Transparent amplifying waveguide optical isolator

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An optical isolator is indispensable in an optical telecom link to protect laser sources from reflected light. With today's commercial bulk isolators the packaging represents 90% of the total cost of an optical transceiver. A waveguide version of an isolator is therefore highly desirable. Several stand-alone waveguide isolators have been demonstrated but the integration with III-V hosts remains an issue that is hard to solve. We are studying a very promising concept that allows for monolithic integration of laser and isolator. It starts from the idea that for an isolator to be easily integratable with the laser, both devices should be similar in structure. Using a transversely magnetized magneto-optic metal as the electrical contact of an amplifying waveguide makes the internal loss dependent on the light propagation direction, thanks to the magneto-optic Kerr effect. Electrical biasing decreases the overall loss level. The result is a device which is transparent in the forward while providing loss in the opposite direction; an optical isolator.

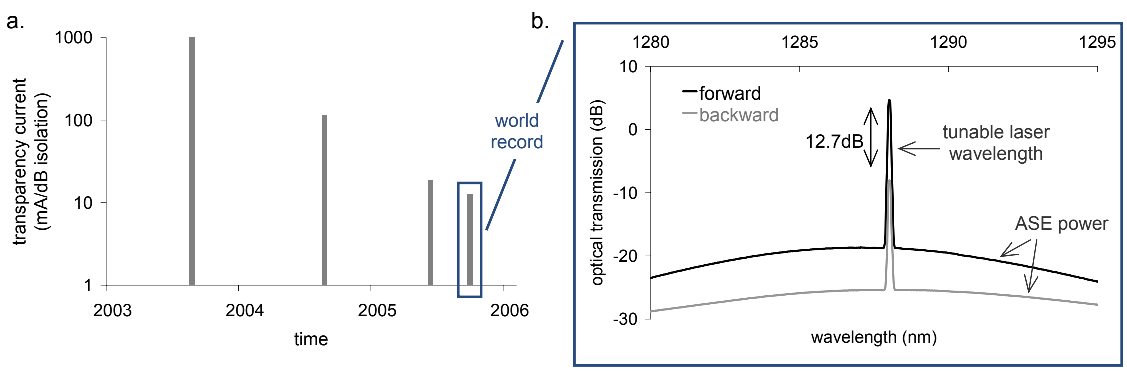

Figure 1a: Advance of the demonstrated isolator performance with time. **1b:** Isolator transmission in both propagation directions, showing 12.7dB optical isolation combined with forward transparency.

The amplifying waveguide optical isolator configuration was theoretically proposed in 1999 by two Japanese groups [1-2]. We experimentally demonstrated the principle in 2003 [3]. Since then, growing understanding of the device continuously enhanced its performance. This is illustrated in figure 1a where the evolution of the transparency current per dB of optical isolation – the relevant figure of merit for this type of isolator – is plotted versus time. This figure of merit of has improved by a factor 80 compared to the first demonstration. The advance results from the development of a proper design strategy combined with enhanced gain properties of the amplifying core, a better choice of the ferromagnetic metal and an optimized fabrication method. Today, our amplifying waveguide isolator is the first transparent optical isolator that can straightforwardly be integrated with a laser diode. The experimental result illustrated in figure 2b shows 12.7dB of optical isolation combined with forward transparency for a bias current of 160mA; the highest level of performance ever demonstrated. We believe that the practical implementation of this isolator configuration is now within reach.

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