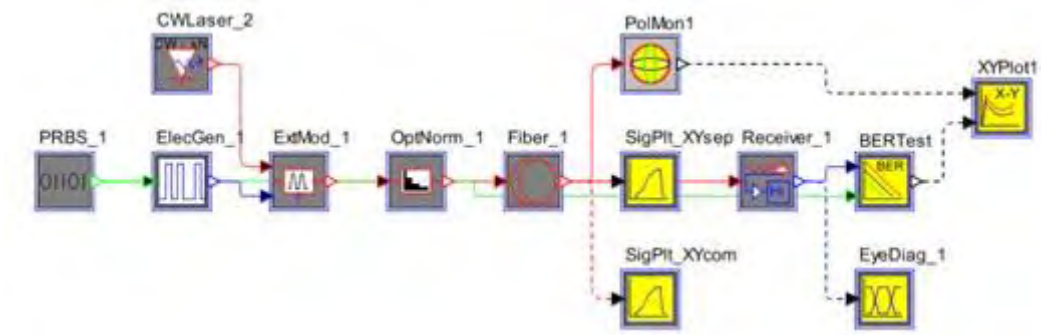
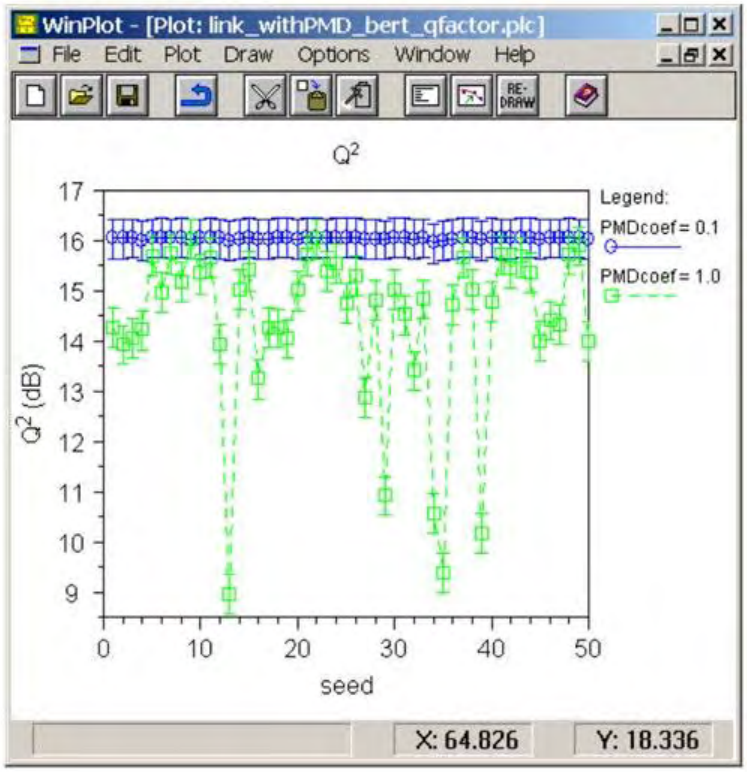
Polarization Mode Dispersion (PMD) Induced Penalties in High Bit-Rate Systems

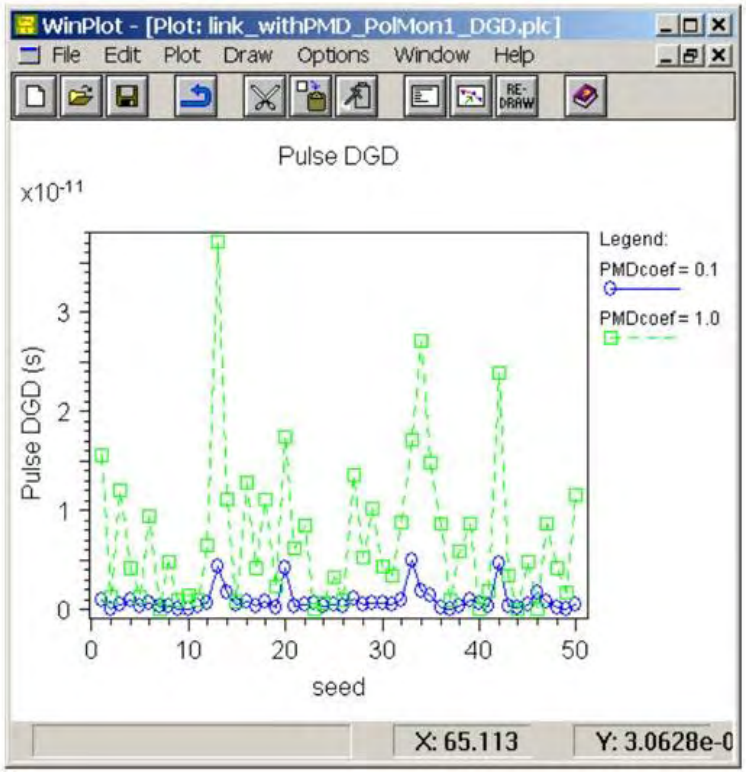
Tool Used: OptSim

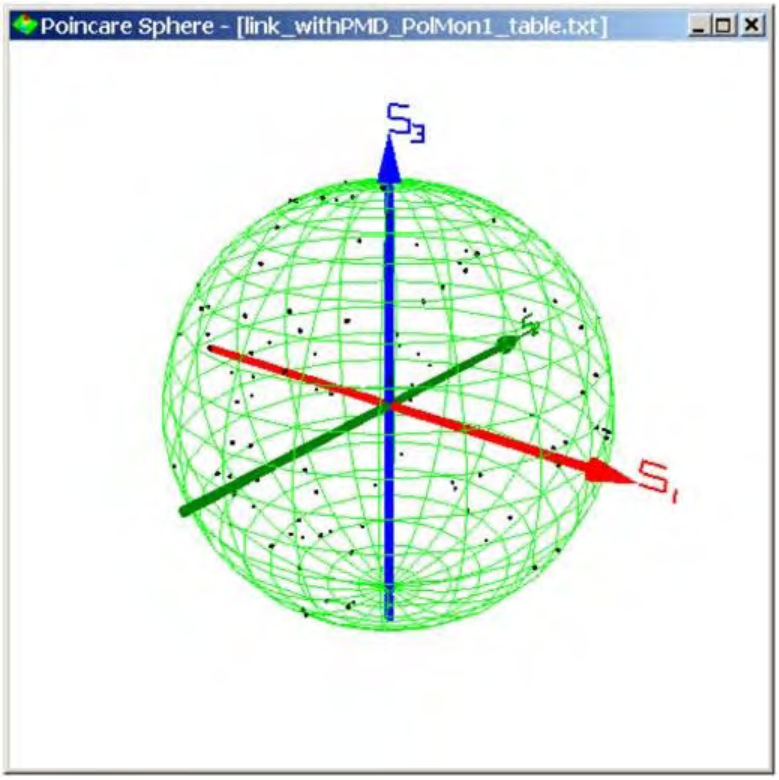
This example demonstrates the effect that Polarization Mode Dispersion (PMD) has on signal propagation in a fiber and on system performance. The setup is shown below:

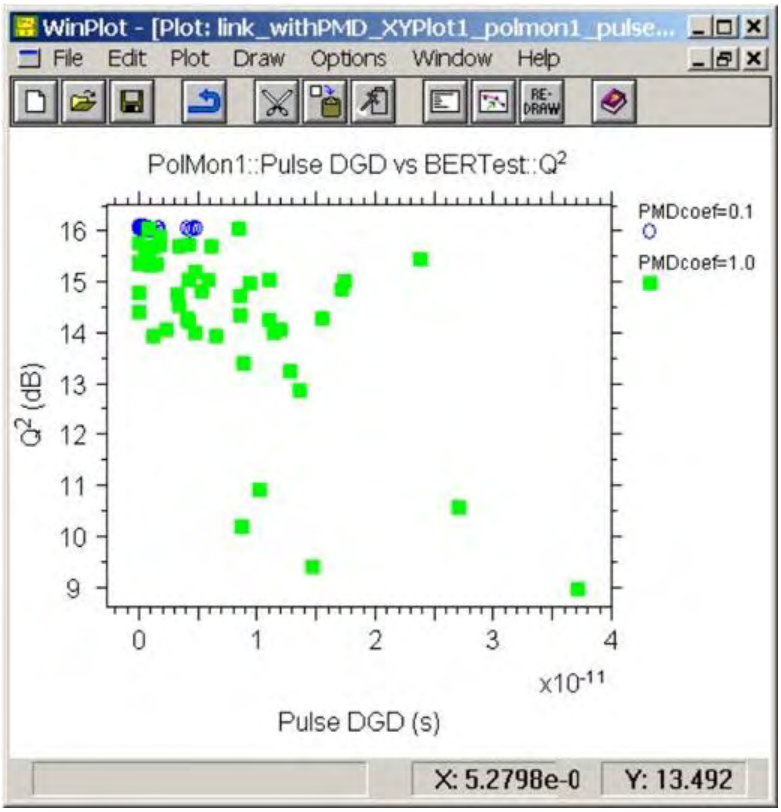


For this setup, a transmitter consists of a 40-Gbps PRBS generator, CW Laser source at 1550 nm, electrical driver, external modulator, and optical power normalizer. A 40-Gbps RZ-modulated signal then is launched into a fiber span. The output from the fiber span is inserted into a receiver. PMD is a statistical effect caused by randomly varying fiber birefringence, therefore the simulation results will be different for different settings of the random seed parameter. PMD causes differential group delay (DGD) between x- and y- polarization components during propagation in fiber, and, hence, eye distortion at the receiver. One can run a parameter scan to obtain DGD and BER/Q for different values of the PMD coefficient and different random seeds. After the simulation run is finished one can double-click on various analysis blocks to view the signal plot, eye diagram, DGD, Stokes parameters on Poincare Sphere, and BER/Q values as shown in the following series of figures:


WinPlot - [Plot: link_withPMD_bert_qfactor.plc]
File Edit Plot Draw Options Window Help
Q²
Q² (dB)
seed
Legend:
PMDcoef = 0.1
PMDcoef = 1.0
X: 64.826
Y: 18.336

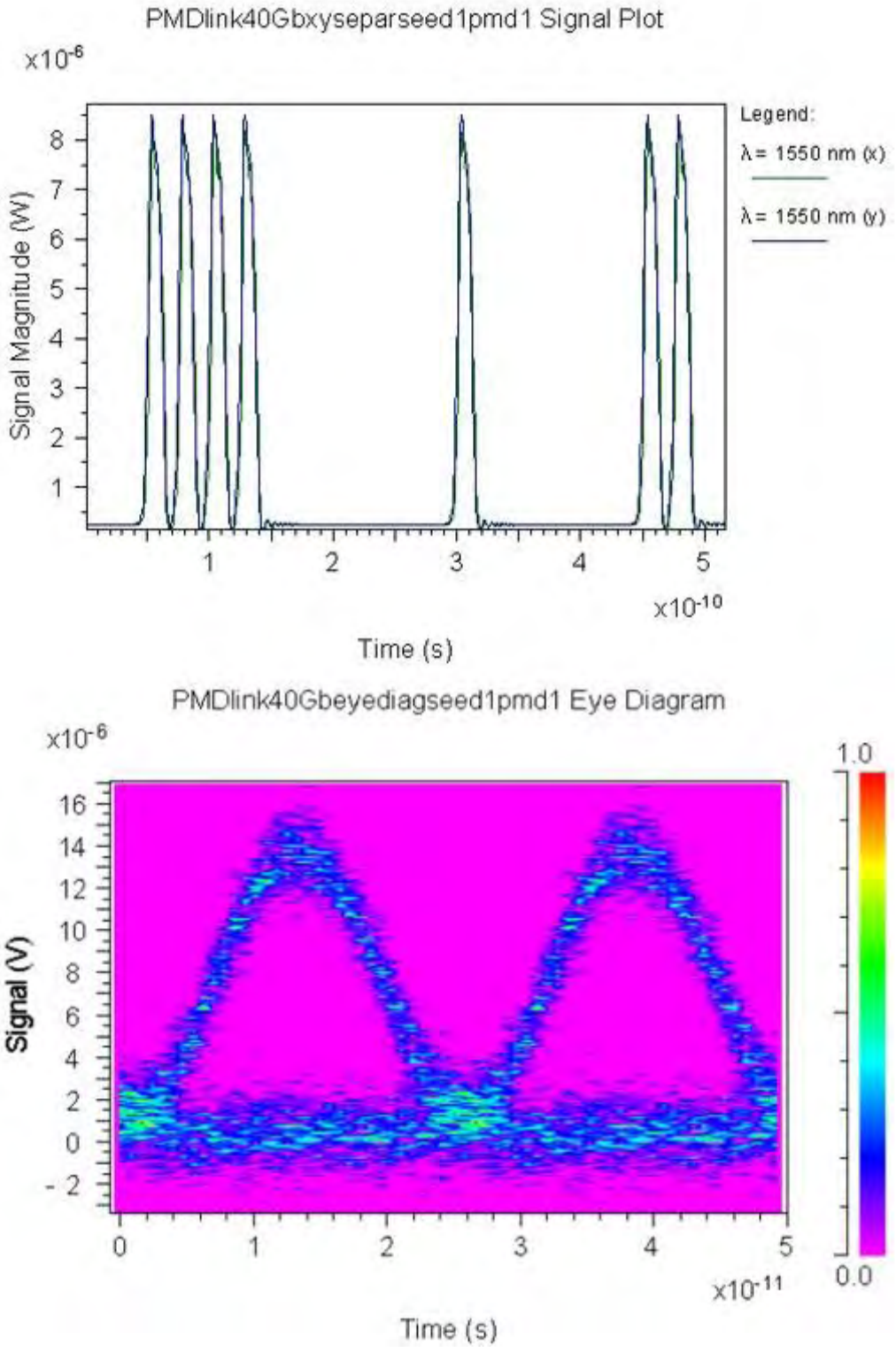

WinPlot - [Plot: link_withPMD_PolMon1_DGD.plc]
File Edit Plot Draw Options Window Help
Pulse DGD
x10-11
Pulse DGD (s)
seed
Legend:
PMDcoef = 0.1
PMDcoef = 1.0
X: 65.113
Y: 3.0628e-0



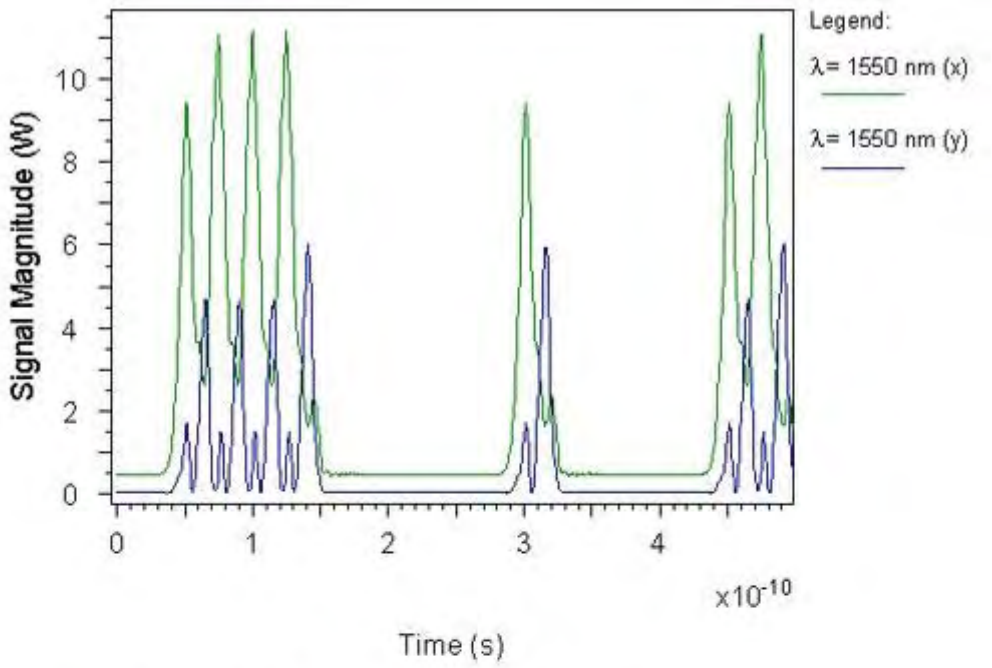


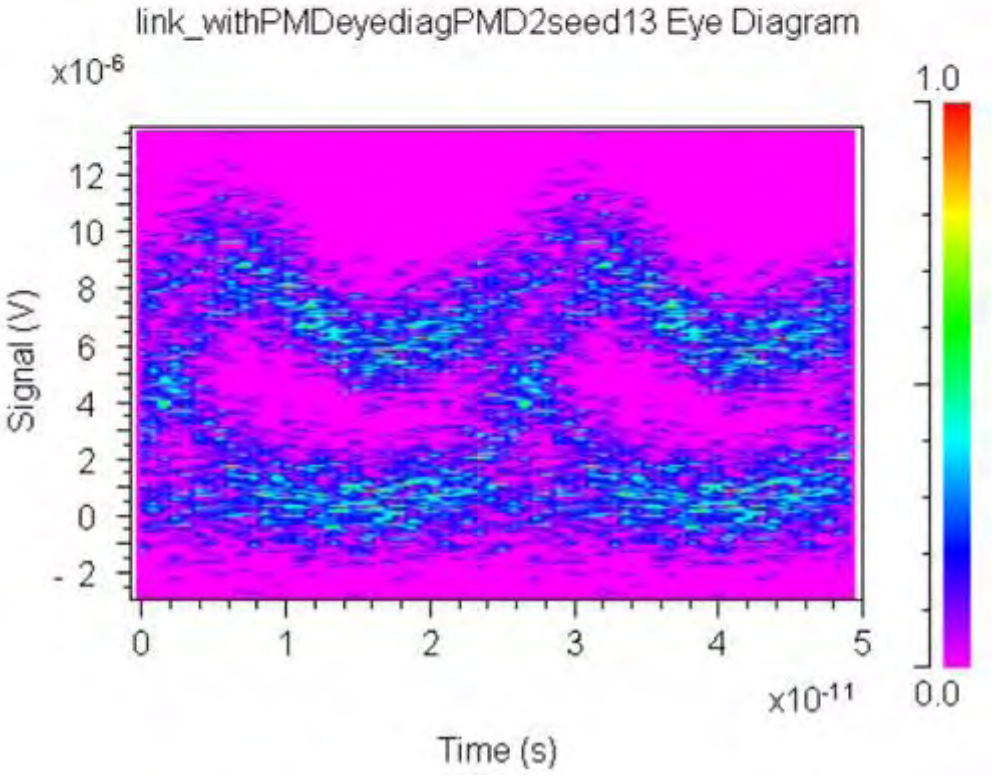
Let us take a look at two particular runs:

(a) best case for low-PMD fiber; Figure below shows corresponding signal plots and eye diagrams. Corresponding Q-factor (and BER) is 16.0 dB (1.0E-10).



(b) worst case for high-PMD fiber. Figure below shows corresponding signal plots and eye diagrams. Corresponding Q-factor (and BER) is 9.0 dB (2.5E-3).





In conclusion, the PMD-induced differential group delay degrades system performance with penalties more severe at higher bit rates and higher PMD coefficients in fibers.