

# Peristaltic Pumping in the Supra-Arcade

Implications of Elliptical Skew

Jade Ream

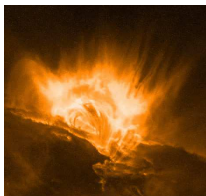
In collaboration with Roger Scott

Montana State University, Department of Physics

Western State Colorado University, Department of Mathematics and Computer Science

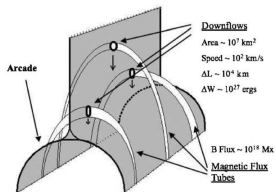
August 6<sup>th</sup>, 2013

## ■ Flares and CMEs



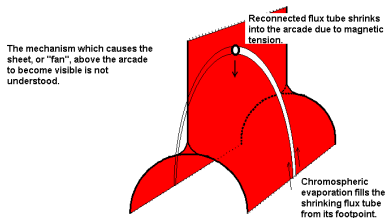
- Resulting From Magnetic Turbulence
- Creating Regions of Immense Heat and Activity

## ■ SADs, Supra-Arcade Downflows and Low-Emission Regions



- Discovered by McKenzie and Hudson in 1999
- Believed to be a Retracting Flux Tube
- The Reconnection Instigating the Downflow is Described as "Highly Localized and Temporally Variable"

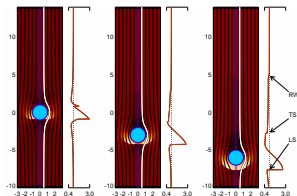
# Supra-Arcade Features



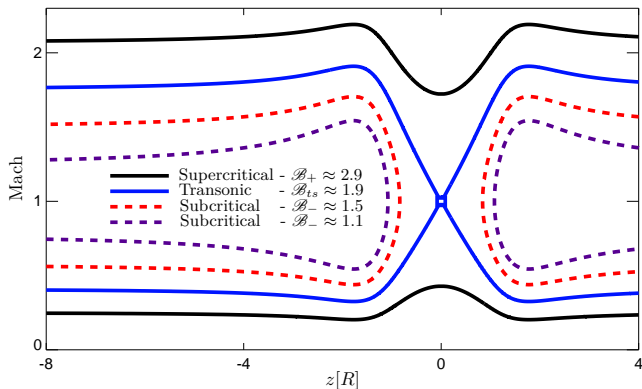
- SADs are Otherwise Described as Wakes
- Resulting From Magnetosonic Shocks and Rarefaction Waves

## ■ What is the Significance of SADs?

- SADs Manipulate Plasma Flow in the Supra-Arcade
- The Speed, the Width of Plasma Flow, and the Ease of Flow are Dependant on the Geometric Eccentricity of the Wake



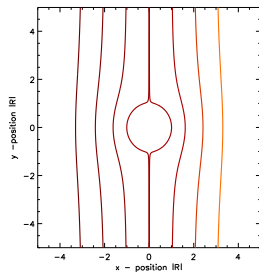
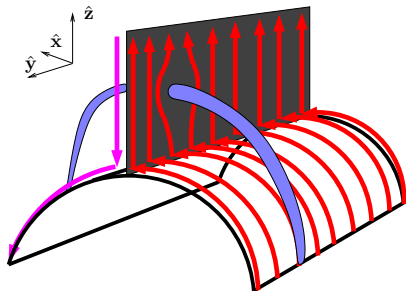
## ■ Transonic Flow



- Subcritical Solutions Between the Upper and Lower Transonic Flow Lines Instigate Shock Formation

## ■ Reconnecting Flux Tubes Create a Descending Deformation

- Resulting Constriction Characterizes Plasma Flow Affecting Unreconnected Field

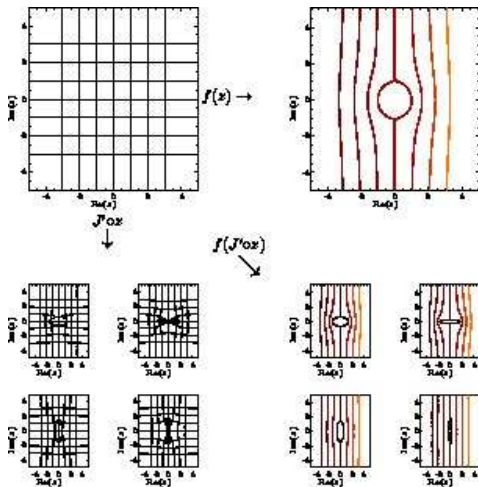


- Dependant on The Condition of Shock Formation
- Limited to Circular Intrusion

- Conformal Mapping via the Inverse Joukowski Transformation

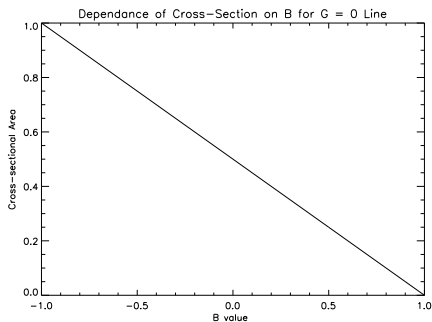
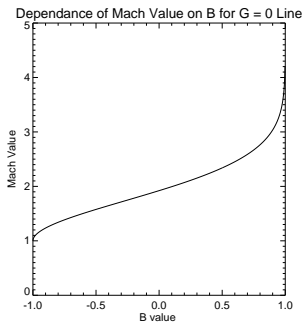
$$J' \circ z = \frac{1}{2A} \left( z \pm \sqrt{z^2 - 4AB} \right).$$

- Transforming a Circle Into an Ellipse

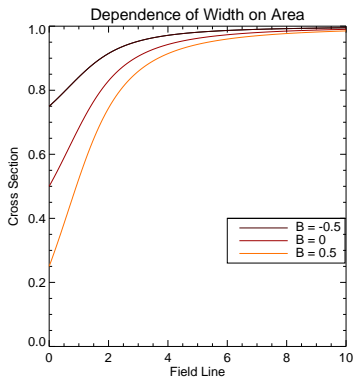
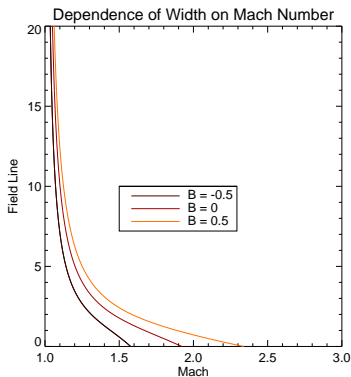




- The Dependence of Critical Mach-Value on B
- How Cross-Sectional Area is Affected by Elliptical Skew



- How Field Line Relates to Mach-Value
- The Dependence of Cross-Section on Field Line



- Elliptical Skew is Directly Proportional to Cross-Sectional Area
- As the skew of the ellipse is stretched horizontally the constriction of flow decreases towards zero, representing no flow
- As the ellipse is stretched vertically the opposite is true, resulting in almost no restriction of flow. The flow restriction is directly proportional to the Mach-value

## ■ Papers

- 1 Scott et al : "'Peristaltic Pumping near Post-CME Supra-Arcade Current Sheets', 2013
- 2 McKenzie : 'Supra-Arcade Downflows in Long-Duration Solar Flare Events', 2000