



Institute for Space Weather Sciences Colloquium

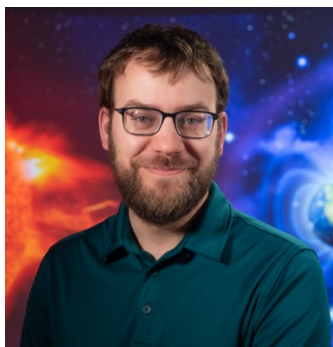
Thursday, 18th of Sep 2025, 1:00pm ET

ECE 202 & via Zoom (meeting ID: 955 9399 6954, password: isws)

Joel Dahlin, University of Maryland / GSFC

Flux Inferring Reconnection Dynamics from the Fine Structure of Flare Ribbons

Solar flares are spectacular manifestations of explosive energy release powered by magnetic reconnection. While the standard CSHKP model has proven highly successful in explaining key features of flare observations in terms of magnetic reconnection, many aspects of the energy release are not yet understood. In particular, the complex three-dimensional structure of the flare current sheet is thought to play important roles in particle acceleration and bursty energy release. Although direct diagnosis of the magnetic field dynamics in the corona remains highly challenging, rich information may be gleaned from flare ribbons, which represent the chromospheric imprints of reconnection in the corona. In particular, recent high-resolution imaging observations from solar telescopes including BBSO/GST, IRIS, and SST have revealed a diversity of fine structure in flare ribbons that hints at corresponding complexity in the reconnection region. We present high-resolution three-dimensional MHD simulations of an eruptive flare and describe our efforts to identify the imprints of current sheet dynamics on flare ribbon fine structure. In our model, the flare current sheet is highly turbulent and dominated by coherent magnetic structures known as plasmoids. We derive a model analogue for flare ribbons and demonstrate that the life cycle of a plasmoid manifests as a transient 'spiral' along the ribbon front. We show how fine-scale ribbon features may be used to constrain quantitative properties of the current sheet dynamics, and discuss implications for interpreting observations of fine structure in solar flares.



Joel Dahlin received his PhD from University of Maryland, College Park where he was advised by Jim Drake and Marc Swisdak. His PhD work involved particle-in-cell simulations of reconnection, and the title of his dissertation was 'Electron Acceleration in Magnetic Reconnection'.

In 2016, he moved to NASA/GSFC for a Jack Eddy fellowship to work on MHD modeling studies of solar flares with Spiro Antiochos.

He is currently an Assistant Research Scientist at University of Maryland (sitting at NASA's Goddard Space Flight Center, GSFC).