Physics 5413: Chaos and Dynamics – Project 6

due April 15, 2022, talks to be given in the week of April 18, 2022

Student talks: Period-doubling and quasiperiodic routes to chaos in experiments

In this project you will explore experimental situations in which the period-doubling and quasiperiodic routes to chaos have been observed. The material is based on research literature, so you may have to follow a few references or come and ask questions. Before you dive into the literature on the quasiperiodic route, you may want to read section 6.11 on *Applications* in the text book.

1. **Chaos in chemical reactions:**
   Section 12.4 on *Chemical Chaos* in Strogatz' book
   R.H. Simoyi, A. Wolf, H.L. Swinney, Phys. Rev. Lett. **49**, 245 (1982)
   J.C. Roux, R.H. Simoyi, H.L. Swinney, Physica D **8**, 257 (1983)
   but see also K. Coffman et al., Phys. Rev. Lett. **56**, 999 (1986)

2. **Chaos in electric circuits:**
   Section 1.3 *A nonlinear electric system* in the textbook
   P.S. Linsay, Phys. Rev. Lett. **47**, 1349 (1981)
   J. Testa et al., Phys. Rev. Lett. **48**, 714 (1982).

3. **Quasiperiodic route to chaos in a convective fluid**
   Section. 6.11 *Some Applications* of the textbook
   J. Stavans et al., Phys. Rev. Lett. **55**, 596 (1985)
   M.H. Jensen et al., Phys. Rev. Lett. **55**, 2798 (1985)

4. **Chaotic cardiac rhythms**
   Section. 6.11 *Some Applications* of the textbook
   L. Glass et al., Phys. Rev. A **29**, 1348 (1984)
   M. Courtemancho et al., Physica D **40**, 299 (1989)

5. **Chaos in the Electrical Conduction in Barium Sodium Niobate**
   S. Martin, H. Leber, and W. Martienssen, Phys. Rev. Lett. **53**, 303 (1984)
   S. Martin, and W. Martienssen, Phys. Rev. Lett. **56**, 1522 (1986)
   S. Martin, and W. Martienssen, Phys. Rev. A **34**, 4523 (1986)

6. **Phase locking in superconductivity**
   Another nice topic, which may require some reading up on superconductivity is
   Phase Locking, Devil's Staircases, Farey Trees, and Arnold Tongues in Driven Vortex Lattices with Periodic Pinning, by C. Reichhardt and Franco Nori, Phys. Rev. Lett. 82, 414 (1999)

In this project you will learn to work with literature. The idea is that you explore what is reported in the literature about the topic and then present it to the class in an understandable way. You are NOT supposed to perform the work yourself. (Of course, complementing your presentation by a simulation or a simple calculation would be nice, but it is not required.)
The talks should be about 20 –25 minutes. Please prepare a suitable Powerpoint (or equivalent) presentation. Each group member should give a part of the talk.