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Observation of Chaotic Solitons in Magnetic Film-Based Feedback Rings ZIHUI WANG, AARON HAGERSTROM, WEI TONG, MINGZHONG WU, RICHARD EYKHOLT, BORIS KALINIKOS, COLORADO STATE UNIVERSITY TEAM, CHINESE ACADEMY OF SCIENCES COLLABORATION, ST.PETERSBURG ELECTROTECHNICAL UNIVERSITY COLLABORATION — Chaos and solitons are two important branches of nonlinear science. Usually one believes that chaos and solitons have no direct relation per se. Recent simulations, however, have indicated the existence of solitons that exhibit chaotic behavior with time. This presentation reports the first experimental observation of chaotic solitons. The experiments were carried out with a magnetic film strip-based feedback ring. At some ring gain level, the ring eigenmode with the lowest decay rate is self-generated and one obtains a continuous spin wave. A further increase in the ring gain leads to the generation of additional modes through a 4-wave process. In the time domain, this corresponds to the formation of a single spin wave pulse that circulates in the ring. At some higher gain level, this pulse develops into a chaotic soliton – a soliton pulse whose amplitude changes with time in a chaotic manner. The pulse has a hyperbolic secant shape and a flat phase profile across the pulse width, which are the signatures of solitons. The overall time-domain signal resulting from the circulation of the pulse exhibits a finite correlation dimension and a positive Lyapunov exponent, which are evidence of chaotic motion.

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