

# The Mauna Loa Solar Observatory



MLSO User Committee Meeting

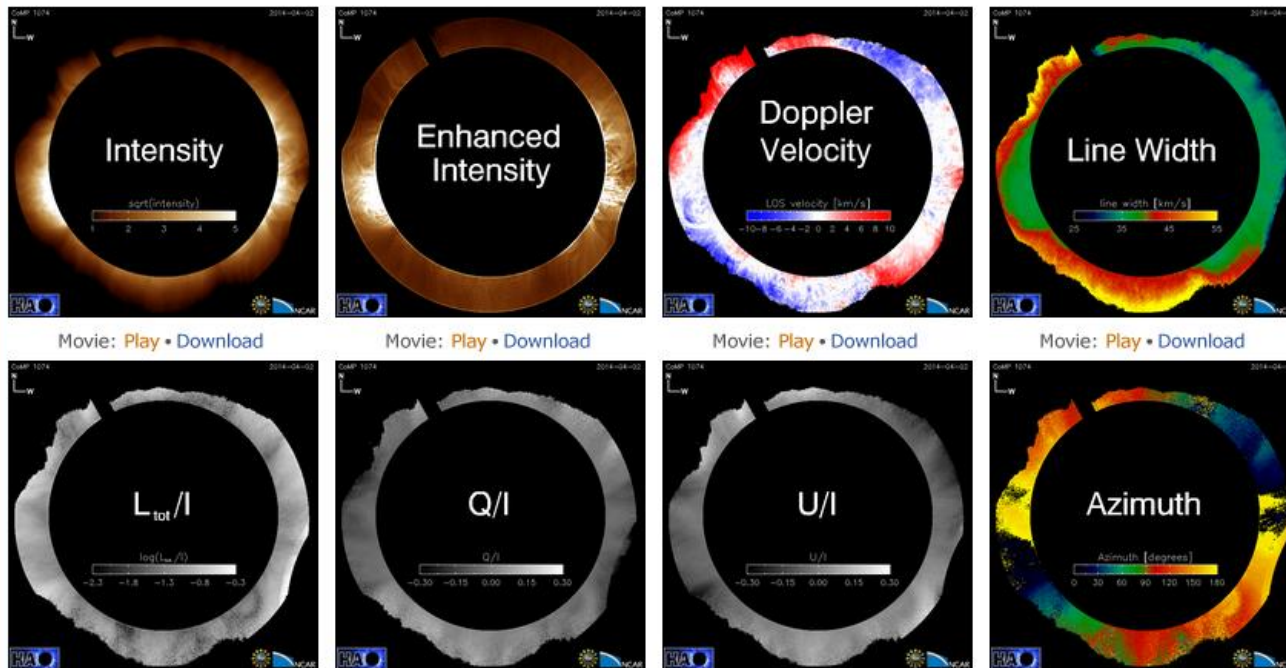
April 22, 2014

# Science Goals

Understand how changes in the Sun's magnetic field drive solar activity and create space weather at Earth

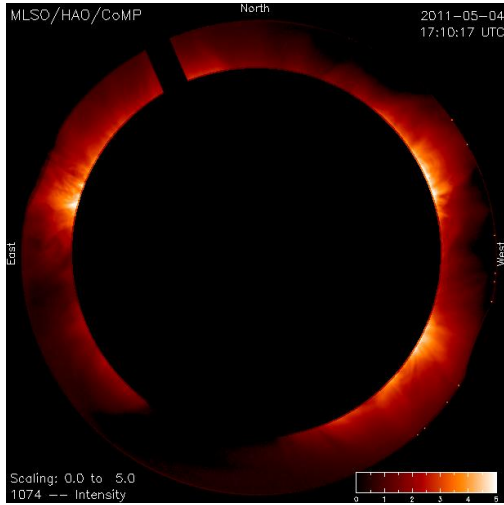
Establish how the coronal magnetic field responds to emerging magnetic flux, plasma flows and large scale motions

Determine solar cycle variations of magnetic field and solar outputs

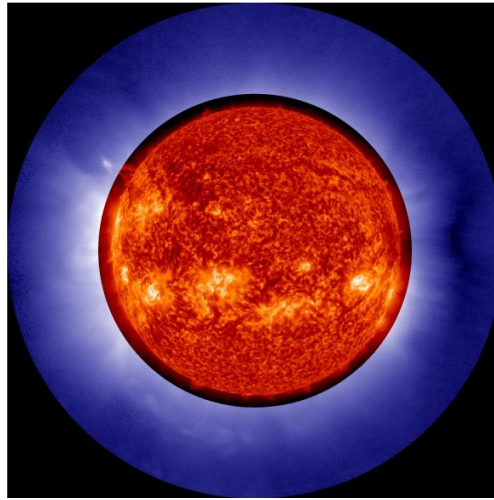


At Left: CoMP observations of coronal plasma and magnetic field properties provided on MLSO web page

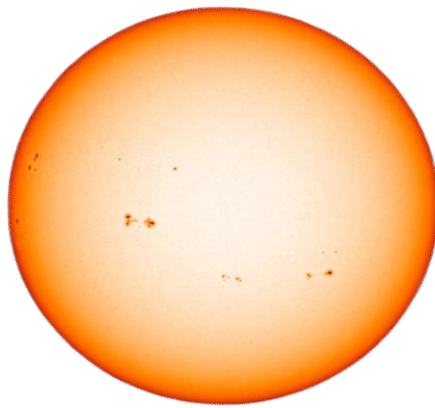
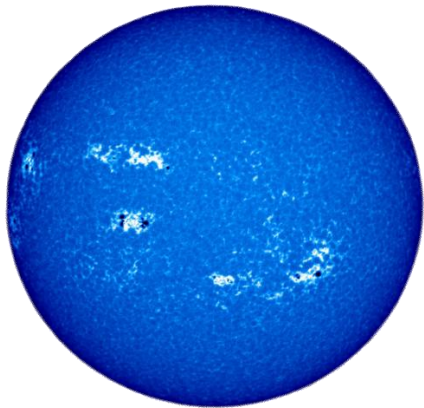
# Instruments at Mauna Loa



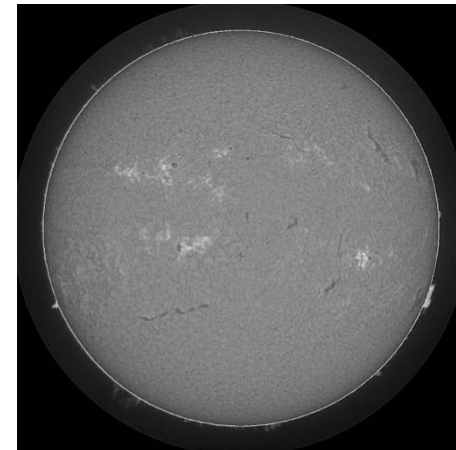
**CoMP:** Fe-XIII 1074.7 and 1079.8 nm and He-I 1083.0 nm full Stokes I,Q,U,V polarization



**COSMO K-Coronagraph:** Linear polarization in white light. Dec 9, 2013 composite image of K-Cor with SDO AIA Helium-I 30.4 nm image.



**Precision Solar Photometric Telescope (PSPT):** Left: CaIIK line center; Right: Blue continuum at 409.4 nm



**GONG H-alpha:** Neutral hydrogen emission at 656.3 nm. Owned by NSO; maintained by HAO.

HAO operates 4 instruments at MLSO: CoMP, K-Cor, PSPT and GONG. HAO is responsible for the data processing and data products for CoMP and K-Cor; Mark Rast at University of Colorado processes and manages all PSPT data and the GONG group processes and manages all GONG data processing and products.

# Status of Coronal Multi-Channel Polarimeter

Instrument is fully operational

Data Products: FeXIII: 1074.7 and 1079.8 nm

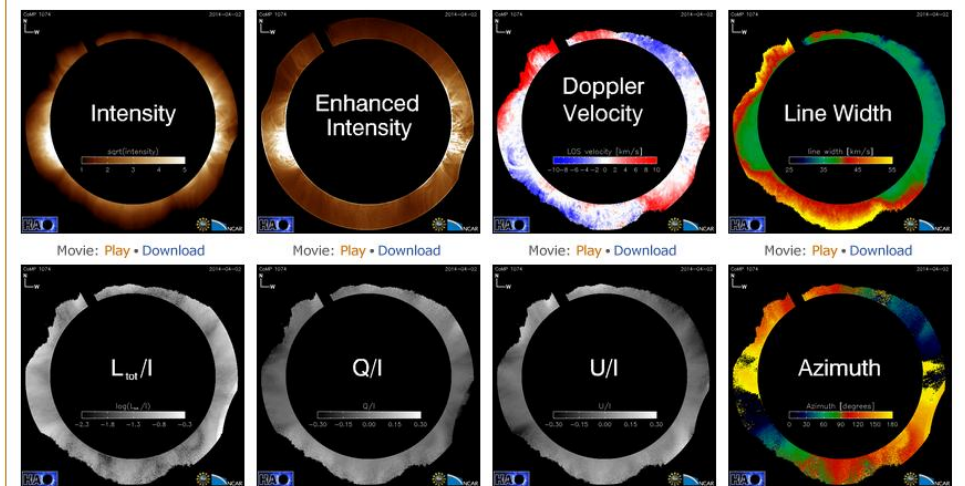
**~1 Minute Time Resolution:**  
'Dynamics' Products:'

Intensity  
Enhanced Intensity  
Corrected LOS velocity  
Line Width

'Polarization' Products:

Intensity  
Enhanced Intensity  
Stokes 'U'  
Stokes 'Q'  
Total Linear Polarization

**PLUS:** 'Dashboard' images (shown below),  
consisting of eight quantities made from best  
avg. images of the day



Coming later in 2014: HAO purchasing new camera that will eliminate need for Liquid nitrogen cooling. HAO has a proposal out to NSF for funds for a second camera. If approved, the second camera would improve spatial resolution and increase the field-of-view.

**Status of PSPT: Jerry Harder has provided  
slides**



At Left: Lisa Waters and Brandon Larson installing K-Cor at MLSO

# What's New at MLSO

- COSMO K- Coronagraph
- Community Observing Campaigns (mostly CoMP)

- Community Forward Modeling Tools utilizing MLSO, SDO, and other data
- 2 New Casual Observers: Lisa Waters, Greg Rose
- New web page launched February 2014
- COSMO Chro-Mag coming to MLSO ~Dec 2014

# Status: COSMO K-coronagraph (K-Cor)

K-Cor performance meets design requirements of recording the white light (WL) corona down to  $1.05 R_{\odot}$ ; lowest WL FOV outside of eclipse

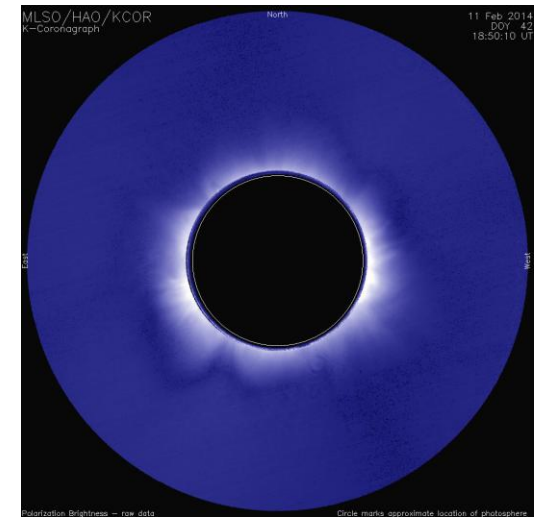


Installed at MLSO September 2013

Have begun providing qualitative data on web page

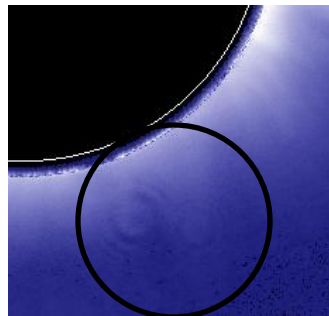
Calibrated data coming later this year: Need to complete analysis of demodulation results and sky polarization removal.

Diffraction pattern artifacts (image at left) may be in or near area of objective lens; will install spare lens in June. Lyot stop may be misaligned. Full realignment of optics in June.



Above: K-cor movie of Feb 11, 2014 CME

Above: K-Cor at MLSO



'diffraction' pattern artifacts

# New MLSO Web Page

UCAR NCAR Closures/Emergencies Locations/Directions Find People

Home About HAO Research Modeling Observations/Data News & Events Partnerships Education For Staff

NCAR UCAR **HAO** High Altitude Observatory

*sun • earth • connections*

Search

## Mauna Loa Solar Observatory

CHROMAG OPTICS TESTING



LATEST MLSO IMAGES

**CoMP**  
  
CoMP 1074nm Intensity  
05-Apr-2014  
Movie: Full Res  
[Get Data](#)

**K-Cor**  
  
K-Corona (720-750nm)  
04-Apr-2014  
Movie: Low Res  
[Get Data](#)

**GONG H-alpha**  
  
H-Alpha Disk/Limb  
Full-Resolution FITS  
Movies: All | Every 4th img  
GONG H-alpha Network

**PSPT CaIIk**  
  
CaIIk (393 nm)  
05-Apr-2014  
[Get Data](#)

**PSPT Blue**  
  
Blue (408-412 nm)  
05-Apr-2014  
[Get Data](#)

**PSPT Red**  
  
Red (605-610 nm)  
05-Apr-2014  
[Get Data](#)

Home

**MLS0**

- MLS0 Home Page
- Data & Movies
- Solar Activity Logs
- Gallery
- Instruments
- About MLS0
- Related Sites
- Contact Us

**UPCOMING HAO EVENTS**

View as: [calendar](#) | [table](#)

- HAO Colloquium Series presents Bette Otto-Bliesner, NCAR/CGD  
Wednesday, April 16, 2014  
- 1:30pm to 2:30pm
- HAO Colloquium Series presents Cora Randall, University of Colorado  
Wednesday, April 23, 2014  
- 1:30pm to 2:30pm
- 2014 CISM Summer School  
Monday, July 21, 2014 -  
8:00am to Friday, August 1,

K-Cor data now becoming available

Updated Instrument pages

Updated News Items

More information about MLSO



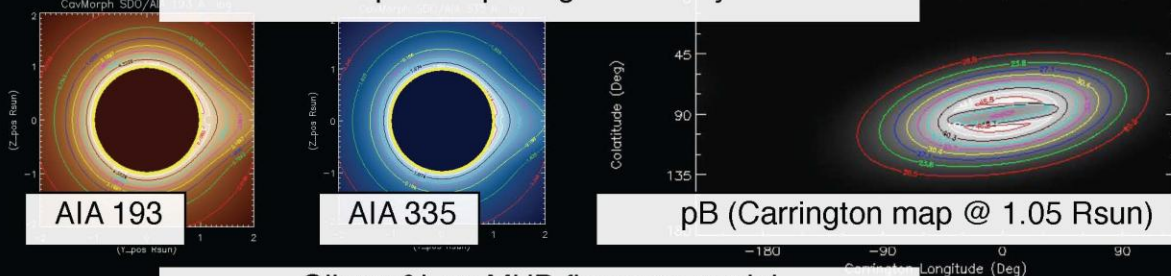
# New Forward Modeling / Data tools

HAO-led development effort of a community tool to compare PFSS and MHD models of solar corona to **MLSO CoMP**, SDO AIA and other data. Contributors: Sarah Gibson, Blake Forland, Jim Dove, Terry Kucera, Phil Judge, Enrico Landi

<http://www2.hao.ucar.edu/mlso/news/forward>

## “FORWARD” SolarSoft IDL Codes

“Cavmorph” morphological density model

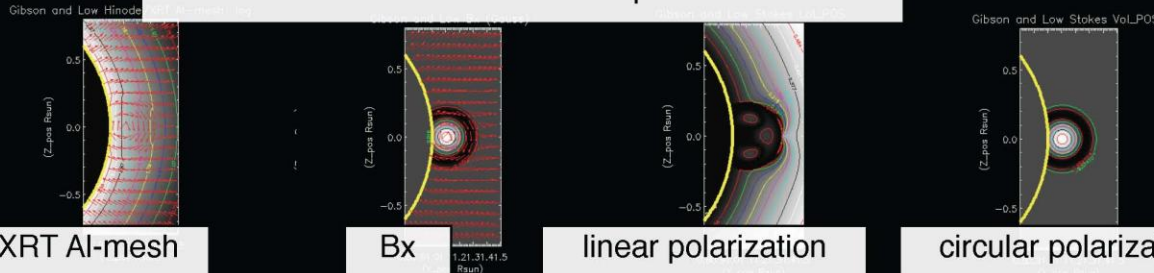


AIA 193

AIA 335

pB (Carrington map @ 1.05 R<sub>sun</sub>)

Gibson&Low MHD flux rope model



XRT Al-mesh

Bx

linear polarization

circular polarization

NOW WITH WIDGETS!

Tool can also be downloaded from MLSO web page under Data and Movies: Emission Corona FeXIII OR Data and Movies: More Products OR MLSO News

# Community Observing Campaign Highlights with CoMP Instrument

**2014:** Increased acquisition of FeXIII at 1079.8 nm to study CME shock compression ratios

***Requested by:*** Hui Tian, Harvard Smithsonian Ctr for Astrophysics and Yao Chen, Shandong University Center for Space Weather Studies

**2013:** Increased doppler observations to study evolution of coronal cavities and eruption of prominences and CMEs.

***Requested by:*** Alphonse Sterling, NASA Marshall Space Flight Center and Tim Bastian, University of Virginia and NRAO

**2013:** Varied observations of circular polarization and FeXIII 1079.8 to study properties of coronal magnetic field

***Requested by:*** Enrico Landi, University of Michigan, Bernhard Kleim, University of Potsdam, Terry Kucera, NASA Goddard Space Flight Center, Kathy Reeves, Harvard Smithsonian Ctr for Astrophysics.

# Community Requests for K-Cor

**2014:** Acquire 8-second time cadence to identify flares with steepening hard-Xray production associated with CME-shock generated solar energetic proton events (SEPs)

**Requested by:** Alan Kiplinger, University of Colorado Boulder

**2014:** Provided successful K-Cor bandpass rejection design and specifications to SCORE coronagraph team.

**2016:** Joint campaign with SCORE coronagraph on NRL sounding rocket flight

**Requested by:** Silvano Fineschi, National Institute for Astrophysics, Torino

# New Community Observing Campaign Web Page

## SPECIAL MLSO OBSERVING CAMPAIGNS

Currently, MLSO has three instruments in operation - CoMP, K-Cor, and PSPT. Each one has different modes of operation that may aid in specific investigations. CoMP is the most flexible and has accepted special campaign requests. HAO encourages special observation requests to maximize scientific discovery for the solar and heliospheric community.



## EXAMPLES OF SPECIAL OBSERVATION REQUESTS

Here are some examples of the type of requests that MLSO has received in the past:

### CoMP Campaign Highlights

2014: Increased acquisition of FeXIII at 1079.8 nm to study CME shock compression ratios Requested by: Hui Tian, Harvard Smithsonian Ctr for Astrophysics and Yao Chen, Shandong University Center for Space Weather Studies

2013: Increased doppler observations to study evolution of coronal cavities and eruption of prominences and CMEs. Requested by: Alphonse Sterling, NASA Marshall Space Flight Center and Tim Bastian, University of Virginia and NRAO.

[▶ more examples >>](#)

## APPLYING FOR OBSERVATION TIME

To apply for an observing campaign with one of MLSO's instruments, please fill out the:

[MLSO Special Observation Request Form.](#)

Campaign requests will be reviewed and implemented as resources allow. Special observing campaigns will be executed by MLSO observers and instrument scientists. On-site presence of requester is not necessary due to remoteness of site and compliance with NOAA observational requirements.

## MLSO SPECIAL OBSERVATION REQUEST

**Title of Campaign \***

For example: 'WHI Streamer Study', 'CME Shock Compression'

**Science Goal \***

Requester's Contact Info

**Name (last, first) \***

The name of the primary requester.

**Institution or organization \***

Name of the primary requester's institution or organization.

**email address \***

**Campaign/planning web page**

URL for a web page containing info about the intended use of these observations (optional).

▼ **Desired CoMP Observations**

### Pre-defined Recipes

- Doppler (Intensity measurements with cadence as short as two seconds.)
- Alfvén Waves (I, Q, U with 30 seconds or longer cadence.)
- Density (Intensity of 1074.7nm and 1079.8nm lines with a few minutes or longer cadence.)
- Total Field (Full Stokes I, Q, U, V; Provides LOS, field strength, and POS field azimuth and polarization)

### Choose desired lines for above recipes

- FeXIII 1074.7nm
- FeXIII 1079.8nm
- He-I 1083.0nm

You may select one, two, or all three available lines for any recipe (except density, which uses 1074.7 & 1079.8 by default).

### Custom campaign

If the pre-defined recipes above will not suit the science goal, please describe the parameters of the desired observations.

▶ **Desired K-Cor Observations**



Chro-Mag at Mesa Lab

# COSMO Chro-Mag (prototype)

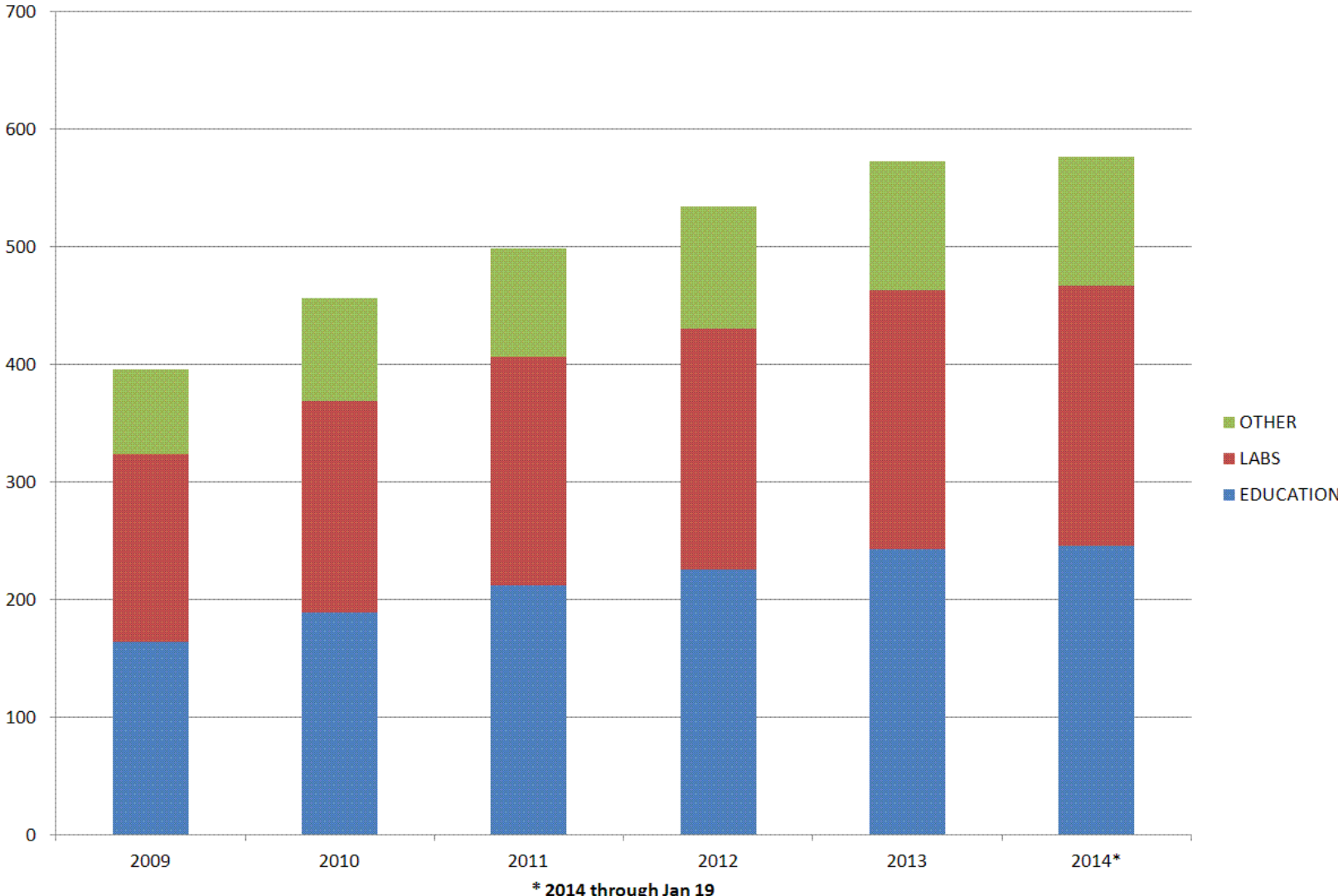
**Science Goal:** Understand how the chromospheric magnetic field and plasma interactions drive the dynamics of prominences and filaments and other chromospheric structures.

- Provides synoptic full-disk imaging spectro-polarimetry:
- He I 587.6 & 1083.0 nm: chromospheric magnetograms
  - H $\alpha$  656.3 nm: chromospheric structure and dynamics
  - Ca II 854.2 nm: chromospheric magnetograms
  - Fe I 617.3 nm: photospheric magnetograms
  - High cadence: < 1 minute for all lines
  - Moderate spatial resolution: 2.2 arcsec (1.1 arcsec pixels)
  - Moderate but sufficient spectral resolution: > 30000
  - Field of view: 2.4 R<sub>sun</sub> square
  - High polarimetric sensitivity: SNR > 103

# MLSO Metrics: Registered Users

*through Jan 19, 2014*

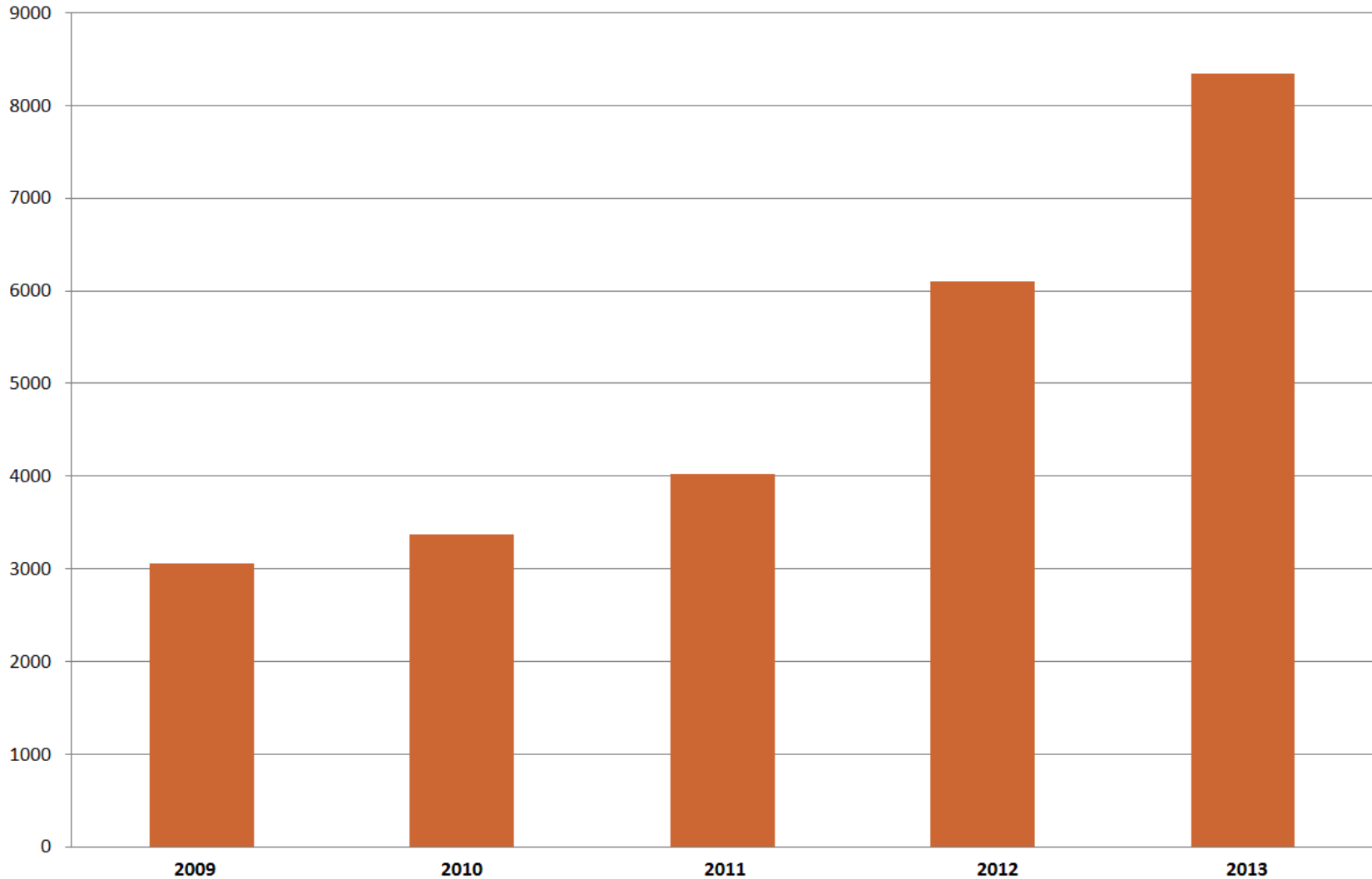
MAUNA LOA REGISTERED USERS



# MLSO Metrics: Data Holdings

## Mauna Loa Data Holdings (Gbytes)

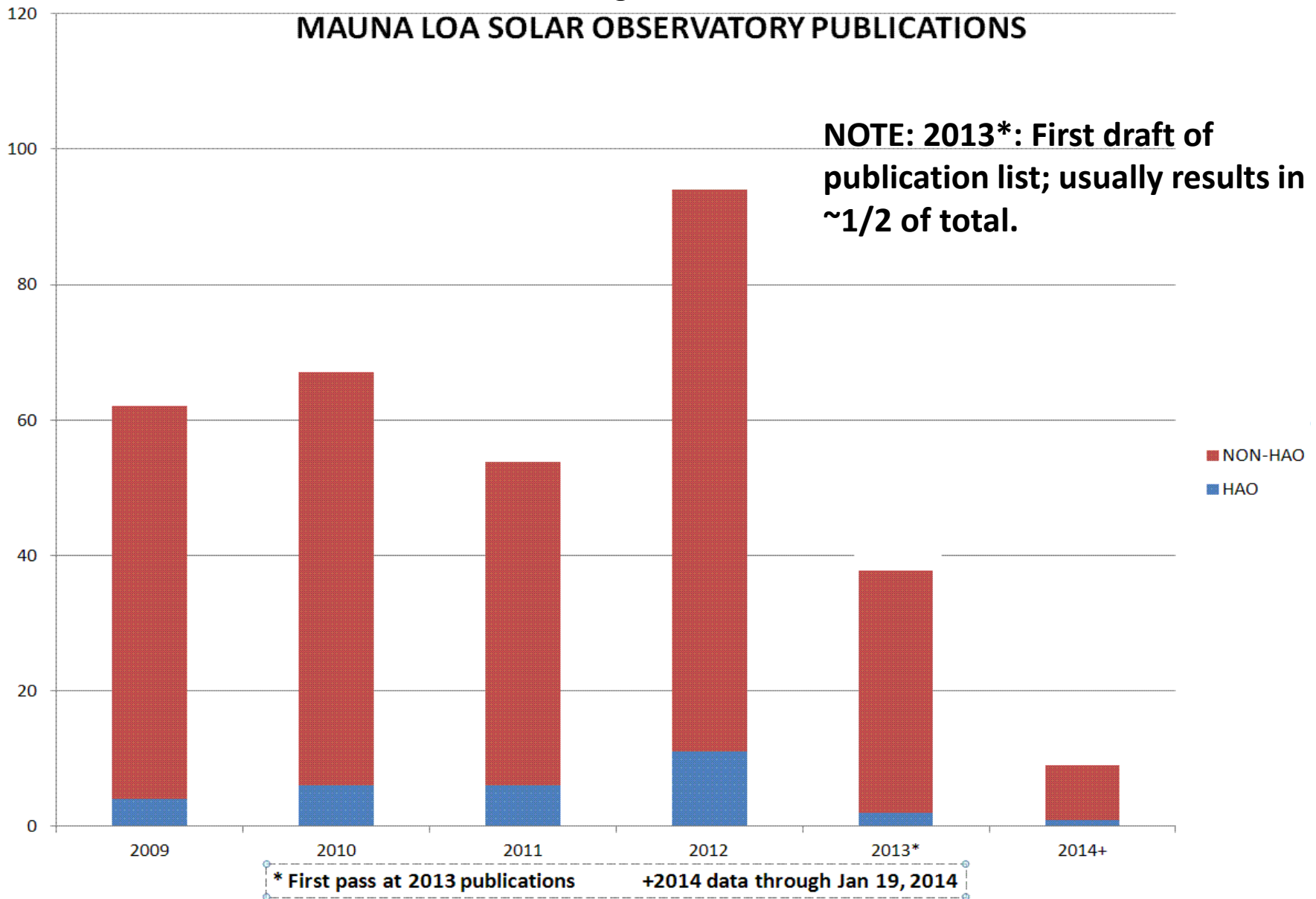
Does not include PSPT or raw data



# MLSO Metrics: Publications

*through Jan 19, 2014*

## MAUNA LOA SOLAR OBSERVATORY PUBLICATIONS





# MLSO Metrics: Publications

*through Jan 19, 2014*

## **2014**

9 papers to date: 5 CoMP, 2 Mk4, 2 PICS H-alpha, 1 PSPT [ 1 paper used Mk4 and Halpha)

## **2013**

38 papers to date: 16 CoMP, 16 Mk4/Mk3; 5 PICS Halpha; 1 PSPT, 1 CHIP, 1 K-Cor [ 2 papers used more than one data set]

Usually takes a few years to find most publications in a given year

# MLSO Staff and Facility

2 new casual observers (each work less than ½ time)



Lisa Waters (Casual)



Greg Rose (Casual)



Ben Berkey



Allen Stueben

# Boulder-side Staff

MLS Data Pipeline Programmer Leonard Sitongia retired end of 2013. Giuliana deToma and I are doing Leonard's job. We have completed interviews for new hire and should have someone in the position soon. Giuliana will continue working on event listings and take on Data Scientist quality control responsibilities.



Leonard Sitongia



Leonard's replacement



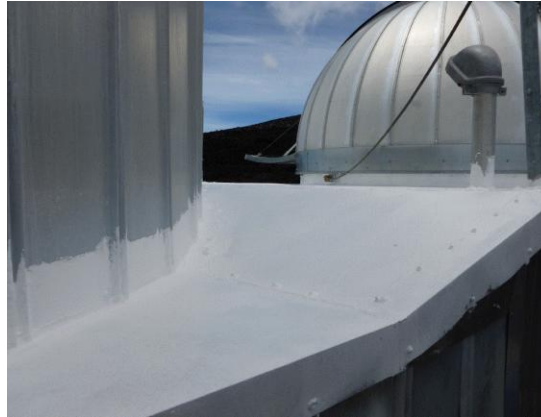
Giuliana deToma

# MLSO Staff and Facility

## MLSO infrastructure improvements include:



UCAR put in new stairs



UCAR repaired roof (it no longer leaks onto PSPT equipment!)



UCAR replaced structure holding up 'doghouse



NOAA paved the road

UCAR has stepped up and is providing major repair funds to the building. Additional work to be completed in 2014 includes:

- Assembly and installation of new dome purchased by HAO
- Removal of asbestos floor tiles
- New floor in control room
- New windows in dome
- Repair wooden boardwalk
- Repair wooden porch
- Replace electrical conduit
- Repair water damage
- UCAR to begin paying for internet with increased speed to 100 Mbps (from 25)

# Recent Post-Docs who have worked with CoMP observations

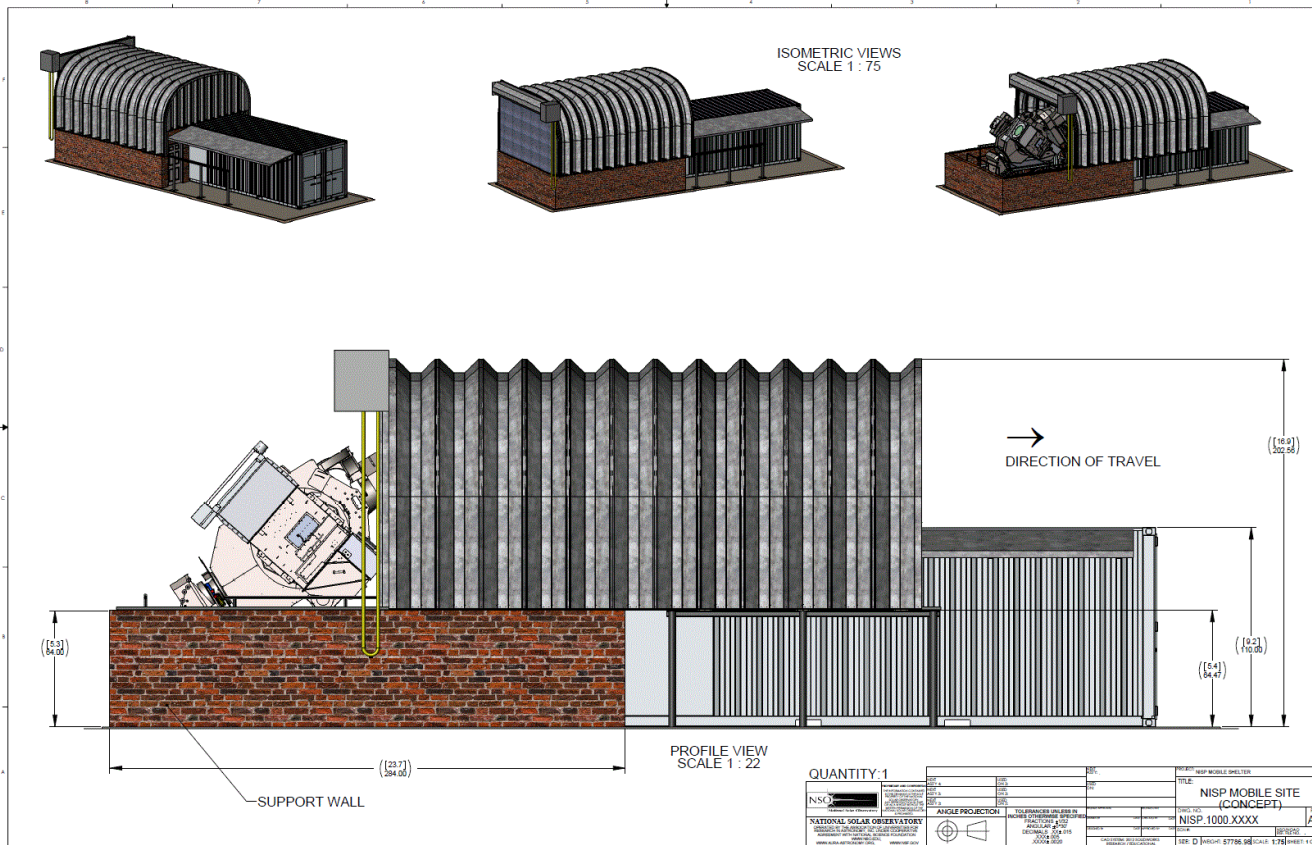
- Joseph Plowman
- Hui Tian (now at CfA)
- Christian Bethge (now at Kiepenheuer Institute)
- Laurel Rachmeler (now at Royal Observatory of Belgium)

## Young Instrument Scientists

- Alfred DeWijn (Dkist VISP, K-Cor, Chro-Mag)
- Junfeng Hou (K-Cor modulator) from National Astronomical Observatories of Chinese Academy

# SOLIS

NSO will move the SOLIS instrument suite from its current location on top of a ~100 tower at Kitt Peak to Tucson, AZ. The system is being automated and configured to consolidate instrumentation, control electronics, and on site computing. Attached image is a conceptual drawing of the proposed upgrade to take place summer 2014. Telescope building has already been ordered and the laboratory space for the ISS instrument, computers, and control electronics is in the process of final modifications.



SOLIS will move in ~2015. Request for information will be solicited later this year. Most likely sites are:

Haleakala, Mauna Loa and Big Bear

# Low-L Pointing Platform at MLSO

Low-L was decommissioned many years ago. Infrastructure includes a solar-pointing system atop a concrete pad behind MLSO. Is anyone in community interested in using the platform? Proposed instruments need to be comparable size to Low-L to avoid conflicts with MLSO instruments. No refrigerants are allowed at the site (NOAA rule).

