

Accelerator Physics and Technology Seminar

Symmetries and Chaos in Modeling Beam Dynamics

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Date: Thursday, December 19

When: 4:00 pm CDT

Where: One West (WH1W) and Zoom

Abstract: In this presentation, we explore the concepts of reversibility, associated families of symmetries, and their implications for periodic orbits and more general invariant sets. These foundational ideas, originally anticipated by G.D. Birkhoff, were partially recognized and utilized by M. Hénon. In the 1950s, René J. de Vogelaere advanced this understanding further, and later, E. McMillan leveraged these symmetries to develop his integrable systems. However, as highlighted in the comprehensive review by J.A.G. Roberts and G.R.W. Quispel, the broader scientific community's awareness of these concepts has remained limited across disciplines.

In the second part of the presentation, we focus on their application to beam dynamics, addressing the following critical questions:

- **Choice of initial conditions:** How can symmetries be used to effectively reduce the combined space of variables and parameters?
- **Selection of chaotic indicators:** What are the most appropriate and efficient methods for visualizing sample trajectories?
- **Averaging over initial conditions:** What crucial information might we miss when considering only simply connected regions of phase space?

By investigating these questions, we aim to bridge the gap between theoretical insights and practical applications in beam dynamics, highlighting the interplay between symmetry and chaos.