Spiral wave chimeras in complex-oscillatory and chaotic systems

Jörn Davidsen [1], *Chad Gu* [1], *Ghislain St-Yves* [1]

[1]Complexity Science Group, Department of Physics and Astronomy, University of Calgary, Canada

While many aspects of synchronization are well understood, recent theoretical and experimental research has produced new and surprising results for populations of coupled oscillators. In particular, it was shown that spontaneous synchrony breaking can occur in uniformly coupled populations of identical oscillators leading to states of sustainable non-uniform synchronization. These new states exhibit coexistence of localized synchronized and unsynchronized subpopulations and are known as "chimera states".

In this talk, we demonstrate for the first time that spiral wave chimeras — spiral waves with spatially extended unsynchronzied cores — can exist in complex-oscillatory and even locally chaotic homogeneous systems under nonlocal coupling. Using ideas from phase synchronization, we show in particular that the unsynchronized cores exhibit a distribution of different frequencies, thus, generalizing the main concept of chimera states beyond simple oscillatory systems. This indicates that chimera states can be expected to occur in a much larger variety of systems and under a larger variety of conditions than initially thought.

We also show that in contrast to simple oscillatory systems spiral wave chimeras in complex-oscillatory and locally chaotic systems are characterized by the presence of synchronization defect lines (SDLs), along which the dynamics follows a periodic behavior different from the bulk. While this is similar to the case of local coupling, the type of the prevailing SDLs can be very different.