Institute for Research in
ELECTRONICS
AND
APPLIED PHYSICS

TREND project:
Magnetic Reconnection and the Dynamics of Energetic Particles

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Outline

- What is Reconnection?
- The Problem with MHD
- Results

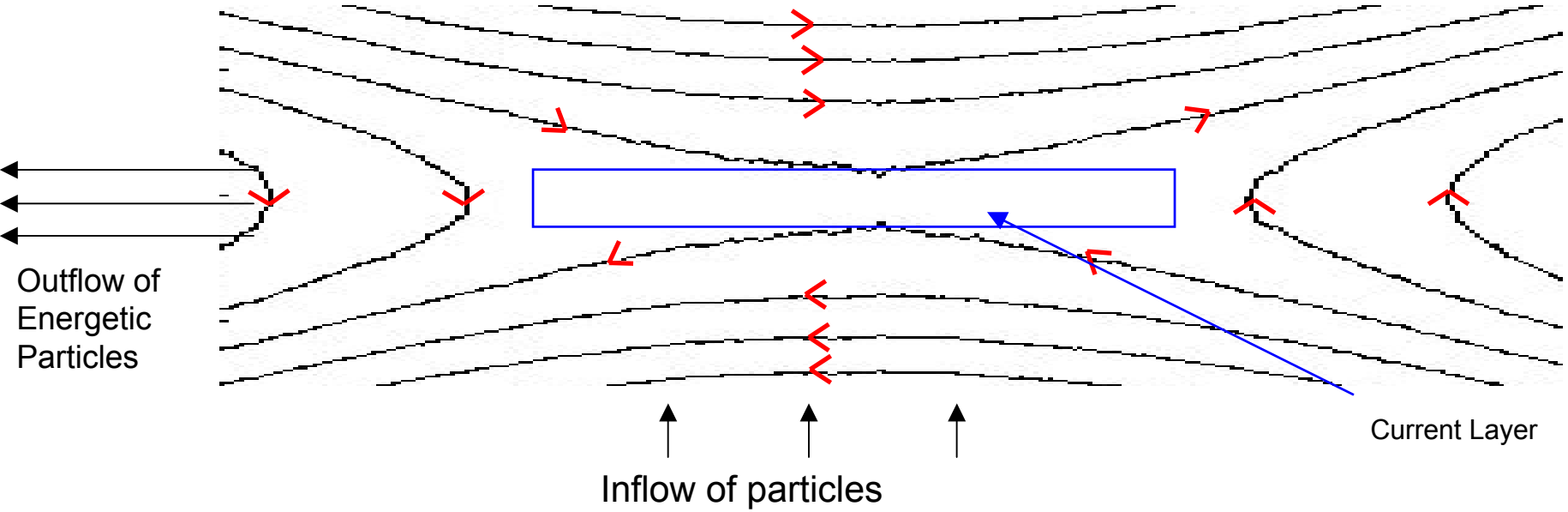
What is Reconnection?

- Magnetic Reconnection is a process that converts magnetic energy into heat and high speed flows
- It occurs where the magnetic field changes direction over a finite distance
- The field lines annihilate, releasing heat and accelerating plasma to high velocities.

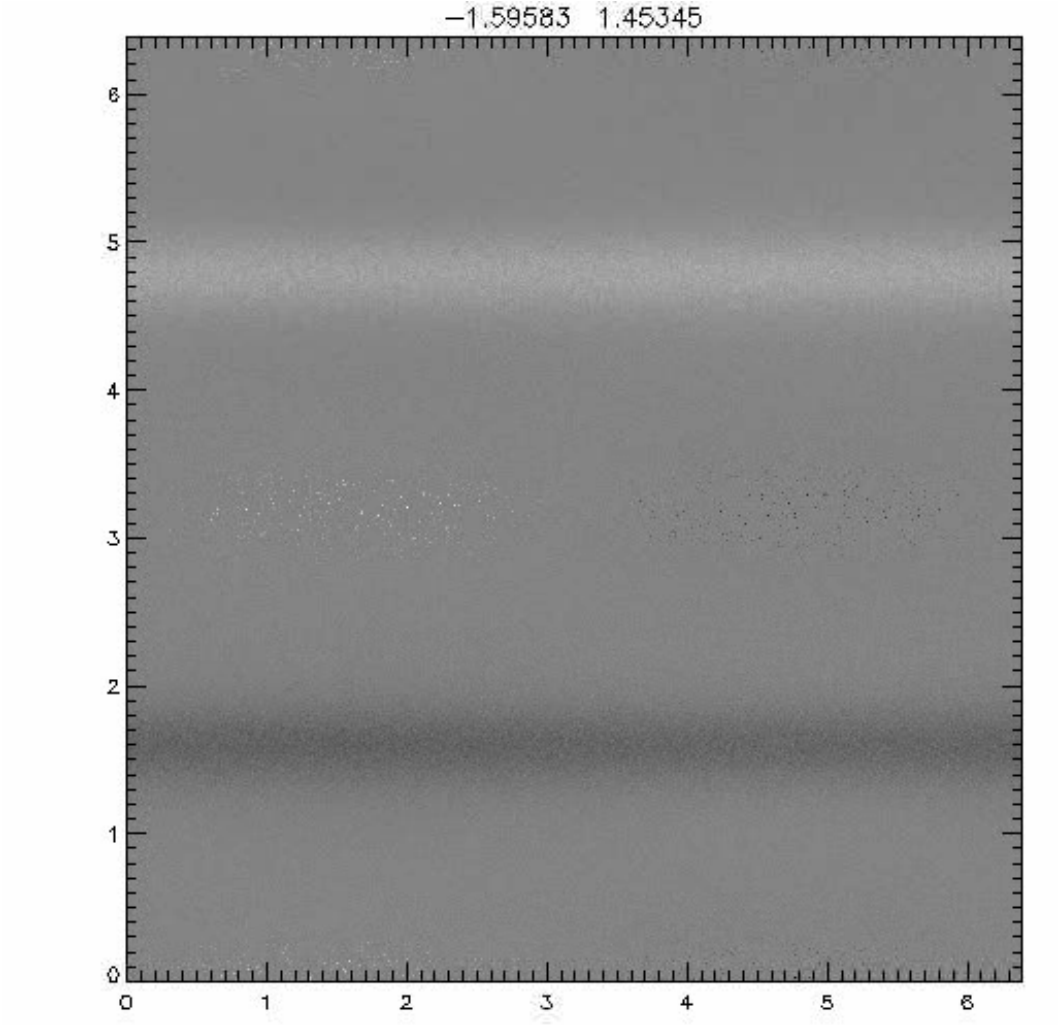
Solar Flare


Solar Flare
1971 October 10
Big Bear Solar Observatory
BBSO

Magnetic Reconnection Geometry



- There may also be a guide field, magnetic field lines pointing perpendicular to the anti-parallel lines of reconnection



This is a movie of reconnection taken from p3d with a guide field of 1

The Problem

- Using MHD to explain reconnection was flawed in that predicted speeds were too slow
  - e.g. the model predicted a solar flare would take 10^4 years, while realistically, it only took 30 min.

- The solution: Anomalously High Resistivity occurs

What causes this anomalously high resistivity?

- In a recent paper, Dr. Drake et al noted that turbulence formed in the presence of a high guide field.

- However, in the presence of no guide field, electrons decouple from the magnetic field lines inside the current layer, and heat, washing out any turbulence

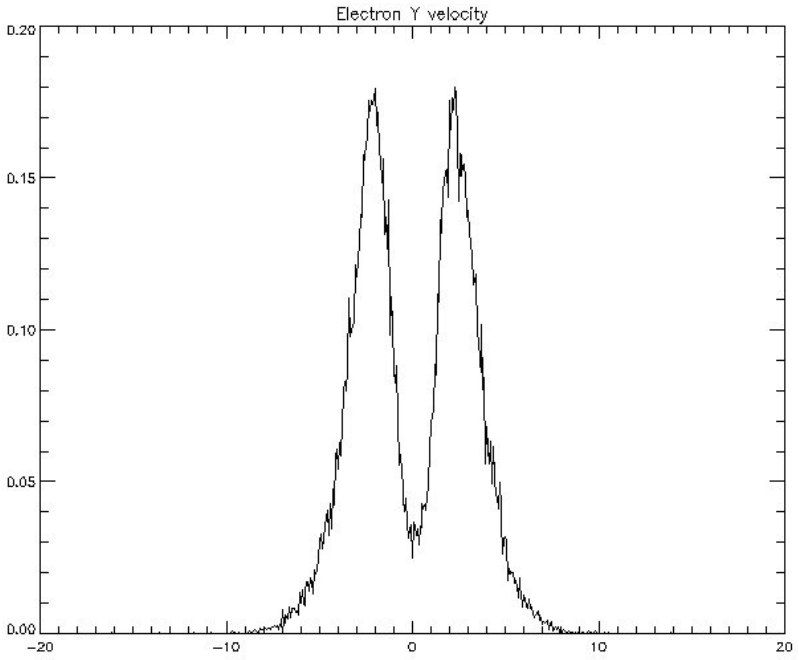
- This formation of turbulence could be a physical explanation of anomalously high resistivity.

- Finding the turning point between a guide field of 0 and 5 then became important.

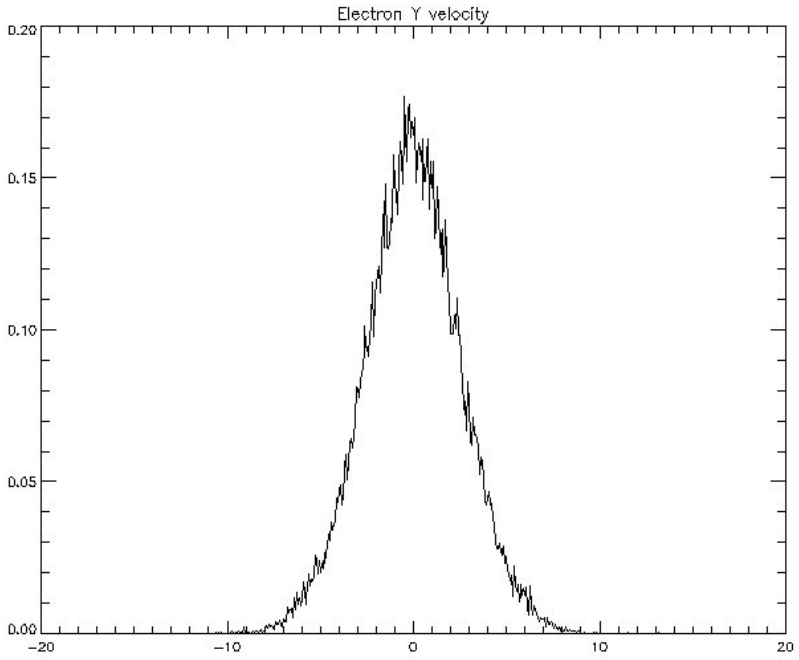
Purpose

- To find the turning point in magnetic guide field strength where electron decoupling no longer occurs and turbulence can occur.
- Below this point, electrons should heat significantly more than above the point

V_{ey} at t = 4.5, guide field .05



V_{ey} at t = 4.5, guide field .1



Results

- The point of .1 guide field strength appears to be the point in question
- At .05 guide field, we see definite electron heating and demagnetization , while at .1, the electron heating is not there