OBSERVING TIME PROPOSAL 2011
for the THEMIS Telescope
at the Observatorio del Teide, Tenerife, Spain

Deadline: 16 January 2011 !

1 Applicants

Principal Investigator:	Július Koza
Affiliation:	Astronomical Institute, Slovak Academy of Sciences, SK-05960 Tatranská Lomnica, Slovakia
Email address:	koza@astro.sk
Co–Investigators(s):	A. López Ariste[1], A. Kučera[2], J. Rybák[2], P. Gömöry[2]
Affiliation(s):	(1) THEMIS - CNRS UPS 853, C/ Vía Láctea s/n. 38200, La Laguna, Tenerife, Spain (2) Astronomical Institute, Slovak Academy of Sciences, SK-05960 Tatranská Lomnica, Slovakia
Email address(es):	(1) arturo@themis.iac.es (2) kucera@astro.sk, rybak@astro.sk, gomory@astro.sk

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

2 Justification

Title of Project: Photospheric oscillations as drivers of chromospheric dynamic fibrils

Scientific Objectives of Observing Time

This campaign aims at two related objectives: (1) Coupling of Hα dynamic fibrils (DFs) with photospheric oscillations, (2) Convective and oscillatory motions from photosphere to low chromosphere as seen in selected barium and iron lines. We plan to perform observations by MSDP (alternatively TUNIS) and MTR instruments, respectively.

1) Coupling of Hα dynamic fibrils with photospheric oscillations

It has been found that chromospheric Hα DFs display repetitive mass loading by magnetoacoustic shocks excited by 5-min oscillations leaking from the photosphere up to the chromosphere along inclined magnetic fluxtubes (De Pontieu et al. 2007). This scenario assumes that considerable power of photospheric 5-min oscillations is concentrated at the bases of inclined magnetic fluxtubes giving rise to the chromospheric DFs. Using Hα filtergrams obtained by the Dutch Open Telescope Koza et al. (2007) have shown that the DFs exhibit significant variations in orientation, which are faster for shorter DFs.

An analysis of the Doppler sensitivity of the spectral lines Ba II 4554 Å and Ba II 6497 Å by Koza (2010) has shown that the latter is a highly sensitive Doppler mapper offering many advantages.

Aim: As an extension of works mentioned above, in this proposal we aim at identification of quiet-sun network areas with increased acoustic power seen in the photosphere and its relation to occurrence of the DFs in the overlaying chromosphere and investigation of their mutual relations in time and space. This improves additional value of the previous works in the sense that the photospheric velocities will be measured by the Doppler diagnostics with the highest sensitivity to photospheric velocities. Thus, time series of spectral observations of both, the photosphere and chromosphere with good temporal and spatial resolution are needed.

To do this we plan to perform fast multispectral narrowband imaging of an extensive area of quiet-sun network with MSDP in Hα and Ca II IR lines, the former as a classical DFs indicator, and in Ba II 4554 Å and Ba II 6497 Å as excellent Doppler mappers of photosphere and low chromosphere. As a result of observations we expect 2-D multispectral time series of filtergrams and Dopplergrams of the photosphere and chromosphere, ideally in all four lines. The obtained Hα Dopplergrams will provide an opportunity to reexamine an existence of bidirectional flows at the base of mottles found in Tziotziou et al. (2003) and indicated in 2-D MHD simulations by De Pontieu et al. (2007). Further, Ca II IR filtergrams will be used for a search for Ca II IR counterparts of DFs seen in Hα.

The DFs may represent the injection of cool material postulated by Judge (2008) as the source of hot sheaths making up the transition region. de Wijn & De Pontieu (2006) have studied transition-region jets in C IV in ultraviolet TRACE images and found remarkable morphological similarities between Hα DFs and their C IV counterparts. Koza et al. (2009) reported on dynamic Lyα jets observed by the Very high Angular resolution ULtraviolet Telescope with kinematics characteristics very similar to those observed for Hα DFs. In the context of these

studies we plan to exploit SDO/AIA observations in He II 304 Å and Fe IX 171 Å channels in a search for transition-region and coronal consequences of DFs.

If some instrumental constraints forbid the simultaneous observing of those lines, as an adequate substitute we propose to use the TUNIS instrument (López Ariste et al. 2010). We plan to combine TUNIS observations of Ba II 4554 Å and Ba II 6497 Å spectral lines with simultaneous Hα slit jaw imaging. The entrance slit of the spectrograph will scan approximately 20 arcsec wide area of photospheric network seen by TUNIS in one of the selected barium lines and Hα slit jaw will provide a context chromospheric imaging.

2) Convective and oscillatory motions from photosphere to low chromosphere as seen in selected barium and iron lines

One of the lines standing at the discoveries of 5-min oscillations and supergranulation was Ba II 4554 Å (Leighton et al. 1962; Simon & Leighton 1964). Observations also evidence that supergranulation reaches its maximum visibility in this line (Noyes 1967; Kushtal & Skomorovsky 2002). Probably due to these historical and empirical facts Ba II 4554 Å earned a credit of an excellent Doppler mapper with a large sensitivity to velocity well worth pursuing in observations of photospheric velocities (Sütterlin et al. 2001; Kostik et al. 2009; Shchukina et al. 2009; Hammerschlag et al. 2010). This property has been habitually explained in Sütterlin et al. (2001), Kushtal & Skomorovsky (2002), Rutten et al. (2004), and Hammerschlag et al. (2010) through a large atomic weight of barium atom, the consequential reduction of thermal broadening of line profile with reduced sensitivity to thermal inhomogeneities in favor of larger sensitivity to non-thermal motions, a rectangular shape of Ba II 4554 Å, and steepness of its flanks. Koza (2010) identified another barium line Ba II 6497 Å as a very promising and highly sensitive Doppler mapper offering many advantages for dedicated studies of velocities in the photosphere and low chromosphere.

Aim: In the context of the Objective (1) we aim at observational testing of Doppler performance of both barium lines Ba II 4554 Å and Ba II 6497 Å. We will compare Doppler velocities derived from their profiles applying methods described in Kostik et al. (2009). Photospheric velocities will be also inferred independently through inversion of lines Fe I 6301 Å and Fe I 6302 Å and compared with those derived from the barium lines observed simultaneously with the former ones.

To do this we plan to perform long-slit MTR spectroscopy of quiet-sun area at disk center in the Ba II 4554 Å, Ba II 6497 Å, Fe I 6301 Å, and Fe I 6302 Å spectral lines. As a result of observations and their follow-up interpretation through λ-meter technique (Kostik et al. 2009) and inversion we expect to gain a deeper insight into Doppler performance of both barium lines and to assess the reliability of oscillatory power maps applied in Objective (1).

3 Observing requests:

Amount of time requested: 10 days

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