A Photometric Full–Disk Telescope for Kanzelhöhe Solar Observatory

M. Steinegger and A. Hanslmeier

Institute of Astronomy, Universitätsplatz 5, A–8010 Graz, Austria

Abstract. A new telescope for photometric full–disk observations of the solar photosphere and chromosphere in various wavelengths will be installed at Kanzelhöhe Solar Observatory in 1998. This instrument can be used either in an automatic routine observing mode or in a campaign mode, allowing observations with high time cadence. All data obtained with this telescope will be made available to the solar community via an on–line archive.

1. Introduction

Kanzelhöhe Solar Observatory, which is operated by the Institute of Astronomy in Graz, is situated in the southern province of Carinthia and is the only professional solar observatory in Austria. The average duration of sunshine at the site is approximately 2000 hours on more than 300 days per year. These favourable climatic conditions in combination with the infrastructure present on the mountain predestines Kanzelhöhe Solar Observatory for various kinds of long–term solar observations of low to moderate spatial resolution.

The main routine observations performed currently at Kanzelhöhe are the following: (a) Drawings of sunspots and spot groups are produced from a projected solar image of 25 cm diameter on a daily basis since more than 50 years. Sunspot numbers are derived from these data and are reported regularly to the relevant data centers. (b) Daily full–disk images of the photosphere at 546 nm (bandwidth 10 nm) are obtained with the Kanzelhöhe photoheliograph (Pettauer 1990). These white light images are recorded on photographic film to achieve very high contrast for the precise determination of sunspot positions and areas (Pettauer 1994, Pettauer & Brandt 1997). Having a diameter of 87 mm these images are one of the highest resolved full–disk images available. (c) Daily Hα images (bandwidth 0.07 nm) are observed with a 8 bit 1 K × 1 K pixel CCD camera. These images are available on–line and are used as ground–based support data for the SOHO (Solar and Heliospheric Observatory) mission (e.g. Domingo, Fleck, & Poland 1995). (d) Recently also full-disk magnetograms are recorded on a daily basis with the new installed magneto–optical filter, which is a co–operation with the Trieste Astronomical Observatory and the Department of Physics at the University of Rome.

Ground–based photometric full–disk observations of the Sun have become of increasing importance in solar physics. These observations are especially valuable and necessary in trying to understand, to model, and to predict solar

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irradiance variations on various time scales. See e.g. Steinegger et al. (1996) for details about using high resolution observations of active regions for the modelling of solar constant variations during a period of maximum solar activity.

The VIRGO (Variability of Solar Irradiance and Gravity Oscillations) instrument onboard the SOHO satellite provides continuous observations of the total solar irradiance as well as of the spectral irradiance at three different wavelengths (Fröhlich et al. 1995). In order to track down the physical origins of the observed variations of the solar energy output many efforts on international level are undertaken or being planned. One example is the RISE/PSPT (Radiative Input from the Sun to Earth/Precision Solar Photometric Telescope) project (e.g. Coulter, Kuhn, & Lin 1996, Ermolli et al. 1997). This is a small network of photometric telescopes for long-term observations of the Sun with high time cadence.

A small observatory such as Kanzelhöhe Solar Observatory is suited very well for this type of long-term observations on a routine basis with high temporal resolution. Such kind of special and dedicated programs using small instruments enable also small observatories to make important and valuable contributions to modern solar physics. Therefore, a project was initiated to construct and operate a small full-disk telescope for photometric observations of the Sun in several different wavelengths. The details of this telescope and the planned observations are briefly outlined in the following sections.

2. The Photometric Telescope

The new photometric telescope will be an enlarged and improved version of an already existing prototype, the so-called "Telescopio Simbiontico" built by the solar group of the Instituto de Astrofísica de Canarias (IAC) at Tenerife, Spain. This Spanish telescope is mounted to the Vacuum Newton Telescope, hence the name **symbiotic telescope**, at the Observatorio del Teide and provides photometric full-disk data since April 1996 (Bonet et al. 1996). However, our telescope will have a larger aperture, a longer focal length, and it will be equipped with a larger CCD camera. Additionally, our instrument will be operated during the whole year, which is not possible with the prototype because the Observatorio del Teide is usually closed in winter time.

The main components of our improved instrument, which should be installed at Kanzelhöhe Solar Observatory in 1998, are the following: (a) A commercially available refractor of 12 cm aperture and 114 cm focal length, both approximately twice that of the prototype and therefore yielding a much better spatial resolution. A filter in front of the objective lens will transmit only about 10% of the incoming light in order to avoid problems with heating inside the tube. (b) A filter wheel constructed to hold a maximum number of eight interference filters of 2 inch diameter. (c) A pair of crossed polarizers which enable us to adjust the level of counts detected by the camera by simultaneously keeping the exposure time constant. Of course, the exposure time can also be controlled by the software of the camera. (d) A 1 K × 1 K pixel CCD camera with 8 bit dynamic range. The effective spatial resolution achieved with this setup will be 4.3".
3. Wavelengths and Modes of Operation

The first three filters to be installed are one for chromospheric observations at Ca K (393.3 nm, bandwidth 1.50 nm), and two for observations of the photosphere in a blue (409.4 nm, bandwidth 0.25 nm) and a red (607.2 nm, bandwidth 0.50 nm) continuum window. The Ca K filter is the same as used at the IAC and the latter two are by intention compatible with the wavelengths used by RISE/PSPT in order to enable data exchange, to fill observation gaps and to stimulate collaborations. Additionally, there are plans for the future to install a small–band Ca K filter, a filter for the G-band, and one for a continuum window in the green wavelength region.

The minimum of intended daily routine observations will be one image per filter per day. However, the aim is to obtain at least one image of the solar disk per filter per hour. In addition to this routine observing mode there will be the possibility to use the telescope also for special dedicated observing campaigns, e.g. for parallel observations with other instruments.

All observations obtained with this instrument will be made available to the public through a World Wide Web server. This data archive will be quite helpful for stimulating collaborations and data exchange with other institutions. It is also planned to provide the data as a ground–based support for the SOHO mission and to incorporate them into other solar data bases.

For a more detailed description of this project see also the paper by Steinegger & Hanslmeier (1997).

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