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A Talk at the 2nd ISNMP Conference

Bad Ems, 28 June to 4 July 2026

Regular Session:

Speaker: François Leyvraz (Universidad de Nacional Autonoma de Mexico, Cuernavaca, Mexico)

Title: *The "goldfish" equations of motion for infinitely many particles*

Abstract: The "goldfish" equations of motion are nonlinear ordinary differential equations of second order connecting N particles on the complex plane. The motion becomes simple once the particles taken to be the zeroes of a monic polynomial, as the particles' motion then translates into free motion for the polynomial's coefficients.

For infinitely many particles, a similar system involves the theory of entire functions developed by Hadamard and others. It is shown that, if the initial values of the coordinates of the z_n satisfy $\sum_{n=1}^{\infty} |z_n(0)|^{-1-\epsilon} < \infty$ for some $\epsilon > 0$, and with an appropriate condition on the initial velocities, then the goldfish equations can trivially be extended by taking the $N \to \infty$ limit. If this condition is not satisfied, interesting complexities arise, and the dynamics of the zeroes is described by different equations. This will be discussed in greater detail.