OBSERVING TIME PROPOSAL FORM 2010
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` if you apply for the German time, and to `EAST_TAC@kis.uni-freiburg.de` for OPTICON/ACCESS or CCI/ITP.
Deadline: 17 January 2010!

For retrieving this form[1] and for information on the VTT consult our web page:
`http://www.kis.uni-freiburg.de/index.php?id=64`

1 Applicants

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[X] We/I want to apply for time under the OPTICON ACCESS program. If yes, please check the box to the left (cf. `http://www.otri.iac.es/opticon`).

[X] We/I want to apply for time under the CCI International Time Program (ITP). If yes, please check the box to the left (cf. `http://www.iac.es/eno.php?op1=5&lang=en`).

For allocation of observing time we have two requests:

Request 1:

[1]Comments and suggestions on this form are appreciated by R. Schlichenmaier (`schliche@kis.uni-freiburg.de`).

[X] We will deliver a technical report on our observing campaign – if granted – within one week after the last day of observation. This report will contain information on: names of observers and assistants, title of project, used instruments, instrument changes, positive feedback, problem feedback, seeing conditions, and a wish list. The report will be sent via email to `vtt@kis.uni-freiburg.de`.

Request 2:

Please let us know about any publication that results from VTT data sets by sending the references to Jo Bruls (`bruls@kis.uni-freiburg.de`).

2 Justification

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

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 2-D spectroscopic means. The two research objectives have been developed on the background and results of previous campaigns. Our research objectives are listed in the following by our priorities:

(1) Photospheric shocks:

From earlier observations we have hints that a detection of photospheric shocks by their spectroscopic signatures is possible (Solanki et al., 1996, A&A 308, 623). Besides a detailed investigation of a particular shock event, statistics of their occurrence have been also derived for the first time by our team (Rybák et al., 2004, A&A 420, 1141, Rybák et al., 2008, 12th ESPM, p.2.36).

Although some properties of shock signatures can be derived from the SOT/Hinode observations using its spectropolarimeter (e.g. Bellot Rubio, 2009, ApJ 700, 284) sufficient data for studying the temporal evolution of the most dynamic events in the solar photosphere can not be acquired with SOT/Hinode[2]. Therefore we would like to repeat our last year's effort to acquire the high spatial resolution 2D spectroscopy data using the TESOS instrument at the VTT.

In order to reach our goal we need to acquire data with the best possible spatial resolution. Therefore we plan to repeat our previous observing procedure updated on experiences gained directly at the VTT from operation with the TESOS instrument in the previous campaign. The premier reason for re-application for TESOS time are obtained preliminary results derived from the August 2009 TESOS/VTT campaign obtained by H. Schleicher which show considerably improved photometric and flat-filed stability of the repaired TESOS instrument.

Previous campaigns: TESOS/VTT 2008 campaign: data taken during this campaign[3] have been recognized to be spoiled by the high spatial frequency noise caused by the instrumental TESOS problems due to the 3rd etalon imperfections and improper electronic signal delivery to it (Kentischer, 2009, KIS staff report). It was recognized that it is impossible to reduce the data without significant spatial smearing of the acquired data (Rybák, 2008, KIS colloquium). TESOS/VTT 2006 campaign: data gained in frame of the TESOS+Echelle/VTT campaign in November 2006, suffered from lower spatial resolution. Just one run was possible to acquire for positions near to the limb but only with the Tip/Tilt KAOS due to poor contrast[4]. Some results were presented in Rybák et al. (2008).

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[2]The proposed observations cannot be performed by the Hinode/SOT instrument. The 2-D sequential scanning of the spectral profiles with the SOT/NFI instrument is possible with a cadence of only 30 s per one spectral wavelength position (personal information: T. Berger, Hinode Data Analysis workshop, Orsay, October 2007), which is insufficient for our purposes.

[3]Details available at http://www.astro.sk/~choc/open/08_vtt/08_vtt.html

[4]Details available at http://www.astro.sk/~choc/open/06_opticon_vtt/06_opticon_vtt06.html

Aim: We plan to determine the locations of the shocks and the center-to-limb dependence of their occurrence caused by projection effects. To reach this goal, we would like to perform 2-D spectroscopic measurements of the quiet solar photosphere in one (or two) spectral lines using the 2-D spectroscopic instrument TESOS. Doppler ($g_{eff} = 0$) lines of Fe I are chosen. The KAOS system will be essential for the success of the program. In particular, the spectral characteristics as the continuum intensity, the Doppler shifts, and especially the line width broadening due to extreme velocity differences of the plasma within the line formation range will be used to identify shocks. Additionally, the spectral line profiles will be compared to the results of numerical simulations.

Comparison with simulations: For the analysis the results of numerical simulations (CO^5-BOLD code) in the form of synthetic spectral profiles (LINFOR3D code) will be prepared by O. Steiner and S. Wedemeyer-Böhm for both pure HD and more realistic MHD simulations. These synthetic data will be compared with the results of the proposed observations. A method for comparing results of the numerical simulations to the spectroscopic observations (Rybák et al., 2006) has been optimized for the 2-D observations. It will be used to degrade the results of the simulations for comparison with the observational results in a proper way.

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 occurrence of the shocks, even in the spectral line forming layers of the photosphere. A statistical approach (see e.g. Rybák et al., 2006) and also case studies of the most prominent shock signatures will be performed using both the observational and numerical results.

(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. It was observationally demonstrated that these acoustic events are localized 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; Toner and Labonte, ApJ 415, 847, 1993).

On the other hand, Khomenko et al. (A&A 369, 660, 2001) have recently found 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 localized above granules and lanes with maximum contrast; 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.

Aim: Basic questions about the origin of the acoustic flux and the differences between the acoustic flux in lanes and in granules are to be addressed using new high-spatial spectral VTT capabilities using the 2-D spectroscopic instrument TESOS.

We plan to verify or to falsify results published by Khomenko et al. (2001) and to make progress in understanding 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.

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. 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 photosphere for particularly selected events, where signatures of the acoustic flux is identified.

Long time series of spectra would 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.

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 references to Jo Bruls (bruls@kis))

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

(1) Dynamic fibrils in the upper photosphere, chromosphere and above, June 1 – 6, 2008

(2) Spectroscopy of the quiet solar photosphere: properties of the shocks and the acoustic flux generation, May 26 – 31, 2008

(3) Spectroscopy of the quiet solar photosphere, Nov 16 – 28, 2006

(4) Solar spectroscopy, July 3 – 18, 2004

(5) Granular spectra, April 1 – 16, 2002

(6) Shock signatures in Fe II lines, April 25 – May 1, 2000

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

(1) Gömöry, P., Beck, C., Balthasar, H., Rybák, J., Kučera, A., Koza, J., Wöhl, H.: 2010, A&A in press, accepted 29 August 2009, DOI: 10.1051/0004-6361/200912807, http://adsabs.harvard.edu/abs/2009arXiv0910.4449G

(2) Rybák, J., Kučera, A., Hanslmeier, A., Wöhl, H., Wedemeyer-Böhm, S., Steiner, O.: 2008, 12th European Solar Physics Meeting, Freiburg, Germany, http://espm.kis.uni-freiburg.de/, p.2.36

(3) Hanslmeier, A., Kučera, A., Rybák, J., Wöhl, H.: 2008, Solar Physics 249, 293

(4) Koza, J., Kučera, A., Rybák, J.; Wöhl, H.: 2006, A&A 458, 941-951

(5) Rybák, J., Kučera, A., Wöhl, H., Wedemeyer-Böhm, S., Steiner, O.: 2006, ASP Conference Series, vol. 354, 77

(6) Odert, P., Hanslmeier, A., Rybák, J., Kučera, A., Wöhl, H.: 2005, A&A 444, 257-264

(7) Rybák, J., Wöhl, H., Kučera, A., Hanslmeier, A., Steiner, O.: 2004, A&A 420, 1141-1152

(8) Hanslmeier, A., Kučera, K., Rybák, J., Wöhl, H.: 2004, Solar Phys. 223, 13-26

(9) Wöhl, H., Kučera, A., Rybák, J., Hanslmeier, A.: 2002, A&A 394, 1077–1091

3 Observing requests:

Amount of time requested: 10-14 days

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

We intend to apply for the supporting observations from two space-born instruments – TRACE satellite and MDI/SOHO. Application for the Hinode support is under considerations. 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 acquired with some intensitygrams (one per hour) for the co-alignment purposes.

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.)

May 14-22, 2010

3.1 Instruments

In the following please specify the needs for your observing run. Please give an overview and describe additional needs at the end of this form in Sect. 3.3.

Some of the following instruments can be used simultaneously: (TIP or Echelle) and (POLIS or TESOS). Additionally, fast cameras for speckle bursts are available.

3.1.1 POLIS [ ]

The neutral iron lines at 630 nm are observed in polarimetric mode. The second channel (Ca H) only records Stokes I.

Slit: [ ] 15 μm (0.18") [ ] 40 μm

Imaging channel: [ ]
The relict of the correlation tracker channel can now be used for imaging in the continuum. For a list of available CCDs, cf. Sect. 3.2.1.

3.1.2 TIP (Tenerife IR Polarimeter) [ ]

Wavelength range:

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

3.1.3 TESOS [ ]

[X] Intensity Mode [ ] VIP (Vector Imaging Polarimeter) (Stokes I, Q, U, & V)

Please contact Thomas Kentischer (tk@kis.uni-freiburg.de) or Luis Bellot Rubio (lbellot@iaa.es) if you want to use VIP.

Please specify the spectral lines you want to use in the prefilter list (cf. Sect. 3.2.2).

3.1.4 Echelle Spectrograph [ ]

Grating:

[ ] 63° Standard [ ] 62° Chromosphere [ ] 55° IR

(The number gives the blaze angle in degrees. Put a question mark if you don't know!)

Spectral lines that you want to observe simultaneously:

You can observe up to 3 lines simultaneously. List the combination(s) that you want to use.

Set	Wavelength [nm]	Order	Remarks
1a			
1b			
1c			
1d			
2a			
2b			
2c			
2d			

[ ] I already have a predisperser mask.
[ ] I need a new prediserser mask.
[ ] Please help me calculating mask parameters.
[ ] I use the predisperser with mirror (no grating) and use filters (cf. Sect. 3.2.2).

Slit width: The image scale on the entrance slit is 4.49 arcsec/mm.

[ ] 40 μm [ ] 60 μm [ ] 80 μm [ ] 100 μm (0.45") [ ] 150 μm
[ ] no slit (mirror)

Detectors in focal plane of spectrograph: cf. Sect. 3.2.1.

3.1.5 Other instruments

In case you plan to use other instruments, please describe your needs in detail here.

3.2 Additional needs

3.2.1 Detectors: CCDs

[X] PCO 1 (4072x2720) [X] PCO 2 (4072x2720)
[ ] Sensicam (1376x1040)

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

3.2.2 Interference Prefilters:

#	Central wavelength [nm]	FWHM [pm]	remarks
1	709,4	1,00	
2	722,7	0,90	
3	557,9	1,10	
4			
5			

3.2.3 Beam Splitter Spectr/Lab:

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

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

3.2.4 Media (Portable data storage devices)

Please specify numbers in checkboxes! Note: Tape media are expensive! SDLT tapes are cheaper, so please use them of your data fits on them.

[ ] SDLT320 (160 GB uncompressed)

[10] LTO4-Tapes (800GB uncompressed,)

3.2.5 Computational environment

[ ] I need a computer account for

Full Name	User name

If you need dedicated IP-numbers for your own devices, please contact Peter Caligari (cale@kis.uni-freiburg.de, Tel.: ++49-761-3198-220)

3.3 Overview and technical description

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

Give an overview and describe your plans, technical remarks, and wishes below:

The same technical setup of the VTT and its 2-D spectroscopic instrument can be used for both proposed research objectives:

- KAOS adaptive optics,
- a mirror to reflect light to the TESOS instrument,
- the TESOS instrument in the intensity mode,
- a dichroic mirror reflecting the G-band light through interference filter on the PCO camera,
- a cube to redirect the Hα light through the Zeiss Lyot filter on the PCO camera