Topology: It's Important!

Topology in 1D quantum systems

Colin Riggert, University of Oklahoma

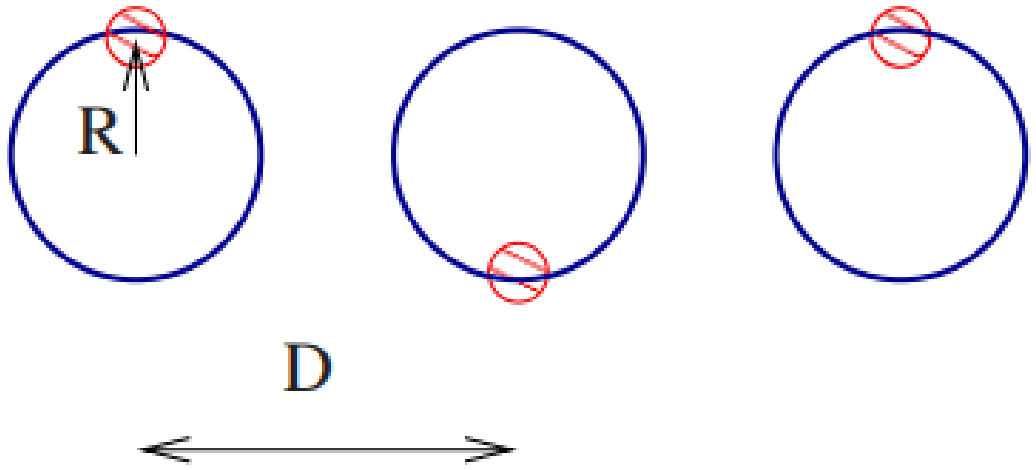
OU REU – 2019

June 11, 2019

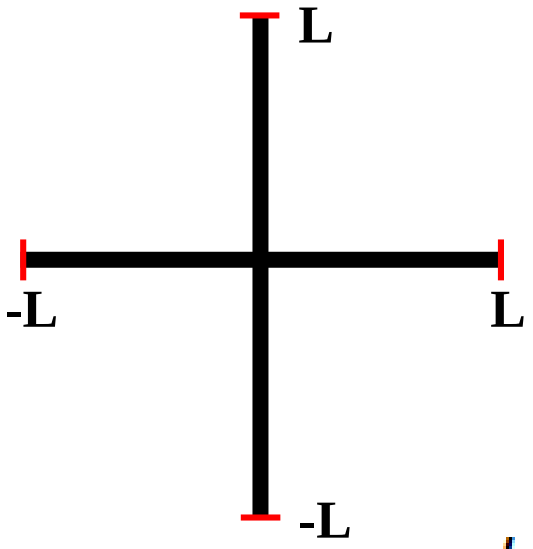
Advisor: Dr. Kieran Mullen

What do we mean by topology?

- Shape of system
- Self-connections
- Boundary conditions
- Example: Antiferroelectric polarization in quantum rings

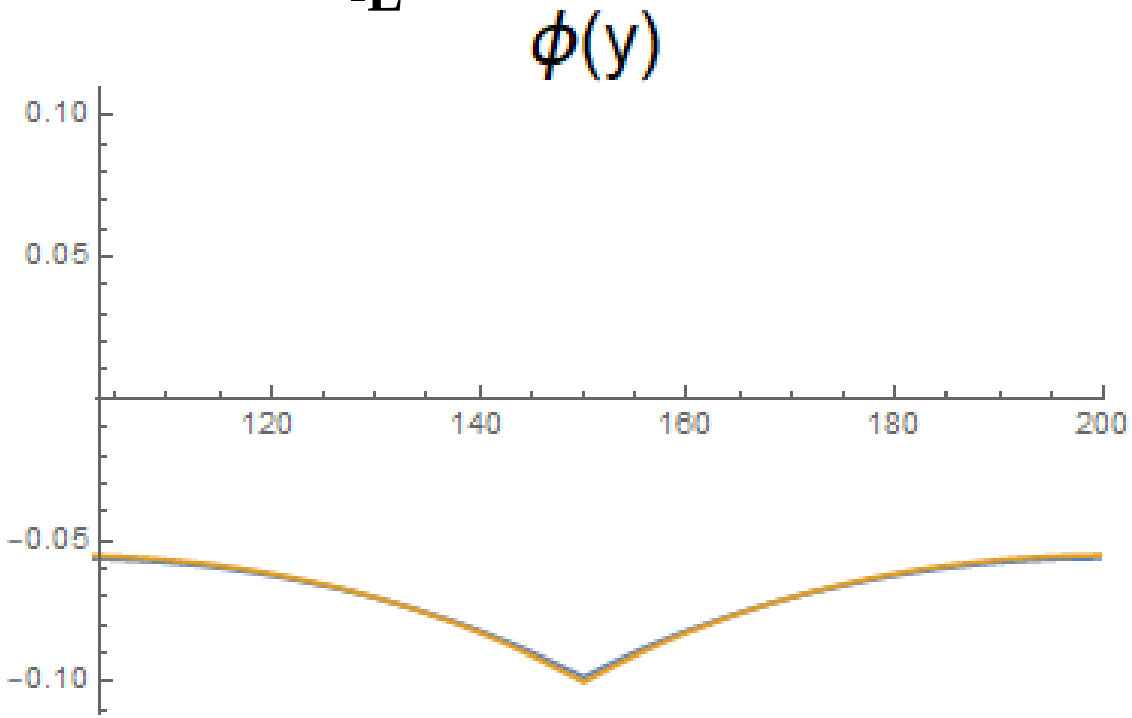


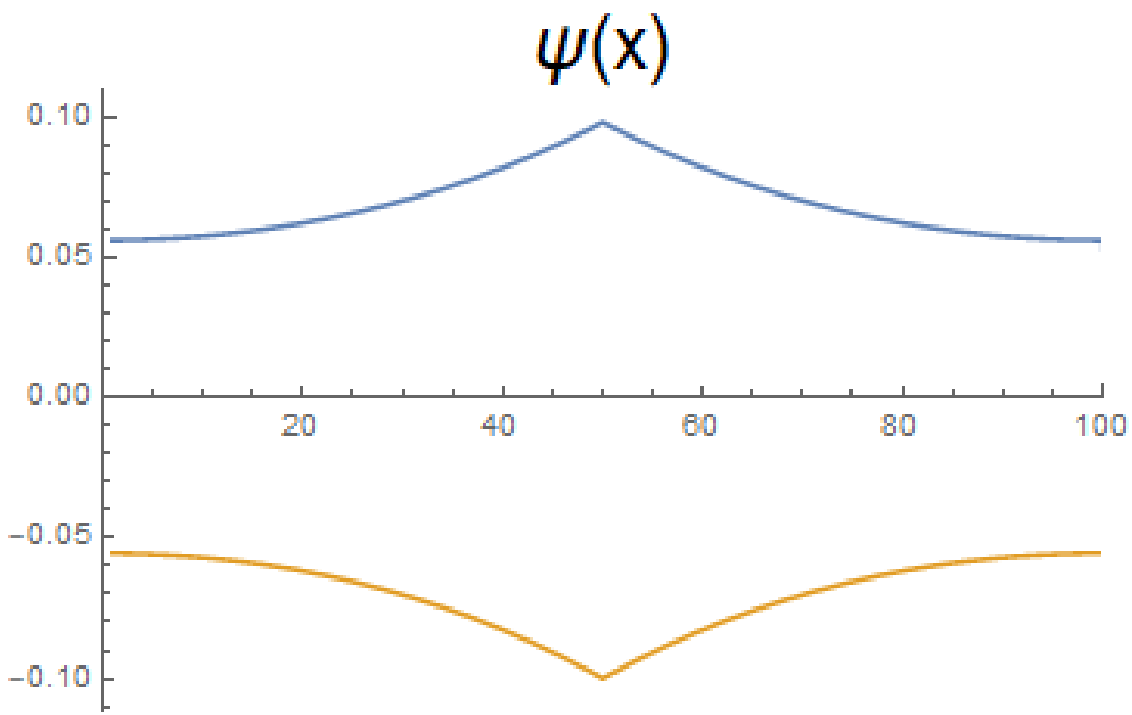
Simple Case: the Crossed Wire Problem



- Bound state with sign-dependent symmetry

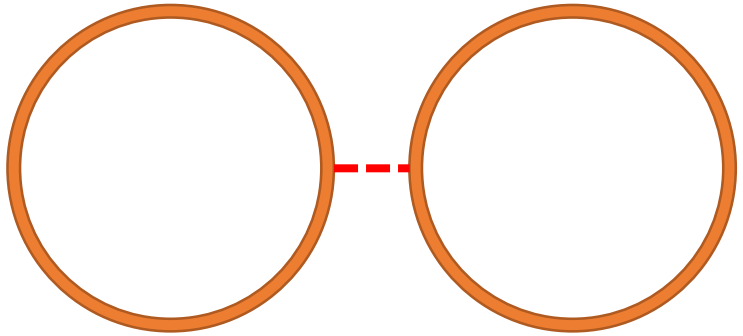
$$\begin{pmatrix} -\partial^2/\partial x^2 & a\delta(x) \\ a\delta(y) & -\partial^2/\partial y^2 \end{pmatrix} \begin{pmatrix} \psi(x) \\ \phi(y) \end{pmatrix} = E \begin{pmatrix} \psi(x) \\ \phi(y) \end{pmatrix}$$



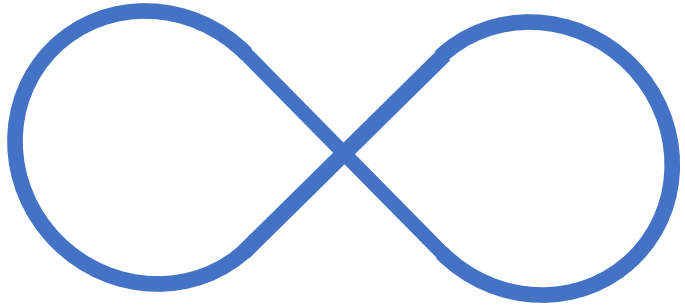


Effects of Topology

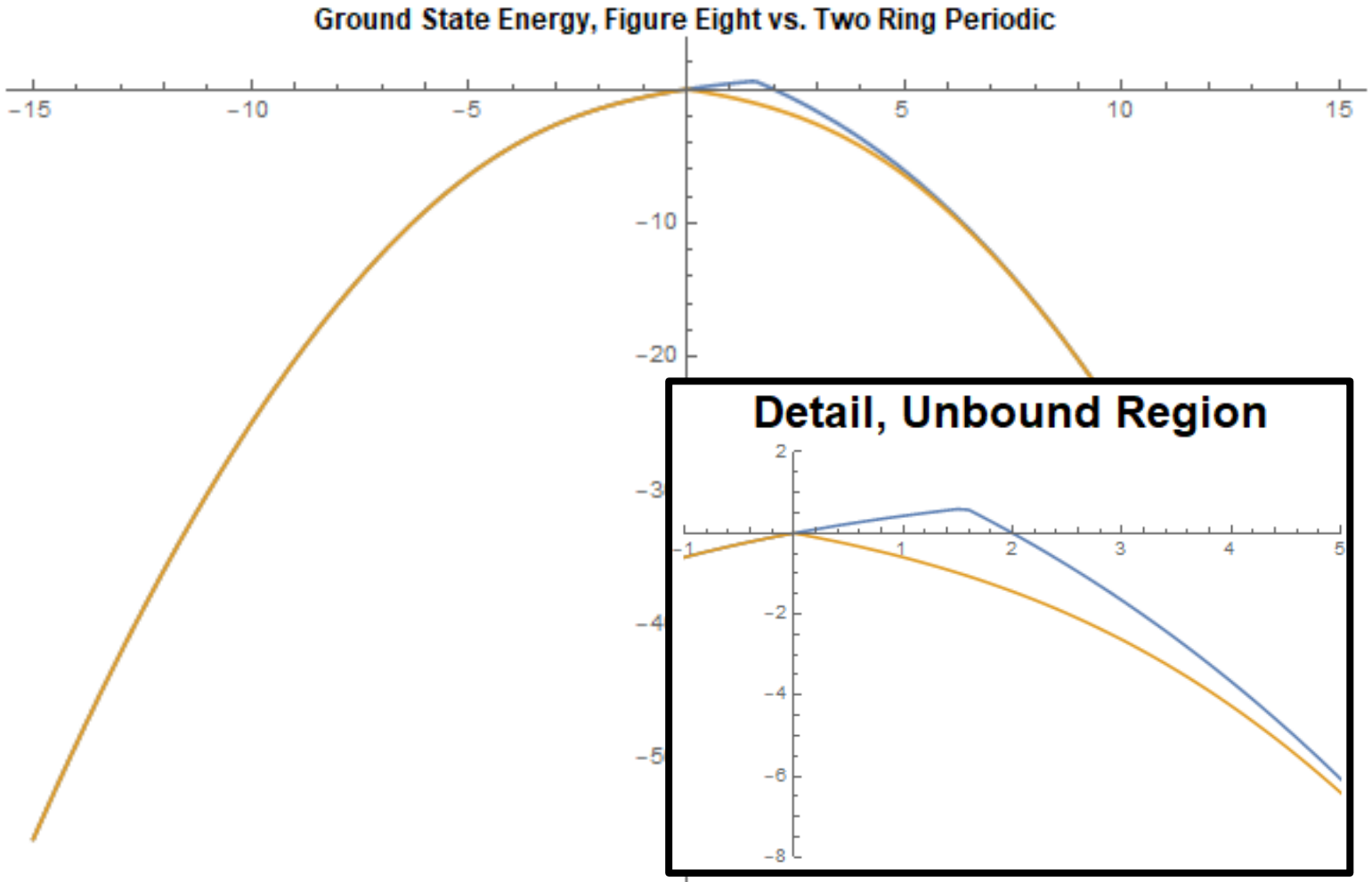
- Two Coupled Rings



- Figure-Eight Ring



- Numerical Results for Ground State:



Future Questions

- How do these two topologies become the 2D cross?
- Can we construct a three wire topology that frustrates the system?
- What happens if we have an array of rings?