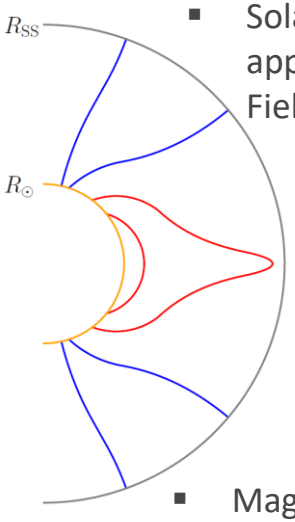
Locations of interchange reconnection near pseudostreamers

V. Aslanyan[1], D. I. Pontin[2], A. K. Higginson[3], P. F. Wyper[4], R. B. Scott[5], S. K. Antiochos[3]

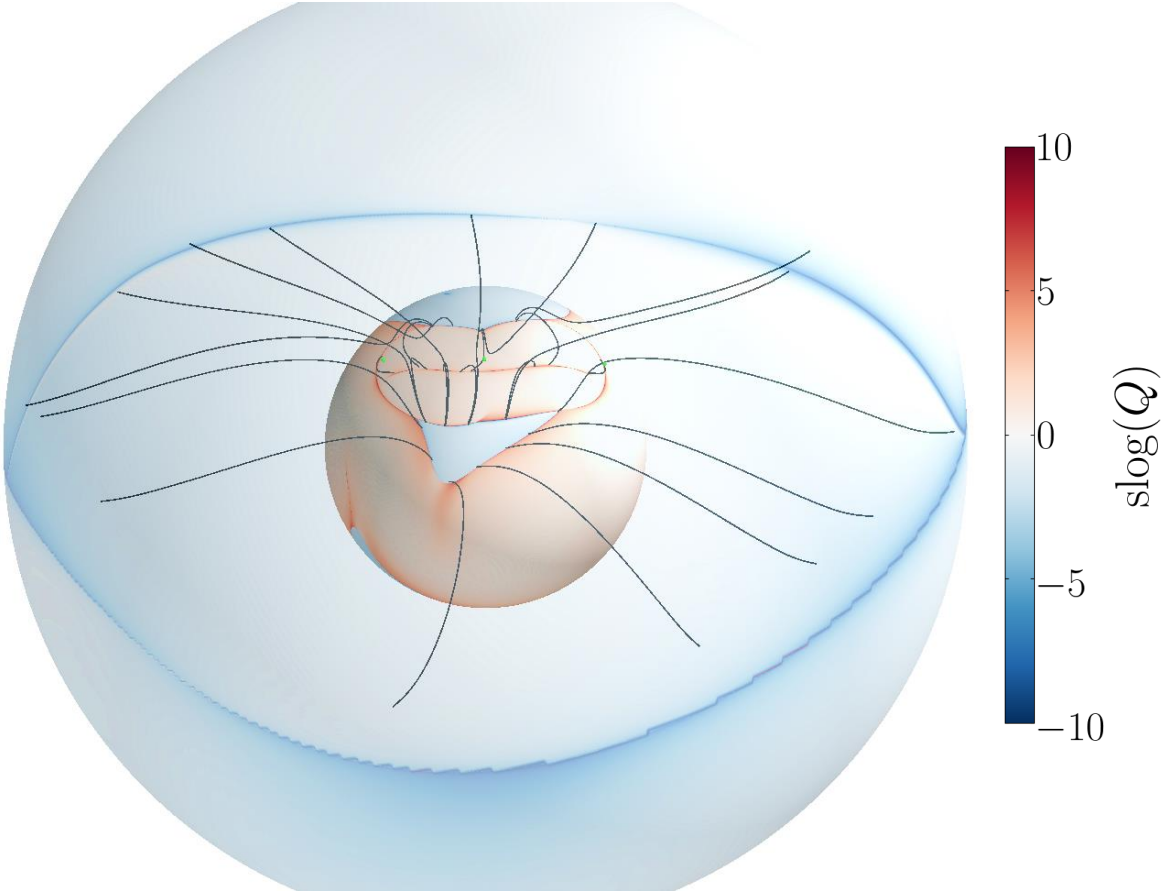
[1]Division of Mathematics, University of Dundee, UK [2]School of Mathematical and Physical Sciences, University of Newcastle, Australia
[3]Heliophysics Science Division, NASA Goddard Space Flight Center, Greenbelt MD 20771, USA
[4]Department of Mathematical Sciences, Durham University, UK [5]U.S. Naval Research Laboratory, Washington DC 20375, USA

Coronal magnetic field

Helmet streamers seen during eclipse; photo credit: NASA



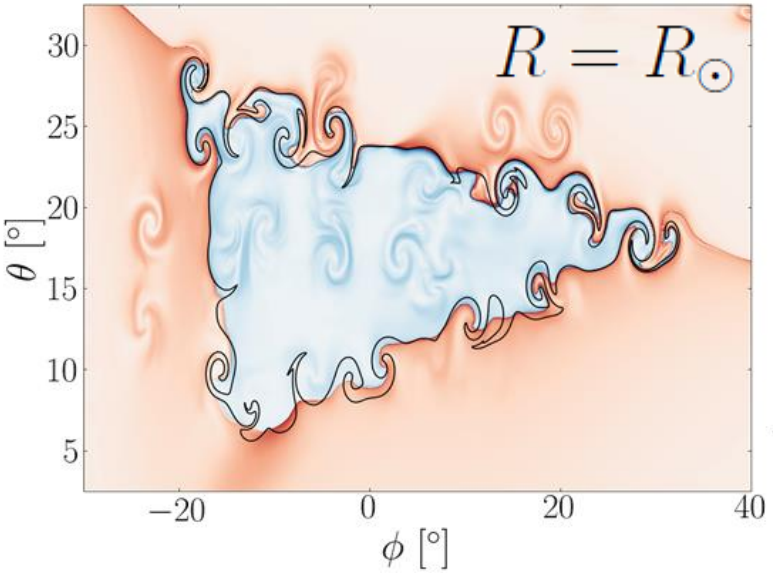
- Solar magnetic field is approximated by the Potential Field Source Surface
  - Coronal holes correspond to open field lines
  - Simulation geometry uses a combination of 4 dipoles to create a coronal hole close to equator
- Magnetic reconnection leads to topological changes

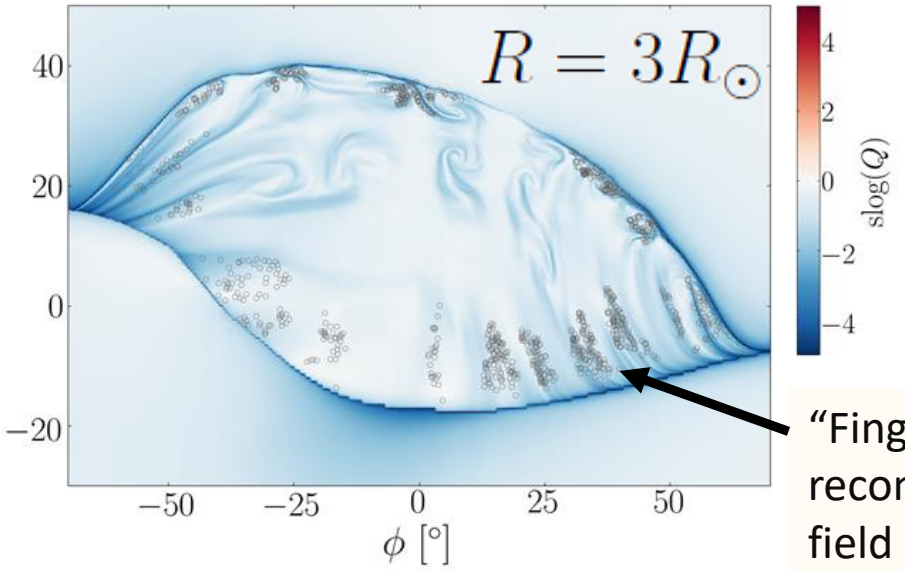


Squashing factor Q on the solar surface and at the source surface; sample open and closed field lines are also shown in black; magnetic nulls shown in green

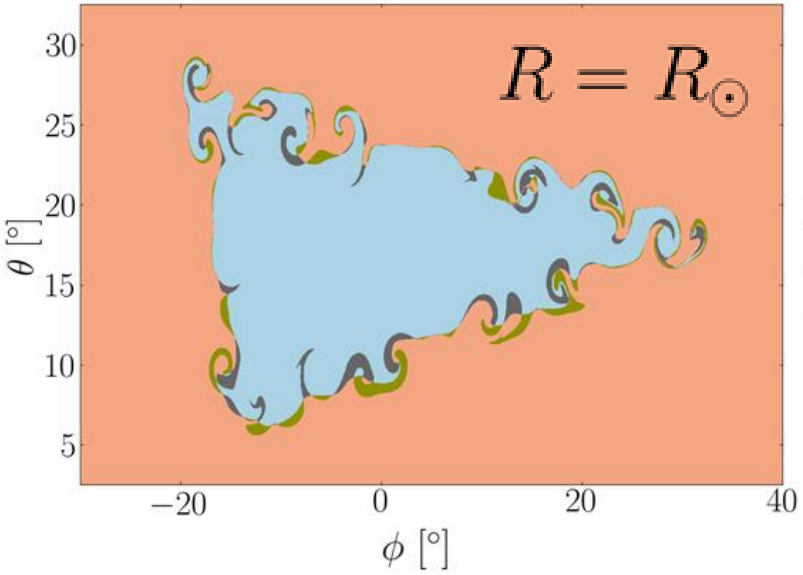
University of Dundee

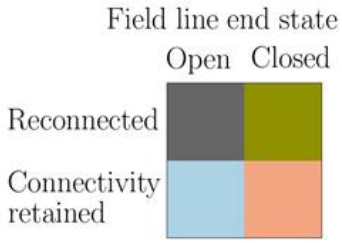
Locations of interchange reconnection near pseudostreamers





"Finger"-like reconnected field lines

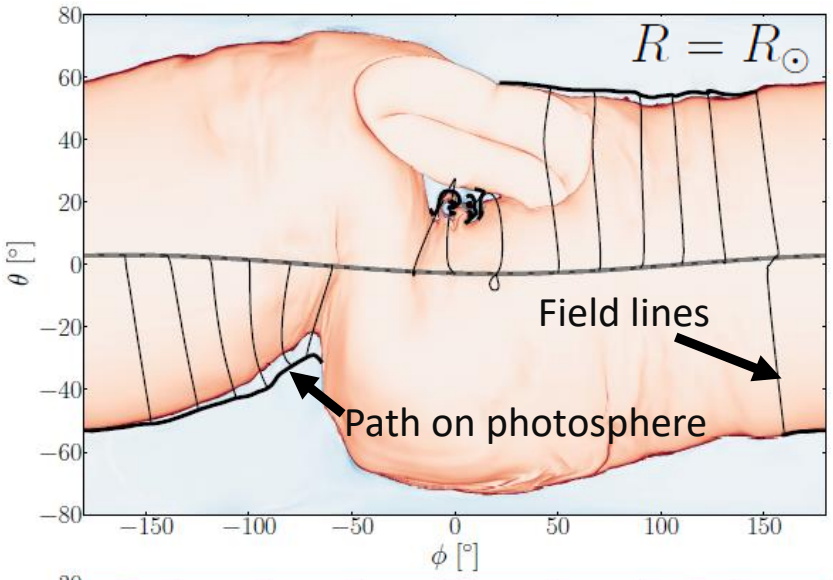


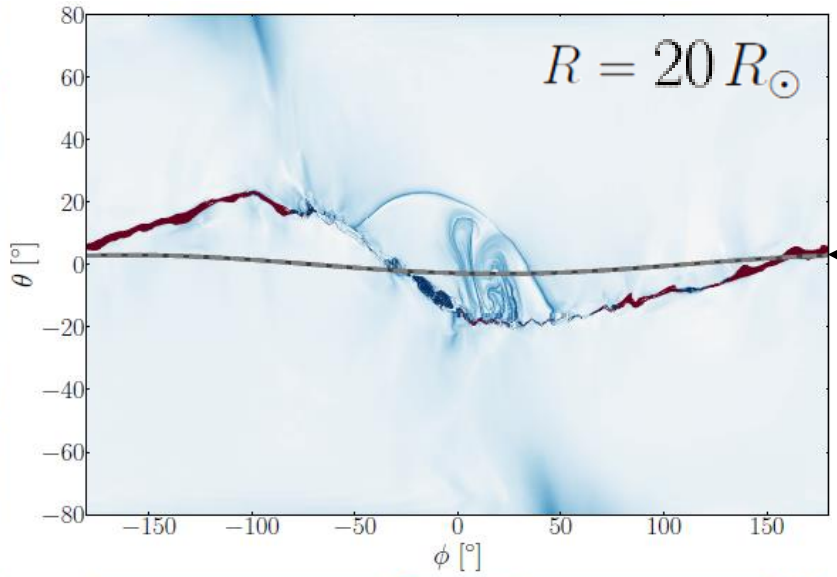


Squashing factor Q for a driven coronal hole boundary (at radii indicated) and footpoints of interchange reconnected field lines (as labelled)

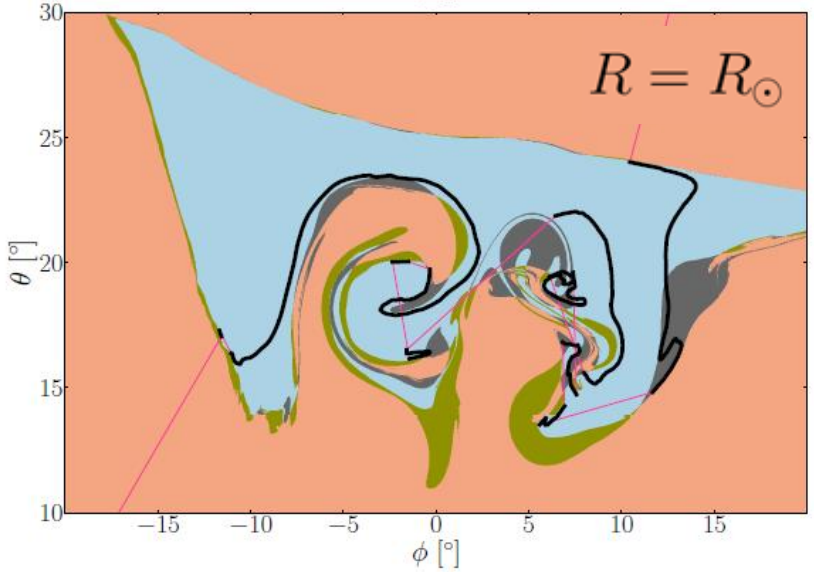
University of Dundee

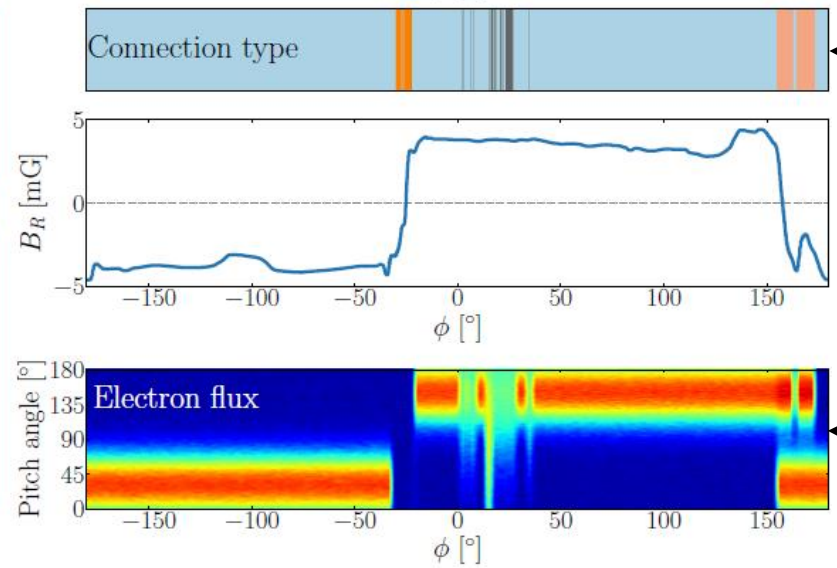
Locations of interchange reconnection near pseudostreamers





Orbit path





Connectivity along the orbit

Synthetic electron spectrum detected at orbit

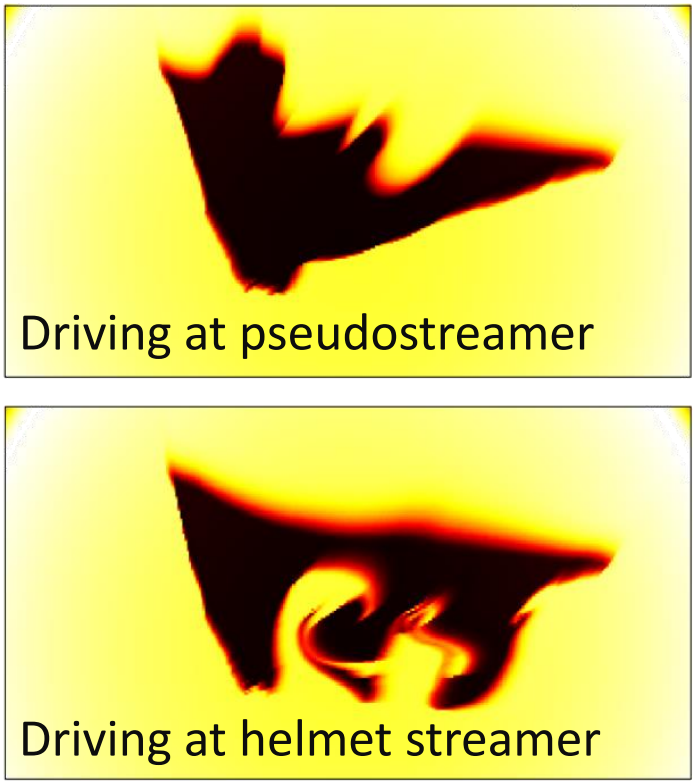
Squashing factor Q (top panels, at radii indicated) and the path of an orbit with −3° inclination. Field lines down from the orbit to footpoints on the photosphere are indicated. Detail of the connectivity map (lower left) with sections of footpoints. The type of connectivity, magnetic field and hypothetical electron flux at the orbit (lower right)

University of Dundee

Locations of interchange reconnection near pseudostreamers

Remote observables

- ARMS simulations have been post-processed
- Density, temperature and emission are largely a function of open vs closed field lines



Synthetic coronal hole images in the Fe XIV spectral range computed with the FOMO3D code

Summary

- We predict that magnetic field lines interchange reconnected from closed to open should form periodic "finger"-like bands
- These bands could be detectable by PSP, or other spacecraft
- The susceptibility to interchange reconnection is higher at the boundary of a pseudostreamer relative to a helmet streamer as visible in synthetic EUV images

References

[1] V. Aslanyan *et al.*, "Effects of Pseudostreamer Boundary Dynamics on Heliospheric Field and Wind", ApJ **909**, 10 (2021).

[2] A. K. Higginson *et al.*, "Dynamics of Coronal Hole Boundaries", ApJ **837**, 113 (2017).

[3] V. S. Titov *et al.*, "Magnetic Topology of Coronal Hole Linkages", ApJ **731**, 111 (2011).