

1998 ACTIVITY REPORT FOR GERMANY

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1. Freiburg

1.1. Technical developments

1.1.1. Vacuum Tower Telescope at Izaña

The IAC's new infrared polarimeter has been implemented and tested successfully in collaboration with KIS.

Internet software has been developed which allows remote online operation and control of the main technical functions of the VTT. Operational data are transferred to Freiburg at a rate of approx. 10 bytes/s. Online transfer of video data can be accomplished by a frame grabbing unit. The main aims of the software package are:

- optimizing telescope usage,
- gathering operational data,
- special purpose tasks (e.g. vibrational analysis),
- remote software updating.
- localizing technical deficiencies.
- problem-related maintenance.

1.1.2. Adaptive Optics

Within the framework of a cooperation with the Stockholm Observatory a multichannel digital-to-analog converter has been built. Software models were developed for an AO system at the VTT using the 19 segment mirror donated by Lockheed. First tests with the new fast RETICON camera for the wavefront sensor were performed at the telescope.

1.2. Observational work

23 observing campaigns took place at the VTT and 13 at the GCT. Application statistics show the strong interest in 2D spectroscopy triggered by TESOS and the Göttingen FPI.

Flows in a sunspot penumbra at different photospheric levels have been observed with the TESOS spectrometer at the VTT, as a part of the research project "penumbral dynamics". The data analysis is underway.

The migration of penumbral grains was studied from a 4 1/2 h time series observed at the SVST (La Palma). The main results are: there exists a dividing line between inward and outward moving grains: their lifetime and travel speed are almost independent from the position in the penumbra; the dynamics of their motion is only partially reproduced by numerical simulations.

Within JOP78, performed on May 14, 1998, data about oscillations of UV emission lines were collected using SUMER, CDS, EIT, MDI and TRACE. The data reduction is up to now concentrated on spectra from SUMER taken at disk center during almost 4 hours with a cadence of 15 seconds.

The center-to-limb variation of the solar oscillation spectrum was investigated from MDI/SOHO full disk Dopplergrams taken during 17 hours on June 10, 1996 with a cadence of 1 minute. The results were compared with models.

1.3. Theoretical work

In the field of *magnetoconvection* the convective collapse of photospheric magnetic flux tubes has been successfully simulated in a 2D numerical calculation. A code for magnetoconvection including radiative transfer, both 2D and 3D, is presently prepared in collaboration with the Institute of Applied Mathematics at the University of Freiburg. The thin-flux-tube approximation is used for peripatetic magnetic tubes in a sunspot penumbra, in an effort to understand the visible structure and the mechanism of energy transport in the penumbra.

As far as *global properties of the Sun* are concerned, the effect of small-scale temperature and velocity fluctuations in the convection zone upon the oscillation frequencies of solar p modes is calculated for non-radial oscillations. As in the radial case, the frequencies of the standard solar model decrease slightly. The coupling of low-degree oscillations by poloidal motions of large scale has been considered in a perturbation analysis.

2. Göttingen

2.1. Technical developments

2.1.1. Gregory-Coudé Telescope (GCT) at Izaña

A new software for the "primary image guider" (PIG) has been developed and successfully tested. The "hold" modus is significantly more stable than that of the old guider operating with a separate refractor. The "scan" modus is much faster with the new software, while not yet as fast as with the old guider. This will be improved when the new telescope drives will be implemented allowing a defined change of pointing. Problems still occur with the precision of the pointing. The cause is a distortion of the guider image due to the small f-ratio required for the small sensor area. (See also Solar Phys. 182, 247 (1998).)

2.1.2. Fabry-Perot spectrometer in the Vacuum Tower Telescope (VTT) at Izaña

The Universal Birefringent Filter, which was used as an order sorter for the narrow-band Fabry-Perot interferometer (FPI), was replaced by a 2nd, yet broad-band, FPI from Queensgate. The spectrometer's transmissivity is substantially increased, as expected, and the exposure times at 30 mÅ interferometer bandwidth are now <20 ms.

2.2. Observational work and data analysis

Again, many programmes were devoted to simultaneous observations with GCT, VTT, and instruments onboard SOHO (SUMER, CDS, and EIT mainly) and TRACE. This includes also the International Time with the solar telescopes on the Canaries.

The regular photoelectric and visual measurements of the solar diameter at the GCT have been continued. A total of 1205 drift time measurements were obtained in 1998. Except for a weak 27-day modulation, which is visible in the daily means, the results - and in particular the annual mean diameters for the period 1992-1998 - show no fluctuations in excess of $\pm 0.05''$.

Progress was made in the data analysis for high resolution imagery with speckle reconstruction, phase diversity methods, and deconvolution methods for the narrow-band images from the

Fabry-Perot spectrometer. Results include images with high spatial resolution revealing the height variation of granular dynamics. It could be shown by means of temperature response functions that the granular intensity pattern has faded away above heights of 100–150 km.

2.3. Theoretical work

The dynamo action of magnetic buoyancy instability in a rotating convection zone is investigated analytically and numerically and applied to models of the solar and stellar dynamo. The variability of solar and stellar activity is described as intermittency in a dynamo based in this effect. A formalism for stability analysis of stationary flows in thin magnetic flux tubes is derived and applied to siphon flows in penumbrae of sunspots.

3. Lindau-Katlenburg

The main activities of the MPAE in 1998 were concentrated on observations with the instruments on SOHO and, later on, their recovery. The analysis of data obtained with SUMER resulted in 44 publications in refereed journals and 29 presentations at conferences. Details on observing programmes, results and publications can be found under:

[http : //www.mpaе.gwdg.de/mpae.projects/SUMER/sumer.html](http://www.mpaе.gwdg.de/mpae.projects/SUMER/sumer.html)

During the first 2.5 years of almost uninterrupted observations the 3 LASCO coronagraphs on SOHO have revealed a wealth of information on the dynamics of the solar corona, from close to the sun's limb out to 30 Rs. The slow solar wind can for the first time be made visible and analyzed in detail, the acceleration profiles of various types of CMEs were measured, more than 50 sun-grazing comets were discovered. The new groundbased MICA (Mirror Coronagraph for Argentina, located near San Juan in the Argentinean precordillera) telescope complements the SOHO observations in that it allows to study transient processes in the corona at very high time resolution. Details on both LASCO and MICA can be found under:

[http : //lasco2.mpaе.gwdg.de](http://lasco2.mpaе.gwdg.de)

4. Potsdam

4.1. Solar Observatory 'Einsteinturm'

4.1.1. Technical developments

The reconstruction of the building of the 'Einsteinturm' is going on. Although there was a fire in January, it is expected that the reconstruction of the building will be finished during spring 1999 and the repair and installation of coelostat and telescope will be completed in summer 1999.

The new Stokes vector polarimeter based on liquid crystal variable retarders was tested successfully at the GCT on Tenerife. The crossover properties proved excellent.

4.1.2. Observations

The daily patrol observations in white light were continued and reported to the SIDC Bruxelles. Observational campaigns addressed:

- coordinated polarimetric observations at the VTT and the GCT (Tenerife) for the investigation of the magnetic field structure in sunspots;
- time series of spectro-polarimetric scans of sunspots at the GCT for investigating oscillations of velocity and magnetic field;

- scanning of sunspots with the correlation tracker at the VTT to obtain several spectral lines simultaneously at the slit spectrograph;
- test observations with TESOS.

4.1.3. Theory

Existing theory seems to predict much smaller magnetic oscillations in sunspots than they have now been observed by several groups. However, new model calculations of hydromagnetic fluxtube oscillations in sunspots are able to reproduce the basic and strange properties of such magnetic oscillations found recently in our observations.

4.2. Observatory of Solar Radioastronomy in Trensorf

4.2.1. Technical Development

The data recording system of the radio-spectral-polarimeter has been extended for a storage period of four days.

4.2.2. Observations

The radio-spectral-polarimeter working in the range 40–800 MHz is used for daily patrol observations. The whole system is working fully automatically in the Observatory Trensorf. In particular, two multi-channel spectrometers cover the frequency range 226–246 MHz and 693–740 MHz with high spectral and temporal (10 ms) resolution. One of them is able to measure the polarization of the solar radio radiation.

The daily patrol observations of solar radio activity are reported in "Solar Geophysical Data". Furthermore, these observations are sent weekly to the SOHO data center at the NASA/Goddard Space Flight Center and can be found under:

[http : //sohowww.nascom.nasa.gov/synoptic/solar_radio.html](http://sohowww.nascom.nasa.gov/synoptic/solar_radio.html).

4.2.3. Data Analysis

In a framework of a SOHO Guest Investigator project the radio data together with the SOHO data of the EIT and LASCO instruments are investigated for special events in order to clarify the triggering of CME onset.

4.2.4. Theoretical work

A model of electron acceleration at coronal shock waves has been developed in order to explain the production of relativistic electrons in the solar corona as observed by the COSTEP instrument onboard SOHO.

5. Würzburg

Extending the analysis of wave characteristics beyond the photosphere and chromosphere into the transition region and lower corona, we have analysed data from the joint SOHO/VTT (Tenerife) campaign of '96/'97. We found that the 3-minute wave-field only expands into the transition region up to the 50000 K temperature layer. Around this height the wavetrains seem to be reflected having a knot in the intensity and a maximum in the velocity signal, as the power spectra indicate.

The picture of reflected waves is substantiated by the observation of yet another phase-jump in the velocity signal of Na D₂ at high frequencies. In October '98 we observed this spectral line using the 2-D spectrometer TESOS to discriminate between the phase signal of the *p*-mode ridges and interridges in the *k*, *ν*-plane. The analysis of this data shall provide a better understanding of the different contributions of running and standing components to the observed signal.

Regarding the relation of excitation and propagation of oscillations in the solar atmosphere to granulation, we found a strong temporal and spatial correlation. Currently we are analysing new simultaneous filtergram time series from three different formation heights to better describe and understand this interaction. For further analysis we will use two-dimensional velocity time series from different formation heights also observed with the new TESOS instrument at the VTT (Tenerife).