DEMONSTRATION OF OPTICAL NAND GATE

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INTRODUCTION

This is the novel dual wavelength operated all optical logic gate. This method makes use of bi-directional coupler with unequal lengths of waveguide to couple the light from one port to another there by optical phenomenon occurs.

BASIC IDEA

When light travels inside the medium, its property changes due to the parameters of the medium. When two optical beam of same wavelength travels with a constant phase difference, they interfere each other.

Light interaction are of two types

1. Constructive Interference
2. Destructive Interference

When the path length of optical beam is controlled we can get dedicated constructive and destructive interferences. So we are controlling the path length of optical beam such that it will give output as optical logical operation.

PRINCIPLE

- We are using two waveguide of different path lengths, which are giving different phases for different wavelengths.
- Here, we are using two wavelengths, for them phase differences are different.
- First is for constructive interference and second one is for destructive interference.
- So we are getting two different logics Logic 0 and logic 1.

Here, we are using bidirectional coupler using this we are making two wavelengths to interact each other. In optical beam splitter power is coupled from one port to another by using this coupling phenomenon we are getting optical operations. By choosing a controlled interaction length we can transfer half power into other guide, which is used for interference.

DIRECTIONAL COUPLER

Power at both the output ports is the function of interaction length z, which is a function of optical path length that depends on wavelength.

$$P_1 = P_0 \frac{\kappa^2}{\gamma^2} cos^2 \gamma z$$

$$P_2 = P_0 \frac{\kappa^2}{\gamma^2} sin^2 \gamma z$$

If input wavelength is varying then optical path length will vary and interaction length will also vary. Because power transfer is depending upon wave vector and wave vector is depending upon the wavelength.

WORKING

1. A signal of λ_1, if applied device will work as 3 dB beam splitter, this will give logic 1 as shown in Fig. 2a.
2. A signal of λ_1, if applied device will work as 3 dB beam splitter, this will give logic 1 as shown in Fig. 2a.
3. When a signal of λ_1, is applied at both input ports this will give output corresponds to logic 1
4. When a signal of λ_2, is applied at both input ports 1 and 2, minimum power will follow the path of port 3. This will refer as logic 0, which is represented in Fig. 2d.

SIMULATION RESULTS

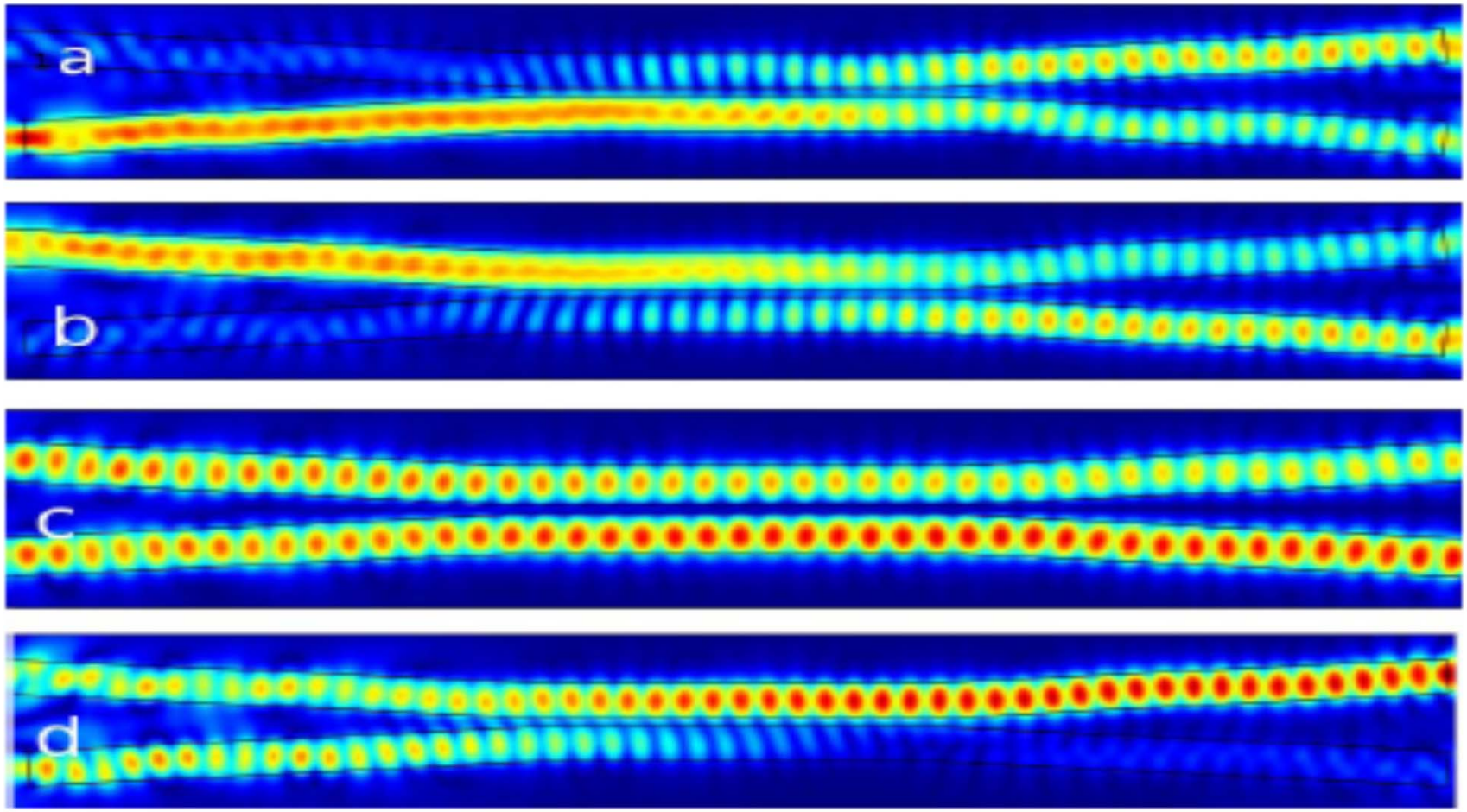

Figure 3. Simulation Result Of NAND Gate

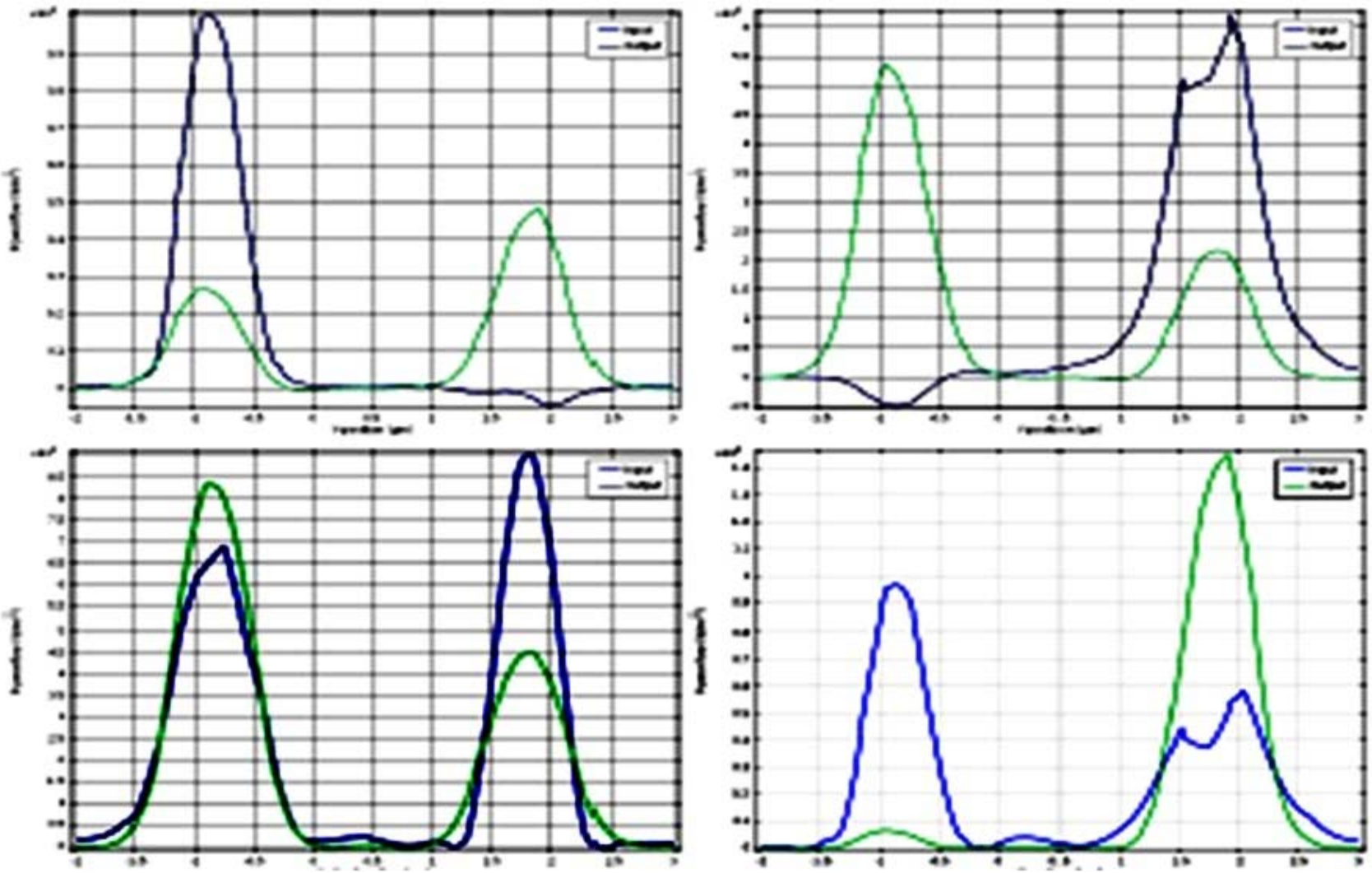

Figure 4. 1D Simulation Result

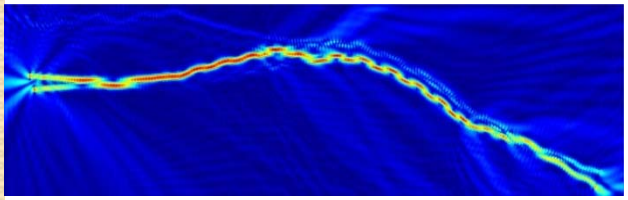

Figure 5.a

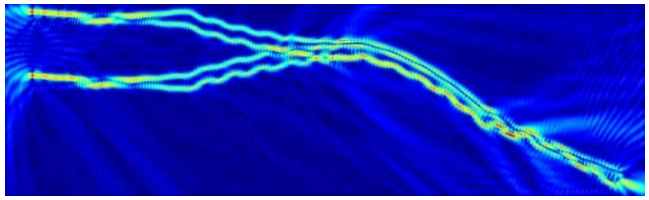

Figure 5.b

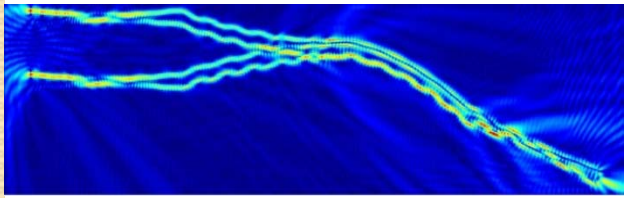

Figure 5.c

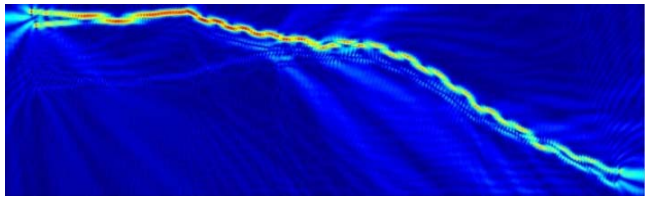

Figure 5.d

Figure 5. Simulation Result Of AND Gate

Figure 5.a	Output of logic 00
Figure 5.b	Output of logic 01
Figure 5.c	Output of logic 10
Figure 5.d	Output of logic 11

CONCLUSION

- In conclusion we proposed a novel method for all optical logic operation using simple bi-directional coupler with unequal length of waveguides.
- The simulated results show that the logic operation is possible.
- The truth table established shows the NAND logic operation.

FUTURE SCOPE

- Since we proposed NAND GATE, which is universal gate so all other gate could be made by using this and all the logic operator can be make by using this.
- Since the logic operations are performed with all optical circuits without the help of any electronic system, ultrafast operations of the order of hundreds of THz could be possible

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Thank you