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# (POS-44) Understanding Chaos in the Double Pendulum: Visualizing KAM Theory and Orbit Dynamics

*Tuesday 10 June 2025 18:02 (2 minutes)*

The double pendulum is renowned for its chaotic behavior, characterized by extreme sensitivity to initial conditions and complex orbit structures. In this study, we explore how changing the arm-length ratio affects the system's dynamics, approximating the Lyapunov exponent and analyzing orbit structures using Poincaré maps. We also investigate the persistence and breakdown of specific regular regions—known as invariant tori—as described by Kolmogorov-Arnold-Moser (KAM) theory.

To visually illustrate these concepts, dynamic simulations of the double pendulum and the corresponding trajectories on the torus are presented. These visualizations clarify the generation of Poincaré maps and effectively demonstrate the principles of KAM theory. KAM theory explains the stability of regular motion regions under small perturbations and predicts their breakdown as disturbances increase. Through a combination of visual aids and analytical insights, this poster elucidates the interplay between regular and chaotic dynamics, highlighting transitions that enhance our understanding of chaos in the double pendulum system.

## Keyword-1

Mechanics

## Keyword-2

Dynamical Systems

## Keyword-3

Chaos

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