OBSERVING TIME PROPOSAL FORM 2006
for the Vacuum Tower Telescope (VTT)
at the Observatorio del Teide, Tenerife, Spain

Please send the completed form by email to: `tac@kis.uni-freiburg.de`
Deadline: 15 January 2006!

For retrieving this form and for information on the VTT consult our web page:
http://www.kis.uni-freiburg.de/obsvtt/

1 Scientific Information

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Title of Project: Spectroscopy of the quiet solar photosphere: properties of the shocks and location of the acoustic flux generation.

[X] We/I want to apply for time under the OPTICON ACCESS program.

Scientific Objectives of Observing Time

(Please give a brief statement of the scientific objectives of the requested observing campaign. This information will be used to evaluate the scientific merit and the observatory's general capability to conduct the type of research you intend to do. Please make sure that all necessary information is provided.)

This observing campaign has two research objectives with the common aim to gain further insights into the dynamics of the solar photosphere by spectroscopic means. The two research objectives have developed on the background and results of previous campaigns with different aims. Our research objectives are listed in the following by our priorities:

(1) Photospheric shocks:

From earlier observations we have hints that a detection of the photospheric shocks by their spectroscopic signatures is possible. Besides a detail investigation of a particular shock event, also statistics of their occurence have been derived for the first time by Rybák et al. (2004).

Unfortunately, the data used in this work are of limited value due to the short duration of the time series of the spectra and due to less than optimal seeing conditions. Therefore, we plan to repeat our previous observing procedure consisting of 1-D Echelle spectroscopic measurements of the quiet solar photosphere using several spectral lines in combination with the recording of the G-band slit-jaw images for tracing the G-band bright points as indicators of magnetic flux concentrations. The second DALSA camera shall acquire the Ca II H line core emission in order to trace the chromospheric response of the photospheric dynamics. With these data we plan to derive the center-to-limb dependence of occurence of the shock signatures.

We plan to perform 2-D sequential scanning (now at the disposal at VTT) across an area of a limited spatial width while using the AO system at the VTT.

Results of numerical simulations (CO^5BOLD code) in form of synthetic spectral profiles (LINFOR3D code) have already been prepared by S. Wedemeyer-Böhm. These synthetic data will be compared with results of the proposed observations (Fe II 645.638 nm line, CLV positions $\mu = 0.2$, 0.3, 0.4, ..., 1.0). A new method for comparing results of numerical simulations to spectroscopic observations has been developed and tested for this purpose (Rybák et al. 2006).

The main goal of our attempt is to verify or falsify results on photospheric dynamics derived from three-dimensional numerical simulations of the solar convection with and without the magnetic fields. Such simulations predict frequent occurence of the shocks, even in the spectral line forming layers of the photosphere.

(2) Location of the acoustic flux generation:

Is is widely accepted that the 5-min oscillations are stochastically excited by acoustic noise driven by turbulent convection in and below the solar photosphere as suggested by numerical simulations. It was observationally demonstrated that these acoustic events are localised in intergranular lanes (Rimmele et al., ApJ 444, 119, 1995; Goode et al. ApJL 495, L27, 1997; Espagnet et al., A&AS 109, 79, 1994; Espagnet et al., A&A 313, 297, 1996).

On the other hand, Khomenko et al. (A&A 369, 660, 2001) have found recently that the situation is more complex. They report that: a) oscillations above granules and intergranular lanes occur with different periods; b) the most energetic intensity oscillations occur above intergranular lanes; c) the most energetic velocity oscillations are localised above granules and lanes with maximum contrast, i.e. above the regions with maximum convective velocities; d) velocity oscillations at the lower layers of the atmosphere lead oscillations at the upper layers in intergranular lanes.

This means that discrepancies with the accepted view and confusion still remain. Basic questions about the origin of the acoustic flux and the differences between the acoustic flux in lanes and in granules are planned to be addressed using new high-spatial 2-D spectral measurements by the VTT using the sequential spatial scanning with the Echelle spectrograph.

In particular, the continuum intensity, the vertical motion (Doppler velocity), and the turbulent broadening (line width) will be compared using various lines spanning the photospheric layers with their formation range. Simultaneous inversion of several spectral lines using the SIR code will be later carried out in order to determine the time evolution of the physical parameters through the whole photosphere for particularly selected events, where signatures of the acoustic flux is identified. Spectral lines of the Doppler and Zeeman lines of Fe I and Fe II are specially selected in order to be acquired simultaneously (see Sect. 3.2.1).

Long time series of spectra will allow to separate the 5-min velocity signal from the dynamics or thermodynamics of the granulation. Thus, the vertical stratification of the oscillation dynamics can be identified if the 5-min signal is filtered out.

We plan to verify or to falsify results published by Khomenko et al. (2001) and progress in understanding the evolutionary differences between the acoustic events in lanes and in granules. With the proposed observing program at the VTT we want to expand the time coverage up to at least 40-60 minutes using 2-D sequential scanning.

Former projects

(If this proposal is a continuation of a former project, please provide a list of previous program titles and a brief progress report on a separate sheet. Please include references to publications which resulted from your earlier observing programs. Apropos: Please let us know about any publication that results from VTT data sets by sending the reference to schliche@kis)

We have experience with similar projects at the VTT and its Echelle spectrograph since 1992. Programs performed within the last years were:

(1) Shock signatures in Fe II lines, April 25 - May 1st, 2000

(2) Granular spectra, April 1st - 16, 2002

(3) Solar spectroscopy, July 3 - 18, 2004

References of publications related to the scientific contents and the data reductions of these projects are:

Hanslmeier, A., Kučera, K., Rybák, J., Wöhl, H.: 2004, Solar Physics 223, 13-26

Hanslmeier, A., Kučera, K., Rybák, J., Wöhl, H.: 2001, 'The location of Solar Oscillations in the Photosphere', in Hanslmeier, A., Messerotti, M., Veronig, A. (eds.): 'The Dynamic Sun', Kluwer, Dordrecht, 267–270

Koza, J., Bellot Rubio, L.R., Kučera, A.; Hanslmeier, A., Rybák, J., Wöhl, H., 2002, in: 'Solar variability: from core to outer frontiers', proceedings of 10th European Solar Physics Meeting, 9-14 September 2002, Prague, Czech Republic, ed. A. Wilson. ESA SP-506, Vol. 1., Noordwijk, ESA, 443–446

Koza, J., Kučera, A., Hanslmeier, A., Rybák, J.; Wöhl, H., 2002, in: ed. H. Sawaya-Lacoste: SOLMAG = IAU Koll.188, ESA SP-505. Noordwijk, ESA, 457–460

Koza, J., Bellot Rubio, L.R., Kučera, A., Hanslmeier, H., Rybák, J., Wöhl, H., 2003, in: proceedings of the workshop 'From the Gregory-Coude Telescope to GREGOR', 24-26 July 2002, Göttingen, Germany, Astronomische Nachrichten, 324, 349–351

Kučera, A., Rybák, J., Hanslmeier, A., Wöhl, H., 2003, Hvar Observatory Bulletin, 27, 25–37

Odert, P., Hanslmeier, A., Rybák, J., Kučera, A., Wöhl, H., 2005 Astronomy & Astrophysics 444, 257-264

Rybák, J., Wöhl, H., Kučera, A., Hanslmeier, A., Steiner, O.: 2004, Astronomy & Astrophysics 420, 1141-1152

Rybák, J., Kučera, A., Wöhl, H., Wedemeyer-Böhm, S., Steiner, O.: 2006, in: 'Solar MHD: Theory and Observations - a High Spatial Resolution Perspective', proceedings of the NSO Workshop 23 ,July 18-22, 2005, Sunspot (USA), ASP Conf. Ser., submitted[1]

Wöhl, H., Kučera, A., Rybák, J., Hanslmeier, A., 2002, A&A 394, 1077–1091

Backup Program: Title and Science Objectives

(Please specify a backup observing program in case the conditions encountered (e. g., seeing, sky transparency) does not meet the needs of your original proposal. In case you do not propose a backup program of your own, the observing time may be shared with another program and/or you may be asked to perform the program of a colleague during conditions which are not suitable for your own.)

If periods of bad seeing are 'available' we intend to perform some calibration measurements needed for the detail data reduction. In particular we plan to get auxiliarly data for estimation of the atmospheric/instrumental scattered light measuring the limb/aureola intensity profile. Also attempts will be made to derive average spectral 'atlas' profile of the investigated spectral regions in order to derive the instrumental profile of the VTT echelle spectrograph using the approach described by Lind and Dravins (A&A 90, 151, 1980).

[1] `http://www.astro.sk/~choc/open/sacpeak/rybak_ms.ps`

2 Information on campaign schedule

Amount of time requested: 10 days

Coordinated observation: (Please indicate if you are planning coordinated observations with other facilities.)

We intend to apply for the supporting observations two space-born instruments – TRACE satellite and MDI/SOHO. We shall apply for observing time once the VTT time will be granted and scheduled.

TRACE: In particular we are interested in the high resolution images (0.5") taken by TRACE in the white light (WL) channel, UV 1600 Å continuum channel, and in the Lyman alpha channel. Expected exposure times are 0.2, 4, 2 sec, respectively. Therefore cadence of one set of these exposures per 20 seconds can be reached.

MDI/SOHO: high-resolution longitudinal magnetograms (0.6") of the 1-min cadence will be acquited with some intensitygrams (one per hour) for the co-alignment purposes.

These data will be used for tracing evolution of the solar atmosphere around the slit of the VTT spectrograph together with the digital slit-jaw images taken in G-band and Ca II H line at the VTT using two DALSA cameras. The MDI/SOHO high-resolution longitudinal magnetograms will be used for estimation of the evolution of the magnetic field strength around the VTT slit.

The WL channels will be used for the post-facto co-alignment of the VTT, TRACE and MDI images.

Impossible Dates: (In order to make most efficient use of observing time in view of personnel limitations, the number of reconfigurations of the telescope and its instrumentation will be limited. We therefore will group observing requests of similar technical nature into combined periods. An attempt will be made to accommodate a very limited amount of "impossible time" in the schedule. There is absolutely no guarantee for success of this attempt. Please keep this in mind when specifying your restrictions above these lines. Please keep also in mind the possibility of having your observations made by a colleague in cases of time conflicts. Thank you for your cooperation.)

3 Specific Program Needs

In the following please specify the needs for your observing run. Please describe additional needs on page 10 (Sect. 3.8).

3.1 Telescope

The Kiepenheuer Adaptive Optics System (KAOS) is installed in the tank. We note that the tip/tilt correction of KAOS can be used, even if the AO is not switched on. The old IAC/KIS CT is no longer available.

3.2 Postfocus Instrument

3.2.1 Echelle Spectrograph [X]

Mode of spectrograph:

[X] Spectrograph with predisperser
[ ] Spectrograph without predisperser
[ ] Predisperser with mirror (no grating)

Grating (the number gives the blaze angle in degrees):

[X] 63° Standard [ ] 62° Chrom. [ ] 55° IR

Spectral lines that you want to observe simultaneously:

If you take advantage of the predisperser, you can observe up to 3 lines simultaneously. List the combination(s) that you want to use.

Set	Wavelength [nm]	Order	Remarks
1	Fe II 645.638	35	more lines around this line
	Fe I 543.453	42	more lines around this line
2	Fe II 499.335	45	more lines around this line
	Fe I 543.453	42	more lines around this line
3	Fe I 630.150	36	more lines around this line
	Fe I 630.276	36	more lines around this line
	Fe I 557.610	41	more lines around this line

[X] I already have a predisperser mask.
[ ] I need a new prediserser mask (please specify on last page).
[ ] Please help me calculating mask parameters.

Slit width: The image scale is 4.49 ”/mm.

[X] 40 μm [X] 60 μm [ ] 80 μm [ ] 100 μm (0.45”) [ ] 150 μm
[ ] no slit (mirror) [ ] adjustable slit

Focal length of camera mirror:

The default focal length of the camera mirror of the spectrograph is 7.5 m (reducing the image scale in the spectral plane to 2.25”/mm). If you urgently need the old 15 m focal length please contact Thomas Kentischer (tk@kis.uni-freiburg.de) and specify in Sect. 3.8.

Detectors in focal plane of spectrograph: cf. Sect. 3.3.

3.2.2 TESOS [ ]

Please specify the spectral lines you want to use in the prefilter list (cf. Sect. 3.4).

TESOS will be equipped with new cameras. Therefore, TESOS will only be available in the second half of next season.

VIP (Vector Imaging Polarimeter) was successfully tested within TESOS in Nov 2005 to produce full Stokes polarimetric data. Yet, the new camera software may not be ready for next year’s season. Therefore VIP cannot be offered as an supported instrument. For news on the status of VIP, please consult L. Bellot Rubio (lbellot@iaa.es) or Th. Kentischer (tk@kis.uni-freiburg.de).

3.2.3 Göttinger FPI [ ]

Intensity Mode:	FOV 35 x 25 arcsec (70 x 50 arcsec with 0.21 arcsec/Pixel)
Stokes-V Mode:	FOV 22 x 13 arcsec (44 x 16 arcsec)
Wavelength range:	400 — 780 nm
FWHM:	2.5 (4.5) pm

Please contact F. Kneer (kneer@uni-sw.gwdg.de) if you apply for observing time with the Göttinger FPI.

[ ] Intensity Mode [ ] Stokes-V Mode

Please specify the spectral lines you want to use in the prefilter list (cf. Sect. 3.4).

3.2.4 POLIS [ ]

In 2006 only the neutral iron lines at 630 nm can be observed in polarimetric mode. The second channel (Ca H) only records Stokes I.

Slit: [ ] 15 μm (0.18”) [ ] 40 μm

3.2.5 TIP (Tenerife IR Polarimeter) [ ]

Wavelength: [ ] 1040 - 1100 nm [ ] 1200 - 1260 nm [ ] 1530 - 1800 nm

3.2.6 Others instruments

Others instruments:

[ ] Visitor Instrument in Optical Lab

Needs for visitor instruments (please specify):

3.3 Detectors

CCDs:

[ ] AT1-C (1024 x 1024) [ ] AT1-E (1024 x 1024)
[ ] AT1-D (1024 x 1024)
[X] DALSA I (1024 x 1024, fast) [X] DALSA II (1024 x 1024, faster)
[X] Xedar A (2048 x 2048) [X] Xedar B (2048 x 2048)

Video Cameras: [ ] COHU 2/3" (RS170) [ ] COHU 2/3" (CCIR)

3.4 Interference Prefilters:

#	Central wavelength [nm]	FWHM [pm]	remarks
1			
2			
3			
4			
5			
6			
7			
8			

3.5 Auxiliary Equipment:

Beam Splitter Spectr/Lab:

[ ]	CaK Beam splitter	[ ]	IR/VIS Beam splitter[1]
[ ]	50/50 % Beam splitter	[ ]	Mirror

(1: to be used if you observe with TIP & POLIS or TIP & TESOS.)

3.6 Media (Portable data storage devices)

Please specify numbers in checkboxes!

[ ] Exabytes

DAT-Tapes: [40] DDS-3 [ ] DDS-4

DLT-Tapes: [ ] DLT-IV (black, for DLT4000 and DLT8000)
[ ] SDLT1-Tape (green, for SDLT320)

[10] S-VHS Tapes
[ ] VHS Tapes

Note: Media are expensive ! Please recycle your old tapes.

3.7 Computational environment

[ ] I need a computer account for

Full Name	User name	on SUN	on PC
		[ ]	[ ]
		[ ]	[ ]
		[ ]	[ ]
		[ ]	[ ]

If you need dedicated IP-numbers for your own devices, please contact Peter Caligari (cale@kis.uni-freiburg.de, Tel.: ++497613198220)

3.8 Triggers, simultaneous observations, technical remarks and other needs

[X] We want to make simultaneous measurements with different devices/cameras.

We plan:

- spectrograph tank rotation having the slit perpendicular to the horizon
- sequential scanning perpendicular to the slit direction - 0.1 arcsec step over at least 2 arcsec area
- AO-Scanner triggering: Xedar A and Xedar B at the Echelle spectrograph, the DALSA cameras at the SJC, JPEG grabbing of video SJ signal using the main computer
- long observing sequences - large data storage capacity at the XEDAR camera computers

3.9 Skills

[X] I am expert in telescope and instrument handling and need no assistance
[ ] A little help will be fine.
[ ] I am not familiar with the telescope and/or the instrument and need assistance.