AN OVERVIEW OF THE NEW GLOBAL HIGH-RESOLUTION $H\alpha$ NETWORK

M. STEINEGGER 1, A. HANSLMEIER 2, W. OTRUBA 3, H. FREISLICH 3, C. DENKER 1, P. R. GOODE 1, W. M. MARQUETTE 1, J. VARIED 1, H. WANG 1, G. LUO 4, D. CHEN 4 and Q. ZHANG 4

1 Big Bear Solar Observatory, New Jersey Institute of Technology, Big Bear City, USA
2 Institute of Geophysics, Astrophysics and Meteorology, Graz University, Austria
3 Kanzelhöhe Solar Observatory, Treffen, Austria
4 Yunnan Astronomical Observatory, Kunming, P.R. China

UDC 523.9:520.245
Conference paper
(Received November 10, 2000; accepted November 17, 2000)

Abstract. In this paper we give a brief overview of the new global high resolution $H\alpha$ network which was recently established between the Big Bear Solar Observatory (USA), the Kanzelhöhe Solar Observatory (Austria), and the Yunnan Astronomical Observatory (China). A short description of the sites, instruments, and the scientific aims, as well as some sample data are presented.

Key words: solar observations - global $H\alpha$ network

1. Introduction

The solar chromosphere reveals a lot of information about the physical processes based both in deeper and higher atmospheric layers. Chromospheric full-disk observations obtained in $H\alpha$ allow the detailed analysis of various dynamic phenomena relevant to solar activity and space weather, like e.g., sunspots and their associated magnetic structures, evolution of flare events, evolution of filaments and prominences,
properties of mini–filaments, solar differential rotation and meridional flows, to name just a few.

Nowadays, most solar observing stations have only low resolution Hα imaging facilities available. However, for a in–depth study of the above mentioned phenomena, a high spatial and temporal resolution is required. Moreover, observations at single stations are severely limited by the night–time gap. Many interesting and important phenomena are lost if they occur during the night. To overcome these limitations and to monitor the Sun in Hα with both high spatial resolution and high cadence, the new global Hα network was established.

2. Network Sites

The global high–resolution Hα network utilizes facilities at the following sites: Big Bear Solar Observatory (BBSO) in the USA, Kanzelhöhe Solar Observatory (KSO) in Austria, and Yunnan Astronomical Observatory (YNAO) in China.

All these observatories have excellent weather and seeing conditions allowing high–quality solar observations on more than 300 days per year, well experienced and trained observing staffs, and well established Hα telescope systems (Denker et al., 1999; Otruba, 1999; Goode et al., 2000). In Table I the main characteristics of the sites and their instruments are summarized.

At all three network sites a 2k × 2k CCD camera is in operation, allowing to obtain full–disk Hα images with a resolution of 1 arcsec per pixel and a cadence of at least 1 image per minute. All cameras use the same chip (Kodak KAF–4200), which is important to obtain a homogeneous data set. The largest time difference within the network is about 9.4 h between BBSO and YNAO. The difference between BBSO and KSO is about 8.7 h and that between YNAO and KSO 5.9 h. In summer each station can observe 12 h on clear days and there is no night–time gap. In winter, when each station is expected to operate for 8 hours, the BBSO/YNAO gap will be about 1.6 h and the BBSO/KSO gap about 0.7 h.
Table I: Characteristics of the sites and instruments of the new global high–resolution Hα network.

<table>
<thead>
<tr>
<th></th>
<th>BBSO</th>
<th>KSO</th>
<th>YNAO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitude</td>
<td>+116°54.9'</td>
<td>-13°54.4'</td>
<td>-102°47.4'</td>
</tr>
<tr>
<td>Latitude</td>
<td>+34°15.2'</td>
<td>+46°40.7'</td>
<td>+25°01.5'</td>
</tr>
<tr>
<td>Elevation</td>
<td>2067 m</td>
<td>1526 m</td>
<td>1940 m</td>
</tr>
<tr>
<td>Aperture</td>
<td>15 cm</td>
<td>10 cm</td>
<td>18 cm</td>
</tr>
<tr>
<td>Bandpass</td>
<td>0.05 nm</td>
<td>0.07 nm</td>
<td>0.05 nm</td>
</tr>
<tr>
<td>Tunable Range</td>
<td>±0.10 nm</td>
<td>±0.30 nm</td>
<td>±0.06 nm</td>
</tr>
<tr>
<td>Pixel</td>
<td>2k × 2k</td>
<td>2k × 2k</td>
<td>2k × 2k</td>
</tr>
<tr>
<td>Pixel Size</td>
<td>9 × 9 μm²</td>
<td>9 × 9 μm²</td>
<td>9 × 9 μm²</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>14 bit</td>
<td>14 bit</td>
<td>8 bit</td>
</tr>
</tbody>
</table>

3. Network Data

All network data are processed in exactly the same way to get a uniform high–cadence data set. Contrast–enhanced Hα images are obtained by subtracting the average quiet Sun limb darkening from the dark current and flat field corrected data. As an example, a set of network observations obtained on August 23, 2000 is displayed in Figure 1. BBSO hosts the central data archive of the network, where the most recent data can be accessed through the internet (http://www.bbso.njit.edu/Research/Halpha/index.html).

4. Scientific Objectives

Among the scientific objectives of the new network are the following:

- Feature Identification and Feature Tracking: Local correlation and feature tracking is used to determine global (differential rotation) and local flow fields (flows in active regions and filaments) from full–disk data. Discontinuities in currently available time se-
Figure 1: A series of contrast enhanced \( H\alpha \) data obtained on August 23, 2000, at Yunnan Astronomical Observatory (03:11 UT, left), Kanzelhöhe Solar Observatory (06:37 UT, center), and Big Bear Solar Observatory (15:46 UT, right).

sequences severely inhibits the accurate measurement of these flow fields.

- **Flare Monitoring**: High-resolution \( H\alpha \) images with 24 hours high-cadence coverage are essential to catch all the flares on the visible hemisphere of the sun.

- **Filament Eruption and Coronal Mass Ejections**: Round-the-clock high-resolution full-disk \( H\alpha \) data are extremely important for studying the correlation between filament disappearances and CMEs and for understanding their possible driving mechanisms.

- **Mini-Filaments**: The energy release and mass ejections of erupting mini-filaments are of particular importance, since both can contribute to coronal heating and solar wind acceleration (Wang et al., 2000).

- **Support of Space-Based Observations**: High cadence round-the-clock observations from three different sites, enable us to offer more complete and homogeneous data sets for correlative studies with data obtained in space. Of special interest in this respect is the upcoming HESSI (Holman et al., 1997) mission which will be devoted to solar flare research.
The new global high-resolution $H\alpha$ network represents an important tool, both for solar physics and space weather research, which will certainly increase our knowledge about the physical processes behind the various chromospheric phenomena and their interrelations.

Acknowledgements

A. H. thanks the Austrian 'Fonds zur Förderung der wissenschaftlichen Forschung' for support. This work is supported by NSF under grants ATM-0076602, ATM-9714796, and ATM-9903515, by NASA under grants NAG5-4919, NAG5-7350, and NAG5-7085, and by ONR under grant N00014-97-1-1037.

References

GLOBALNA MREŽA OPAŽANJA SUNCA U LINIJI $H\alpha$
S VELIKIM RAZLUČIVANJEM

M. STEINEGGER 1, A. HANSLMEIER 2, W. OTRUBA 3,
H. FREISLICH 3, C. DENKER 1, P.R. GOODE 1,
W.M. MARQUETTE 1, J. VARIED 1, H. WANG 1, G. LUO 4,
D. CHEN 4 i Q. ZHANG 4

1 Big Bear Solar Observatory, New Jersey Institute of Technology,
Big Bear City, USA
2 Institute of Geophysics, Astrophysics and Meteorology,
Graz University, Austria
3 Kanzelhöhe Solar Observatory, Treffen, Austria
4 Yunnan Astronomical Observatory, Kunming, P.R. China

UDK 523.9:520.245
Izlaganje sa znanstvenog skupa
(Primljeno 10. studenog 2000.; prihvaćeno 17. studenog 2000.)

Sažetak. Ukratko se opisuje nova globalna mreža opažanja Sunca u liniji $H\alpha$
koja je nedavno uspostavljena između opservatorija Big Bear (SAD), Sunčevog
opservatorija Kanzelhöhe (Austrija) i Astronomskog opservatorija Yunnan (Kina).
Prikazuju se lokacije, instrumentarij, znanstveni ciljevi kao i primjeri dobivenih
podataka.

Ključne riječi: opažanja Sunca - globalna $H\alpha$ mreža