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Comments on: Optical computation based on nonlinear total reflectional optical switch at the interface

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Abstract. As we read the paper by Jianqi Zhang and Huan Xu, *Pramana – J. Phys*. **72**, 547 (2009), two issues became clear, that warranted writing this comment. First, the switch, which is the main building block of the devices, and which is used to route the signal, does not work as explained in Section 4.1. Accordingly, the optical router does not work as explained, either. In addition, the half adder does not work as explained and a completely different Truth Table is obtained. The full adder is left to the reader as an exercise. Secondly, the previously published work, which is closely related to the work reported, was not referenced or discussed. In the following paragraphs we discuss each issue in some detail to give the authors the opportunity to better explain their work and clear such issues.

Keywords. Optical computing; beam splitter; optical switch; polarized beams.

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The switch: In Section 4.1, one reads;

1. "The procedure can be described like this: when both A and B are the horizontal polarization light beams, nonlinear effect will only happen in the optical switch 1, the circularly polarized light beams will propagate along the path F (figure 2a)."

This means that when the switch (NM1) is exposed to the polarized light beam(s), it allows the circularly polarized beam to go straight through the switch, and accordingly the router.

2. "when both A and B are the vertical polarization light beams, nonlinear effect will only take place in the optical switch 2, and the circularly polarized light beams will proceed along the path H (figure 2c)."

This means that when the switch (NM2) is exposed to the polarized light beam(s), it allows the circularly polarized beam to go straight through the switch, as before. And,

when the switch (NM1) is not exposed to the polarized light beam(s), it totally reflects the circularly polarized beam.

3. "otherwise the circularly polarized light beams will transmit along the path G (figure 2b)."

In this case, switch NM1 is exposed to the horizontally polarized light which allows the circularly polarized beam to go straight through the switch, as in Case 1 above. The circularly polarized beam will NOT, in this case, go through switch NM2. Therefore, path G cannot be travelled by the circularly polarized beam. Accordingly, figure 2b, is not correct.

As the router is based on routing the beam into three routes, and as we have just seen in (3) above, the beam can only be routed into two routes, then it does not function as described and what is based on it as the half and full adders will not function as described. In the next paragraph we discuss the case of the half adder.

Half adder: in Section 4.1, one continues to read

1. "The calculational terminal is constituted by two parts: one is the 50 : 50 beam splitters (BSs), the other is the polarizers. When the circularly polarized light beams cross a BS, they will be divided into two parts. These two beams will pass through two different polarizers independently. Each polarizer will change the circularly polarized light beam into a linear polarized light. The polarizers are fixed as in figure 3. Taking path H as an example, when the circularly polarized light beams transmit along path H, they will be divided into two circularly polarized light beams. In this case, the output beams will be vertical polarized beams and horizontal polarized beams after going through a vertical polarizer in terminal D and a horizontal polarizer in terminal C respectively."

    a. Path H is the route that cannot be taken by the circularly polarized beam, as discussed above.
    b. In figure 3, path H is where D is horizontally polarized and C is vertically polarized, the opposite of what is stated in the paper; see above.
    b. The information given in table 1 contradicts the information given in figures 2 and 3, and the explanation in the text.
    d. According to figures 2 and 3, and the explanation given above, table 2 should read as follows:

Line 1:	H	H	H	V	Path F (figure 3)
Line 2:	H	V	H	V	Path F (figure 3)
Line 3:	V	H	H	V	Path F (figure 3)
Line 4:	V	V	H	H	Path G (figure 3)

    e. The above Truth Table is not that of a half adder, as can be clearly seen.

Full adder can be examined precisely as the half adder. To limit the size of the communication, we leave this exercise to the reader.

Previously published work: In 2006 the Rail Road (RR) architecture was introduced to implement any binary logic circuit, where signal routing is based on polarization and each branch provides a different and independent polarization manipulation [1,2]. In 2007, using the introduced concepts, the RR-architecture-designs of the half and full optical binary adders were published [3], in addition to that of the threshold gates [4]. Also, in 2007, an invited paper on the subject was presented at an international conference on optics and photonics [5]. In 2009, a conceptually similar design of only two devices, half and full optical binary adders, was published by Zhang and Xu [6], where a probe beam was routed based on the signal polarization and presence, and each branch provides different and independent polarization manipulation. Note that it uses a different switch and that it was proposed two years later. Conceptually, with non-functioning devices, ref. [6] does not add tangible contributions in light of refs [1–5]. However, the main differences are the use of a different switch and additional components. It is clear that the RR architecture provides a methodology to implement any arbitrary Boolean function for any defined and arbitrary number of inputs and not only focussed on half and full adders.

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