

## **The Origin, Evolution, and Diagnosis of Solar Flare Magnetic Fields and Plasmas: Honoring the Contributions of Dick Canfield**

Monday August 9, 2010

8:00am-9:00am – Registration, Breakfast

9:00-9:10am – HAO Director Michael Thompson, Welcome

9:10-9:20am – LOC orientation, practical details

(internet access, bathroom locations, coffee breaks, etc.)

9:20-9:30am – SOC orientation (debate structure, breakout room, etc)

9:30-10:30am – Invited Talk, Lyndsay Fletcher (U. Glasgow)

“The Role of the Chromosphere in Flare Energy Release”

10:30-10:50am – Coffee Break

10:50-11:20am – Adam Kowalski (U. Washington)

“White Light Emission in Stellar Flares”

11:20-11:50am – Tom Schad (NSO)

“Multi-height Full Stokes Polarimetry of a B-Class Flare”

11:50am-12:20pm – Kevin Reardon (Arcetri Obs.)

“Chromospheric Imaging Spectroscopy of Flares”

12:20-1:20pm – Lunch

1:20-1:50pm – Hugh Hudson (SSL/UC Berkeley)

“Flare Momentum, Further Thoughts”

1:50-2:20pm – Charlie Lindsey (CoRA/NWRA)

“Transient Seismic Emission in Solar Flares”

2:20-2:50pm – George Fisher (SSL/UC Berkeley)

“Momentum Balance in Eruptive Flares: The Role of the Lorentz Force”

2:50-3:10pm – Coffee Break

3:10-3:40pm – Jiong Qiu (Montana State U.)

“Reconnection and Energetics in Two-Ribbon Flares”

3:40-5:10pm – Debate: It’s Hard To Believe That The Chromosphere Has  
Anything Fundamental To Do With a Solar Flare”

(Debate coordinator: Hugh Hudson)

5:30-9:00pm – Reception and Dinner, Mesa Lab Cafeteria, Canfield talk:

“Fifty years in Solar Physics”

(Bus will leave Center Green-1 at 5:30pm, and depart the Mesa Lab at  
9:00pm)

Tuesday, August 10, 2010

8:00-9:00am – Breakfast

9:00-10:00am – Invited Talk, Tom Ayres (U. Colorado)  
“A Stellar Perspective on the Solar Chromosphere”

10:00-10:30am – Bill Abbett (SSL/UC Berkeley)  
“Testing a Simplified Treatment of Radiative Transfer in Large-Scale Convection-zone to Corona Models”

10:30-10:50am – Coffee Break

10:50-11:20am – Yuhong Fan (HAO/NCAR)  
“On the Formation and Eruption of Coronal Flux Ropes”

11:20-11:50am – Rudi Komm (NSO)  
“Twisted Subsurface Flows of Active Regions and Flare Activity”

11:50am-12:20pm – Ron Moore (MSFC/NASA)  
“The Driving Magnetic Field and Reconnection in CME/Flare Eruptions and Coronal Jets, or ‘Why S but not X Marks the Spot for CME/Flare Eruptions’ ”

12:20-1:20pm – Lunch

1:20-2:20pm – Invited Talk, Jiong Qiu (Montana State U.)  
“The Relationship Between Magnetic Clouds and Solar Flare/CME Evolution”

2:20pm-2:50pm – Maria Kazachenko (Montana State U.)  
“Energy and Helicity Budget of Four Solar Flares and Associated Magnetic Clouds”

2:50-3:10pm – Coffee Break

3:10-3:40pm – Chris Lowder (Montana State U.)  
“Transient Coronal Holes: A Statistical Study of Coronal Dimming Regions”

3:40-4:10pm – Ben Lynch (SSL/UC Berkeley)  
“The Magnetic Cloud from Nowhere”

4:10-5:40pm – Debate on the Relationship Between Solar Magnetic Fields and Magnetic Clouds (Debate coordinator: Alex Pevtsov)

6:00pm -- Informal Dinner with Dick Canfield at Boulder Beer (within walking distance of Center-Green complex)

Wednesday, August 11, 2010

8:00-9:00am – Breakfast

9:00-10:00am – Invited Talk, Mitch Berger (Exeter U.)  
“The Magnetic Helicity Content of Coronal Magnetic Fields”

10:00-10:30am – Dick Canfield (Montana State U.)  
“Magnetic Helicity Injection, Flares, and CMEs: A Review”

10:30-10:50am – Coffee Break

10:50-11:20am – Alex Pevtsov (NSO)  
“The Vorticity of Photospheric Granulation-Scale Flows and the Surface Dynamo”

11:20-11:50am – Mei Zhang (NAOC, Beijing)  
“Hemispheric Helicity Sign Rule Indicated by Large-Scale Photospheric Magnetic Fields”

11:50am-12:50pm – Lunch

12:50-1:20pm – Dana Longcope (Montana State U.)  
“Helicity as a Proxy of Energy Storage”

1:20-1:50pm – KD Leka (CoRA/NWRA)  
“Solar Magnetic Helicity: Important? Perhaps. Well-Measured? Hard to Believe...”

1:50-2:20pm – Coffee Break

2:20-3:50pm – Debate: “It’s Hard to Believe that Magnetic Helicity has Anything to do with Solar Flares”. Debate coordinator: George Fisher

Pro: Spiro Antiochos (~15m)

Con: Alex Pevtsov (~15m)

Open discussion (~60m)

3:50-4:20pm – Spiro Antiochos (GSFC/NASA)  
“Helicity and Filament Channels? The straight Twist!”

4:20pm – Meeting ends

*The organizers gratefully acknowledge support for this meeting from NSF through a supplemental request to grant ATM0551084 at UC Berkeley. We Thank Paul Bellaire for his assistance. We also thank the acting HAO Director, Stan Solomon, for volunteering to host the meeting at HAO/NCAR.*

## Abstracts of the Invited Talks

Thomas Ayres: *A Stellar Perspective on the Solar Chromosphere*

The Sun is not alone in hosting a chromosphere; virtually all convective stars (F-types and later) possess them. The properties can vary wildly from object to object. Historically, two main systemic behaviors were recognized. One is the so-called rotation-activity connection ("Skumanich law"): chromospheres strengthen as stellar spin increases. The second is codified in the "Wilson-Bappu effect," a steady broadening of the chromospheric Ca II H and K emission cores with increasing visual luminosity, extending over a stunning 15 stellar magnitudes. The Skumanich law tells us something about the magnetic foundation of the chromosphere, which apparently strengthens with intensifying dynamo action. The W-B effect tells us something about the structural properties of a chromosphere, whose thickness and mean electron density apparently behave systematically with decreasing surface gravity. In the modern era of ultraviolet and X-ray spectroscopy from orbiting platforms, additional phenomenology has been recognized, mainly relating to the importance of atmospheric dynamics. In this review, I will outline some of the insights contributed by stellar astronomy to the understanding of general chromospheric structure. I also will present some very recent UV spectroscopic studies of yellow dwarfs and giants -- from Space Telescope Imaging Spectrograph and Cosmic Origins Spectrograph on Hubble -- which mirror, and emphasize, the "relentlessly dynamic" view of the solar chromosphere uncovered in recent years by Hinode. I also will touch on the so-called "buried coronae" of red giant stars -- also illustrated with new COS FUV spectra and earlier STIS measurements -- which provide a cautionary tale of coronal heating deep in the chromosphere itself, perhaps very relevant to the Sun.

Mitchell Berger: *The Magnetic Helicity Content of Coronal Magnetic Fields*

This talk reviews the observations, theory, and geometry of solar magnetic helicity. Helicity can arise from the twisting, shearing, kinking, and linking of magnetic flux. Suppose we divide the closed coronal flux into pieces, where each piece is a set of field lines extending into the photosphere at both ends. Then the helicity divides into a sum of self-helicities of a single piece, and a double sum of mutual helicities between pieces. The self-helicities of single flux tubes relate to the internal twist and kinking of the tubes. These can be measured by quantities known as the Twist number and the Writhe number. Recently, this decomposition has been given much attention, both for thin and fat tubes. Helicity can also be related to the interlinking of poloidal and toroidal flux. The flow of helicity into the corona and beyond, its generation in the solar dynamo, and its implications for activity will also be discussed.

Lyndsay Fletcher: *The Role of the Chromosphere in Flare Energy Release*

The solar chromosphere is the sink for on the order of half of the total magnetic energy released during a solar flare, and therefore the predominant source of radiative losses. Hard X-ray observations demonstrate the presence of large numbers of accelerated electrons in the chromosphere, and the accepted model for flares is that they arrive there from an acceleration site in the corona. However for decades it has been recognized that the electron numbers required are a challenge for coronal acceleration models, which has prompted an examination of the possibility that flare electrons are accelerated or reaccelerated in the solar chromosphere, with the required energy being transported from its storage site in the corona primarily in the form of fast-moving magnetic perturbations. This talk will briefly review the observational constraints on models for flare energy release, introduce models involving electrons in the chromosphere, and discuss the prospects for, and the difficulties with, such scenarios.

Jiong Qiu: *The Relationship between Magnetic Clouds and Solar Flare/CME Evolution*

A good number of magnetic clouds are interplanetary flux ropes observed at 1 AU, which are thought to be associated with the Sun to varying degrees. We will discuss the effort to clarify the association between magnetic clouds and solar surface activities and to understand the underlying physics. For example, have observations been able to settle the long standing debate on the origin of the flux rope, namely, whether the flux rope is formed in the convection zone, which subsequently emerges and erupts, or it is formed during eruption by magnetic reconnection in the corona? Since relevant observations are obtained at the two ends of the solar-terrestrial system, it is important that observational and modeling investigation yields measurements of flux rope properties that may be compared across the path of 1 AU. This talk will briefly review our current standing and progress in this direction.

## List of Registered Meeting Attendees

Bill Abbett, SSL/UC Berkeley  
Loren Acton, Montana State U.  
Spiro Antiochos, GSFC/NASA  
Tom Ayres, U. Colorado  
Mitch Berger, Exeter U.  
Jack Campbell, Exeter U.  
Dick Canfield, Montana State U.  
Yuhong Fan, HAO/NCAR  
George Fisher, SSL/UC Berkeley  
Lyndsay Fletcher, Glasgow U.  
Hugh Hudson, SSL/UC Berkeley  
Maria Kazachenko, Montana State U.  
Rudi Komm, NSO  
Adam Kowalski, U. Washington  
KD Leka, CoRA/NWRA  
Charlie Lindsey, CoRA/NWRA  
Dana Longcope, Montana State U.  
Chris Lowder, Montana State U.  
Ben Lynch, SSL/UC Berkeley  
Anna Malanushenko, Montana State U.  
Ron Moore, MSFC/NASA  
Alex Pevtsov, NSO  
Eric Priest, U. St. Andrews  
Jiong Qiu, Montana State U.  
Kevin Reardon, Arcetri Obs.  
Tom Schad, NSO  
Michael Thompson, HAO/NCAR  
Alexandra Tritschler, NSO  
Martin Woodard, CoRA/NWRA  
Mei Zhang, NAOC, Beijing

**Scientific Organizing Committee (SOC):** Yuhong Fan, George Fisher, Hugh Hudson, KD Leka, Dana Longcope, BC Low, Alex Pevtsov

**Local Organizing Committee (LOC):** Janet Biggs (CoRA/NWRA), Yuhong Fan (HAO), Adrian Trujillo (HAO)

**Session Chairs:** Hugh Hudson (Monday morning), Yuhong Fan (Monday afternoon), KD Leka (Tuesday morning), Alex Pevtsov (Tuesday afternoon), Dana Longcope (Wednesday morning), George Fisher (Wednesday afternoon)

**Debate Coordinators:** Hugh Hudson (flare chromosphere), Alex Pevtsov (magnetic clouds), George Fisher (magnetic helicity)