

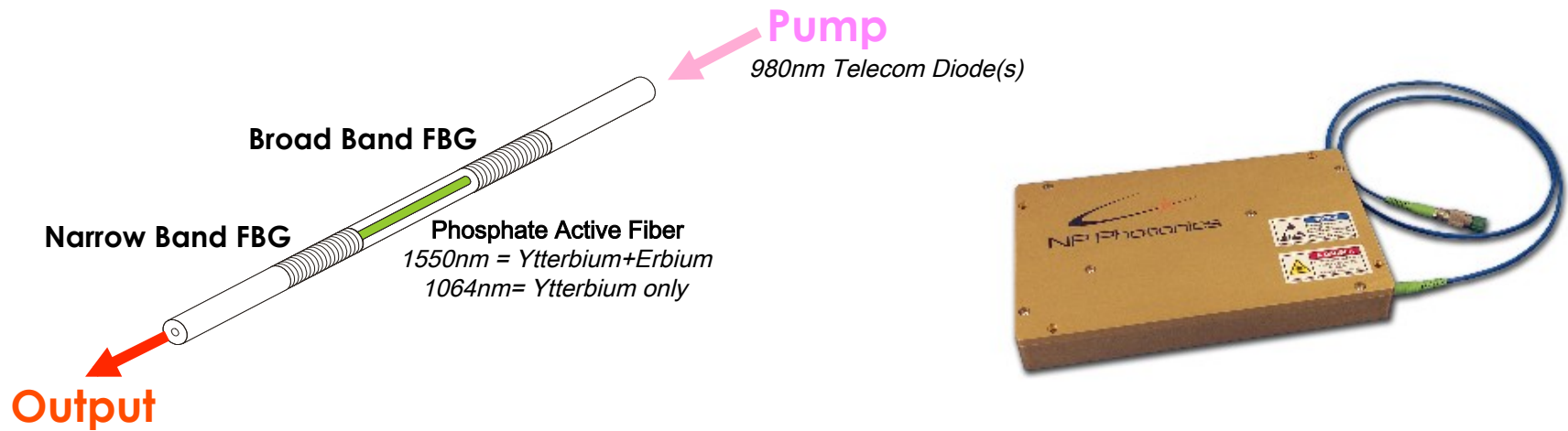


NP Photonics Lasers And A New Laser-Frequency Offset Device

Lukas Gruber
9-8-2010

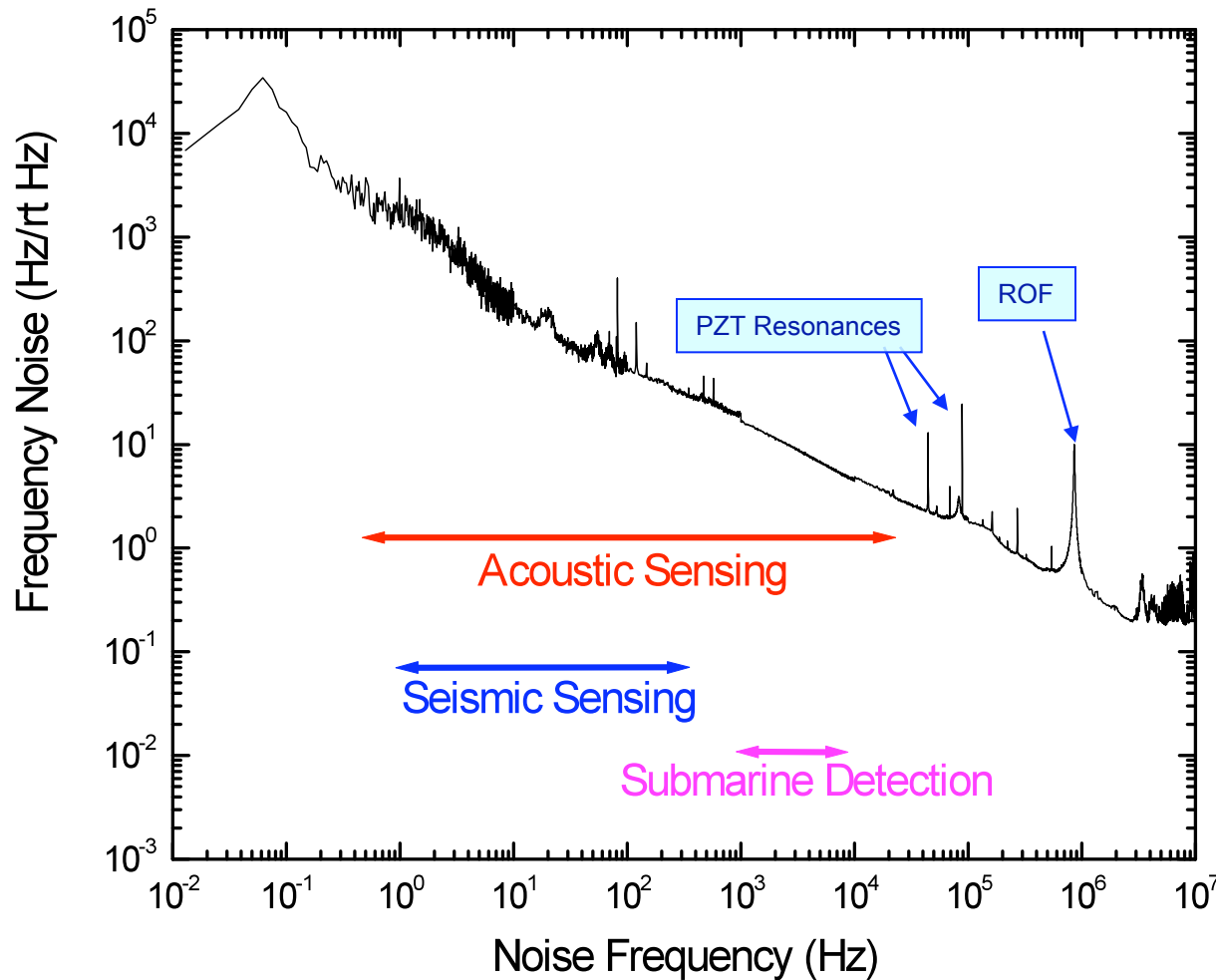
- NP Photonics Single Frequency Lasers
- Laser-Frequency Locking Device
- Applications to PDV
- Summary

The Fiber Laser – NP's Engine



- Key attributes/features
 - Single longitudinal mode (single frequency; 2.5GHz FSR)
 - Long coherence length (3kHz and < 500Hz line width)
 - Tunable: slow (30 GHz) and fast (300 MHz)
 - Polarized
 - Ultra-low phase noise
 - Mechanically robust

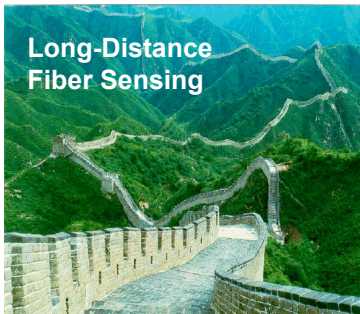
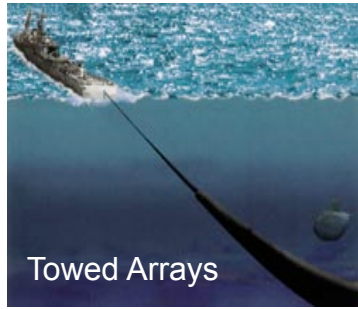
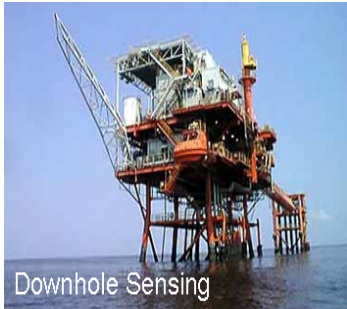
Phase Noise



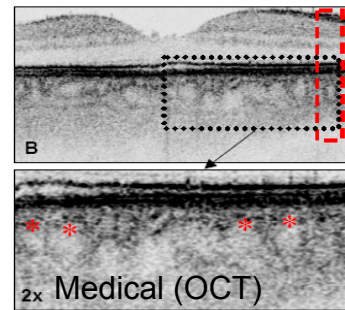
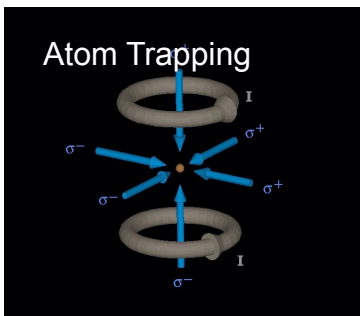
Key performance measure for NP Lasers

Different applications focus on different ranges in the phase noise spectrum.

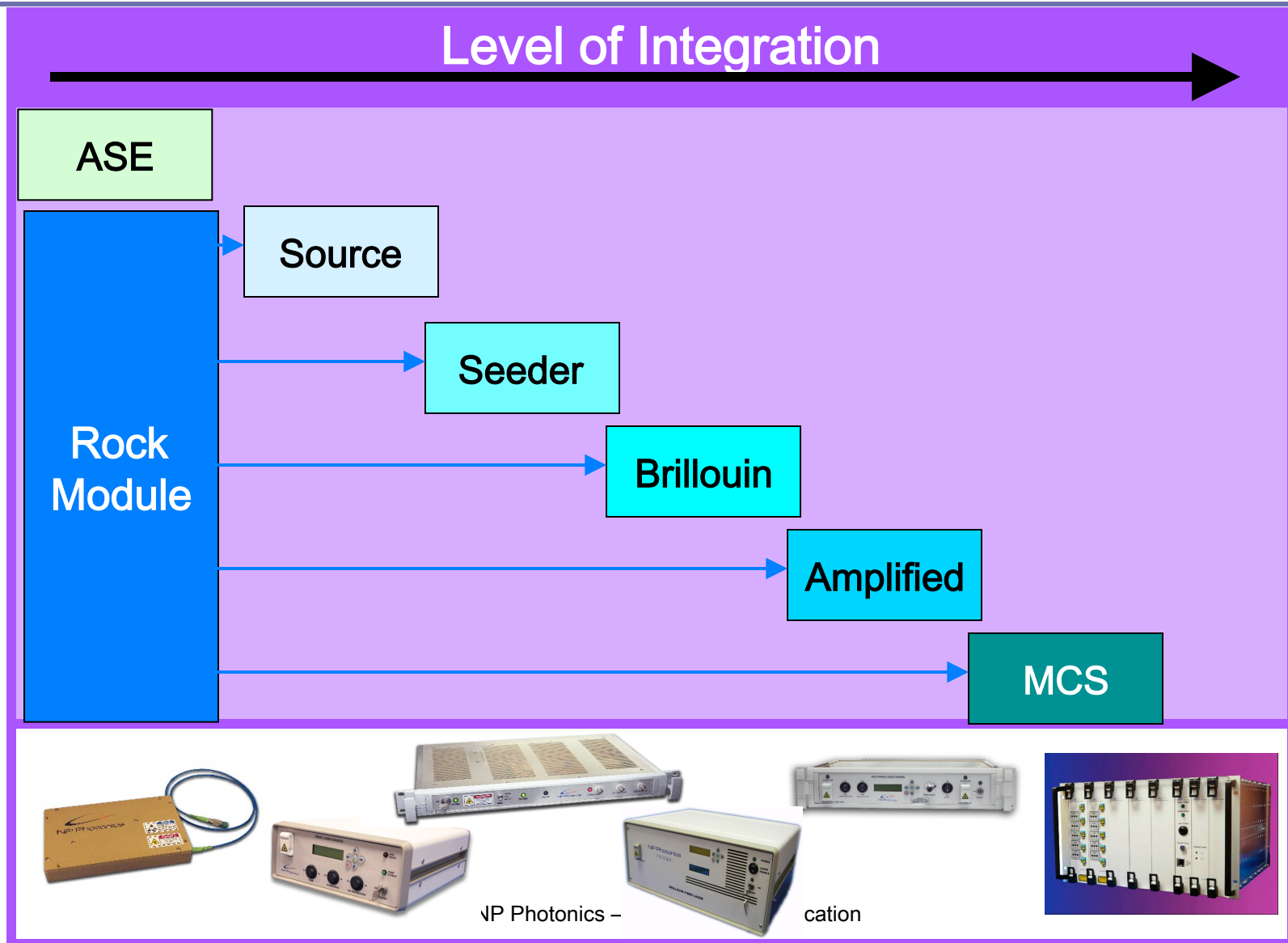
Adjacent spectrum yields a < 500 Hz line width



Markets



NP Product Categories



High Power Fiber Laser

- High Power Source
 - Designed for End User Application
 - Main Features:
 - Up to 5 W Optical Output
 - Seed Laser Output Port
 - Full Front Panel Operation
 - CDRH Compliance
 - RS232 Interface
 - Power Control
 - Continuous Power Monitoring
 - Easy Wavelength Tuning Via Front Panel
 - Digital Wavelength, Power and Current Display
 - Automatic Data Collection



Multi-Channel System

- MCS
 - Designed for applications w/ many lasers
 - Main Features:
 - Modular Line cards
 - Up to 5 lasers/line card
 - Up to 5 line cards/enclosure
 - Configurable system
 - Amplifier line card possible
 - Locking line card possible
 - Water-cooled
 - Ethernet communication
 - GUI

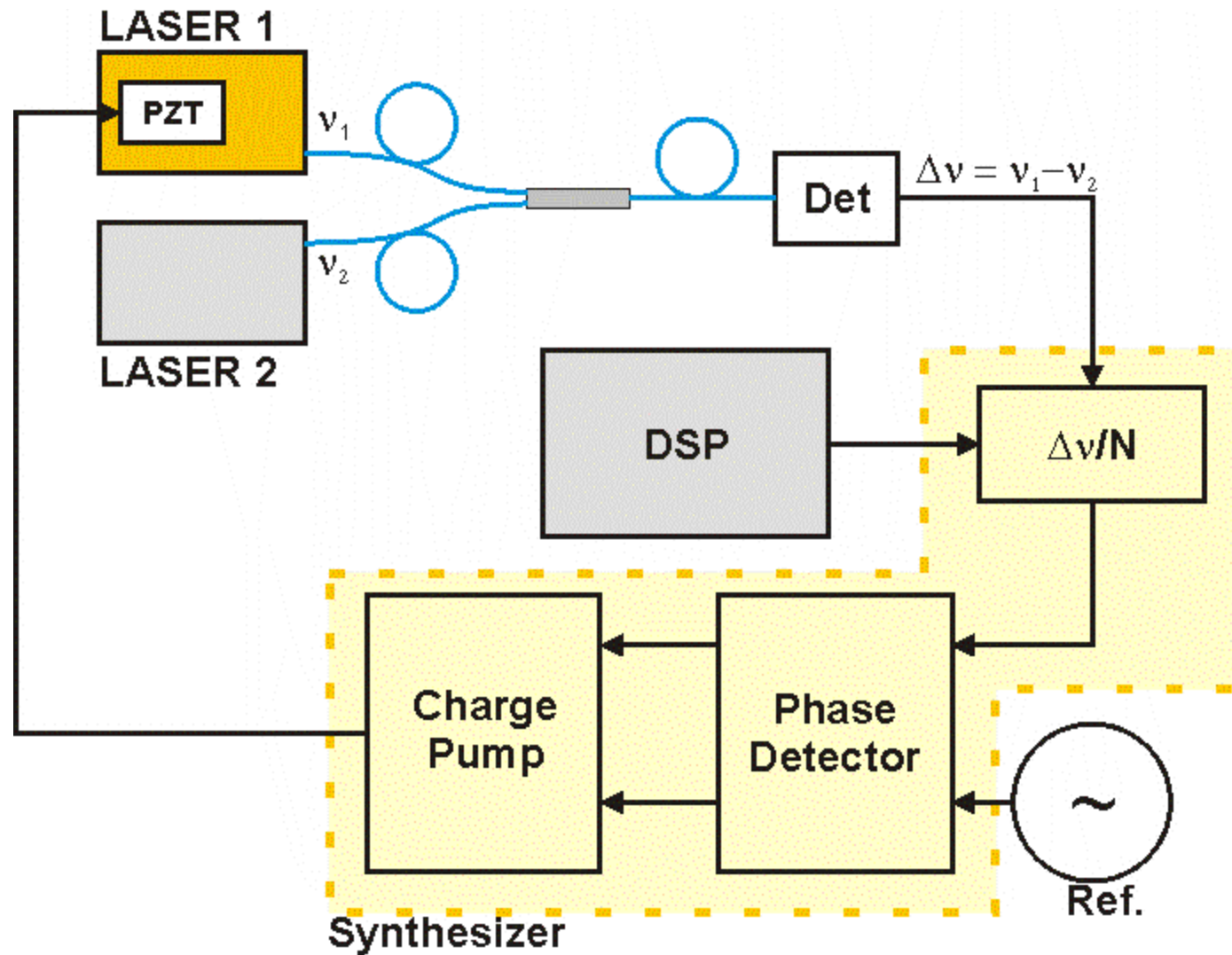


Laser-Frequency Locker

- Laser-Frequency Locker
 - Designed for applications with need of two lasers with stable frequency offsets
 - Main Features:
 - Locks Rock laser frequency with respect to another source
 - Locking range: 200MHz – 2GHz
 - Works with Rock modules
 - LCD display
 - Front panel controls
 - RS232 communication
 - GUI

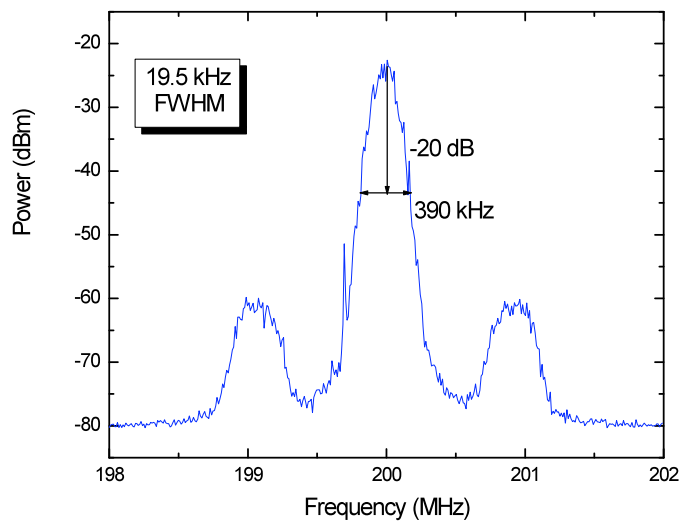


Locker: Principle of Operation

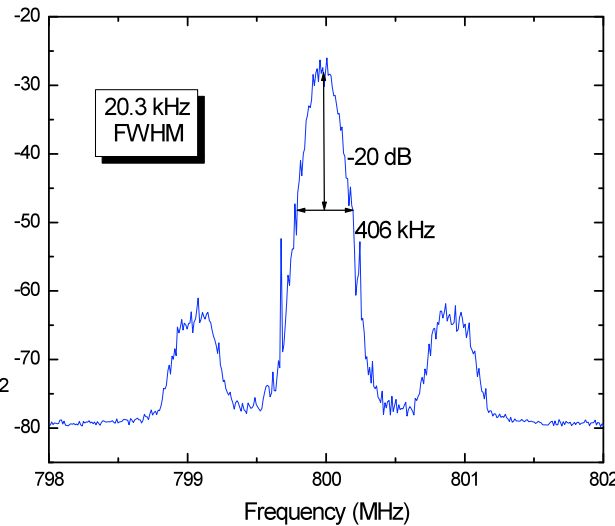


Flexible Frequency Offset

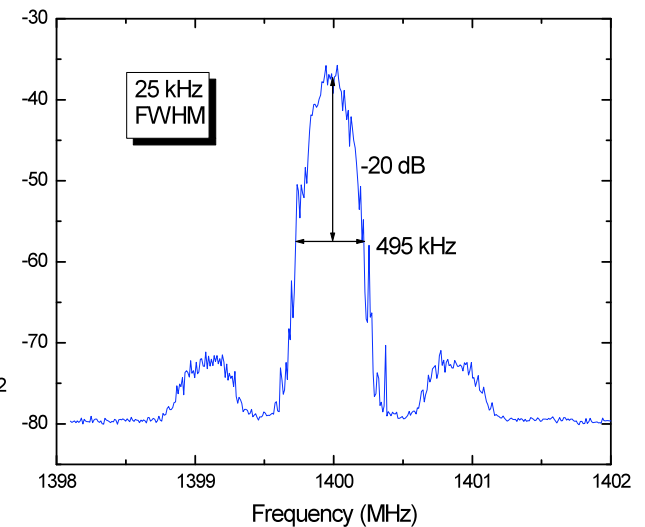
Settable difference frequency. Same performance.



200 MHz



800 MHz

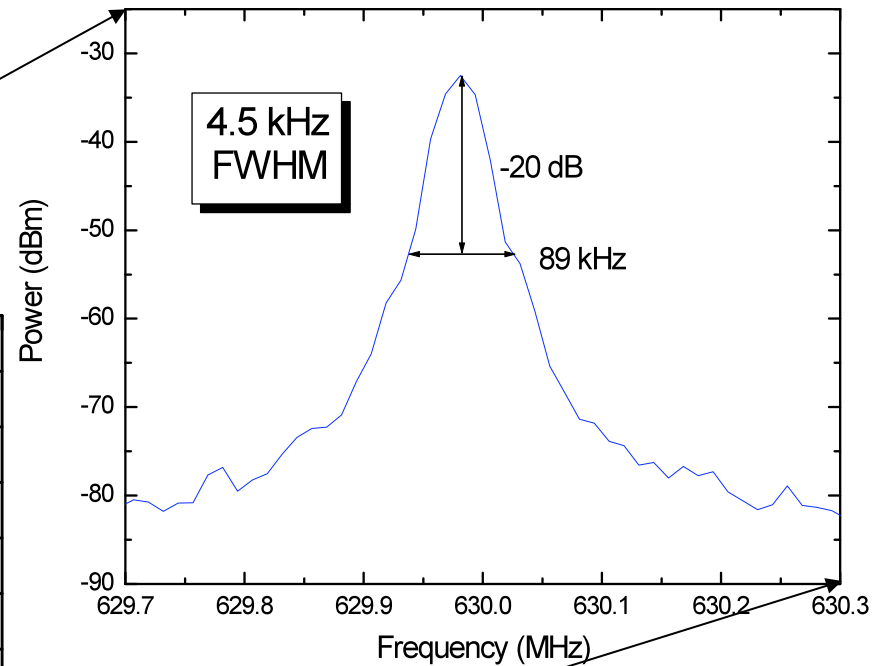
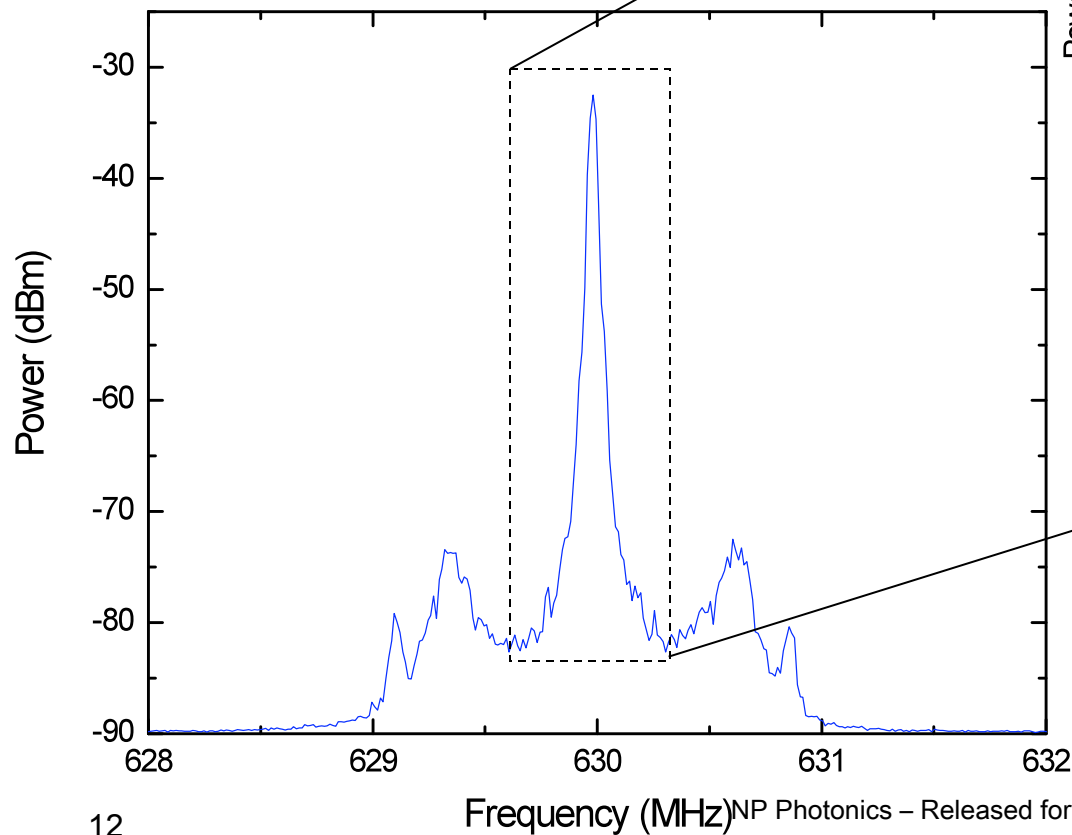


1.4 GHz

Lasers used: ~10 kHz line width

Line Width of Frequency

2 Lasers w/ $\sim 3\text{kHz}$ line width used for this experiment.



Interface: GUI or Front Panel



- Consistency of experiment
 - Every time same offset can be chosen and relied upon.
- “Zero frequencies” can be avoided.
 - Fewer artifacts at the onset of the acceleration
- Frequencies can be shifted to desired ranges:
Up-shifted PDV
 - Built-in identification of velocity direction
 - Possibly relaxed requirements for digitizers
- Advantage over AOM?
 - 2 lasers can generate arbitrary beat frequency. Limitation only by detector and electronics. AOM limited to about 500MHz
 - Selectable frequency for every experiment – flexible.

- NP Photonics lasers are ideal instruments for PDV
 - Single mode
 - Selectable power (25mW – 5W standard)
 - Low noise (long coherence length)
 - Flexible configuration: single OEM module, amplified system, multi-laser system
- Laser Frequency Locker
 - Enables up-shifted, flexible PDV
 - Consistency of experiment
 - Convenience of operation

**Thank you
for your attention!**

Thanks to
Sean Staines, Colin Chambers, Adam Escobar,
Terry Hannon, Eddie Oteiza
NP Photonics

Extra Slides



Fiber Laser Module

- OEM Fiber Laser
 - Designed for Industrial and Systems Applications
 - Specifications:

Wavelength Range	1530–1565, 1030-1080 nm
Output Power	25, 50, 80, 100, 125 mW
Longitudinal Mode	Single Frequency
Wavelength Set Resolution	50 MHz
Spectral Line Width (Heterodyne)	< 5 kHz – 10 kHz. 1kHz optional
Frequency Stability (*)	< 50 MHz
Relative Intensity Noise (RIN) @ Peak ~ 1 MHz	<-110 dB/Hz for 1550 nm, <-100 dB/Hz for 1μm
Relative Intensity Noise (RIN) > 50 MHz	Shot Noise Limited
Signal to ASE Noise Ratio (50 pm, bandwidth)	> 65 dB
Signal to ASE Noise Ratio (Integrated)	> 35 dB
Side Mode Suppression Ratio (SMSR)	> 50 dB
Polarization Extinction Ratio (PER)	> 23 dB for 1550 nm, > 20 dB for 1μm
Tuning Range (Thermal)	≥ 30 GHz
Fast Frequency Modulation Range	± 150 MHz
Modulation Speed	Up to 30 kHz
Connectors	FC/APC
Fiber Pigtail	PM Fiber, 1 m Long
Package Dimension	200 x 120 x 26.35 mm
(*) Over 1 hour with base temperature constant to within < 2° c after 30 min warm-up	



Products



Fiber Laser Module



Fiber Laser Source



Seeder



High Power Laser Source



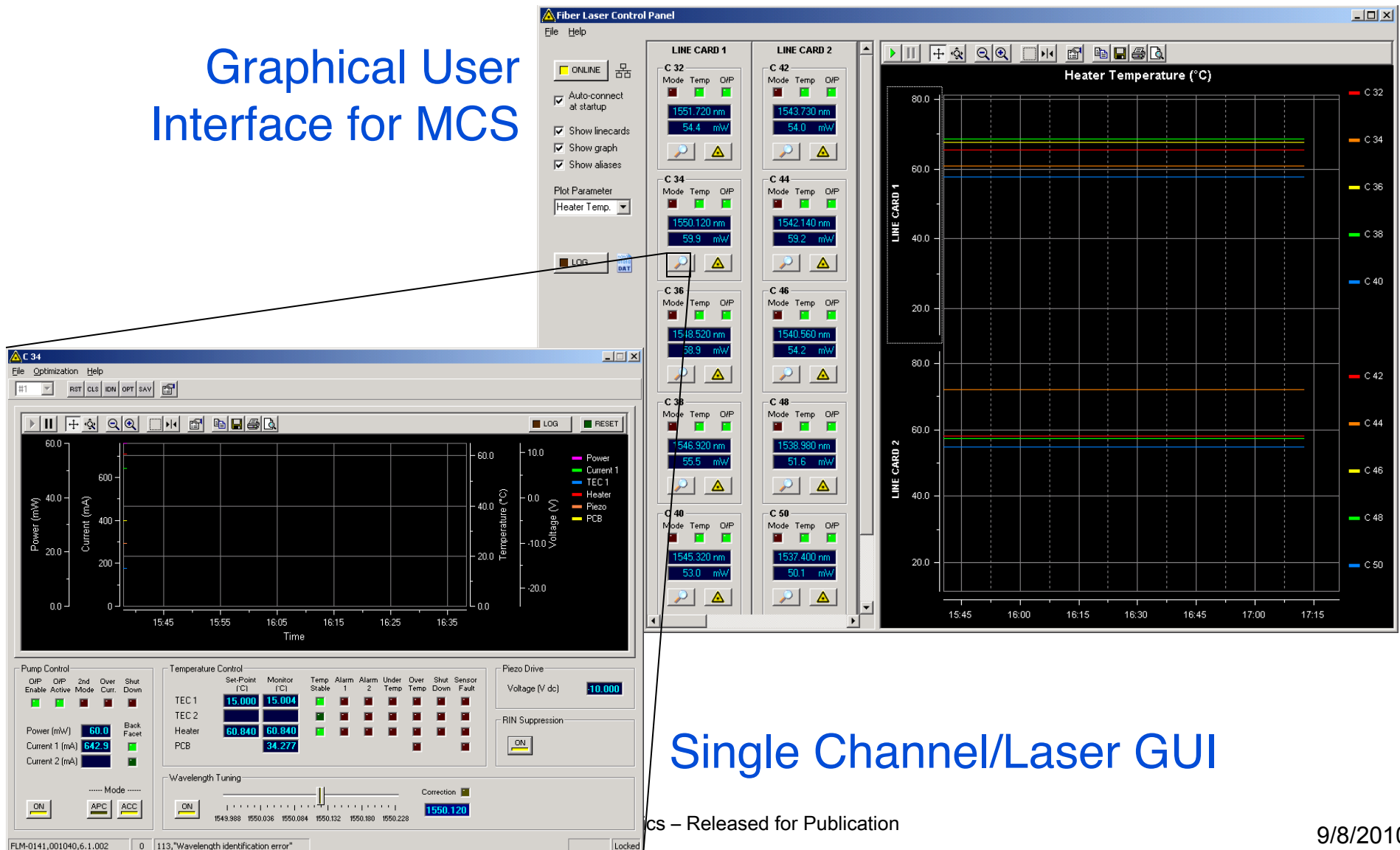
MCS

Line Card for MCS



- 5 Lasers per Line Card
- Water cooled
- Internal RS485 comms
- Modular
- “Plug and Play”

Graphical User Interface for MCS



The screenshot displays the 'Fiber Laser Control Panel' software interface. It features a central panel for monitoring and controlling multiple line cards (C 32 to C 50). Each line card displays its Mode, Temperature (Temp), and Output Power (O/P) in mW. A graph on the right shows 'Heater Temperature (°C)' for various line cards over time. The bottom section contains control parameters for Pump Control, Temperature Control, Piezo Drive, and Wavelength Tuning.

Line Card	Mode	Temp (°C)	O/P (mW)
C 32	1551.720 nm	54.4	54.4
C 42	1543.730 nm	54.0	54.0
C 34	1550.120 nm	53.9	53.9
C 44	1542.140 nm	59.2	59.2
C 36	1548.520 nm	58.9	58.9
C 46	1540.560 nm	54.2	54.2
C 38	1546.920 nm	55.5	55.5
C 48	1538.980 nm	51.6	51.6
C 40	1545.320 nm	53.0	53.0
C 50	1537.400 nm	50.1	50.1

Temperature Control Parameters:

Component	Set-Point (°C)	Monitor (°C)
TEC 1	15.000	15.004
TEC 2	60.840	60.840
Heater	60.840	60.840
PCB	34.277	

Pump Control: Power (mW) 60.0, Current 1 (mA) 642.9, Current 2 (mA) [blank].

Piezo Drive: Voltage (V dc) 10.000

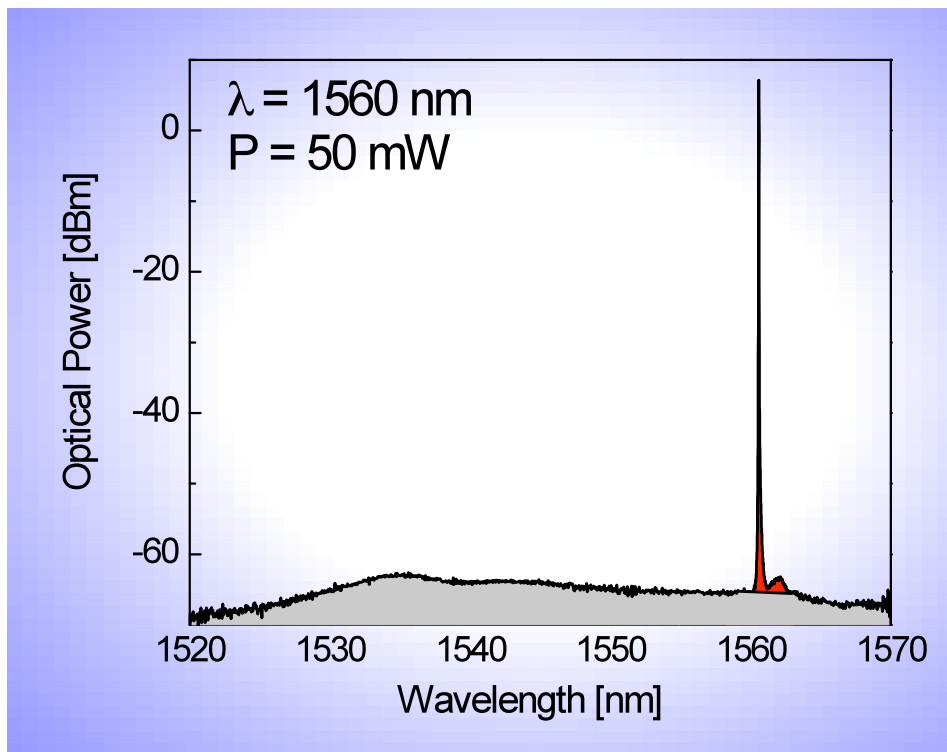
Wavelength Tuning: 1550.120 nm

Single Channel/Laser GUI

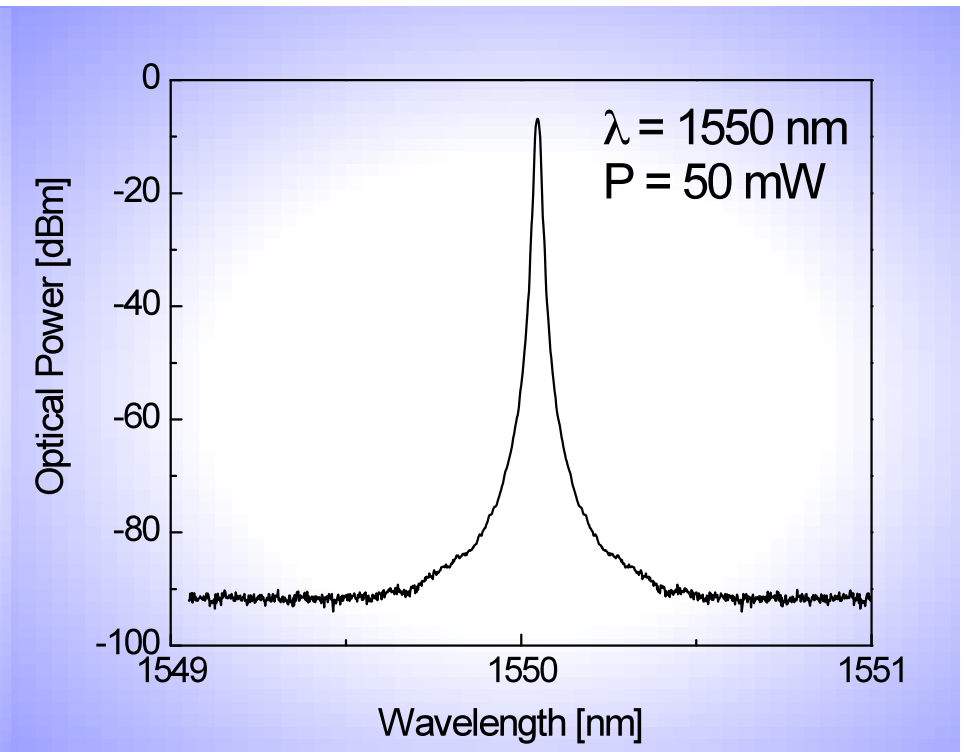
Large Signal to Noise Ratio

Signal-to-ASE

Side Mode Suppression



< 37 dB
1520-1570 nm



85 dB
10 pm Resolution

Large Piezo Bandwidth

