

Lecture 38. New Technologies For Lidar Applications

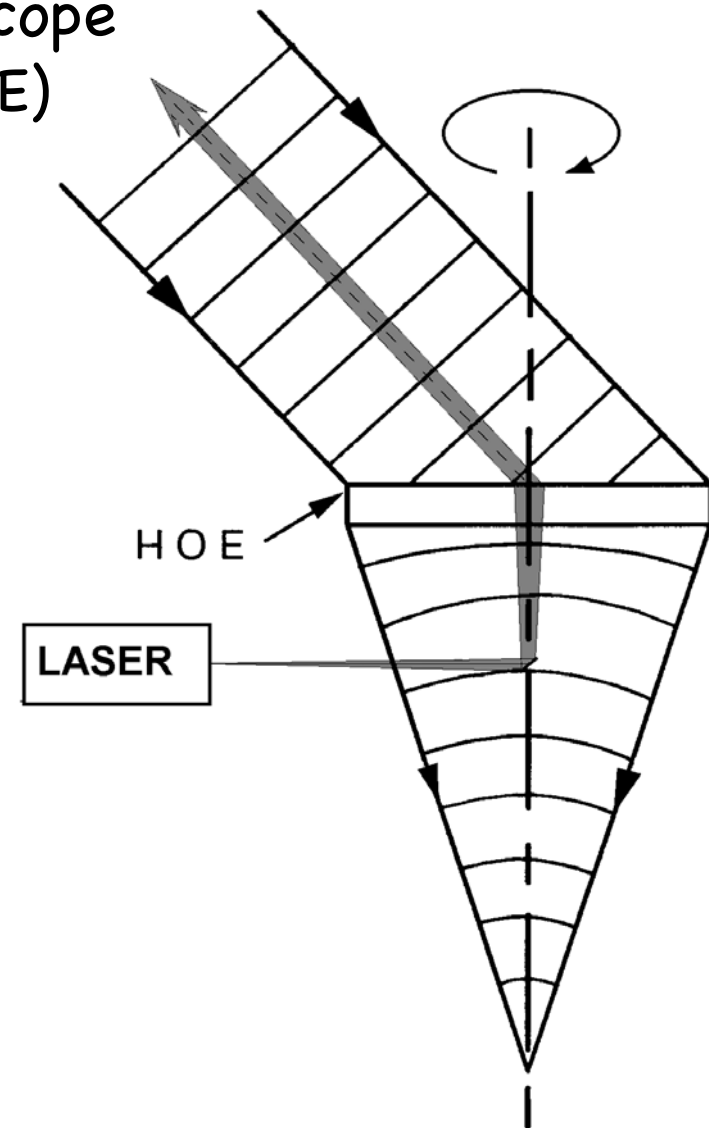
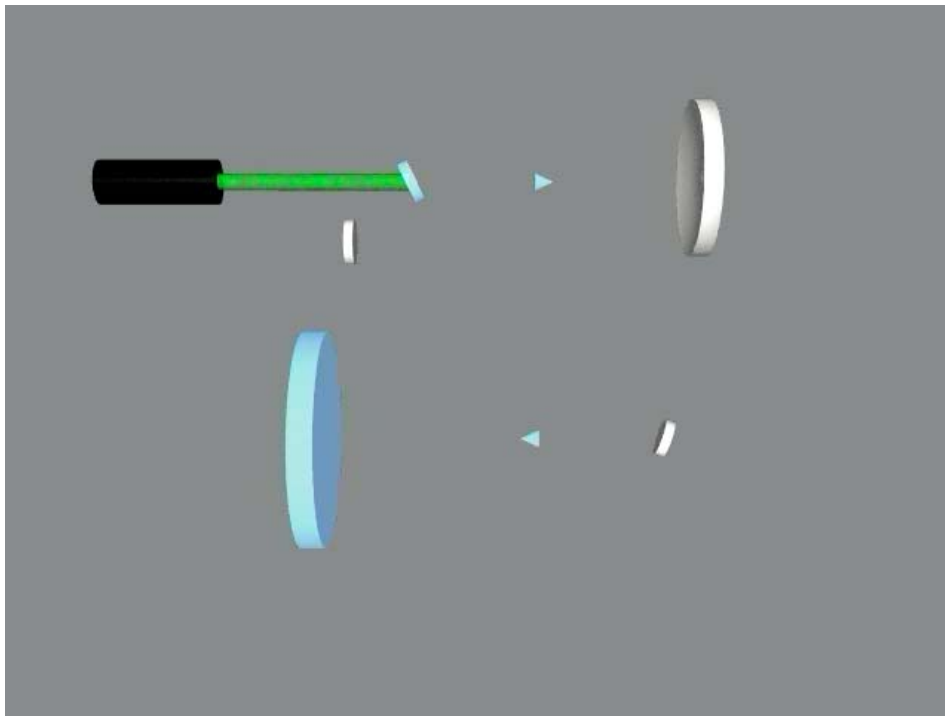
- ❑ Introduction
- ❑ Holographic Optical Elements (HOEs)
- ❑ Novel Doppler-Free Spectroscopy
- ❑ New Lasers
- ❑ New Diagnostic Instruments
- ❑ New Detectors and Receivers
- ❑ New Filters and Fibers
- ❑ Outlook

Introduction

- ❑ Lidar technology development is mainly driven by three factors:
 - (1) Measurement needs (science and application driven),
 - (2) New physical interaction and process findings, and
 - (3) New technologies development.
- ❑ Among these factors, new technology may be the most active factor as many new laser and optical detector technologies are becoming available. They are more powerful, stable, precise, and/or compact, enabling new lidars or lidar applications.
- ❑ Also with more powerful computers become available and cheaper, data acquisition (DAQ) and system control are in the revolution to replace traditional instruments with computer cards.
- ❑ It is necessary to keep an eye on the new technologies, and always look forward to the next level development and improvement.

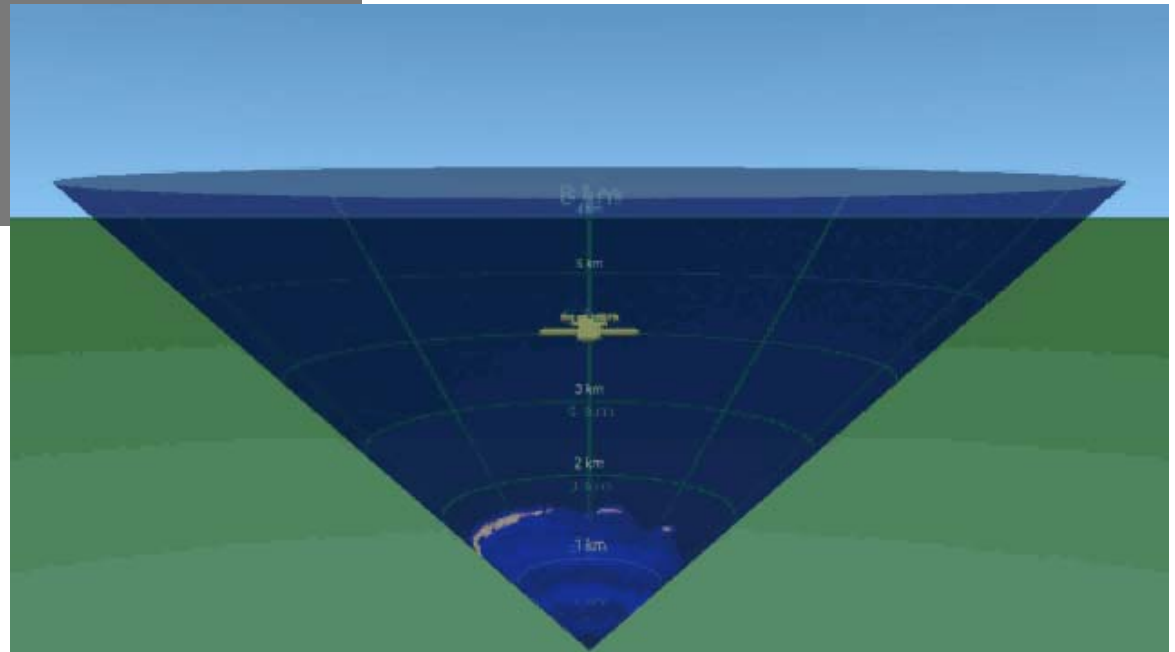
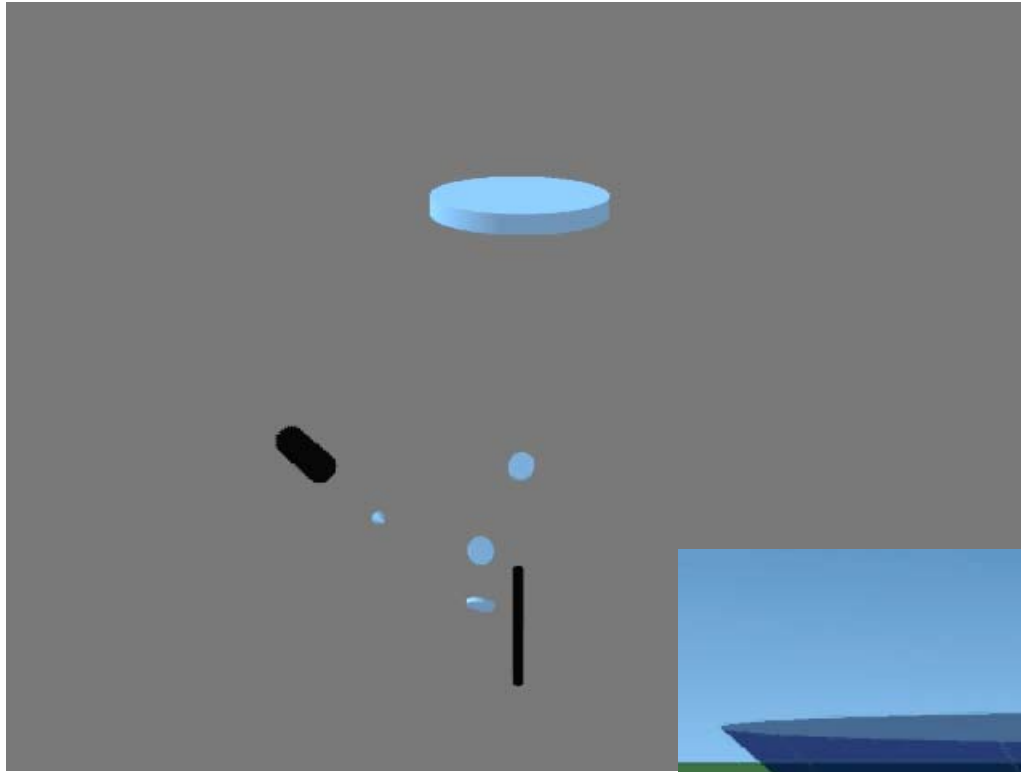
Holographic Optical Elements (HOE)

Holographic Conical Scanning Telescope
Holographic Optical Element (HOE)



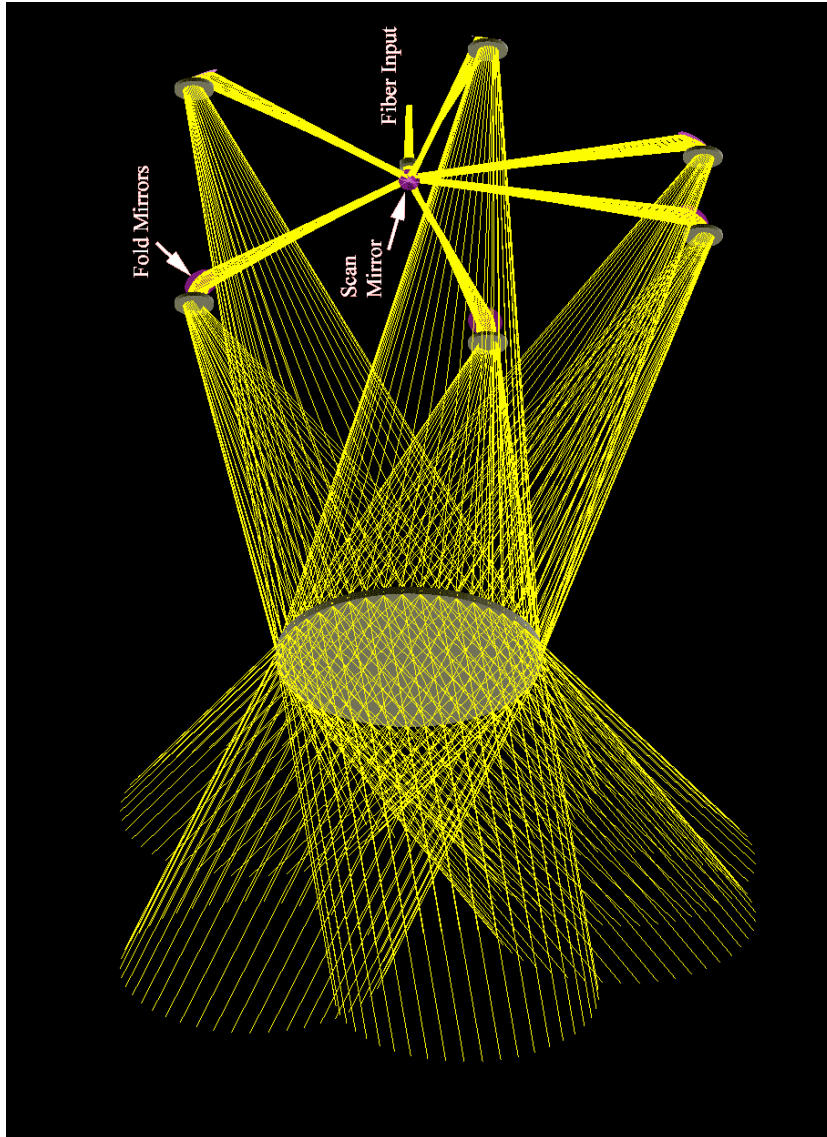
Courtesy of Geary Schwemmer

Lidar with HOE



Courtesy of
Geary Schwemmer

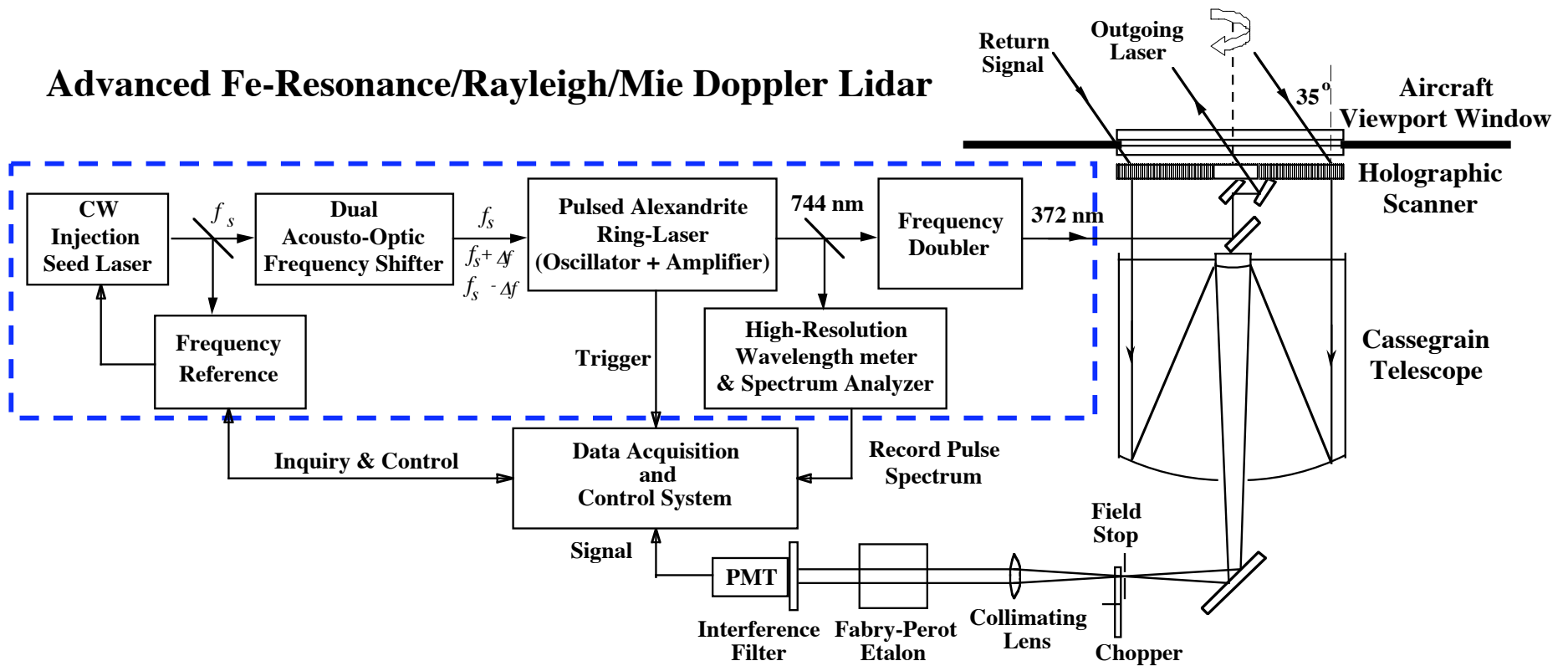
Angle multiplexed HOEs



Courtesy of
Geary Schwemmer

Application of HOE in Airborne Fe Doppler Lidar

Advanced Fe-Resonance/Rayleigh/Mie Doppler Lidar



High-performance Instrumented Airborne Platform for Environmental Research (HIAPER)

HIAPER

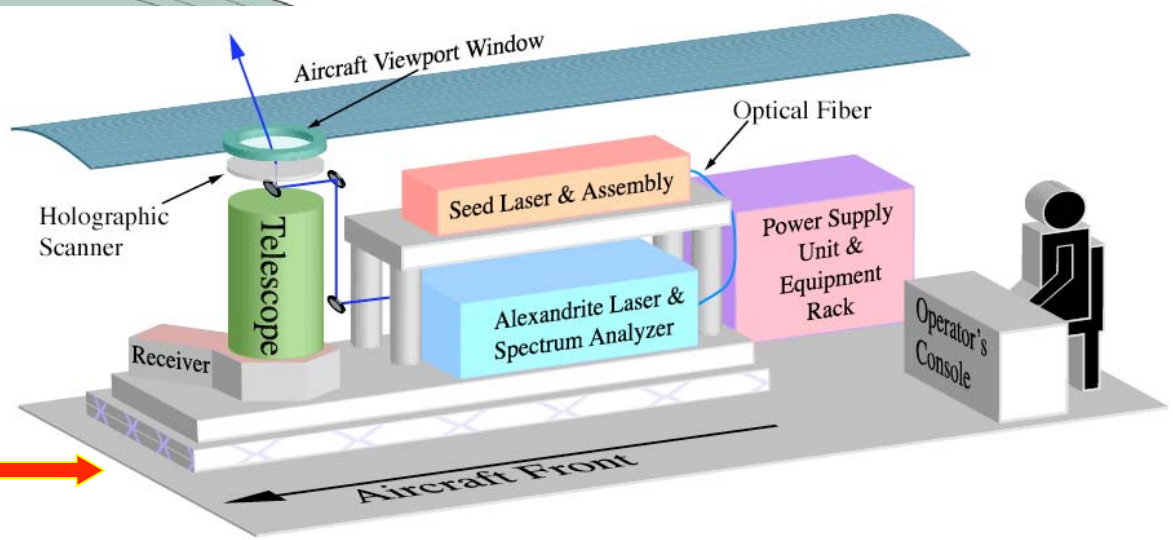
HIGH-PERFORMANCE INSTRUMENTED AIRBORNE PLATFORM FOR ENVIRONMENTAL RESEARCH



GULFSTREAM V®



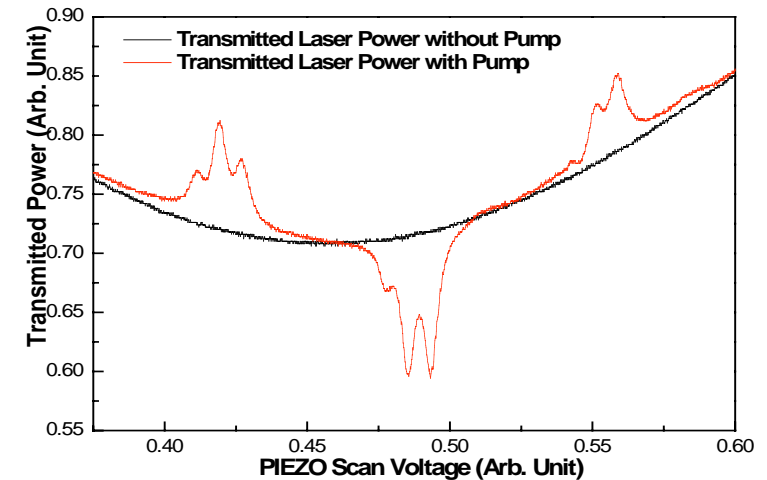
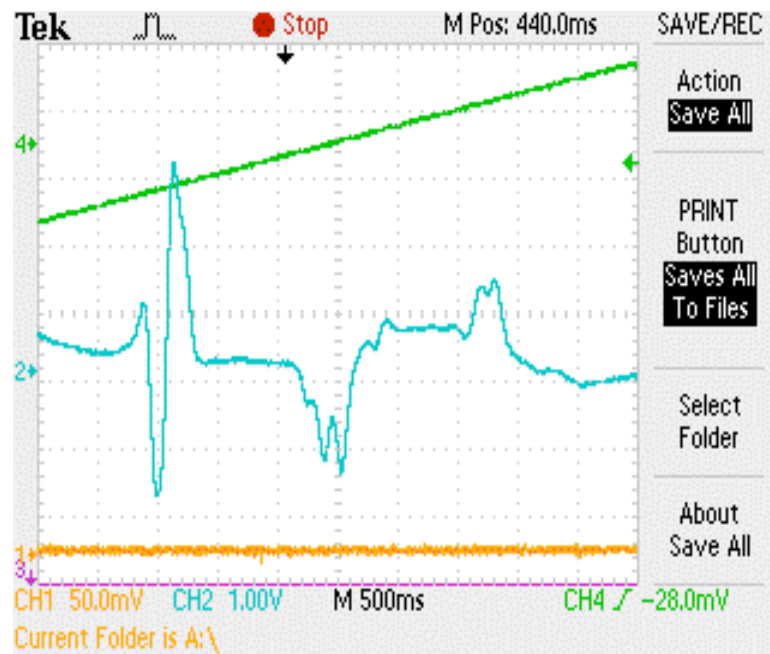
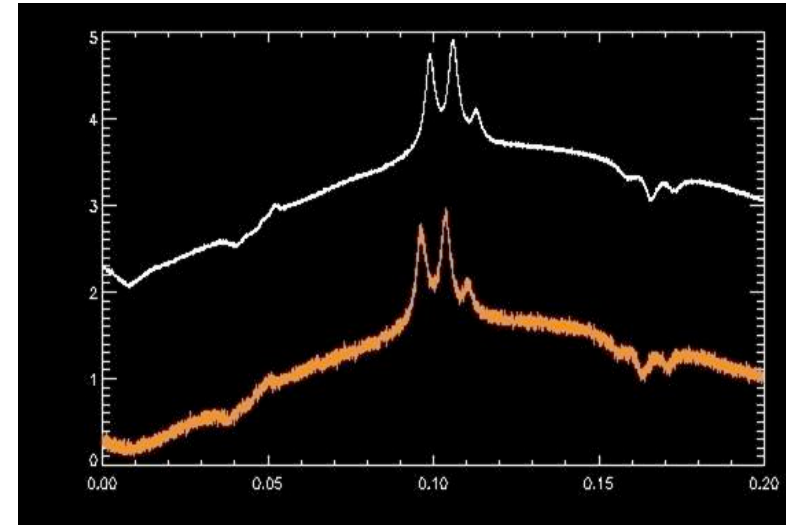
Phase I
Phase II
Options



Proposed Doppler Lidar →

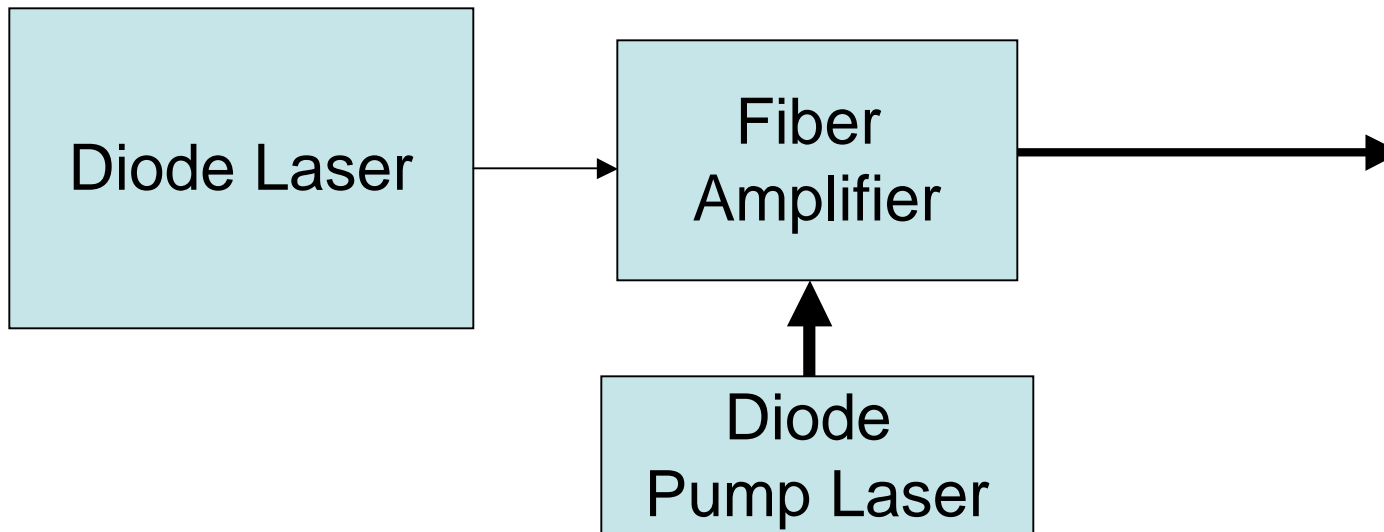
Novel Doppler-Free Spectroscopy

- Saturation-fluorescence spectroscopy
- Saturation-absorption spectroscopy
- Polarization spectroscopy
- Zeeman



New Lasers for Lidar

- ❑ Alexandrite ring laser, Nd:YAG family lasers
- ❑ Femto-second lasers
- ❑ Diode lasers
- ❑ Fiber lasers
- ❑



New Diagnostic Instruments

- ❑ Wavelength Meter for cw and pulse lasers
- ❑ Spectrum Analyzer for cw and pulse lasers
- ❑ Laser Beam Profiler
- ❑ Energy/Power Meters

- ❑ with new accuracy, precision, resolution, speed, etc.

New Detectors, Filters, Receivers, and Fibers

- Photo multiplier tube (PMT)
- Avalanch photo diode (APD)
- CCD

- Large optical mirrors
- Computer cards for DAQ and data processing

- Etalons
- Atomic and molecular filters

- Numerous new fibers

Outlook for Lidar

- ❑ Lidar remote sensing is an advanced technology that is not only replacing conventional sensors in science study, environmental research, and industry application, but also creating new methods with unique properties that could not be achieved before.
- ❑ Lidar technology has been advanced dramatically in the past 20 years, owing to the new availability of lasers, detectors, creative people involved, and the demanding needs from various aspects.
- ❑ Potential growing points at this stage include
 - (1) Solid-state resonance fluorescence lidar for mobile deployment globally
 - (2) Extend measurement range into thermosphere and lower mesosphere
 - (3) Doppler, DIAL, HSRL, and Raman lidar for lower atmosphere research
 - (4) Target lidar for novel applications
- ❑ Always keep eyes open for new potentials: principles, phenomena, effects, and technologies to be applied in lidar remote sensing.