Polarization properties of the nonlinear optical loop mirror with highly twisted fiber and a λ/4 plate birefringence bias

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Abstract: We investigate the operation of a power-symmetric Nonlinear Optical Loop Mirror, which relies on nonlinear polarization rotation. We propose a NOLM operation description in the weakly nonlinear regime, which accounts all possible input polarization states.

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The Nonlinear Optical Loop Mirror (NOLM) is commonly used in many applications such as optical switching and demultiplexing, mode locking, pedestal suppression, pulse shaping or regeneration of ultra fast data streams. Most NOLM designs rely on self-phase modulation, which causes a differential nonlinear phase shift to accumulate only if a power imbalance exists between the beams propagating in the loop. As the power ratio between the beams is generally imposed by construction, such designs offer few possibilities of adjustment, especially in terms of contrast or critical power. In addition, when designing such a NOLM, a compromise often has to be found between high contrast, low critical power and low insertion loss, as in general the three criteria can not be met simultaneously. A NOLM architecture using nonlinear polarization rotation (NPR) was considered recently [1,2]. In this device a polarization asymmetry between the beams can provide switching, even if powers are equal. In previous publications we showed that this NOLM structure, made of a symmetrical coupler, highly twisted fiber and a quarter-wave plate (QWP), and operating through NPR provide very high contrast, more than 4000, and the transmission characteristics can be easily changed by the QWP rotation. In this report, we discuss the transmission with all possible input polarization states and consider separately the transmission of circularly right and left polarized components. Fig. 1 presents the measured transmission for right- and left- circularly polarized output beams when a right circularly polarized beam is launched into the NOLM for two different angles of the QWP. We observe very different behaviors for right and left circularly polarized beams, which provides the possibility of new applications. More generally, the transmission can be adjusted by changing the input polarization.

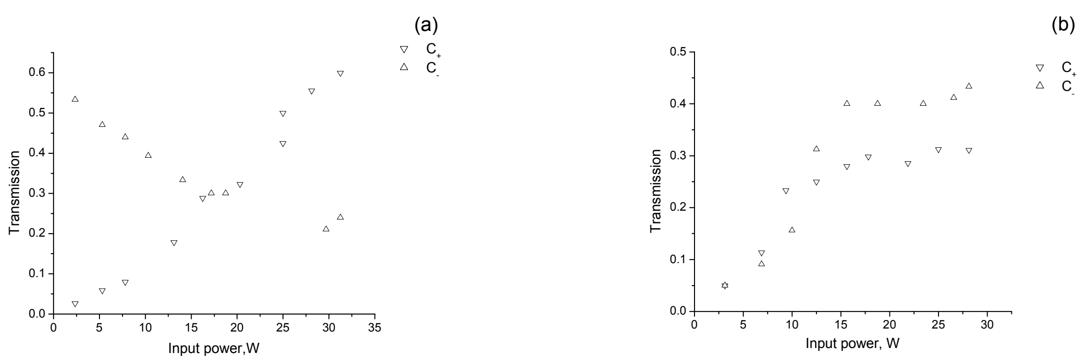

Fig. 1 NOLM transmission: (a) the QWP is adjusted to have a maxima transmission at low power; (b) the QWP is adjusted to have a minima transmission at low power.

[1] O. Pottiez, E.A. Kuzin, B. Ibarra-Escamilla, J.T. Camas-Anzueto, and F. Gutierrez-Zainos, OPTICS EXPRESS **12**, 3878-3887 (2004).
[2] O. Pottiez, E.A. Kuzin, B. Ibarra-Escamilla, J.T. Camas-Anzueto, and F. Gutierrez-Zainos, ELECTRONICS LETTERS **40**, 892-894 (2004).