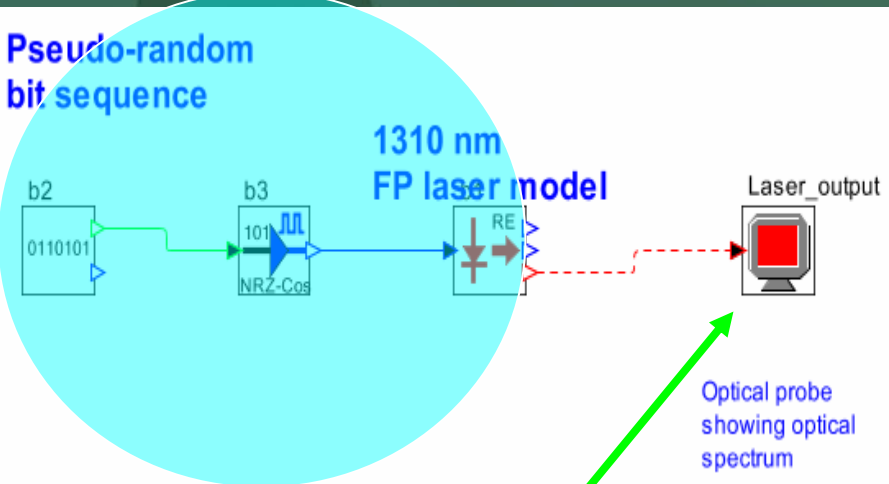


LASERS

- Fabry Perot (FP)
- Distributed Feedback (DFB)
- Vertical Cavity Surface Emitting Laser (VCSEL)

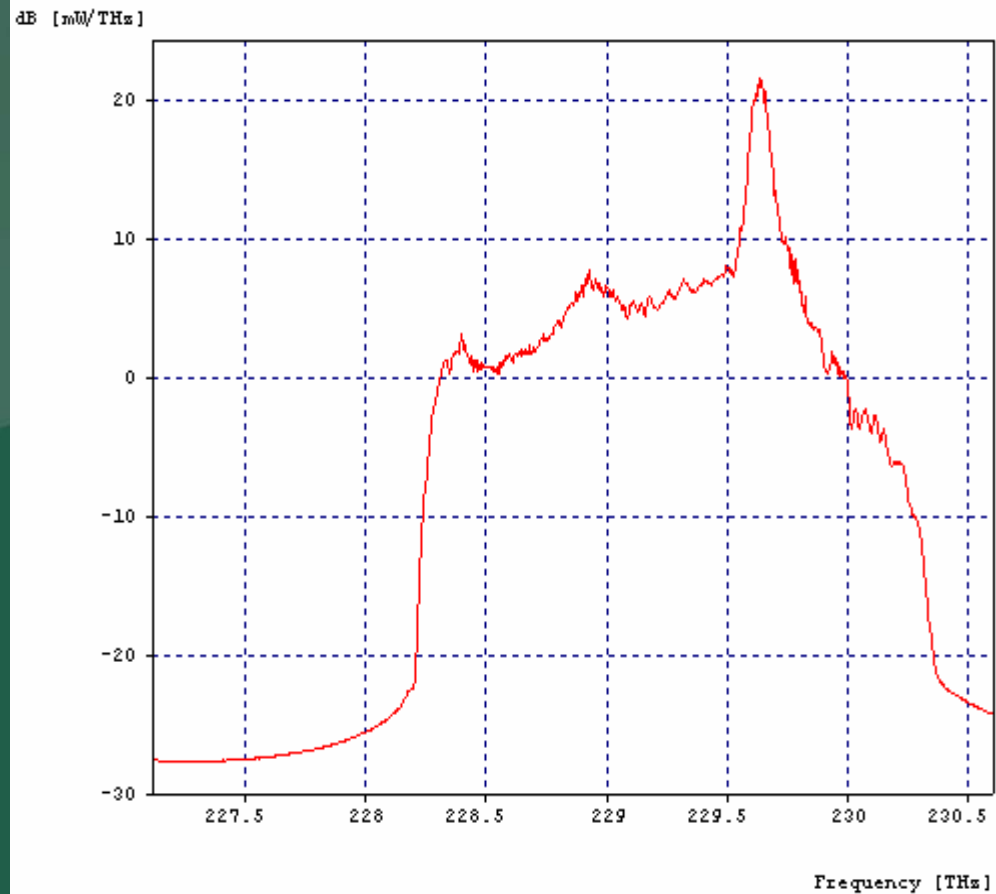
Fabry Perot

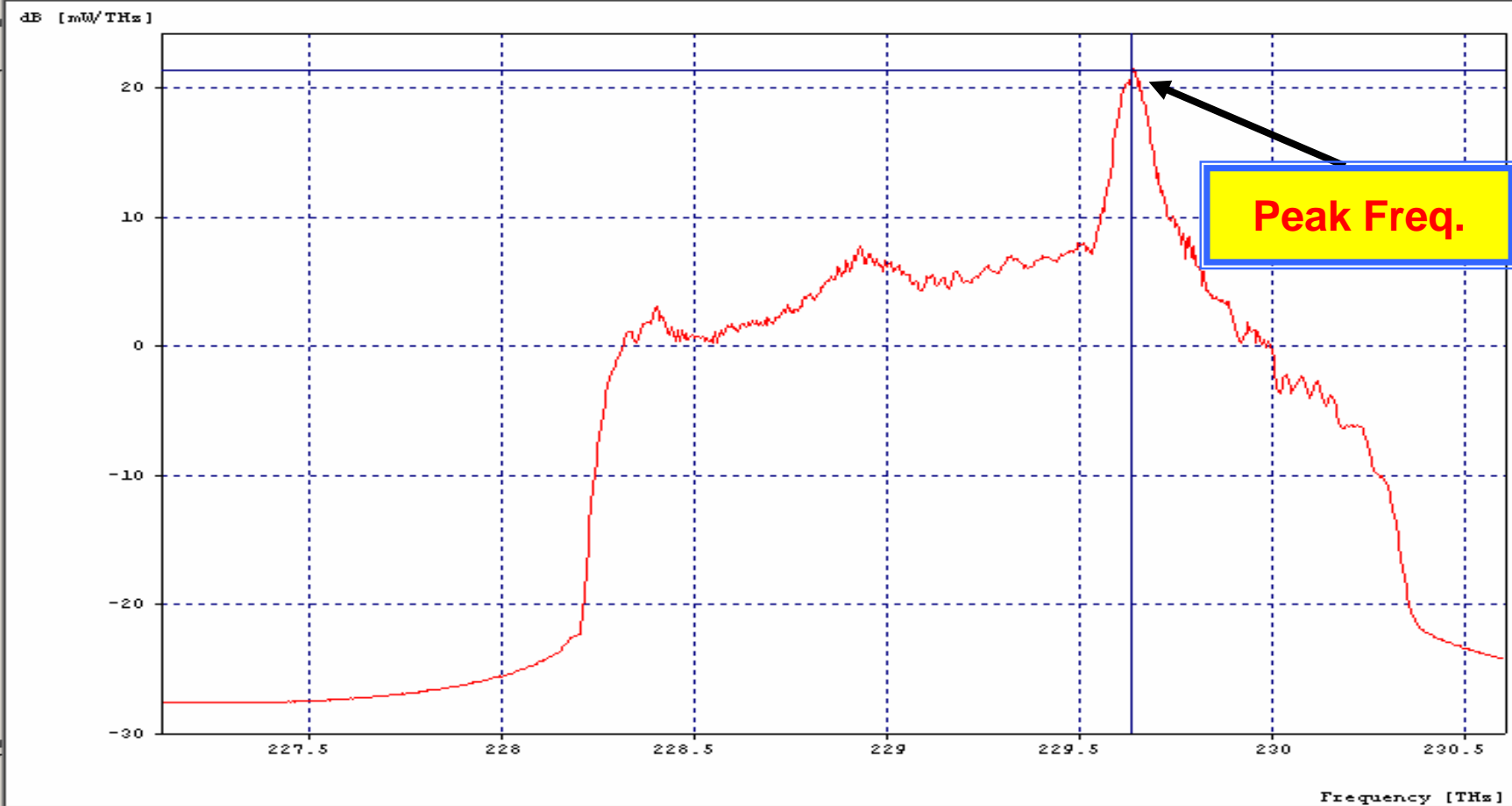
Source



Optical probe showing optical spectrum

Optical Probe





Runs
1

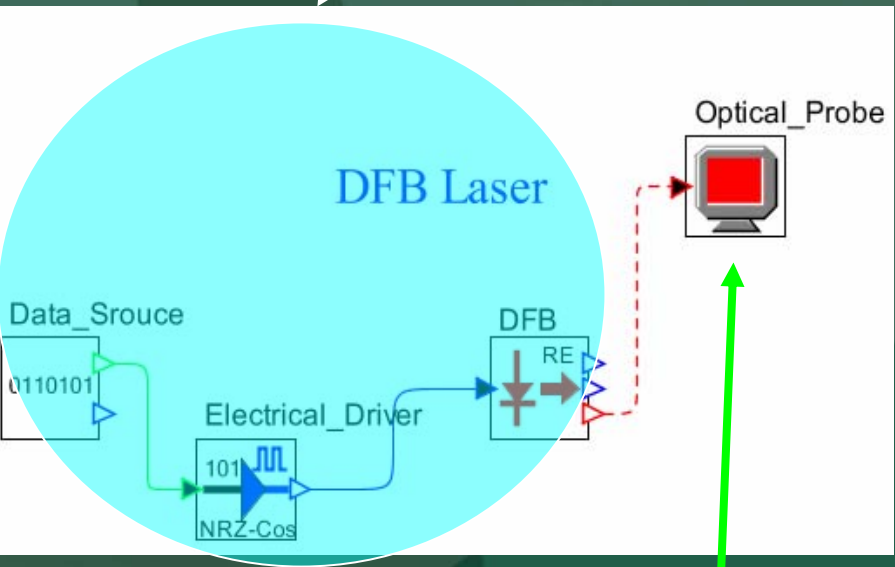
Spans

Highest Peak Frequency 229.644 [THz] Highest Peak Power 21.638405 dB[mW/THz]

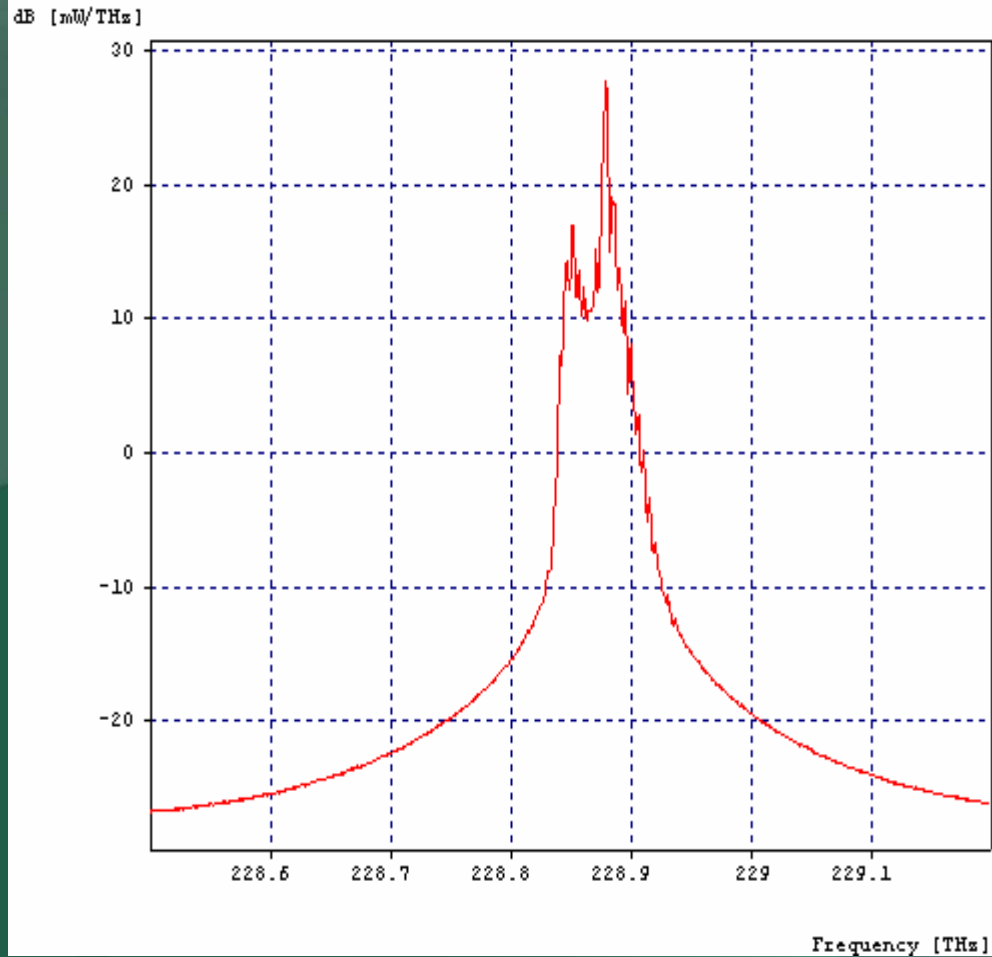
- Peak Frequency = 229.644 THz [1310nm]
- It can be inferred from the spectrum that spectral width of a FP is quite broad [~ 1.7 THz]

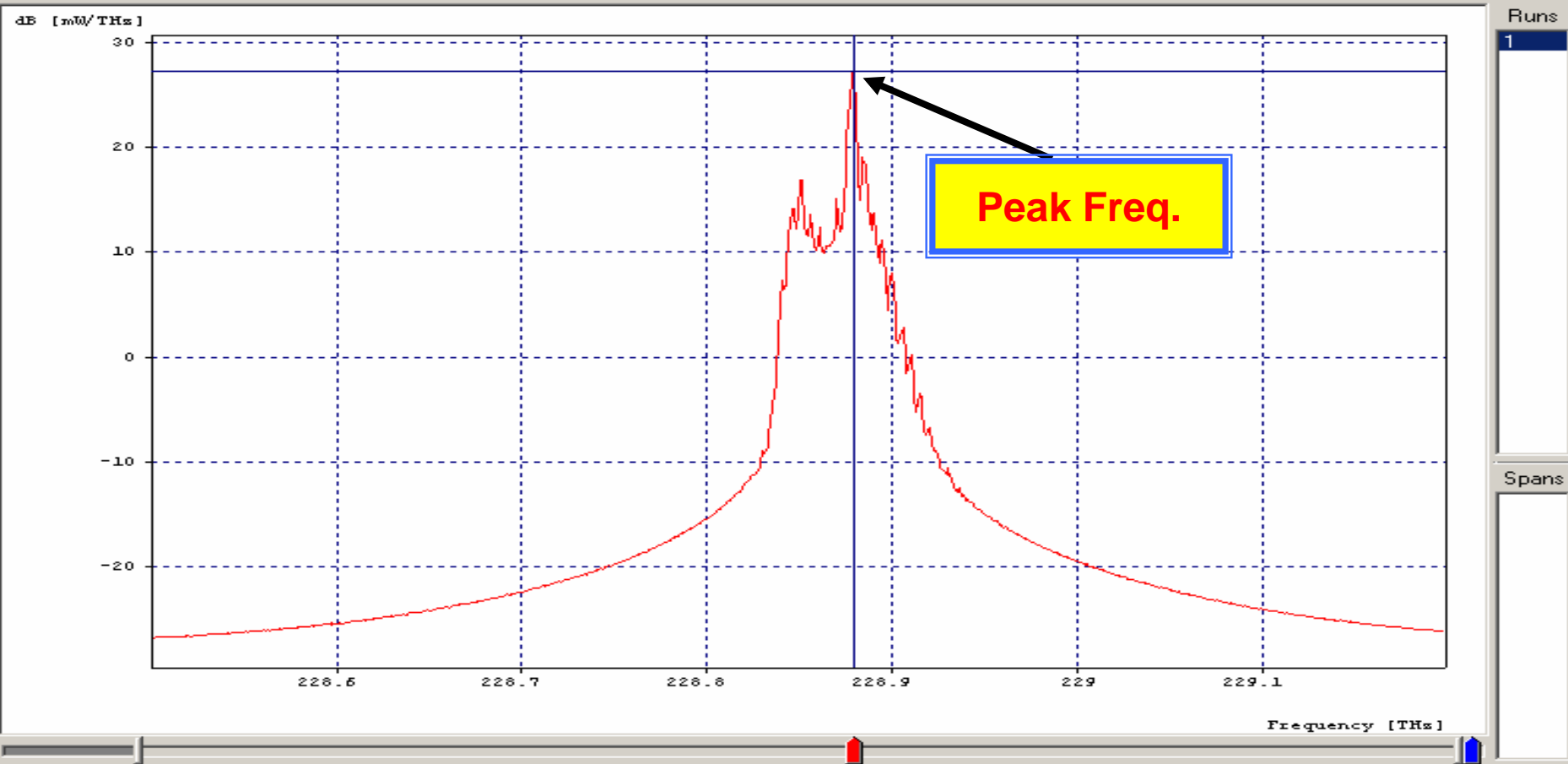
DFB

Source



Optical Probe



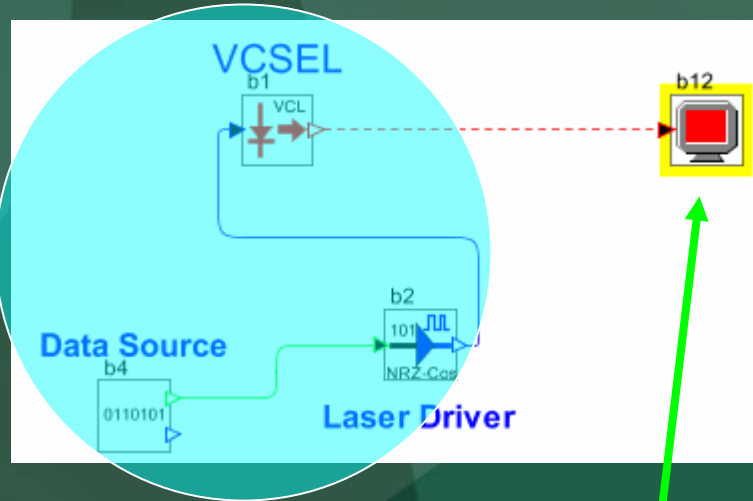


Highest Peak Frequency 228.879 [THz] Highest Peak Power 27.808363 dB[mW/THz]

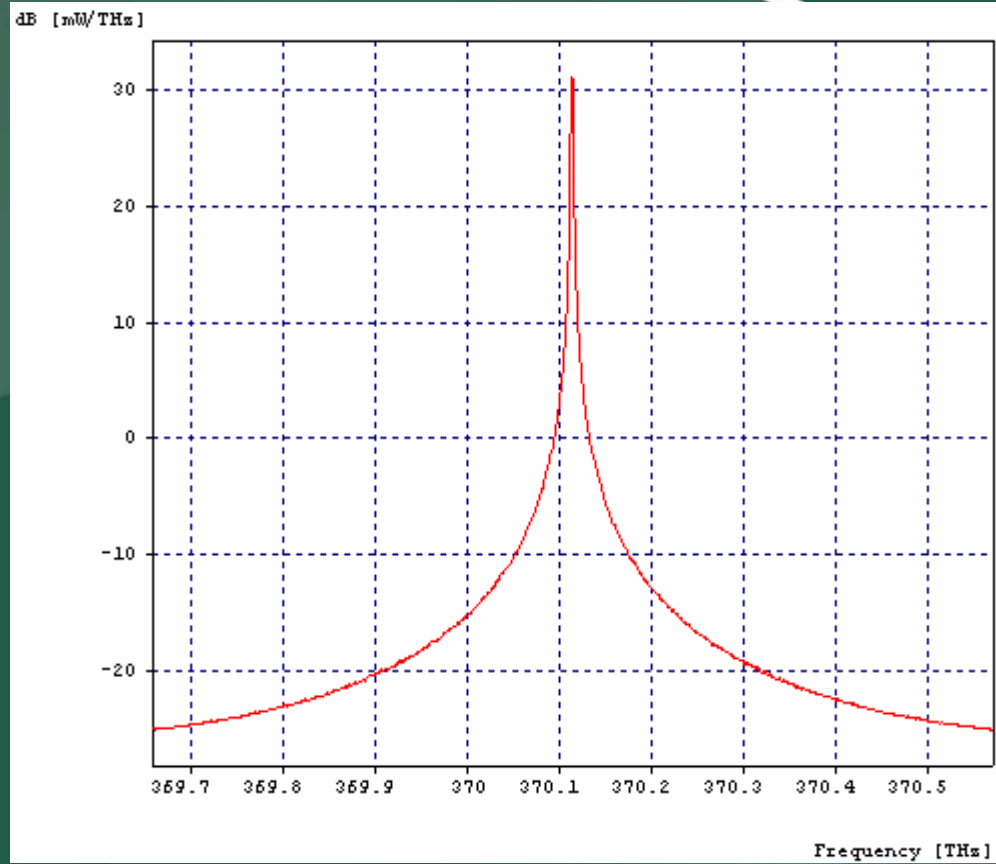
- Peak Frequency = 228.879 THz [1310 nm]
- Line width of a DFB Laser is narrower [~ 0.07 THz] as compared to FP Laser which makes it suitable for long haul communications

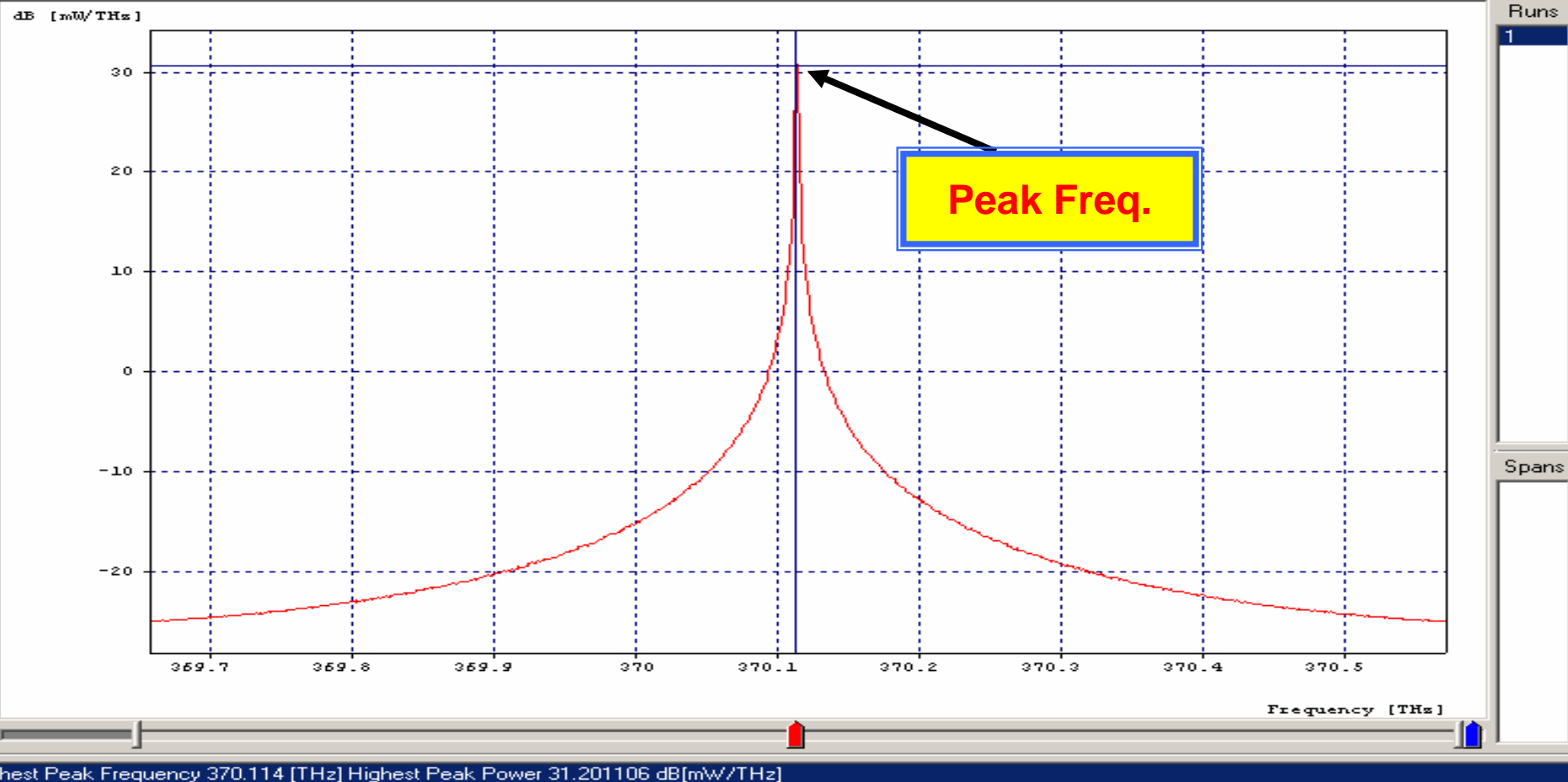
VCSEL

Source



Optical Probe





- Peak Frequency = 370.114 THz
- Line width of a VCSEL is better than the two. [~ 0.04 THz] Because of low power it is suitable for short haul communications

Optsim

Presented by: Fawad Khan



What is Optsim?

Optsim Simulation Software

Used to design and optimize:

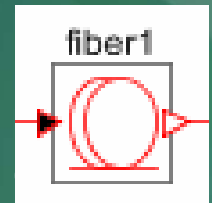
- DWDM and CWDM amplified systems
- FTTH/PON systems
- OTDM systems
- CATV digital/analog systems
- Optical LANs
- Ultra long-haul terrestrial and submarine systems

Motivation

- Since mid-90's, computer simulations have been used to realistically model optical communication systems
- Computer-aided design techniques if used appropriately
 1. optimize entire system
 2. provide optimum values of system parameters
 3. Design goals are met with minimal time and cost
- Commercially available design software packages
 - Optiwave, VPITransmission Maker, Optnet, ZeMax

Optsim Methodology

- Optsim uses **block-orientated simulation** methodology in which each block models a component or subsystem
- Each block model is presented graphically as an icon, has own set parameters which can be modified by user



Simulation Approaches

Optsim supports two simulation engines:

1. Block mode simulation engine: signal data is represented as one block of data and is passed between block to block
2. Sample mode simulation engine: signal data is represented as single sample that is passed between block to block



All Models

Model Palettes

Favorite Schematics

↑ Collapse ↓ Expand

- Sample-Mode Models
- Block-Mode Models
- Compound Components
- Decorative Elements
- User Libraries

- Compound Optical Receiver
- Nonlinear Fiber
- Optical Filter
- XY Plotter
- Eye Diagram Analyzer
- Transient Plotter
- CW Laser
- Physical EDFA
- Black Box Amplifier
- PRBS Generator
- Electrical Signal Generator

Recent

Go Pause Stop Scan Symbols View Plot View Results Inlin

case_study.moml

2 Simulation Modes

Simulation Steps

Five steps to setting up a simulation of a communication system:

1. Create Optsim project and set simulation parameters (Block mode Vs Sample mode)
2. Draw the schematic diagram
3. Set parameter values of block models
4. Run simulation
5. View results with data display tools

- New
- Open ...
- Save Ctrl+S
- SaveAs ...
- Properties F2
- Close
- Close All
- Print Ctrl+P
- Recent Files
- Exit

- Schematic ... Ctrl+G
- Sample-Mode Project Ctrl+O
- Block-Mode Project Ctrl+K**

Pause Stop Scan Symbols View Plot View Results Inlin

- Special Functions
- Optical Sources and Modulators
 - Direct-Modulated Laser
 - Mode-Locked Laser

- Compound Optical Receiver
- Nonlinear Fiber
- Optical Filter
- XY Plotter
- Eye Diagram Analyzer
- Transient Plotter
- CW Laser
- Physical EDFA
- Black Box Amplifier
- PRBS Generator
- Electrical Signal Generator

Create a Block-Mode Project

Expand

Panner Recent

Modeling Stages

- **Stage 1:** General Model (Modeling preliminaries)
- **Stage 2:** Select optimum parameters (Performance Evaluation)
- **Stage 3:** See results after simulation (Optsim Validation)

Stage 1 - General Model

- Design of optical communication systems involves optimizing a large number of parameters such as:
- Transmitters, optical fibers, amplifiers, receivers
- MUX/DEMUX, optical filters,
- Optical cross connects, optical add drop multiplexers etc

Stage 2 - Select Optimum Parameters

- We need to know what **type of noise** is present and how to eliminate or reduce its impact
- Better **SNR (BER)** should be accomplished
- Attenuation minima at 1550nm
- Transmitter noise could be handled by using filters
- Quantum noise in case of photodiodes

Running the Simulation

The screenshot displays the OptSim software interface. The main window shows a schematic diagram of an optical communication system. The components include a CW Laser, a PRBS Generator, an Erbium-Doped Fiber Amplifier (EDFA), a Fiber, a Receiver, and a BER Test block. The simulation is currently running, as indicated by the green light in the 'Go' button of the 'Run' menu.

The 'Run' menu is open, showing the following options:

- Go ... (F5)
- Pause
- Stop
- Scan Variable ... (F4)
- Setup Scan ...
- Simulation Parameters (Ctrl+I)
- Animation


The 'All Models' pane on the left lists various components:

- Sample-Mode Models
 - Block-Mode Models
 - Signal Generators
 - Electrical Modules
 - Special Functions
 - Optical Sources and Modulators
 - Direct-Modulated Laser
 - Mode-Locked Laser
- Compound Optical Receiver
- Nonlinear Fiber
- Optical Filter
- XY Plotter
- Eye Diagram Analyzer
- Transient Plotter
- CW Laser
- Physical EDFA
- Black Box Amplifier
- PRBS Generator
- Electrical Signal Generator

The status bar at the bottom shows the file path: C:\RSoft\products\optsim\block_mode\projects\case_study.moml. The taskbar at the bottom right shows the system tray with the date and time.

Stage 3 - Optsim Validation

- *OptSim* features performance analysis:
 - For example Q value
 - BER (Bit error rate)
 - Eye opening/closure

 - Spectrum Analyzer
 - Signal Analyzer
 - Multimeter
- 
- Analysis Tools



Case Study

Optsim View Layouts

The screenshot displays the OptSim software interface. The main window shows a schematic diagram of an optical communication system. The diagram includes components such as NL Fiber, OptDropMUX, OptCoupl, OptSp, Receiver, BERTest, EyeDiag, and SigP. The system is configured with four parallel channels, each starting with a Nonlinear Fiber (NL Fiber) and followed by a series of optical components leading to a Receiver, BERTest, and EyeDiag. The schematic is connected to a signal source (SigP14) and a signal sink (SigP11).

The 'View' menu is open, and the 'Layout' option is selected, which has opened a sub-menu with the following checked items:

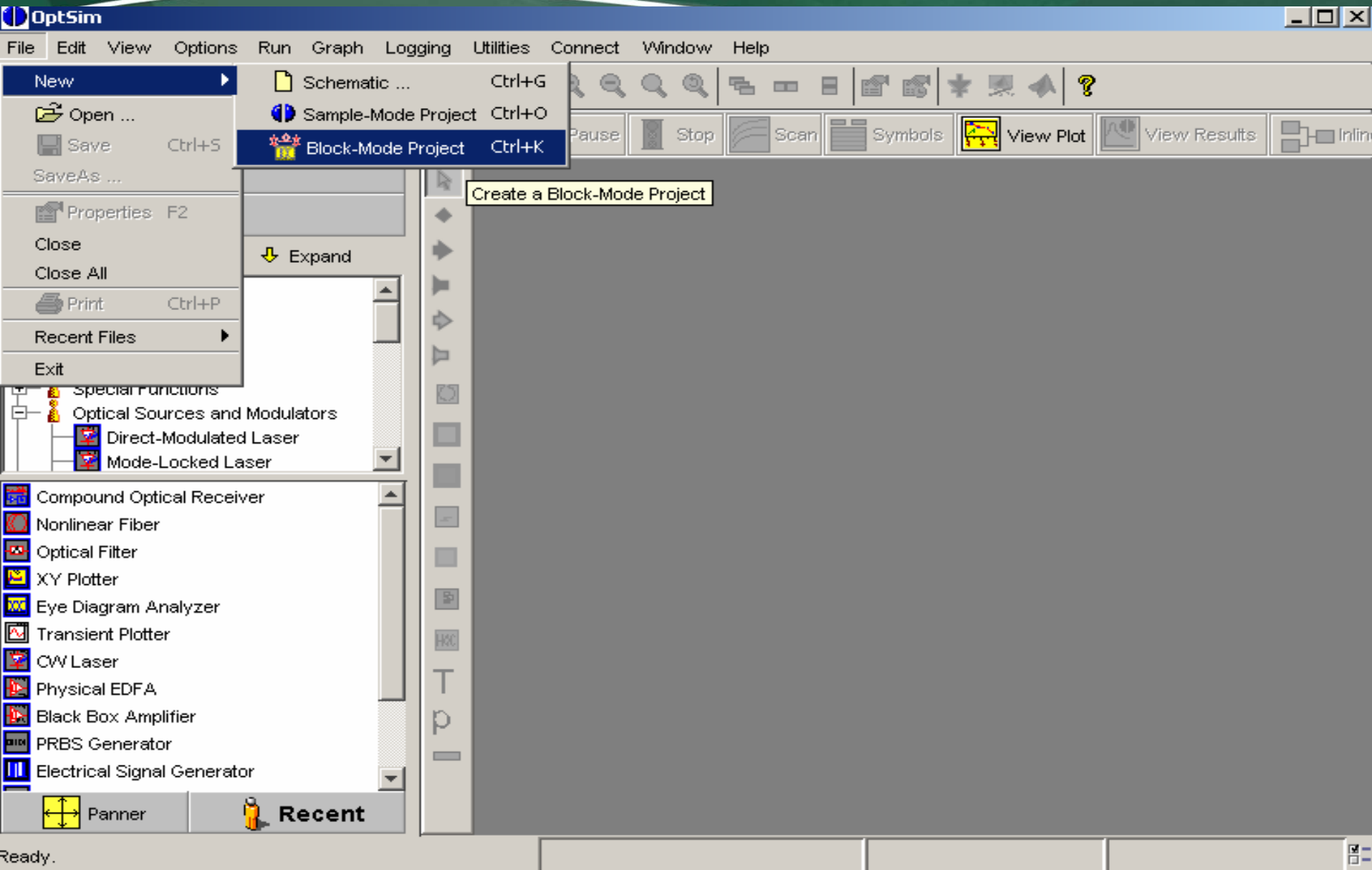
- View Toolbar
- View Statusbar
- View Explorer
- View Toolbox
- View Run Tools

The interface also shows a toolbar with icons for Go, Pause, Stop, Scan, Symbols, View Plot, and View Results. The status bar at the bottom indicates 'Ready' and 'Final.moml'.

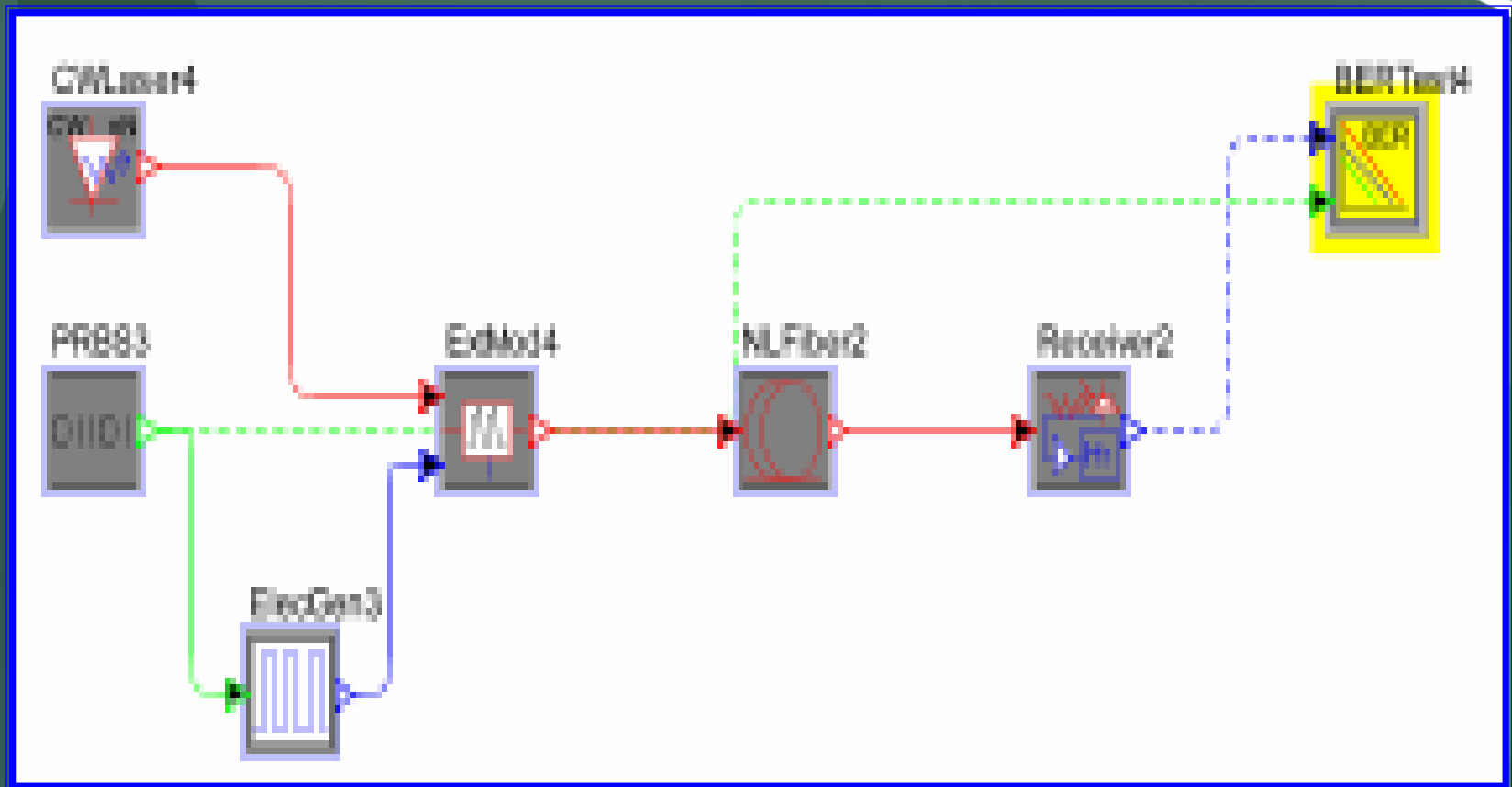
Case Study

- Take the example of a simple transmission system with following specs:
 - Tx (Laser)
 - Modulator
 - Transmission Media (Fiber)
 - Rx (Photodiode)
 - Performance Analyzer Tool (BER Tester)

Step 1: Create Project in Block Mode



Step 2: Design Model/Schematic



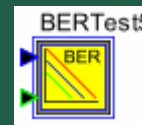
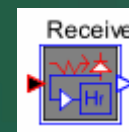
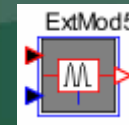
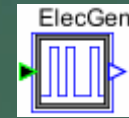
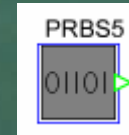
Components

- PRBS Generator
- Electrical Generator
- CW Laser

- External Modulator
- Fiber
- Receiver

Plotting Components

- **BER Tester**



Step 3: Select Parameters

- Laser
 - **Output Power = 4.7 dBm (Approx)**
 - **Wavelength = 1480 nm**
 - **Linewidth = 0.1nm**
- Fiber
 - Length = 10Km
 - Loss / km = 0.25 dB
- Receiver
 - Quantum Efficiency = 0.85

Step 4: Run the Simulation

The screenshot displays the OptSim software interface. The main window title is "OptSim - C:\RSoft\products\optsim\block_mode\projects\case_study.moml". The menu bar includes File, Edit, View, Options, Run, Graph, Logging, Utilities, Connect, Window, and Help. The Run menu is open, showing options: Go ... (F5), Pause, Stop, Scan Variable ... (F4), Setup Scan ..., Simulation Parameters (Ctrl+I), and Animation. The left sidebar contains "All Models" and "Sample-Mode Models" sections. Under "Sample-Mode Models", "Block-Mode Models" is expanded to show "Signal Generators", "Electrical Modules", "Special Functions", and "Optical Sources and Modulators". The "Optical Sources and Modulators" section is further expanded to show "Direct-Modulated Laser" and "Mode-Locked Laser". Below this, a list of components includes "Compound Optical Receiver", "Nonlinear Fiber", "Optical Filter", "XY Plotter", "Eye Diagram Analyzer", "Transient Plotter", "CW Laser", "Physical EDFA", "Black Box Amplifier", "PRBS Generator", and "Electrical Signal Generator". The main workspace shows a circuit diagram with components: CWLaser1, PRBS1, Mod1, ElecGen, Fiber1, Receiver1, and BERTest1. The diagram is connected by red and green lines. The bottom status bar shows "Case Study.moml" and "case_study.moml".

Step 5: View Results/Validate

RUN#	BER	BER_lo	BER_hi
1	8.8266e-055	1.2298e-059	3.8846e-050

After viewing the output using BER Tester we found out that 8.826e-55 is very good result



Thank You!