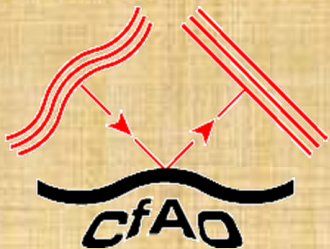


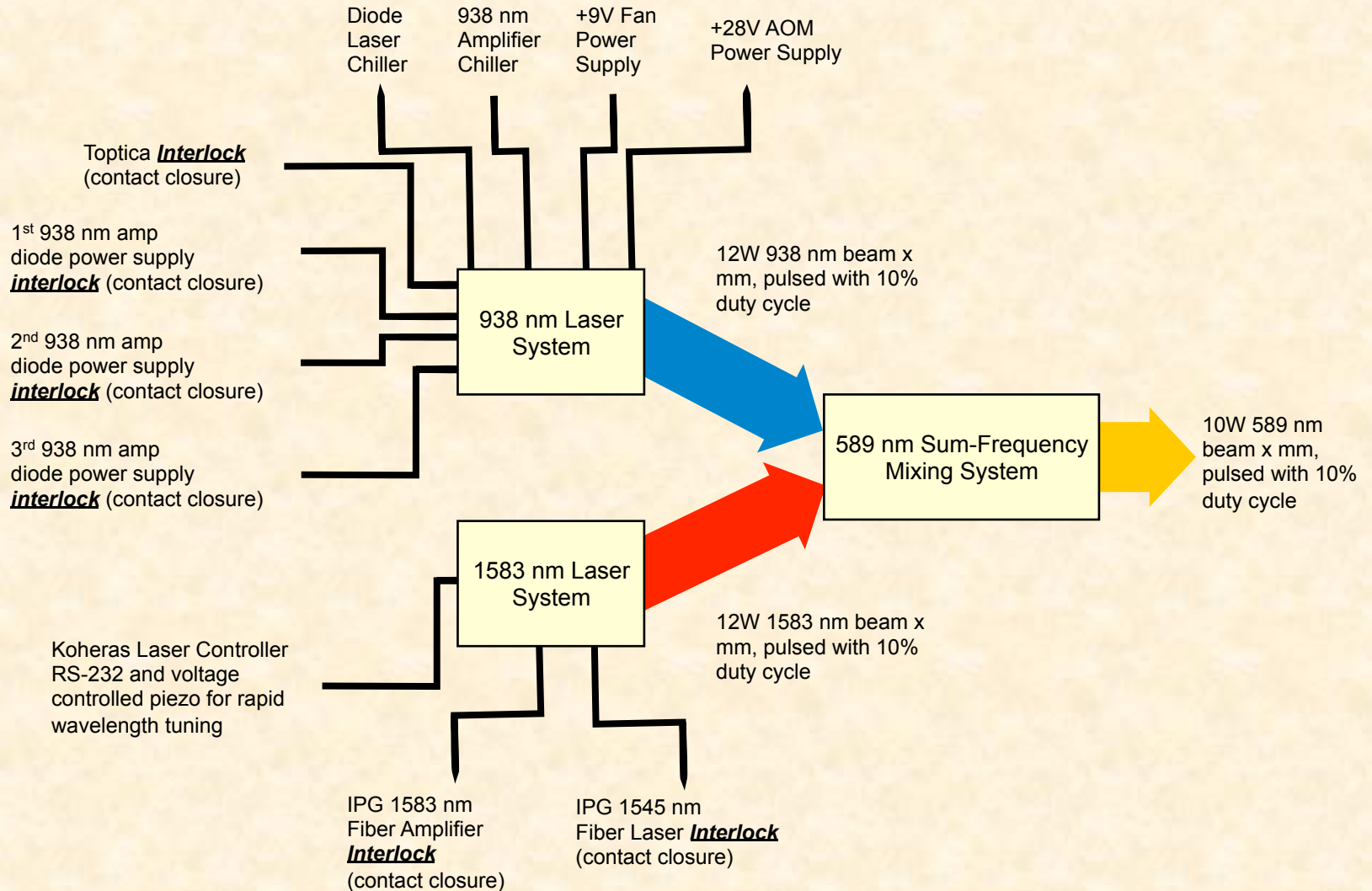
LAO Laser Guide Star - Fiber Laser Systems

Review & Discussion

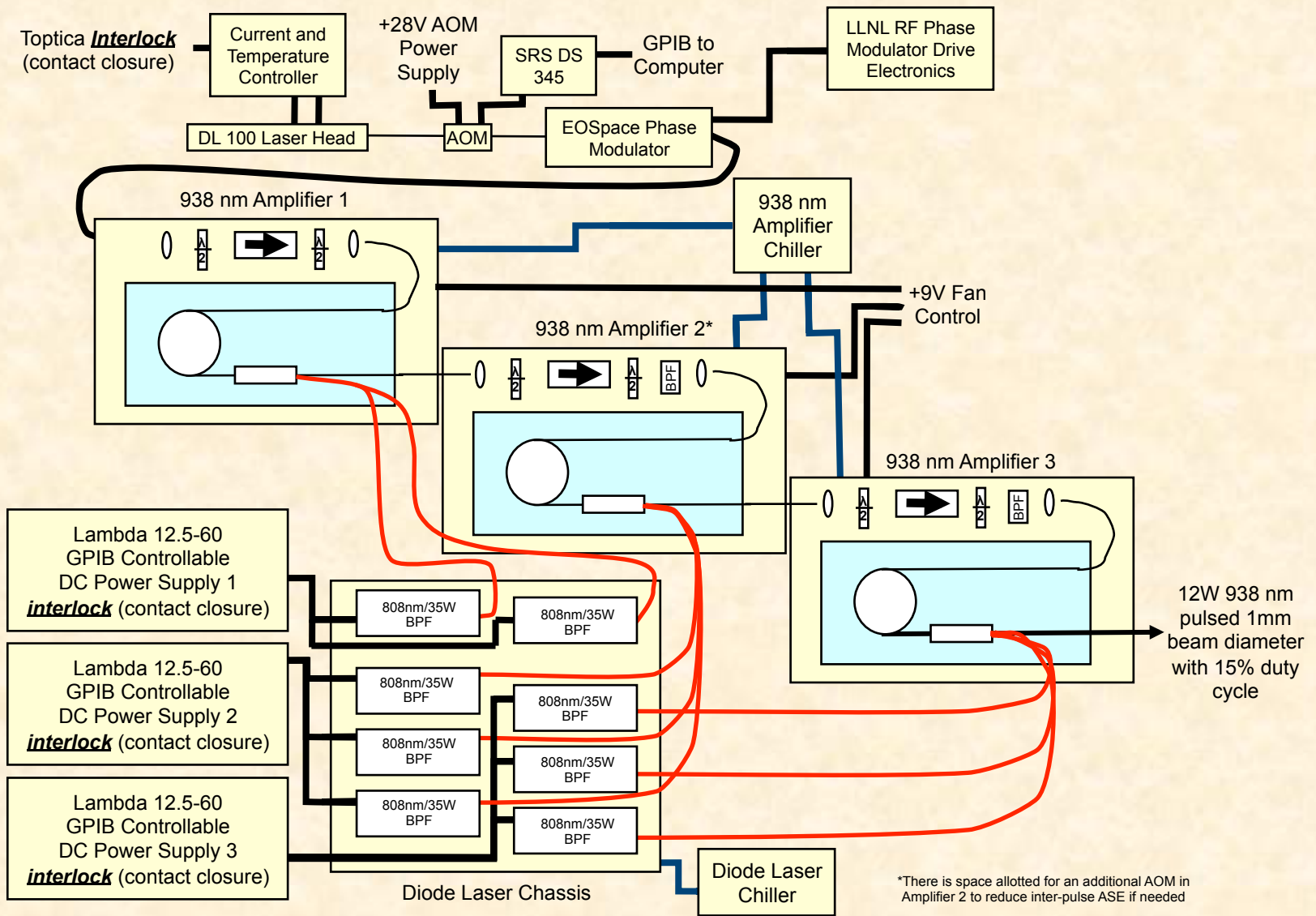
- Outline for today:
 - Review status of LLNL (Dawson) 938nm + 1583nm fiber laser
 - Current Status
 - Consider new fiber laser design using:
 - 1908nm Thulium Fiber Laser
 - 1540nm C-Band Fiber Laser



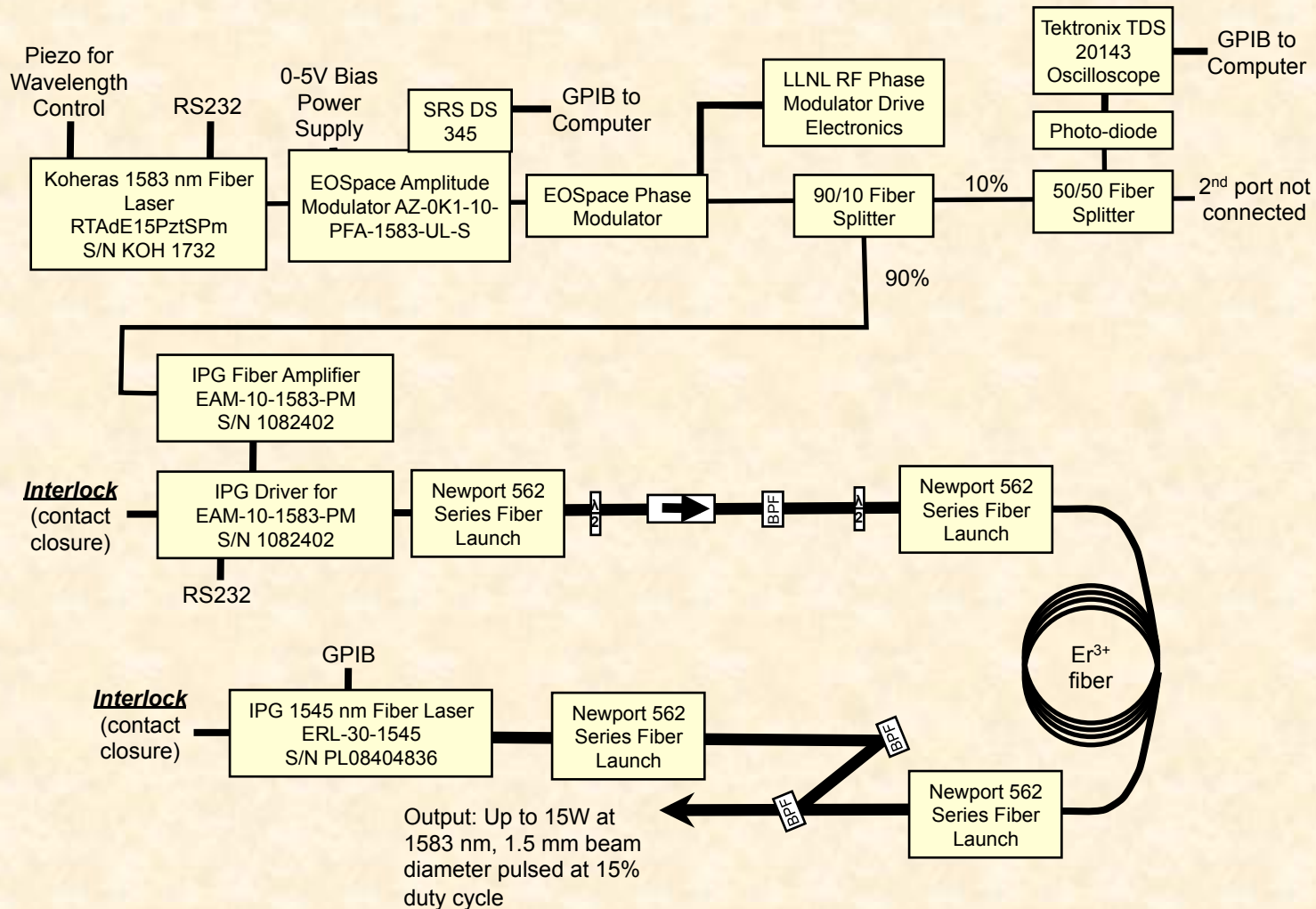
LLNL (Dawson) 589 Fiber Laser



LLNL (Dawson) 938nm Fiber Laser system



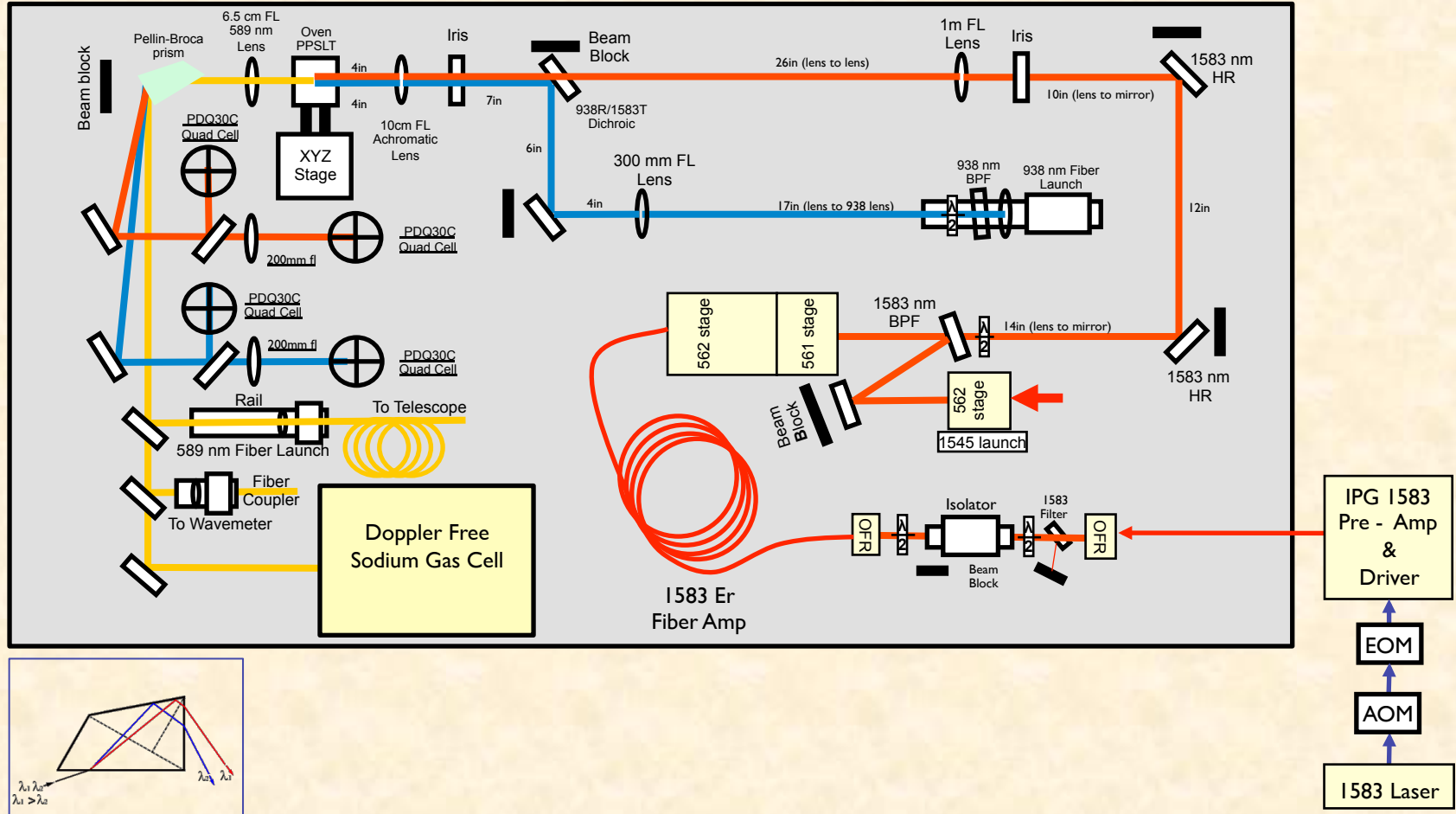
LLNL (Dawson) 1583nm Fiber Laser system



*There is space allotted for an AOM between the two main amplifiers to reduce inter-pulse ASE if needed

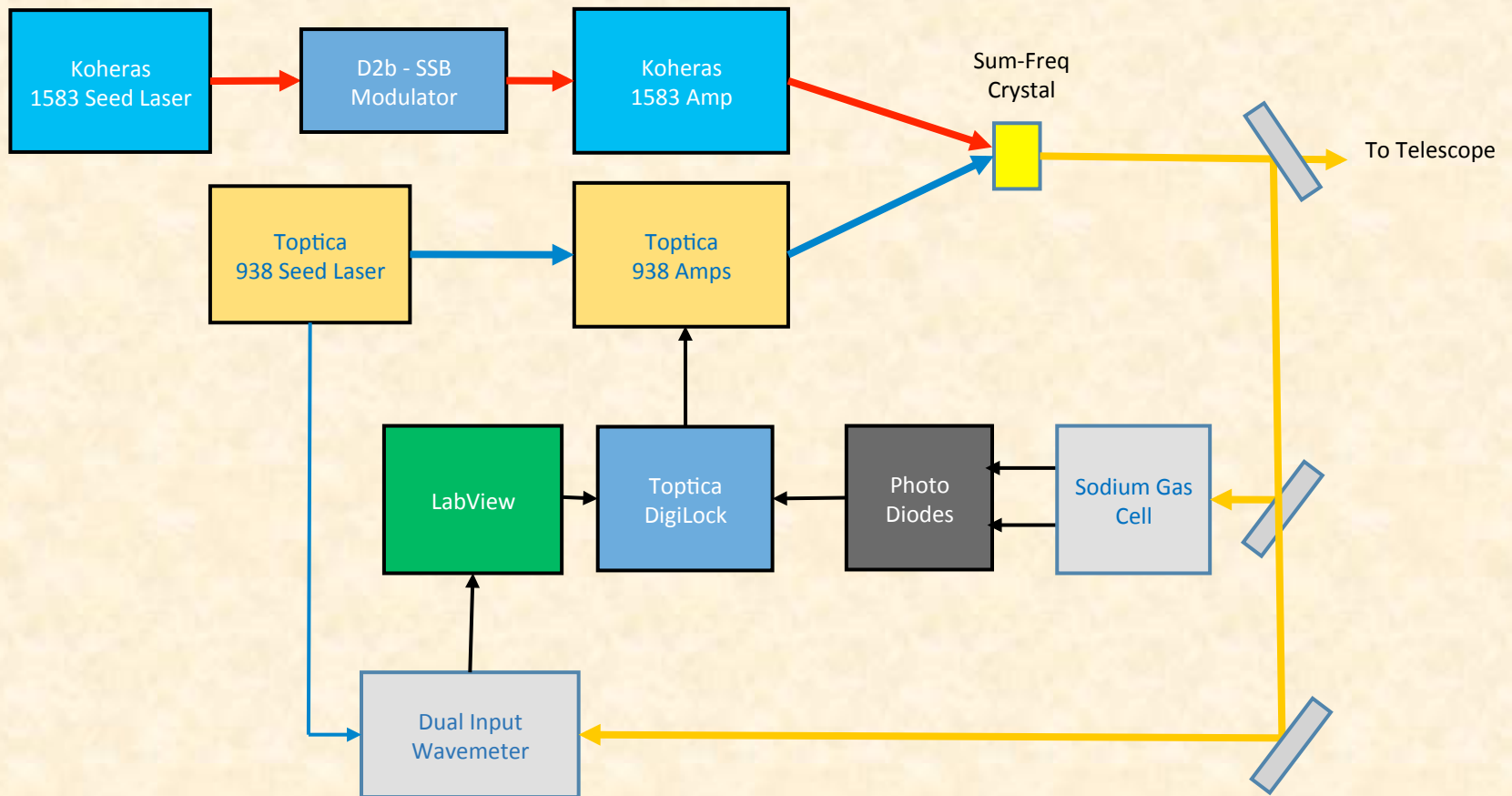
The 938nm + 1583nm IR lines are combined to make 589nm Sum-Frequency Layout

2.5ft x 5ft Sum-Freq Optical Table

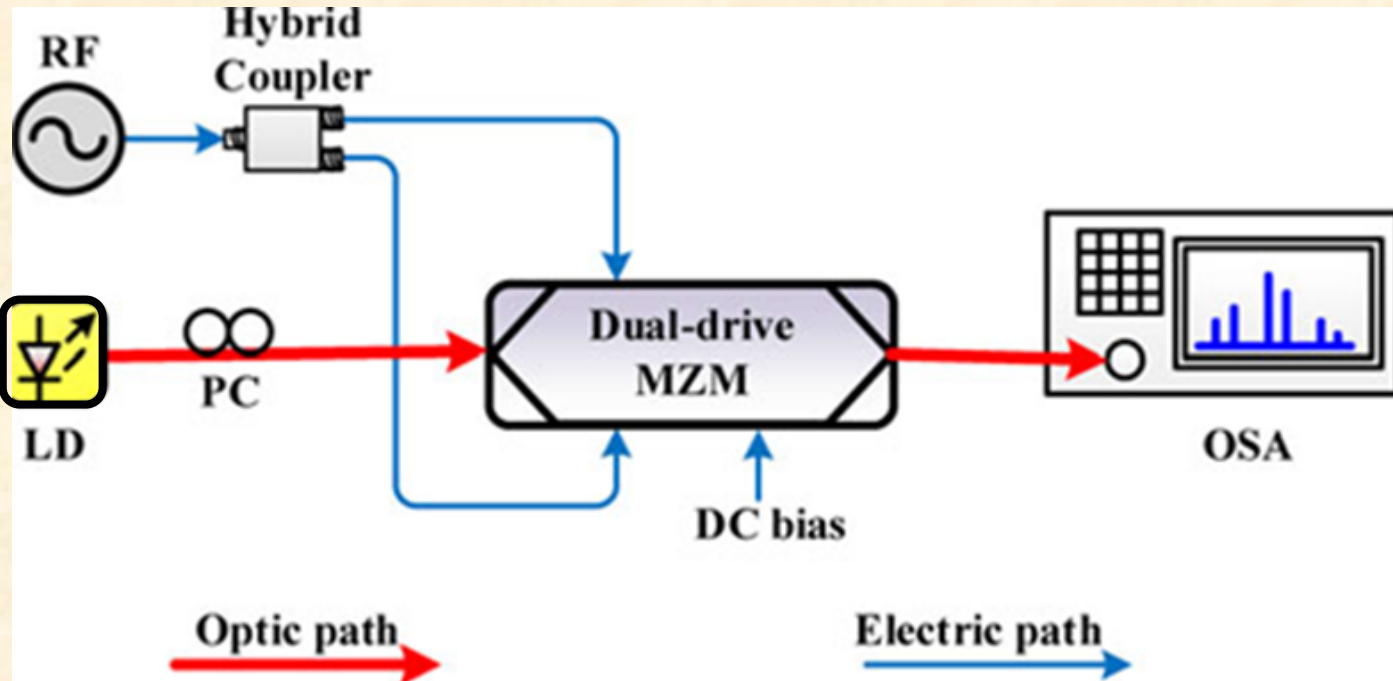
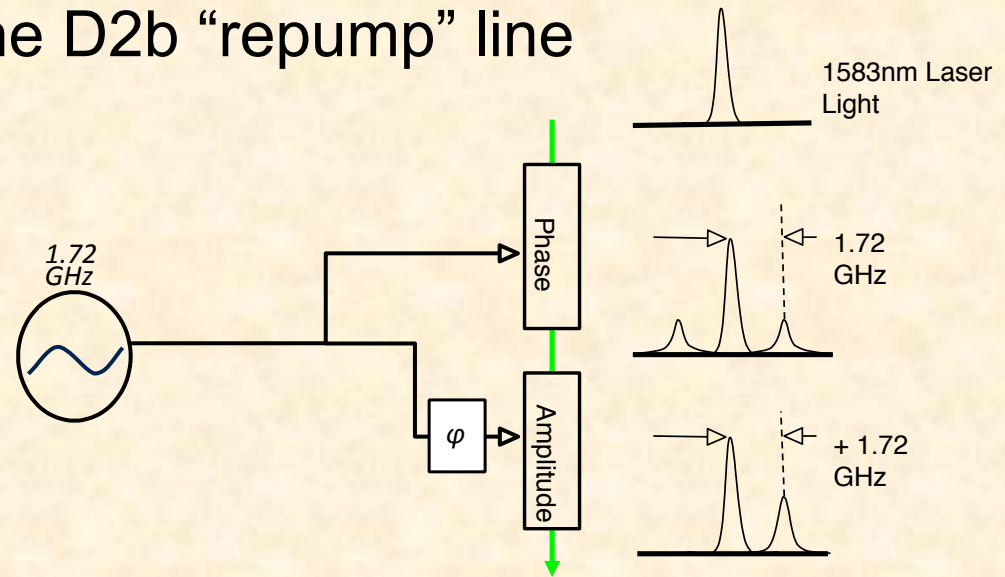


Wavelength Locking to Wavemeter and Sodium Gas Cell

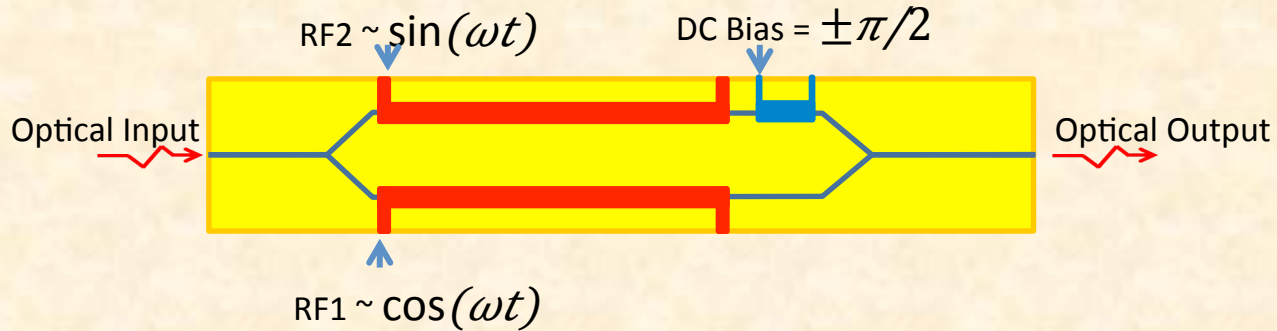
- Wavemeter is a 600MHz version with two wavelength monitor
- DigiLock controls Toptica 938 fine wavelength via sodium cell
- Wavemeter controls Toptica 938 course wavelength



How we are going to create the D2b “repump” line

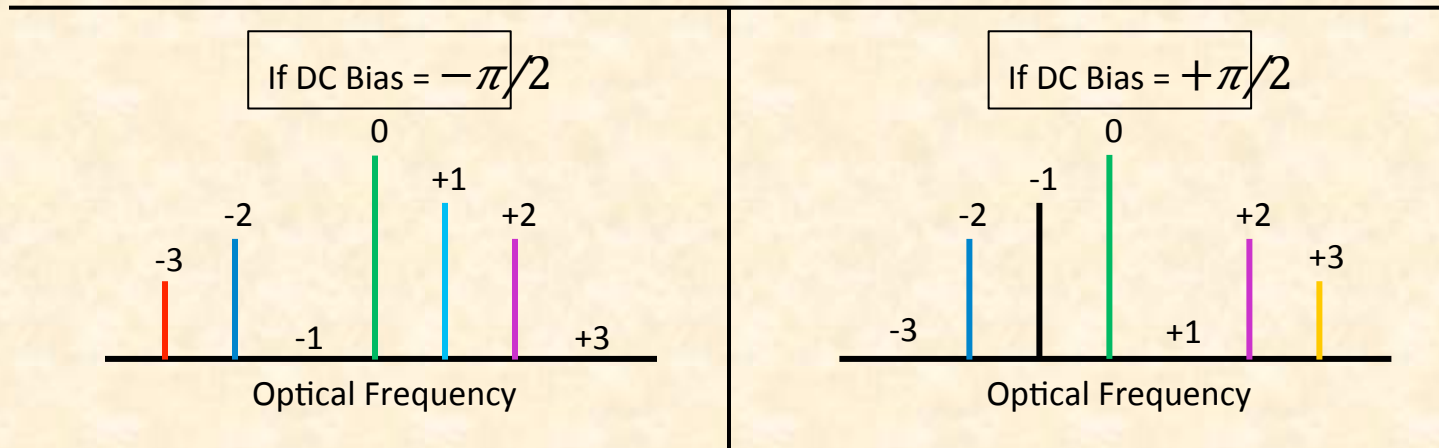


Details on the D2b – Single Sideband Modulator

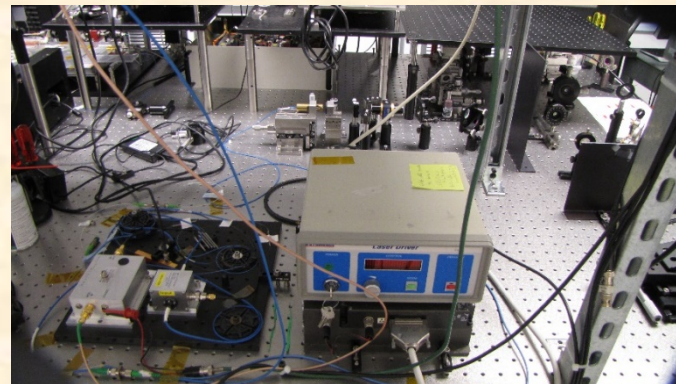
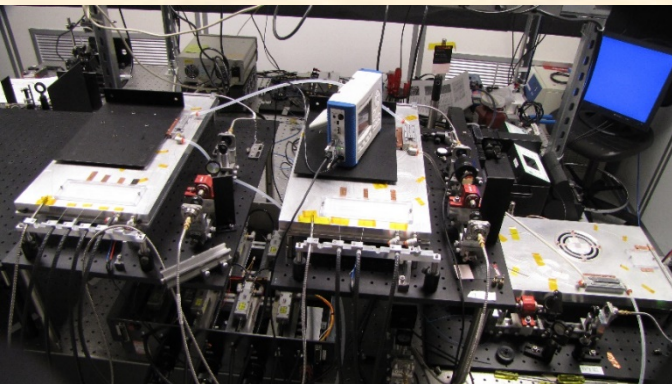
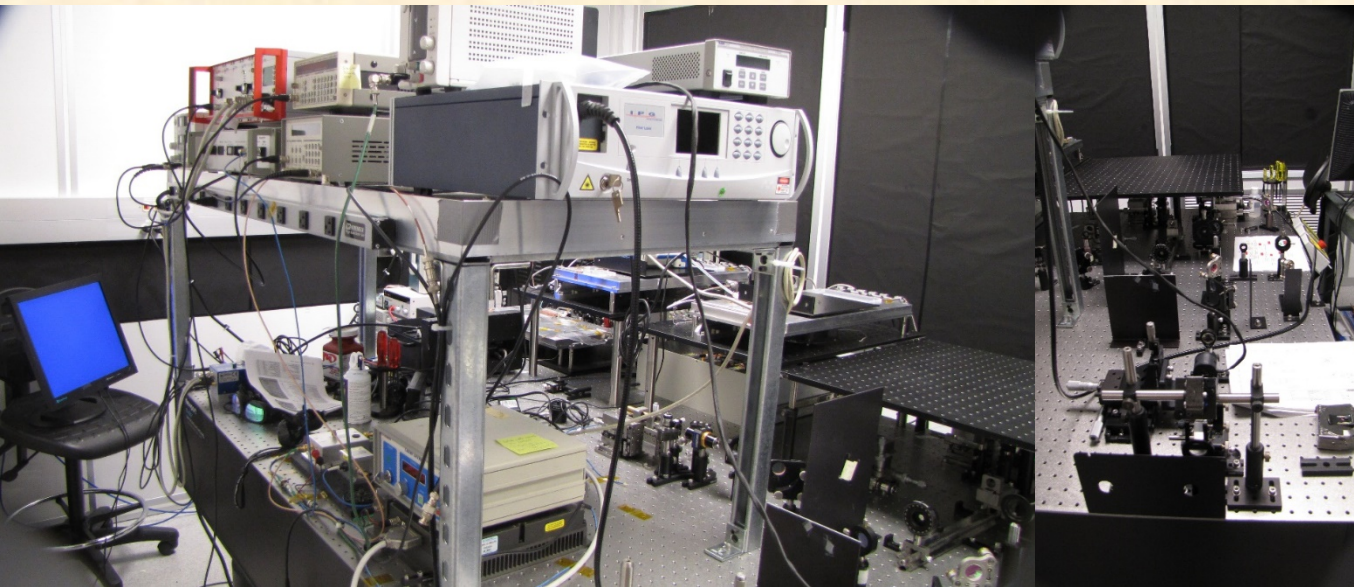


Basic Operation: A SSB Modulator can be achieved using a dual drive MZM in which RF1 and RF2 are 90 degrees out of phase and the modulator is biased at quadrature.

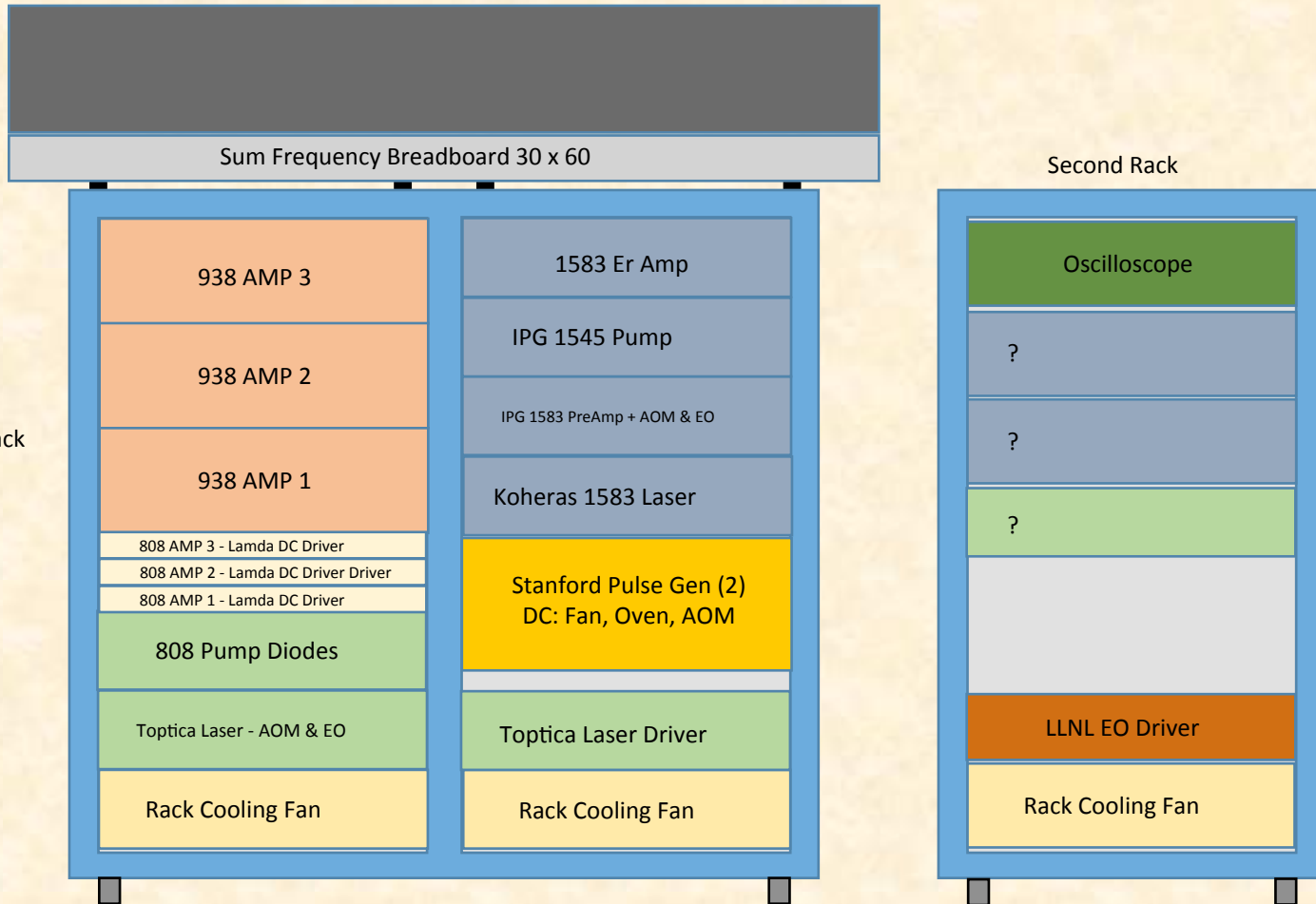
Optical Spectrum Produced by SSB Modulator



Current Fiber Laser Setup at UCSC



Sodium Laser Rack Layout

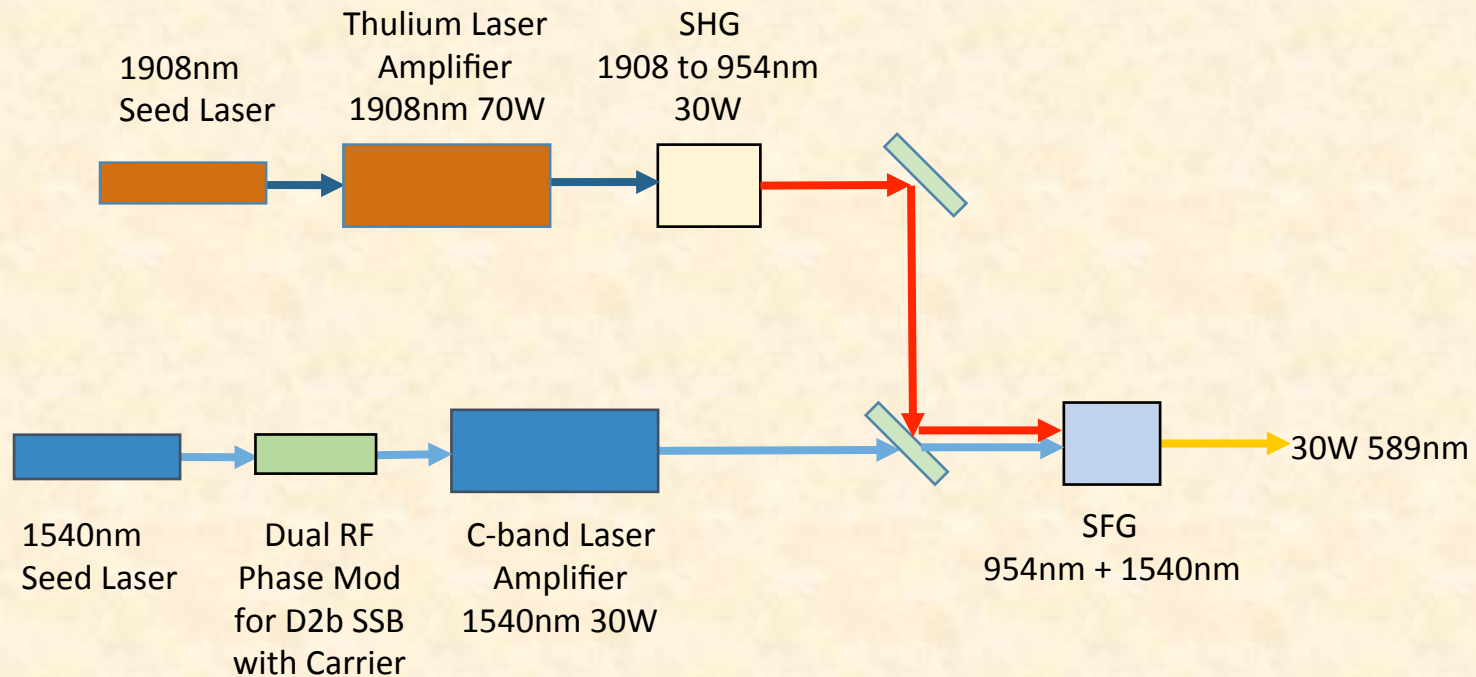


A new laser solution using Thulium

Question:

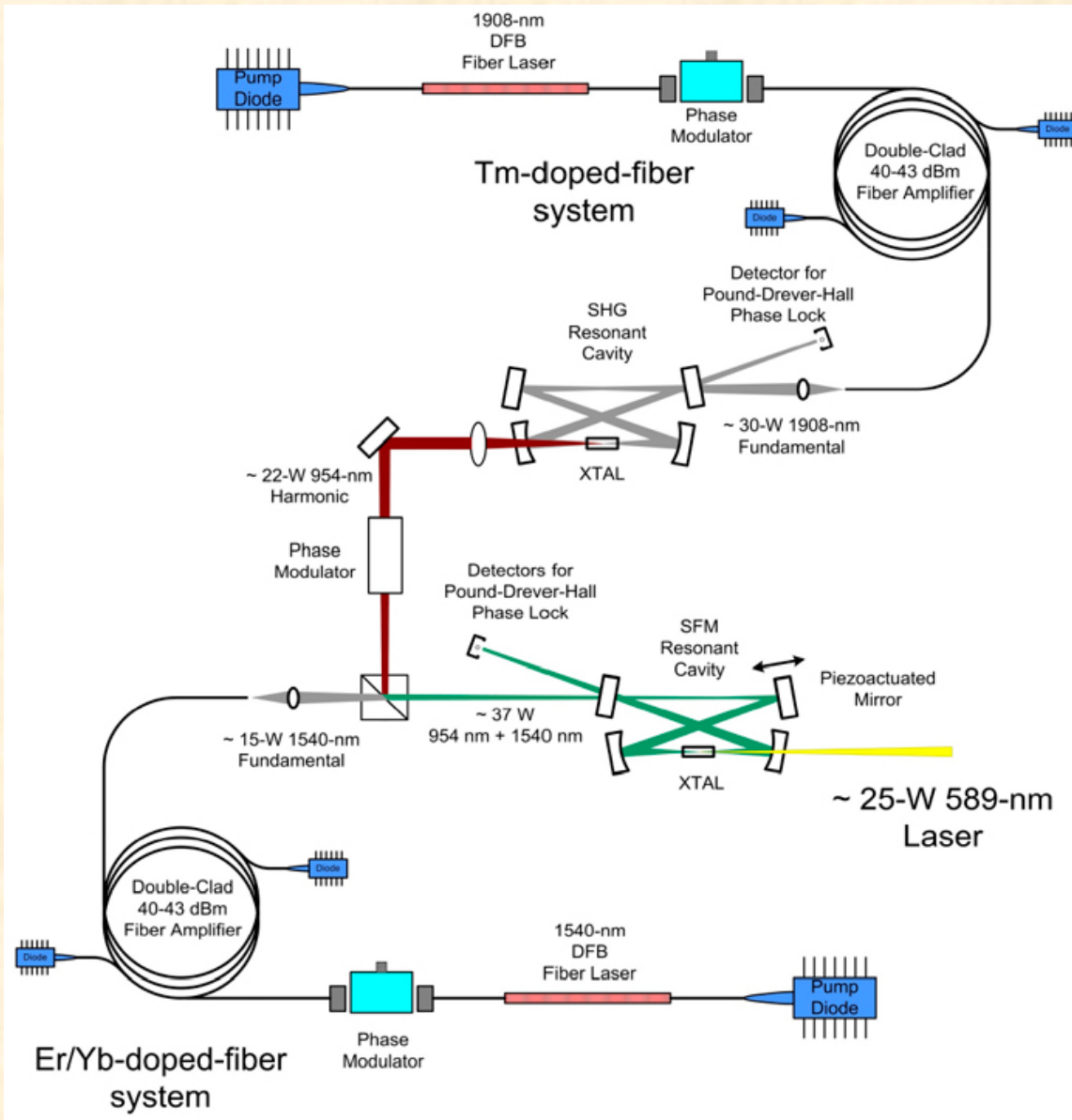
- Can we make a fiber laser that's smaller & more powerful using off the shelf components?
 - Propose two lasers:
 - Thulium Laser @ 1908nm
 - C-Band Laser @ 1540nm
 - Thulium doped fibers promise much higher power capacity
 - Pulsed?
 - CW?

Concept for a pulsed Thulium 589nm Laser Design



Concept for CW Thulium 589nm Laser Design

from Evans & Sutherland




John Garner and Dennis Elkins talked about this at an earlier Laser Workshop

2009 SPIE
10.1117/2.1200912.002529


Jesse Anderegg and
 Forrest Williams
 Evans & Sutherland

30w C-Band 1540nm Laser Amplifier

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- ▶ 0.9 Micron (Diode)
- ▶ 1 Micron (YAG wavelength)
- ▼ 1.5 Micron
 - Lasers
 - Amplifiers
 - Randomly Polarized
 - ▼ Linearly Polarized
 - EAR-LP Series
 - Single Frequency
 - Broadband Sources
- ▶ 2 Micron Fiber Lasers
- ▶ Raman Fiber Laser
- ▶ Product Accessories
- ▶ Laser Seam Stepper
- ▶ Microprocessing Systems

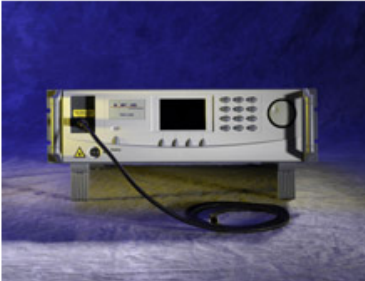


EAR-LP Series: 1-30 W Linearly Polarized C or L Band Erbium Fiber Amplifiers

The EAR-LP Series is a line of universal broadband, high power, linearly polarized, single mode fiber amplifiers covering the spectral range from 1540 to 1600 nm. The series includes 1-30 W versions. These user friendly devices are designed to serve laboratory or OEM maintenance free applications over a wide range of ambient conditions.

Typical bandwidth of the amplifier is 10-25nm (depending on output power) which allows for tunability of input signal for exact wavelength matching. Input power range can vary from microwatts to 10s of milliWatts.

EAR-LP Series amplifiers do not need water cooling or replacement parts. They require only a 110/220V AC power source to provide amplification for your low power signal. EAR-LP Series is optimized for linearly polarized CW or pulsed input signals and can be used for variety of applications including coherent or spectral beam combining, detection system, free-space communications, and other applications.




Main Features:

- Output powers up to 30 W
- High extinction ratio
- No maintenance
- Wide dynamic range
- Linear or circular polarization
- Automatic power and current control

Applications:

- Coherent or spectral beam combining
- Detection systems
- Free-space communications
- High power testing

70w 1908nm Thulium Laser



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- ▶ 1 Micron (YAG wavelength)
- ▶ 1.5 Micron
- ▼ 2 Micron Fiber Lasers
 - Thulium CW Fiber Laser
 - Thulium CW Fiber Laser Module**
 - Pulsed Thulium Nanosecond Fiber Laser
- ▶ Raman Fiber Laser
- ▶ Product Accessories
- ▶ Laser Seam Stepper
- ▶ Microprocessing Systems

TLM-120 Thulium CW Fiber Laser Module

IPG's new Thulium Continuous Wave (CW) Fiber Laser Modules are available in air-cooled units, 10-50 W or water-cooled modules, 50-120 W. These compact modules can be purchased for single-mode or multi-mode operation with wavelength range of 1900-2050 nm. IPG's Thulium modules are attractively priced for OEM's and integrators and serve a wide range of medical, materials processing and laser pumping applications.



Datasheet:

-  [TLM Fiber Laser Modules](#)
-  [Application Note #14: Welding Clear-to-clear Polymers with Thulium Fiber Lasers](#)

Main Features:

- Compact Size
- High Wall-plug Efficiency
- Beam Quality $M^2 < 1.1$ for Single-mode Version
- Wide Selection of Wavelengths
- Advantage over CO₂ & Ho:Yag
- Cost-effective, Compact OEM Solution

Applications:

- Medical Treatment
- Medical Surgery
- Plastic Materials Processing
- Other Non-metal Materials Processing
- Solid State IR Laser Pumping
- Pollution Control