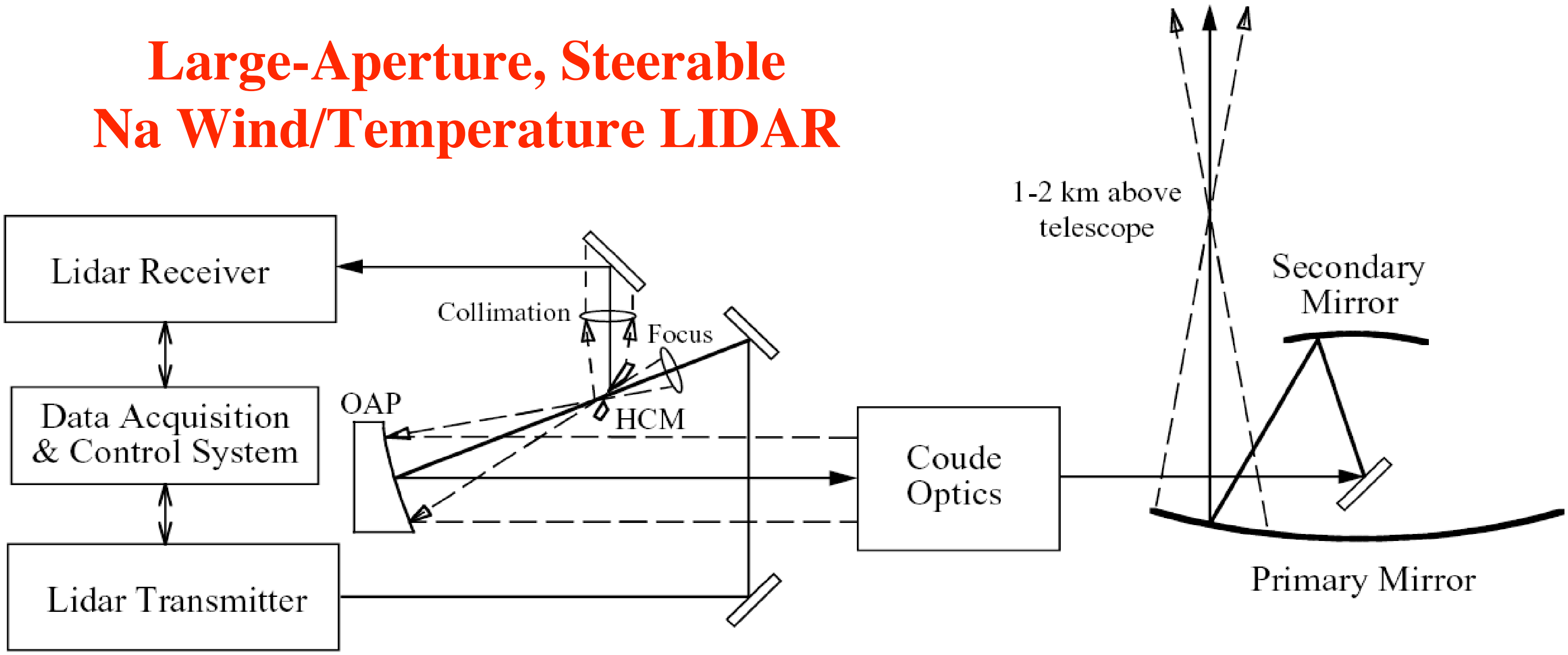
Na W/T Lidar Receiver





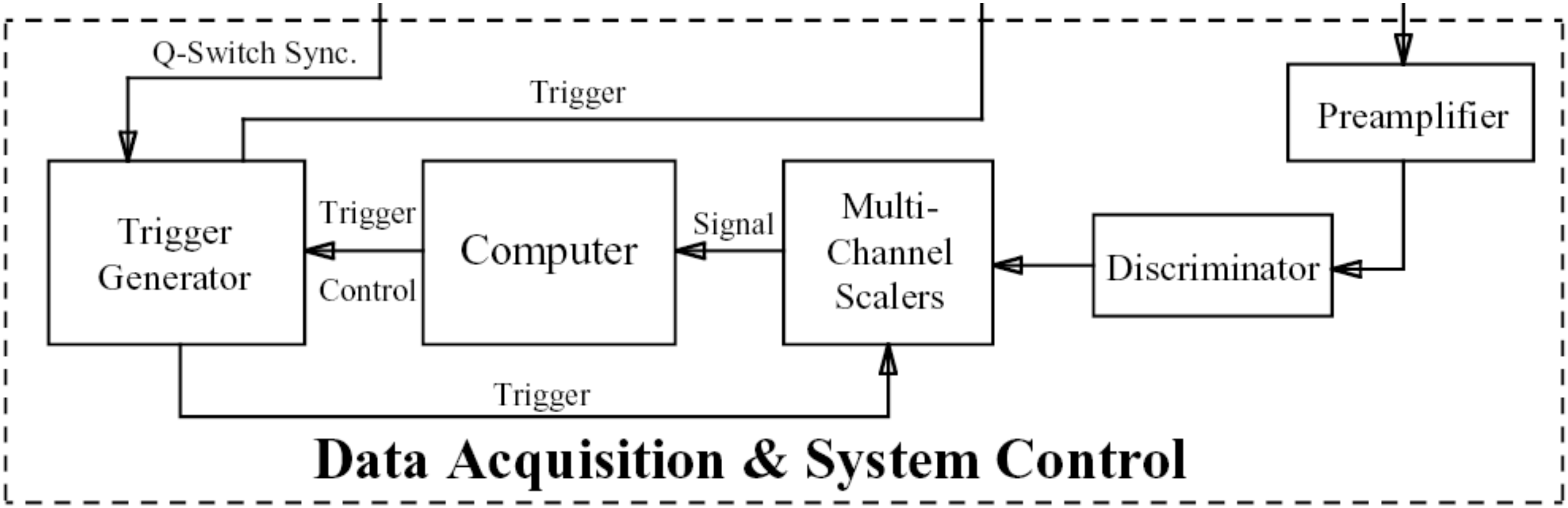
Steerable Na W/T Lidar at SOR and Maui

Large-Aperture, Steerable Na Wind/Temperature LIDAR

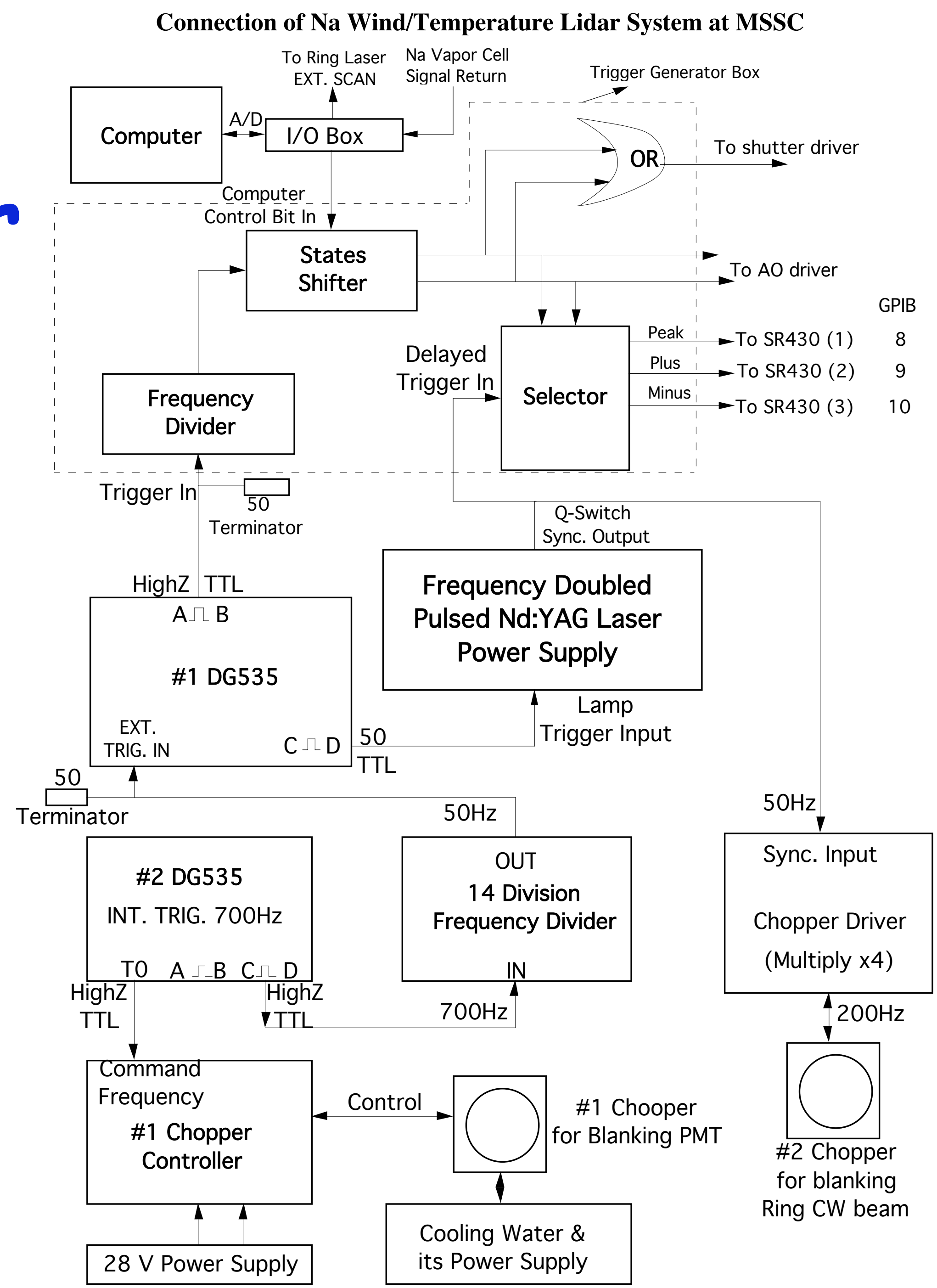


Data Acquisition and System Control

- Ring laser control
- Trigger timing control
- PMT + Discriminator
- Multichannel scaler



Na Doppler Lidar System Control



Summary

- Currently state-of-the-art Na Doppler lidar is the dye-laser-based Na wind and temperature lidar – "ring dye laser + pulsed dye amplifier" configuration.
- One main feature is the narrowband Na lidar transmitter with precise frequency control and narrow laser linewidth: Na Doppler-free fluorescence spectroscopy for frequency calibration and locking, acousto-optic frequency modulator for generating two wing frequencies with high stability and fast switching, pulsed amplification with very low ASE.
- The lidar receiver (broadband) and DAQ subsystems have various styles and forms. They are also progressing rapidly.
- Na Doppler lidar can be realized with other laser configurations, e.g., solid-state Nd:YAG laser frequency mixing, or alexandrite laser Raman shift, etc.