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Effect of Self- Phase Modulation on WDM link

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Abstract

The need of high data rates, bandwidth and communication distance is increased by optical fiber communication technology. But at the high power levels some nonlinear effects are induced in the fiber. But SPM nonlinear effects are occurs at low power level less than 10mw. These effects degrade the performance of the system. The optsim simulation tool is used to analyze the Q-factor and BER of SPM nonlinear effect by varying dispersion parameter from 0 ps/nm/km to 16 ps/km/nm of fiber through eye diagrams.

Keywords- *BER, DWDM, FWM, ICI, ISI, SPM, Q-factor, XPM*

I. INTRODUCTION

The optical fiber communication fulfills the today's demand of higher data communication rates with minimum losses. During the data transmission in the optical fiber many nonlinear effects taking place [3]. These nonlinear effects are SPM, FWM and XPM. But SPM capture special attention because it is the reason of XPM nonlinear effect [1]. These nonlinear effects in the optical system induce inter symbol interference (ISI) and inter channel interference (ICI) [2]. So DWDM type optical systems are used to reduce the cost and increase the efficiency of telecommunication system [6]. SPM is the self phase modulation in which transmitting signal itself modulates the phase of the signal [. Normally nonlinear effects are occurs at high power levels but SPM effects are occurs at low power levels below 10mw [1]. The benefit of the self-phase modulation is that it motivated spectral progression of signals propagating in extremely non-linear media [5]. These SPM effects are analyzed by varying dispersion of the optical fiber and evaluate the value of Q-factor and BER effects. The SPM and XPM effects are occurred at ultrafast time scale less than 10fs because of the fiber nonlinearity non resonant nature. SPM broadens the spectral width, so optical filter is used to select the peak from the broaden spectrum [4].

II. SYSTEM DESCRIPTION

The analysis of SPM is simulated by using the software optsim simulation tool. The optsim is the Optimization and simulation consulting (optsim) software tool used for simulating and designing optical fiber systems. This simulation tool results are very accurate and efficient. I analyzed the SPM effects in sample mode of optsim simulation tool. The WDM link is consists of three sections transmitter section, link section and receiver section. The transmitter sections contain PRBS generator, laser, NRZ cosine driver and MZM modulator. The link section links the transmitter and receiver section. The receiver section contains sensitivity receiver, Q-factor estimator, BER estimator and electrical scope.

III. SIMULATION WORK OF SPM

The transmitter section frequency is set to 1552nm. The optical fiber parameter dispersion value is varied from 0ps/nm/km to 16ps/nm/km.

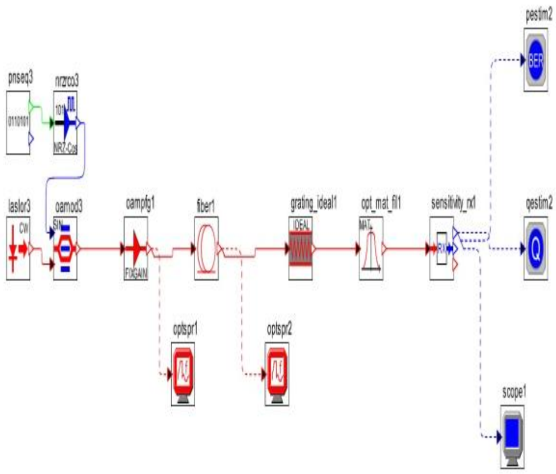

Fig-1"Simulation Setup of Self Phase Modulation"

IV. RESULTS AND DISCUSSION

The results and discussions defined the information of Q-factor and BER by varying the value of dispersion. The Inter Symbol Interference (ISI) and inter channel interference causes the variation the Q-factor and BER by varying dispersion. When value of dispersion is increased this reduces the value of Q-factor and increases the BER values; so various mitigation techniques are used to compensate these effects by using dispersion compensation techniques.

The Input Optical Spectrum Analyzer (or OSA) is used to analyze the input signal generated after modulation. This gives quantified input frequency signal.

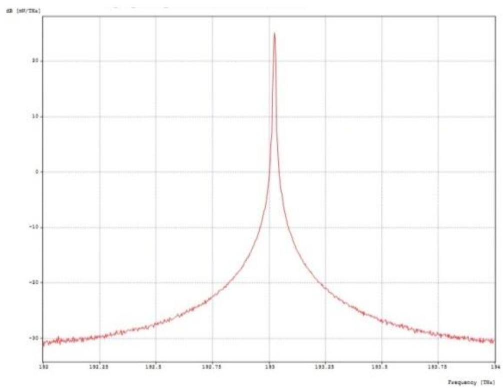

Fig-2"Input Signal from Input Optical Spectrum Analyzer"

The output Optical Spectrum Analyzer (or OSA) is used to analyze the output signal generated after fiber. This gives quantified input frequency signal.

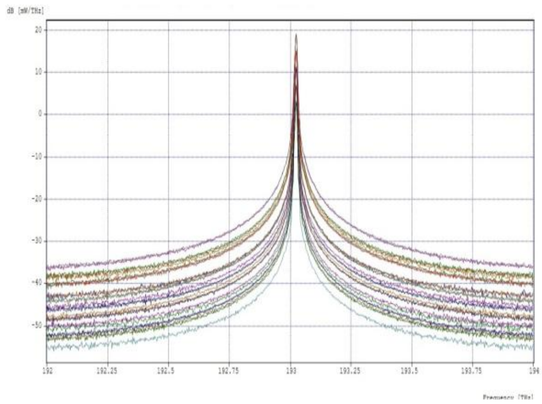

Fig-3"Output Signal from Output Optical Spectrum Analyzer"

Table-1 Dispersion as Variable and Power, Length Constant

PARAMETER	PARAMTER 1	PARAMETER 2	PARAMETER 3
RUN#	POWER	DISPERSION	LENGTH
RUN 1	3	0	70
RUN 2	3	4	70
RUN 3	3	8	70
RUN 4	3	12	70
RUN 5	3	16	70
RUN 6	6	0	70
RUN 7	6	4	70
RUN 8	6	8	70
RUN 9	6	12	70
RUN 10	6	16	70
RUN 11	9	0	70
RUN 12	9	4	70
RUN 13	9	8	70
RUN 14	9	12	70
RUN 15	9	16	70
RUN 16	12	0	70
RUN 17	12	4	70
RUN 18	12	8	70
RUN 19	12	12	70
RUN 20	12	16	70
RUN 21	15	0	70
RUN 22	15	4	70
RUN 23	15	8	70
RUN 24	15	12	70
RUN 25	15	16	70

The opening of eye diagrams defined the value of Q-factor and BER variation of self-phase modulation through electrical scope. Q-estimator is used to estimate the value of Q-factor; it should be 16 in dB and BER-estimator is used to estimate the value of BER; it should be less than or equal to 10^{-9} for better performance of optical system.

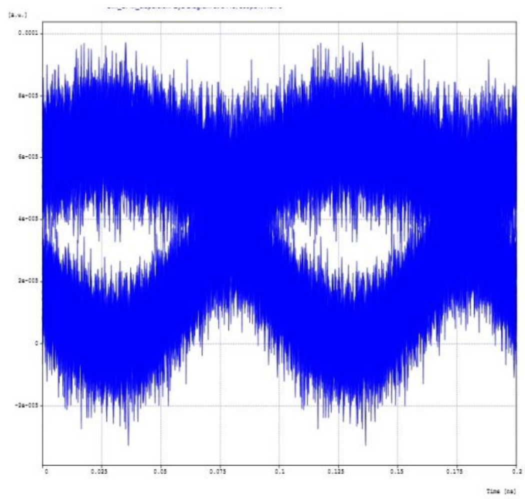

Figure- 4.1(a) the Eye Opening of Eye Diagram at Power 3mw, Dispersion 16ps/nm/km and Length 70km.

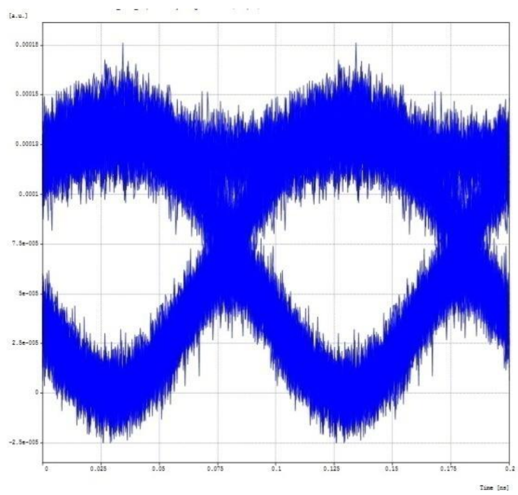

Figure- 4.2 (b) The Eye Opening of Eye Diagram at Power 3mw, Dispersion 16ps/nm/km and Length 70km.

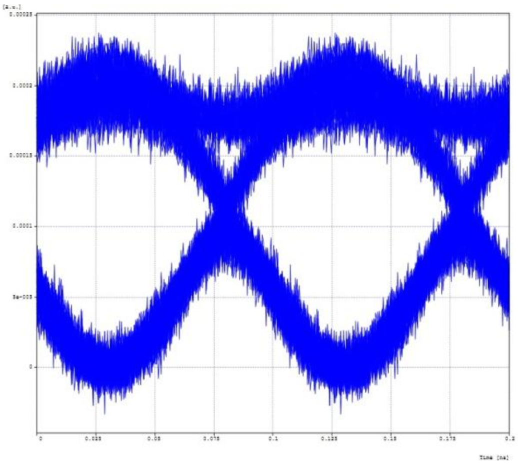

Figure- 4.3(c) The Eye Opening of Eye Diagram at Power 3mw, Dispersion 16ps/nm/km and Length 70km.

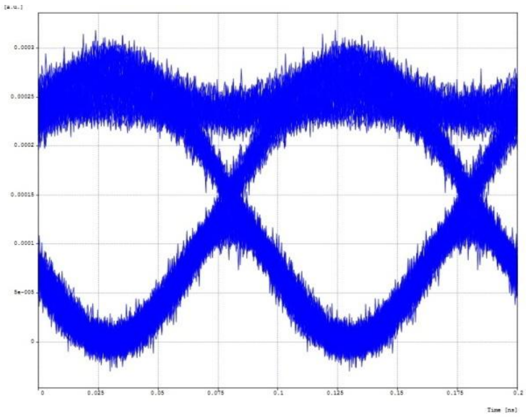

Figure- 4.4(d) The Eye Opening of Eye Diagram at Power 3mw, Dispersion 16ps/nm/km and Length 70km.

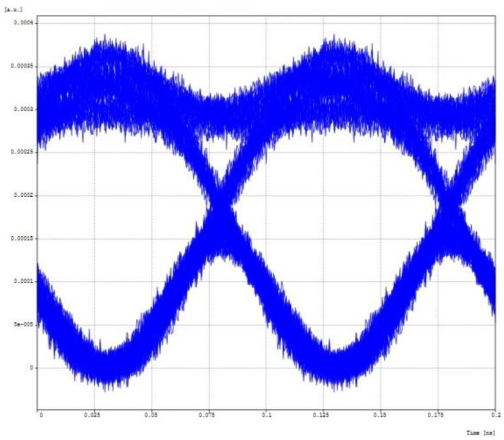

Figure- 4.5(e) the Eye Opening of Eye Diagram at Power 3mw, Dispersion 16ps/nm/km and Length 70km.

Q-Factor

The value of q-factor decreases as we increase dispersion and power, length constant at certain value.

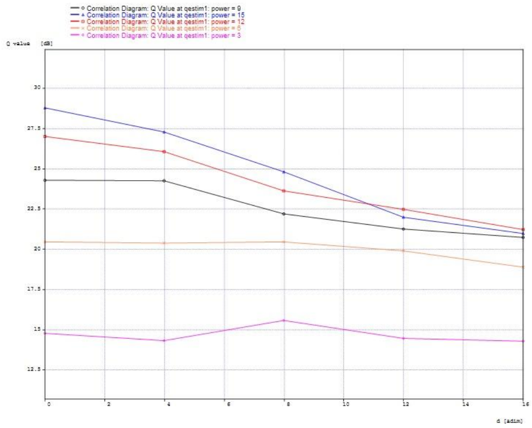

Fig-4.1 (f) "Q-Factor vs. Dispersion"

BER

The value of ber increases as we increase the dispersion; power and length constant at certain value.

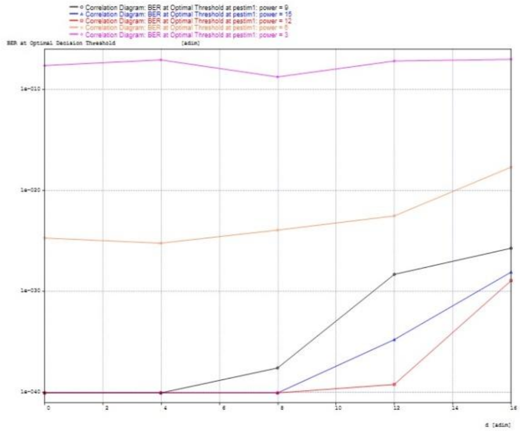

Fig-4.1 (g) "BER vs. Dispersion"

V. CONCLUSION

SPM shows different effects with varying dispersion parameter of optical fiber. When we increase dispersion it decreases Q-factor value and increases BER value. But when we increase power it increases Q-factor values and decreases BER values.

REFERENCES

[1] Govind P. Agrawal (2007), " Self-Phase Modulation in Optical Fiber Communications: Good or Bad?"
[2] G.P. Agarwal (2002), "fiber optic communication system ", 3rd edition, New York: Wiley.
[3] Sharddha N.Bhusari, Vikas U.Deshmukh(2016), "Analysis of Self-Phase Modulation and Four-Wave Mixing in Fiber Optic Communication".
[4] Ozdal Boyraz, Tejaswi Indukuri, and Bahram Jalali (2004), "Self-phase-modulation induced spectral broadening in silicon waveguides".
[5] Clément Courvoisier, Julien Fatome and Christophe Finot (2011),"All-Optical Measurement of Residual Chromatic Dispersion and OSNR Using Self-Phase Modulation in Optical Fiber".
[6] Olga Reshetnikova, Vikas U. Deshmukh (2012), "Influence of Optical Signal Self-Phase Modulation on a Channels Quality of DWDM System".