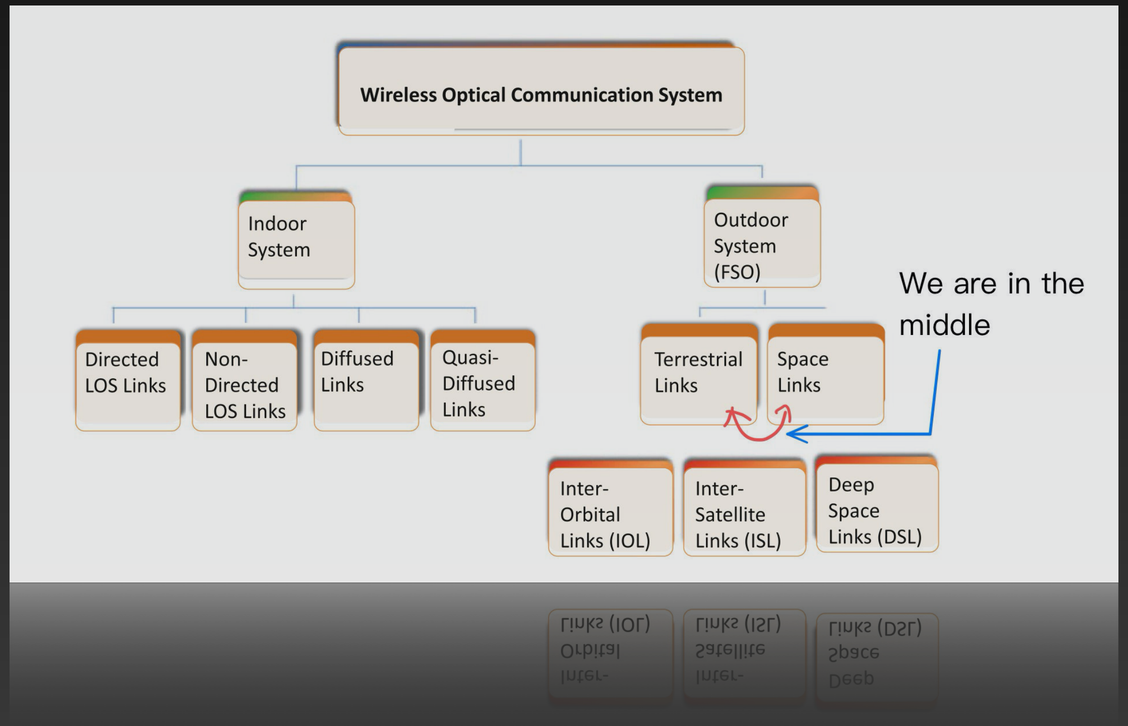
FSO communication system

Group 3

Longqian Huang 2020.7.30

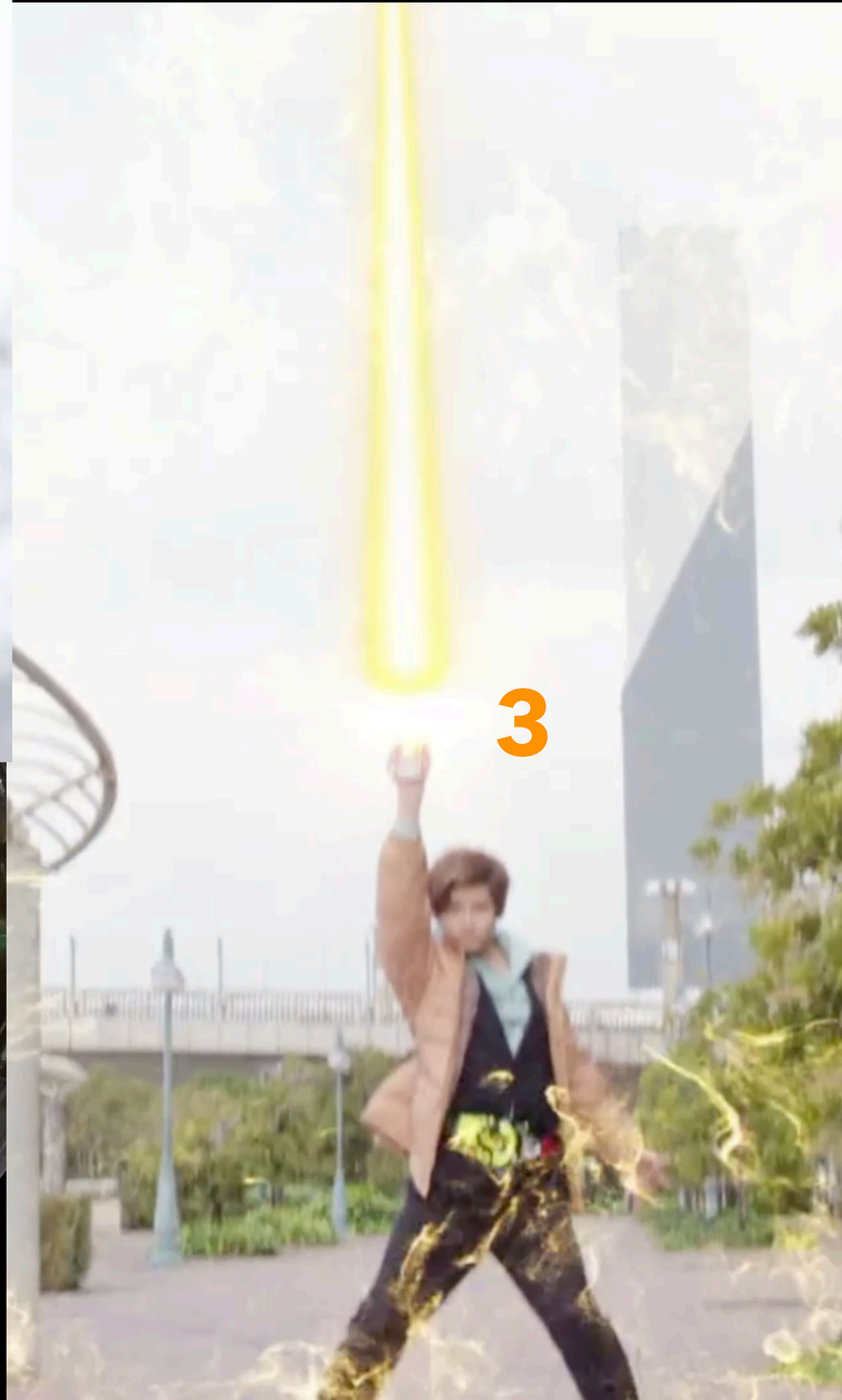
What we are doing?

- A Free Space Optical Communication System (FSOCS)
- To be more specific , we want to make a Ground-to-Satellite FSOCS




腾讯视频 纯播

强化升级



4 Questions

Wavelength to use ?

- 1550 nm [1]

- Reduce background noise and Rayleigh scattering
- High transmitter power
- Eye-save wavelength

[1] Kaushal H, Jain V K, Kar S. Free space optical communication[M]. Gurgaon, Haryana: Springer, 2017.

LED or Laser ?

- CW Laser

- We don’t believe LED’s light can survive after 100km’s traveling

Laser Type ?

- Fiber Laser [2]

- High optical gain (long active regions)
- Compact
- Faster

[2] https://www.wikiwand.com/en/Fiber_laser

Modulator ?

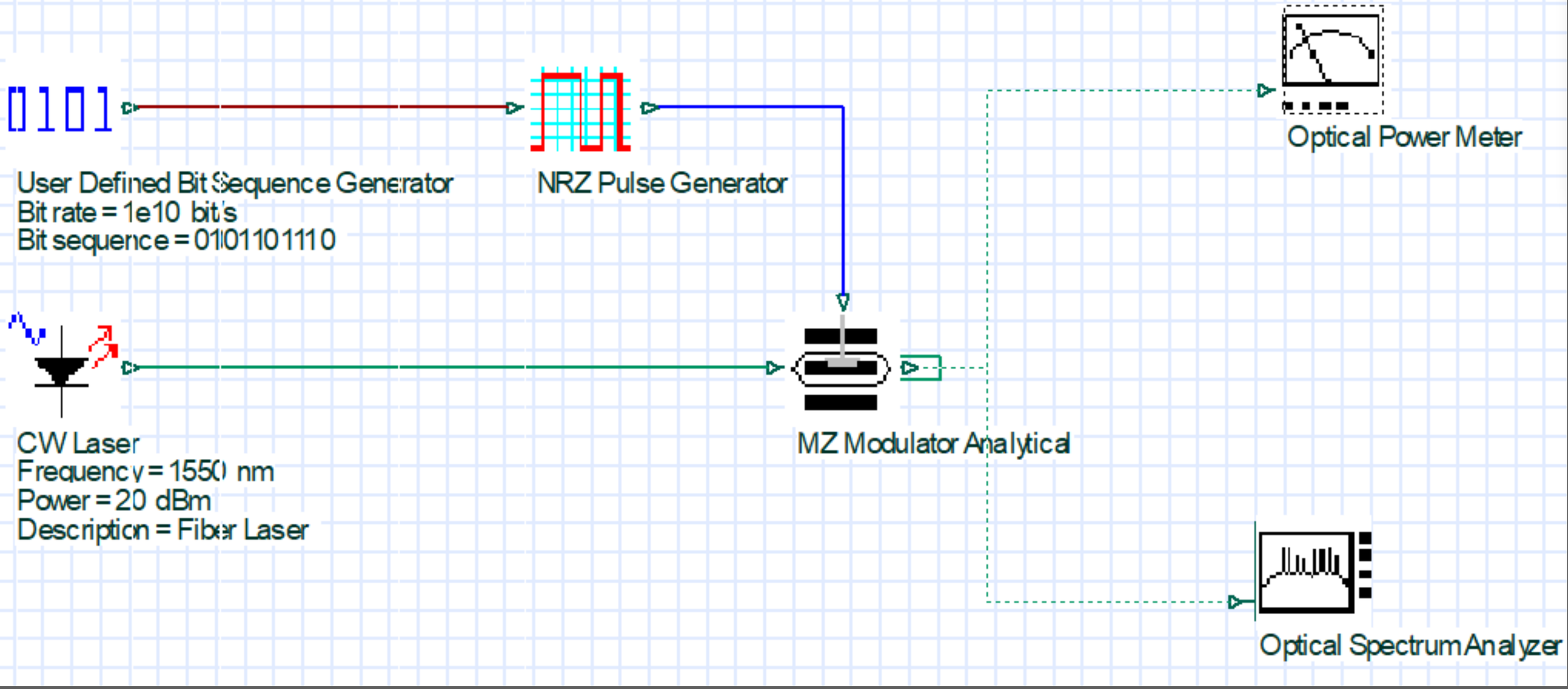
- Electro-optic modulator [3]
- More specific : $LiNbO_3$ Mach-Zehnder Modulator

- Nice performance
- Mature technology

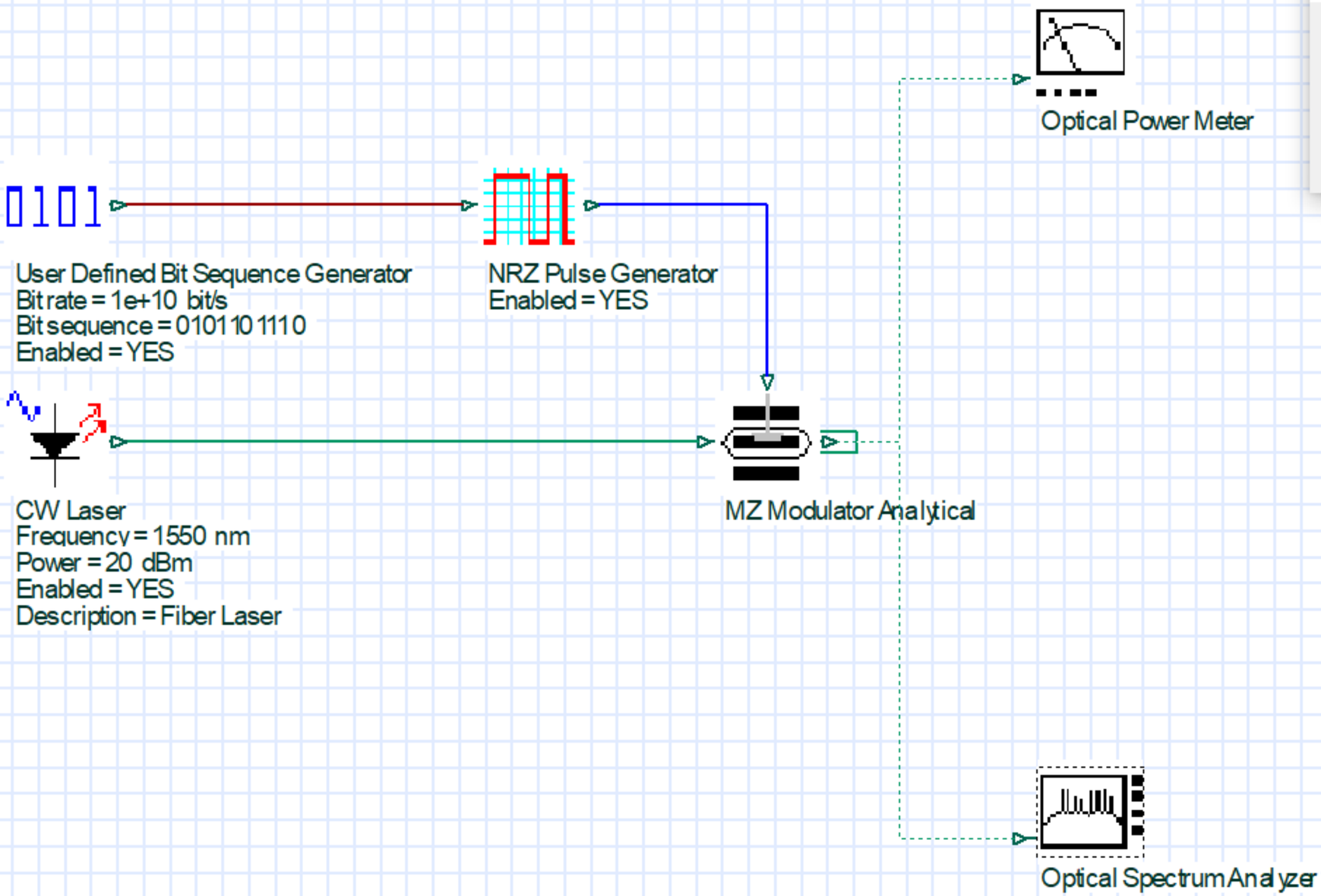
[3] https://www.wikiwand.com/en/Electro-optic_modulator

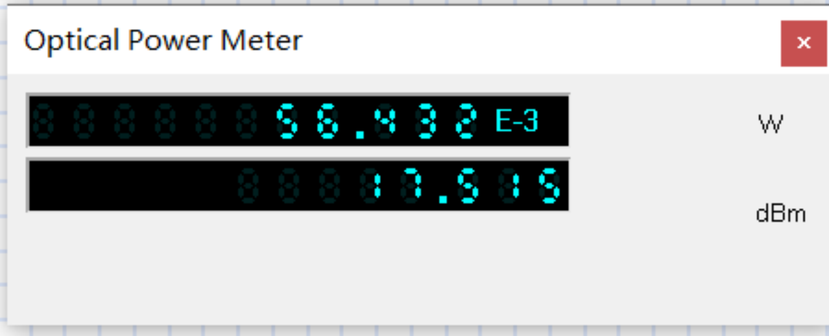
Optical Transmitter

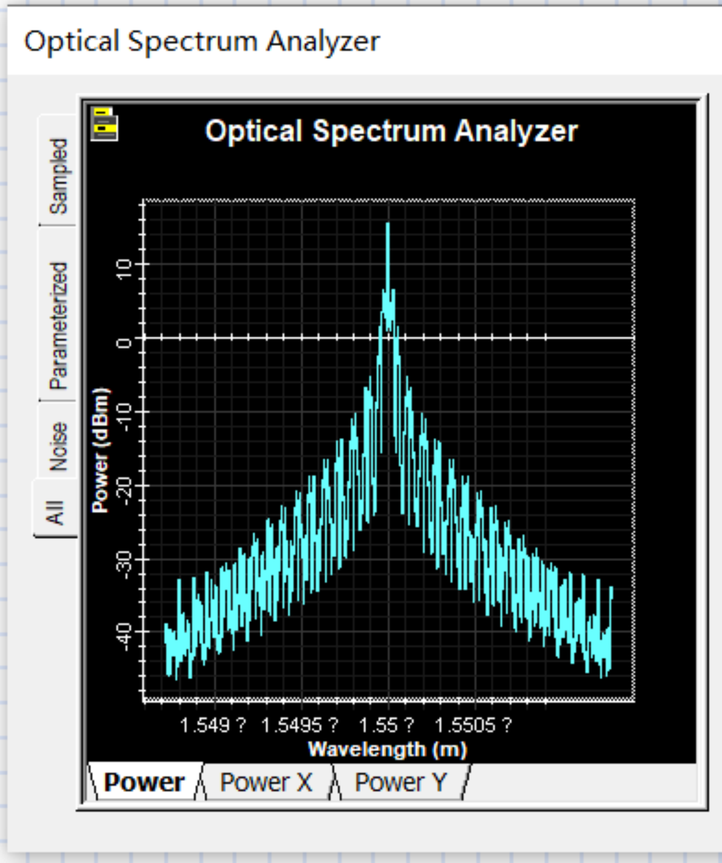
Transmitter Layout



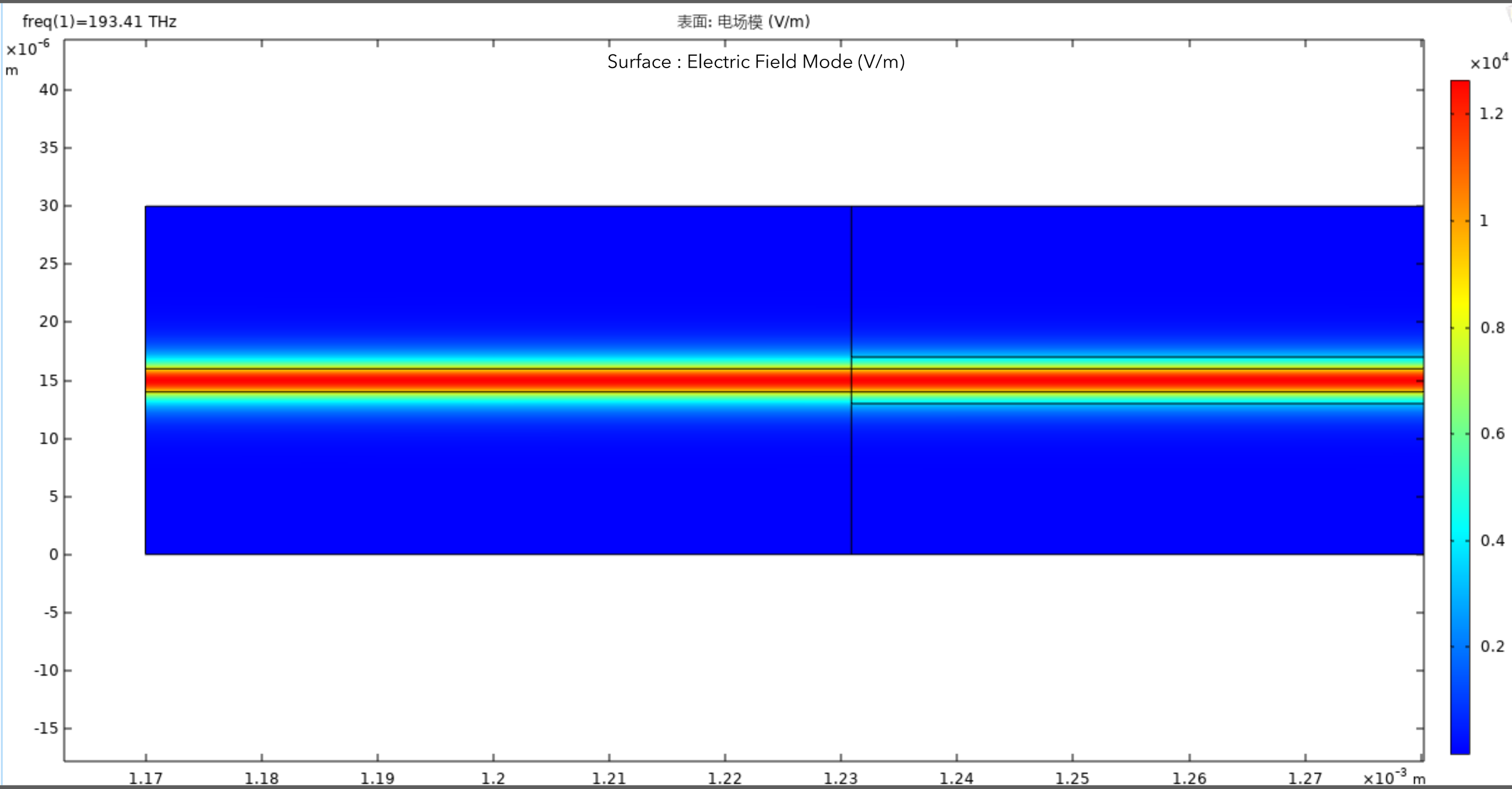
Simulation Result





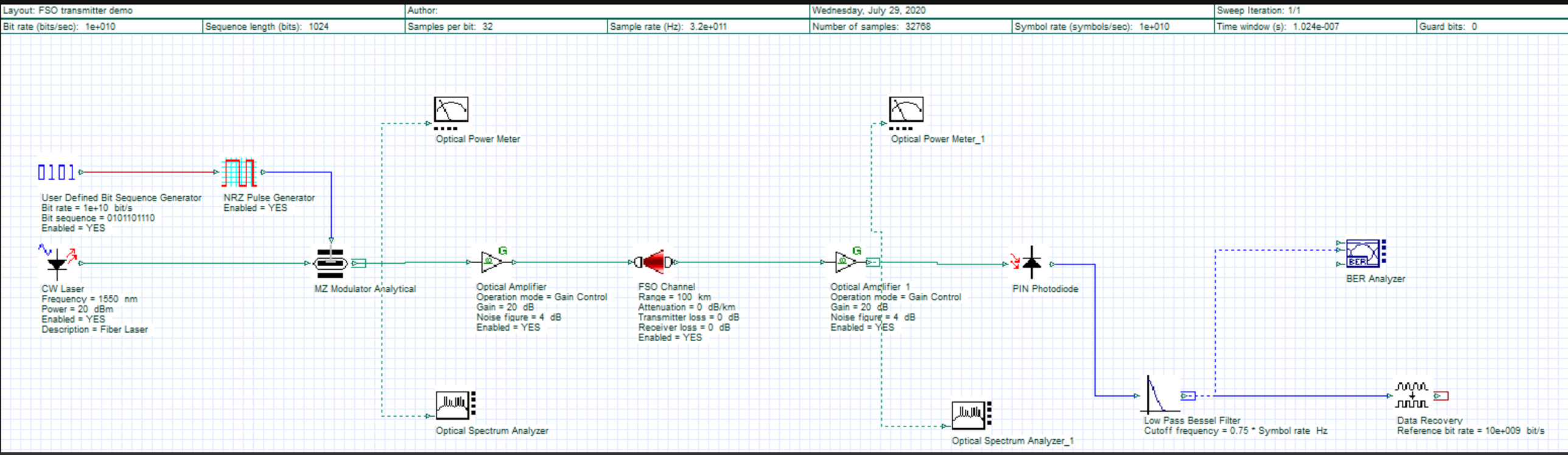


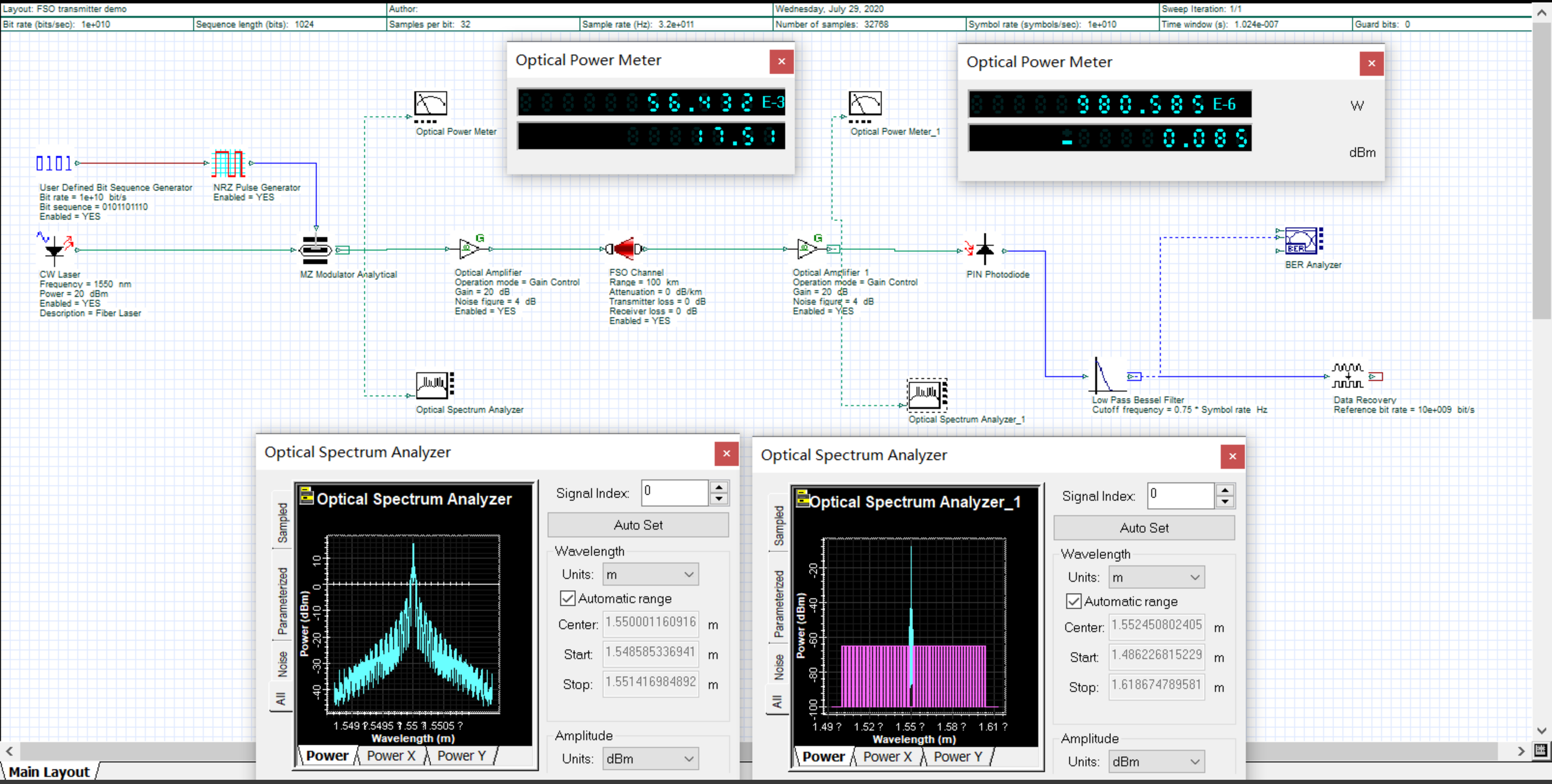
Internal electric field simulation


freq(1)=193.41 THz
表面: 电场模 (V/m)
Surface : Electric Field Mode (V/m)
×10^-6 m
40
35
30
25
20
15
10
5
0
-5
-10
-15
1.17
1.18
1.19
1.2
1.21
1.22
1.23
1.24
1.25
1.26
1.27
×10^-3 m
×10^4
1.2
1
0.8
0.6
0.4
0.2

FSO communication system (demo)

FSOCS demo layout




Layout: FSO transmitter demo
Author:
Wednesday, July 29, 2020
Sweep Iteration: 1/1
Bit rate (bits/sec): 1e+010
Sequence length (bits): 1024
Samples per bit: 32
Sample rate (Hz): 3.2e+011
Number of samples: 32768
Symbol rate (symbols/sec): 1e+010
Time window (s): 1.024e-007
Guard bits: 0
Optical Power Meter
56.432 E-3
Optical Power Meter_1
980.585 E-6
W
-0.085
dBm
User Defined Bit Sequence Generator
Bit rate = 1e+10 bit/s
Bit sequence = 0101101110
Enabled = YES
NRZ Pulse Generator
Enabled = YES
CW Laser
Frequency = 1550 nm
Power = 20 dBm
Enabled = YES
Description = Fiber Laser
MZ Modulator Analytical
Optical Amplifier
Operation mode = Gain Control
Gain = 20 dB
Noise figure = 4 dB
Enabled = YES
FSO Channel
Range = 100 km
Attenuation = 0 dB/km
Transmitter loss = 0 dB
Receiver loss = 0 dB
Enabled = YES
Optical Amplifier 1
Operation mode = Gain Control
Gain = 20 dB
Noise figure = 4 dB
Enabled = YES
PIN Photodiode
BER Analyzer
Optical Spectrum Analyzer
Optical Spectrum Analyzer_1
Low Pass Bessel Filter
Cutoff frequency = 0.75 * Symbol rate Hz
Data Recovery
Reference bit rate = 10e+009 bit/s
Optical Spectrum Analyzer
Optical Spectrum Analyzer
Sampled
Parameterized
Noise
All
Power (dBm)
Wavelength (m)
Power
Power X
Power Y
Signal Index:
Auto Set
Wavelength
Units:
Automatic range
Center:
Start:
Stop:
Amplitude
Units:
Optical Spectrum Analyzer_1
Optical Spectrum Analyzer_1
Signal Index:
Auto Set
Wavelength
Units:
Automatic range
Center: 1.552450802405 m
Start: 1.486226815229 m
Stop: 1.618674789581 m
Amplitude
Units:
Main Layout

Division of work

Longqian Huang: Host discussion, OptiSystem simulation, Integration

Jinquan Shi, Yiru Pan: COMSOL simulation

Liang Sun, Yuxuan Liu, Junchi Feng,

Yuhao Ma, Zhuo Cheng, Dongao Cui,

Muxi Zhao: Searching, Reading and Completing the four questions regarding Optical Transmitter

Thanks !