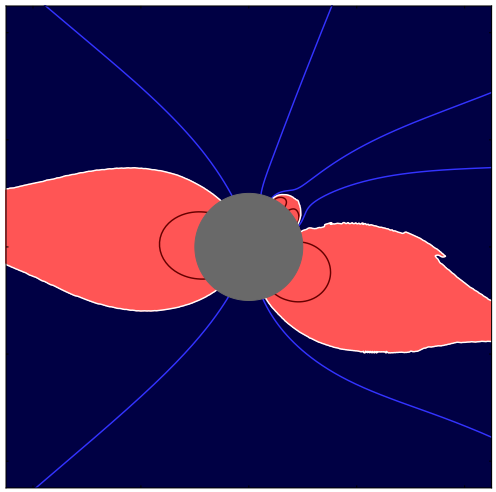
Effect on heliospheric magnetic field and wind due to supergranular driving of streamers and pseudostreamers



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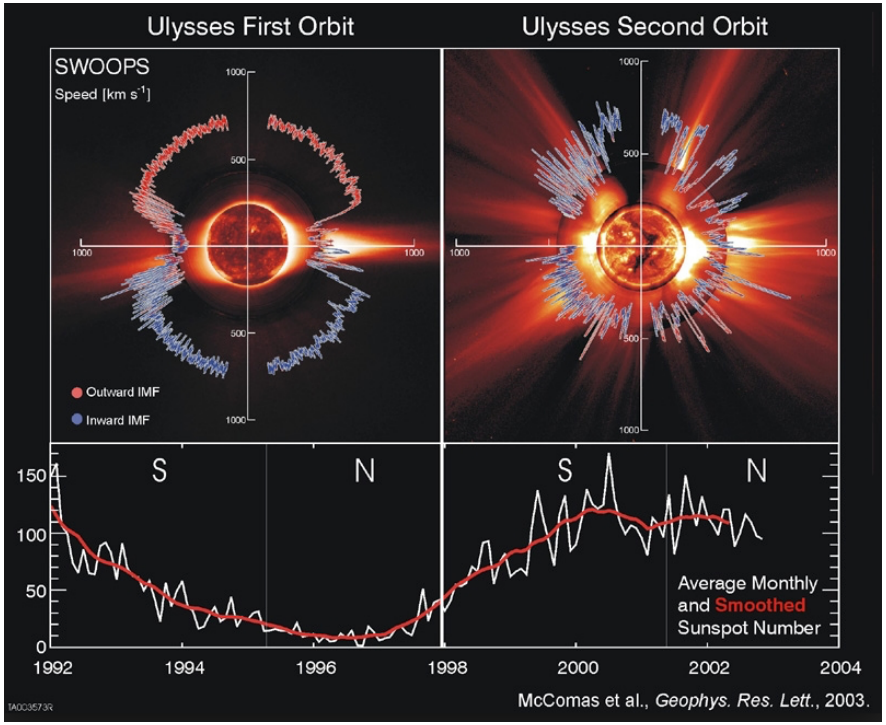
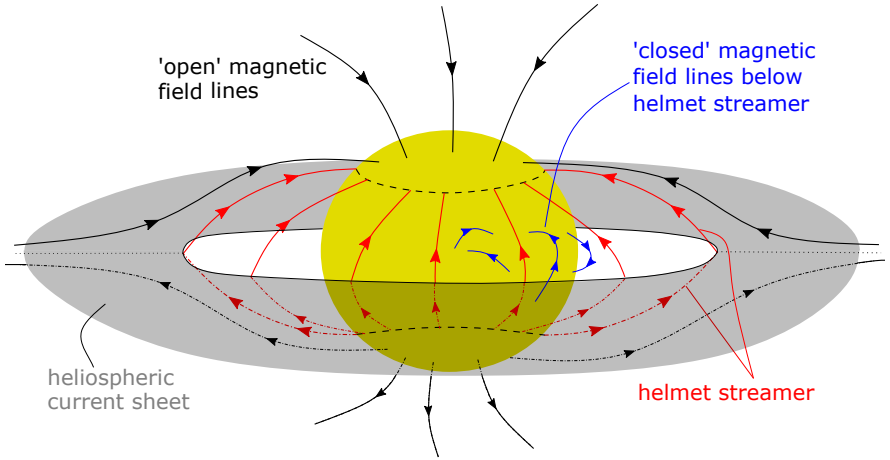
Interchange reconnection and the SSW

- The origin of the SSW is at present unknown.
- Composition suggests the plasma may originate in the magnetically closed corona.
- Release of this plasma onto open field lines requires interchange reconnection.
- Question:
  What is the role of interchange rec in coupling streamers and pseudostreamers to the heliosphere?

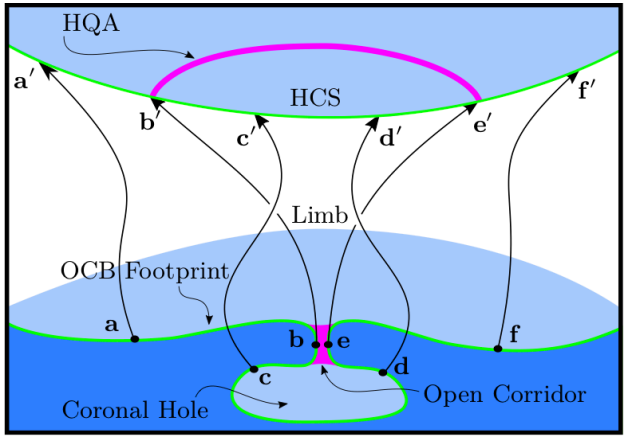


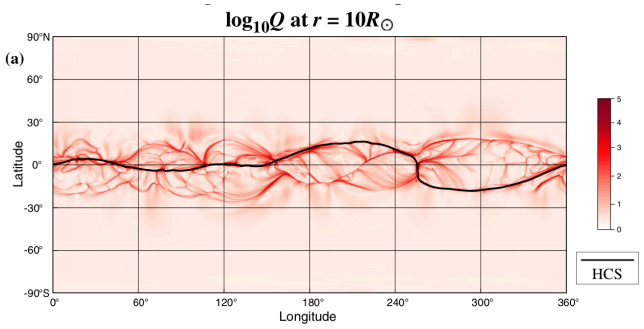


Over-simplified model:

The Sun's open-closed flux boundary

- Flux tubes passing close to the open-closed boundary are candidates for release of closed-field plasma.
- Locations of released plasma predicted by "S-Web" model (Antiochos+ 2011)
- Boundary can be (i) helmet streamer, (ii) separatrices associated with magnetic nulls, or (iii) narrow corridors of open flux





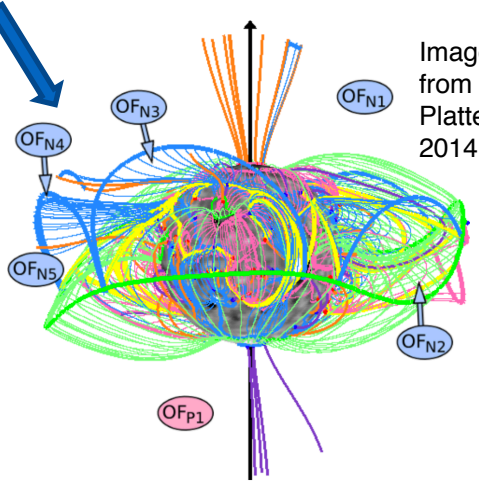
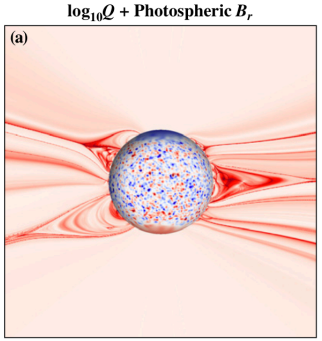


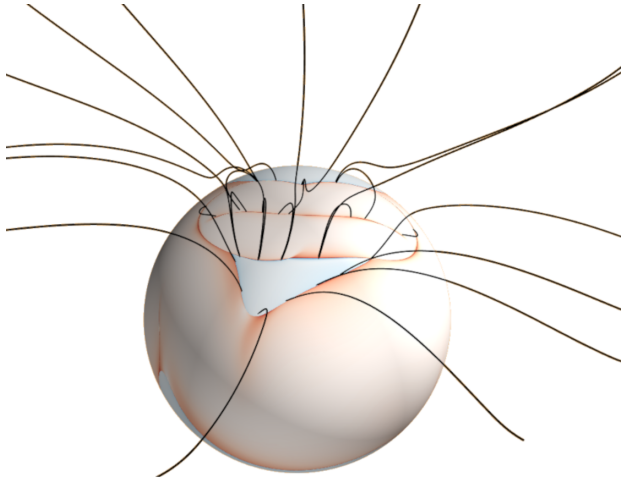
Image from Platten+ 2014

Images from Antiochos+ 2011

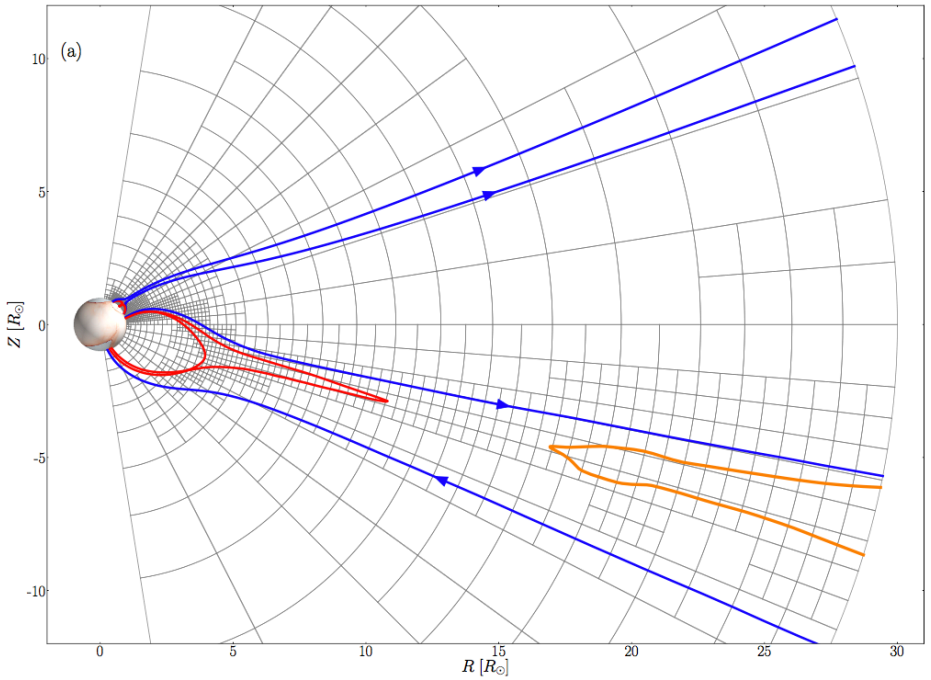
- These structures can be revealed by calculating the squashing factor, Q.
- They form the "S-Web". This forms in a latitudinal band consistent with location of slow solar wind.



Model magnetic field



(a)

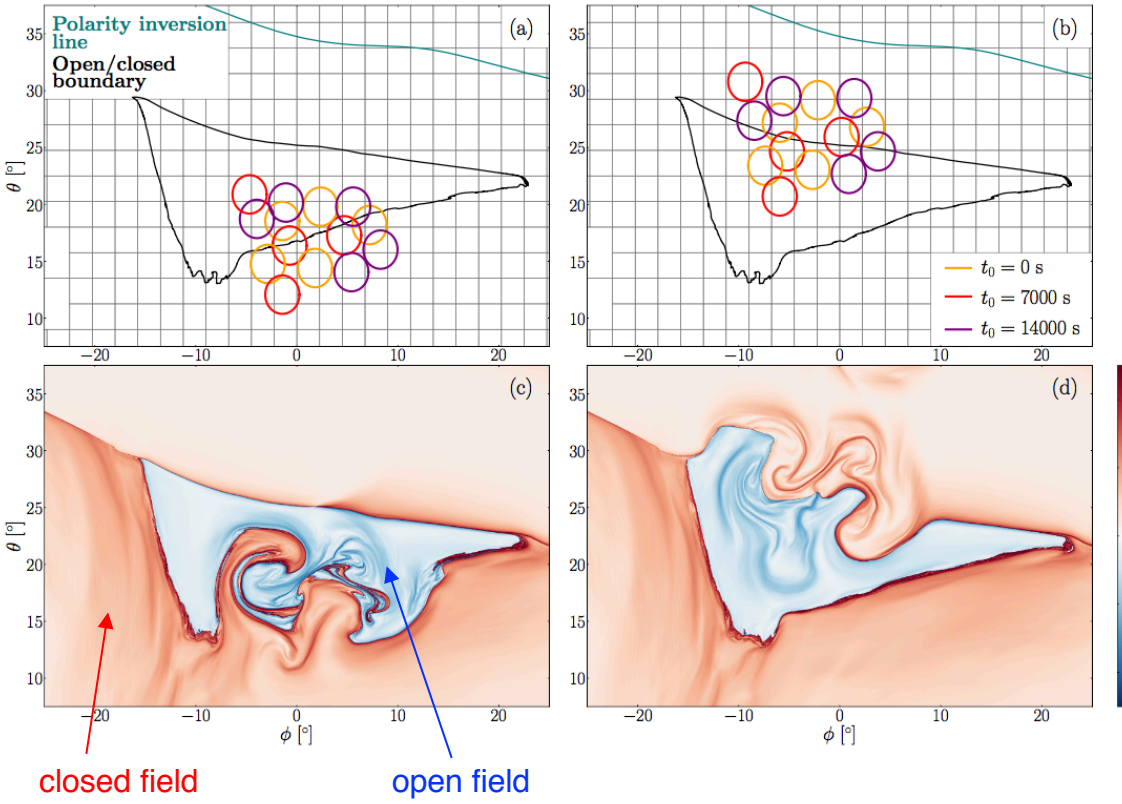


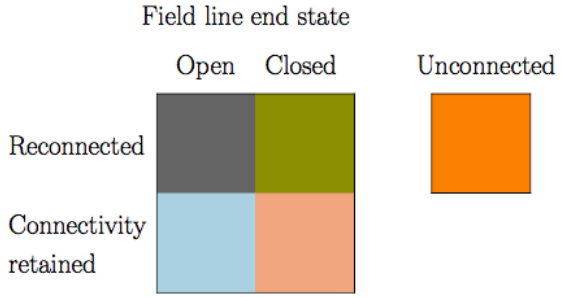
- MHD simulation: geometry contains low-latitude coronal hole partitioned from polar hole by a pseudostreamer
- Vortical driver mimics super-granulation: Induces interchange reconnection at nulls of pseudostreamer and at helmet streamer

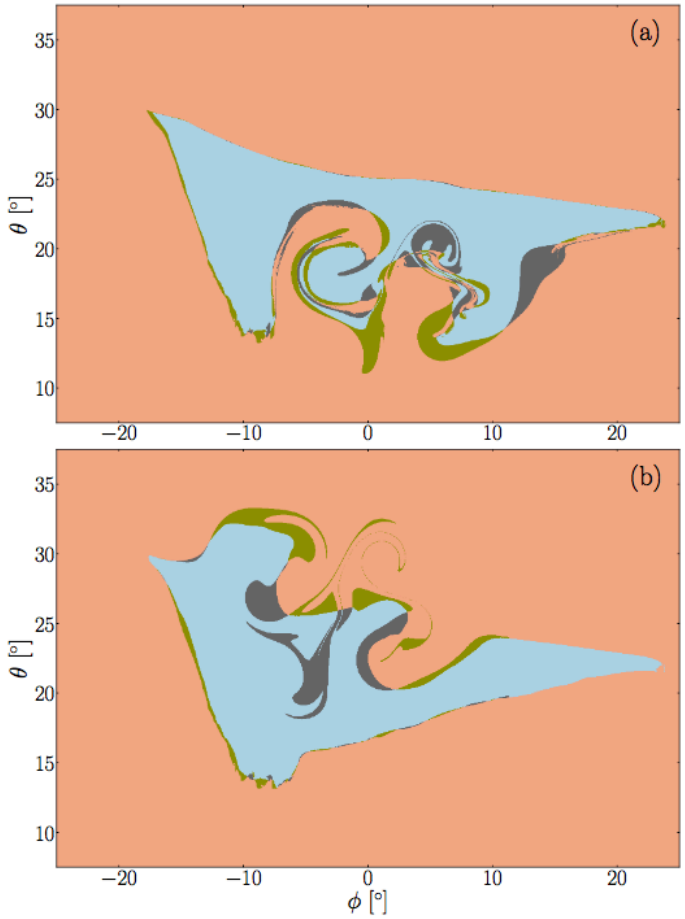
Aslanyan, V., Pontin, D.I., Wyper, P.F., Scott, R.B., Antiochos, S.K. & DeVore, C.R. *Effects of pseudostreamer boundary dynamics on heliospheric field and wind.* ApJ, 909:10 (2021)

Aslanyan, V., Pontin, D.I., Higginson, A.K., Wyper, P.F., Scott, R.B. & Antiochos, S.K. *The Dynamic Coupling of Streamers and Pseudostreamers to the Heliosphere*. To be submitted to ApJ

Interchange rec at coronal hole boundaries

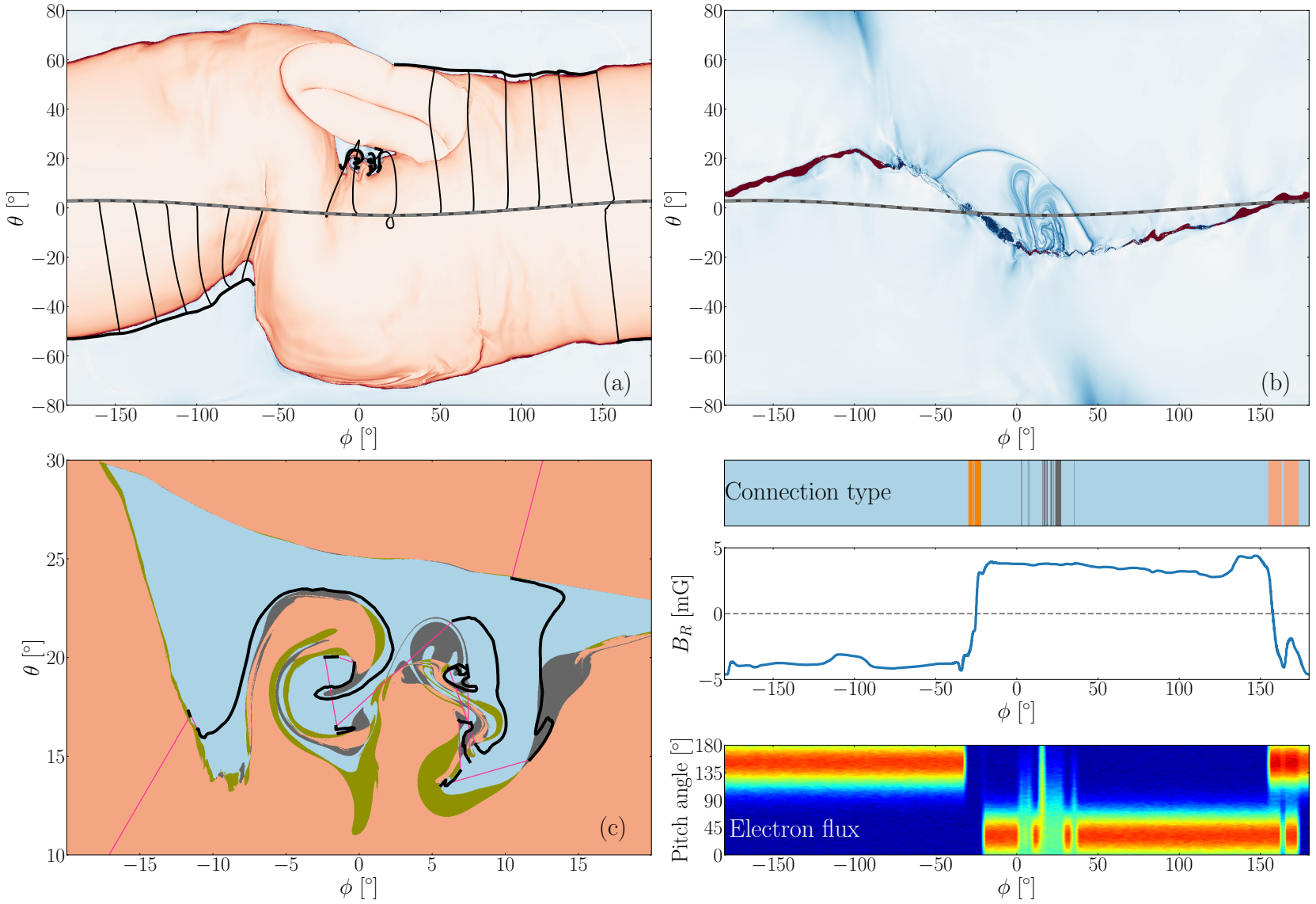






- Newly opened magnetic field lines extend out into the heliosphere in filaments imprint of photospheric network.
- Filaments extend far from HCS
- Open-closed boundary becomes highly corrugated – especially at helmet streamer

Connectivity of a synthetic spacecraft trajectory



Summary

- Supergranulation at the photosphere drives interchange rec. in lanes between supergranules
- Rec. occurs at nulls/separators (pseudostreamer drive) and in the lower HCS (helmet streamer drive)
- Filaments of newly-opened flux extend out into heliosphere
- Pseudostreamer boundaries of CHs more susceptible to reconnect, so remain smoother, with implications for spacecraft connectivity

Aslanyan, V., Pontin, D.I., Wyper, P.F., Scott, R.B., Antiochos, S.K. & DeVore, C.R. *Effects of pseudostreamer boundary dynamics on heliospheric field and wind.* ApJ, 909:10 (2021)

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