Comment on "Dark pulse emission of a fiber laser"

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A recent Brief Report [Zhang *et al.*, Phys. Rev. A **80**, 045803 (2009)] presents experimental results in which dark pulses are generated in a fiber laser. Contrary to what is presented, the data published in that Brief Report do not support the claim that the duration of the dark dips are in the 8 ps range and that these pulses are related to genuine dark solitons.

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In their recent Brief Report [1], Zhang *et al.* describe an erbium-doped fiber laser mode locked through nonlinear polarization rotation that is found to generate dark pulses, i.e., narrow intensity dips on an otherwise continuous-wave laser emission background [see Fig. 2(a) of Ref. [1]]. Although this is not the first known example of the generation of dark pulses directly out of a laser cavity [2,3], Zhang *et al.* provide a proper temporal recording of the laser output with an oscilloscope, rather than, e.g., an autocorrelator as was done previously [3]. However, due to the limited bandwidth of the oscilloscope (350 MHz) and photodetector (2 GHz) used in the experiment, the temporal recordings of the output pulses only provide a 500 ps upper limit for the duration of the dark dips. Eventually, observations of the optical spectrum of the laser, combined with the assumptions that the dark pulses are transform limited and have the hyperbolic-tangent profile of a dark soliton [4] lead to an estimate of 8 ps for the full width at half maximum (FWHM) of the dark pulses. The authors' findings are complemented by numerical simulations that reveal that the laser under investigation would indeed support 8 ps dark soliton-shaped pulses. This leads the authors to conclude that the intensity dips they observe are shaped through the same mechanism than the one leading to dark solitons in the nonlinear Schrödinger equation [4].

This analysis does not, however, take into account the limited bandwidth of the oscilloscope and photodetector. An 8 ps dark soliton hitting a 2 GHz bandwidth photodetector would be severely filtered. The detected dip would appear much broader and much shallower. At the same time, the continuous-wave background of the dark soliton would be unfiltered by the photodiode. As a result, a genuine dark soliton, whose intensity drops to zero at the center, would be detected as a shallow dip on a strong background. With Zhang *et al.*'s parameters, we expect a depth-to-background intensity ratio of a few percent at best (this estimate does not even take into account the bandwidth of the oscilloscope). Given the level of intensity noise visible in Fig. 2(a) of Ref. [1], the dark soliton would be undetectable. Hence, the deep dark pulses with nearly 100% "blackness" observed by Zhang *et al.* with their 2 GHz bandwidth photodiode do not seem compatible with 8 ps dark soliton-shaped pulses.

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