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**Explosive attractor solutions to a universal cubic delay equation**[1]

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This presentation describes new explosive attractor solutions to the universal cubic delay equation found in both the fluid [F. J. Hickernell, Jour. Fluid Mechanics, 142, 431 (1984)] and (for a kinetic system) in the plasma literature [B. N. Breizman et al. Phys. Plas. 4, 1559 (1997)]. Our results will be explained in the notation of the plasma problem, where a cubic delay equation describes the evolution of a wave in a kinetic system, and is characterized by a control parameter $\phi$ (its value is determined by the linear properties of the kinetic response). The linear eigenvalues do not exist in absence of the kinetic response (with exceptions for $\phi = 0$ or $\pi$) but with the kinetic contribution, marginally unstable modes emerge when the kinetic drive is at a critical level. The simulation of the temporal evolution reveals the development of an explosive mode, i.e. a mode growing without bound in a finite time. The two main features of the response are: (1) a well-known explosive envelope $(t_0 - t)^{-5/2}$, with $t_0$ the blow-up time of the amplitude; (2) a spectrum with ever-increasing oscillation frequencies that is critically-dependent upon the parameter $\phi$. A code has been constructed that resolves these oscillations over many periods by calculating their Fourier transform with respect to the pseudo-time $x = -\ln(t_0 - t)$. In addition, our analytic modeling explains the results and quantitatively nearly replicates the attractor solutions found in the simulations. A physical result of these solutions is the development of frequency chirping of the observed wave. This effect continues beyond the applicability of the cubic delay equation [H. L. Berk et al., Phys. Plas. 6, 3102 (1999)], and thus the attractor solutions that we study represent precursors to long-lived phenomena that may be used in an experimental situation to understand the nature of a system's equilibrium.

[1]Dr. Herbert L. Berk