COMMISSION 10. SOLAR ACTIVITY (ACTIVITE SOLAIRE)

President : M. Pick Secretary : S.R. Kane
Vice President : E. Priest
Organizing Committee : C. Alissandrakis, R. Falciani, T. Hirayama,
P. Kaufman, V. Krishan, G.V. Kuklin,
E. Tandberg-Hanssen, E. Valnicek, Z.D. Zhang.

In preparing the present report, which covers the period July 1, 1984, to June 30, 1987, close collaboration has taken place between Commission 10 and 12, the two solar commissions, in order to avoid duplications and to insure that pertinent subjects are treated. The reader is referred to the report of Commission 12 for further solar topics. The proceedings are found at the beginning of the references for each section, followed by the usual alphabetical listing. In some sections this listing refers to the previous proceedings by their numbers ; in others we retain the conventional reference. It is a pleasure to acknowledge the excellent work of the reviewers who wrote the different sections of this report, and all the members of the commission who provided information on research to be included.

I. Ground - Based Optical Solar Instrumentation
(W. Mattig)

This report is necessarily incomplete. However, it is to be noted that the IAU has also a special Commission for Instruments and Techniques (Commission 9), and that a section on solar instrumentation is also contained in the report of commission 12.

A great part of the instrumental development in recent years has been reported at special meetings. The proceedings of these meetings are a rich source of information, e.g. the meetings in Kunming 1983 (I), in Huntsville 1984 (II), in Toulouse 1984 (III), and in Tenerife 1986 (IV). On the occasion of the ceremonial inauguration of the observartories on the Canary Islands a special issue of the "Vistas in Astronomy" has been published (V).

A. TELESCOPES

The advantages and disadvantages of possible telescope configurations for high resolution solar observations have been discussed in a review by Dunn (1985). At the Hida Observatory (Japan) a new domeless solar tower telescope was installed. This system includes a Gregory telescope with vertical and horizontal spectrographs. The best resolution achieved is 0.3 arcsec (Nakai and Hattori, 1985). At the Kunming Observatory a SPAR with double tubes of 26 cm aperture has been installed for white light photographs and for chromospheric studies with a Hα filter of 0,25 Å passband.

For the Beijing Observatory a refractive imaging system with an effective aperture of 35 cm was installed to measure the solar magnetic field (Li, 1985). A new 60 cm Gregory telescope for the same observatory is under construction. The solar tower telescope of the Nanjing University and its multichannel spectrograph for studying solar flares and prominences are described by Fang and Huang (1985). Beckers (1985) has discussed future techniques and instrumentation in solar-stellar physics ; the National Solar Observatory is taking initiative to make available the McMath Solar Telescope at Kitt Peak for fully scheduled nighttime observations which pertain to "solar-stellar-connection" astronomy (Smith, Jaksha, 1984).

In Cuba a Horizontal Solar Telescope is being installed by the Pulkovo Observatory staff (Nikonov et al., 1984).

Great progress has been made to put into operation the solar instruments on the Canary Islands. On La Palma, the new Swedish tower telescope with a 50 cm diameter lens, described by Wyller and Scharmer (1985) and Scharmer and Brown (1985) is operating now and has demonstrated the high quality of the instrument and the site. From the German solar telescopes on Tenerife described by Schroter, Soltau and Wiehr (1985) the Gregory Coudé telescope is now operating. The building for the 60 cm Vacuum

https://doi.org/10.1017/S0251107X0000691X Published online by Cambridge University Press

Tower Telescope is ready. The beginning of the scientific work, in particular the high resolution spectroscopy with an echelle spectrograph, is scheduled for 1988. At the same "Observatorio del Teide" the Spaniards have built a new solar laboratory mostly for global oscillations of the sun (Roca Cortes, 1984). France is planning to build the THEMIS solar telescope. The 90 cm polarization-free instrument is expected to be finished by 1990 (Mein and Rayrole, 1985).

Extended studies for the LEST (formerly "Large European Solar Telescope", now renamed to "Large Earth-based Solar Telescope") have been carried out in the last years. They are published in the series of LEST Foundation Technical Reports 1-24. Many fundamental problems and technical details are discussed in this series. General reviews have been given by the LEST Foundation and, e.g., by Stenflo (1985b) and Engvold (1985). The design of the 2,4 m aperture telescope is "polarization-free". Helium-filling and adaptive optics are used with the aim of achieving a 0.1 arcsec spatial resolution. Beside all these new installations many improvements of existing instruments have been developed. Pierce (1987) has built a windscreen around the heliostat of the McMath telescope, resulting in a reduction of the declination windshake amplitude by at least a factor of 10.

The use of dynamical dampers for reducing the vibration level of a solar telescope is reported by Korenev and Kitov (1984).

A scanning heliometer measuring the fluctuations of the maximun brightness gradient all around the solar limb is being developed by Rosch and Yerle (1984). Sofia et al. (1984) have drafted the concept of an instrument called the solar disk sextant to be used in space to measure the shape and the size of the sun and their variations.

B. MAGNETOGRAPHS

The vector magnetograph of the Okayama Astrophysical Observatory (Makita et al, 1985 a,b) is in operation since the autumn of 1982. It is fed by the 65 cm solar Coudé telescope with a 10 m Littrow Spectrograph.

A detailed description of Sayan Solar Observatory (Irkutsk) is given by Grigoryev (1985).

At the Beijing Observatory a video-magnetograph is in operation ; a specially designed birefringent filter with a FWHM of 0.15 Å is used. (Li 1985, Ai and Hu, 1985, Hu and Ai, 1985a, 1986).

A new video Stokes polarimeter is designed by Richter et al. (1985) for the 61 cm Vacuum telescope of the San Fernando Observatory. By using a TV camera system simultaneous scans of six polarization components of a given line profile are possible.

Recent improvements of the Haleakala polarimeter include a high resolution echelle spectrometer coupled to telescope by optical fibers and 128-element diode array detectors (Mickey, 1985 a,b). A new apparatus is described by Scholiers and Wiehr (1985 a,b) which measured the Stokes profiles by means of a two dimensional 100*000 detector array. The spatial range covers 75 arcsec; the spectral window is about 1.8 Å. The Marshall Space Flight Center magnetograph has undergone an extensive upgrading in both electronic control of the magnetograph hardware and in polarisation optics (West,1985, Hagyard et al., 1985).

The new solar magnetograph for the Canary Islands Observatory, THEMIS, has been designed for measurements of the magnetic field without interference with the local variations of the thermodynamical parameters (Rayrole, 1985, Rayrole and Ribes, 1985). A number of new instrument concepts for magnetic and velocity field measurements is proposed by Stenflo (1985a): (a) schemes for simultaneous recording of all four Stokes parameters requiring only one piezoelastic modulator; (b) a system using a solid polarizing Michelson interferometer in combination with broad-band prefilters and a piezoelastic modulator.

C. BIREFRIGENT FILTERS

A new birefringent filter of the Lyot type (FPSS) with a passband of 0.13 Å or a spectral resolution of 45000 is used with a 28 cm solar refractor at the Observatoire de Meudon for radial velocity imaging (Dollfus et al., 1985, Dollfus, 1985). A Stokes parameter modulator is placed at the entrance of the filter to produce vector polarisation mappings over the solar surface.

The Beijing solar telescope is equipped with a birefringent filter with two

https://doi.org/10.1017/S0251107X0000691X Published online by Cambridge University Press

passbands (5234 Å and Hβ) with a half-width of 0.15 Å ; also Solc elements are used (Ai et al., 1984, 1985) for measurements of both the solar magnetic vector field and the sight-line velocity field. The law of conservation of the integrated transmission of a tunable Lyot birefringent filter is described by Hu and Ai (1985).

By using polarizing beam splitters a 5-resp. 9-channel birefringent filter is under construction for observations with the newly planned 60 cm Vacuum Gregory Telescope at the Huairou reservoir station of Beijing observatory (Ai, and Hu, 1985, Hu and Ai, 1985b, 1986).

On the Pamirs solar telescope of the Pulkovo Observatory an additional optical channel with a birefringent filter for Hα with 0.5 Å Bandwidth was built (Krundal, 1986).

The Arcetri group is planning solar two-dimensional spectroscopy with a Universal Birefringent Filter (UBF) and a Fabry-Perot-Interferometer (Bonaccini et al., 1985). A progress report on the updating of the Zeiss UBF for the Vacuum Tower Telescope in Izana, Tenerife, is given by Cavallini et al.,(1985).

A Spectrophotometer was newly installed at the Arcetri Observatory Solar Tower (Cavallini et al., 1987). This instrument basically consists of a Fabry-Perot Interferometer mounted in tandem with a medium-sized grating spectrograph.

In connection with narrow band filter the temperature variation of ADP birefringence is measured and discussed by Harvey (1987).

Rust et al. (1986) have designed and fabricated a tunable Fabry-Perot filter from a 50 mm wafer of optical-quality lithium Niobate crystal. The passband (FWHM) is 0.017 nm, the effective finesse 18,6. A design consideration for a satellite-borne magnetograph with the Fabry-Perot filter has been done also by Rust (1985).

An imaging triple Fabry-Perot interferometer has been developed by Winter (1984, 1985). It is tunable over the range 400 - 680 nm with a bandwidth of 20 - 50 mλ. A multiloop servocontrol system maintains the parallelism and spacing of the plates to an accuracy of λ/500.

D. MISCELLANEOUS

Semel (1987) has derived the laws of refraction for the general case of plane waves incident on uniaxial crystals. Optical aberrations and their effects on observations with high spatial resolution are discussed.

To improve the image quality in large instruments, sunspot trackers have been built by von der Luhe and Title. The instruments have been tested and are used at the Vacuum Newton Telescope in Izana and at the Sacramento Peak Observatory.

Correlation trackers are under construction by Dunn, von der Luhe and Title.

A 57-actuator active mirror has been developed by Smithson et al. (1984). Laboratory tests and seeing measurements show that the mirror is potentially capable of reaching the diffraction limit of a 20 to 40 inch aperture telescope in uncorrected seeing of about 2 arsec or better.

Adaptive optical systems for LEST have been proposed by von der Luhe (1983).

References

I : Proceedings of Kunming Workshop on Solar Physics and Interplanetary Travelling Phenomena, Science Press, Beijing, China, de Jager, C., and Chen Biao (eds), 1985.

II : Measurements of Solar Vector Magnetic Fields. NASA Conference Publication 2374, Hagyard, M.J. (ed), 1985.

III : High Resolution in Solar Physics. Lecture Notes in Physics 233, Springer, Heidelberg, Muller, R. (ed), 1985.

IV : The Role of Fine Scale Magnetic Fields on the Structure of the Solar Atmosphere. Proceedings of the Inaugural Workshop for the D-E-S Telescope Installations on the Canary Islands, Cambridge, Schroter, E.H., Wyller, A.A., and Vazquez, M. (ed), 1987.

V : Vistas in Astronomy 28, 411-576, Murdin, P. and Beer, P. (ed), 1985.

Ai, G., Hu, Y., Li, T., He, F., Hou, H., Gu, Z., Ni, H.: 1984, Scienta Sinica (Series A) 27, 173, 1985, 1, 1236.

Ai, G., Hu Y.: 1985, II, 257.

Beckers, J.M.: 1985, Australian J. Phys., 38, 791.

Bonaccini, D., Cavallini, F., Ceppatelli, G., Righini, A.: 1985, III, 118.

https://doi.org/10.1017/S0251107X0000691X Published online by Cambridge University Press

Cavallini, F., Ceppatelli, G., Paloski, S., Tantulli, F: 1985, JOSO Ann. Rep., p. 58.
Cavallini, F., Ceppatelli, G., Righini, A., Meco, M., Paloschi, S., Tantulli, F.: 1987, Astron. Astrophys., in press.
Dollfus A., Colson, F., Crussaire, D., Lannay, F.: 1985, Astron. Astrophys. 151, 235.
Dollfus, A.: 1985, II, 192.
Dunn, R.B.: 1985, Solar Physics 100,1.
Engvold, O.: 1985, III, 15.
Fang, C., Huang, Y.: 1985, I, 1177.
Grigoryev, V.M., Kobanov, N.I., Osak, B.F., Selivanov, V.L., Stepanov, V.E.: 1985, II, 231.
Hagyard, M.J., Cumings, N.P., West, E.A.: 1985, I, 1216.
Harvey, J.: 1987, Appl. Opt., 26, 2057.
Hu, Y., Ai G.: 1985a, I, 1236.
Hu, Y., Ai G.: 1985b, I, 1252.
Hu, Y., Ai G.: 1986, Scienta Sinica, 8, 889, (in Chinese).
Korenov, B.G., Kitov, A.K.: 1984, Issled. Geomagn. Aehron. Fiz. Solntsa, Moskva, 69, 197.
Krundal, A.V.: 1986, Soln. Dannye 1986, Nº 3, 85.
Li, T.: 1985, I, 1204.
Luhe, O.V.D.: 1983, LEST Technical Report Nº 2.
Makita, M., Hamana, S., Nishi K.: 1985a, II, 173.
Makita, M., Hamana, S., Nishi, K., Shimizu, M., Koyano, H., Sakurai, T., Komatsu, H.: 1985b, Publ. Astr. Soc. Jpn. 37, 561.
Mein, P., Rayrole, J.: 1985, Vistas in Astronomy, 567.
Mickey, D.L.: 1985a, II, 183.
Mickey, D.L.: 1985b, Solar Physics 97, 223.
Nakai, Y., Hattori, A.: Contrib. Kwasan, Hida Obs., Univ. Kyoto, Nº 260.
Nikonov, O.V., Kulish, A.P., Lebedeva, L.A., Muzalevskij, Yu.S.: 1984, Soln. Dannye 1983, Nº 12, 70.
Pierce, A.K.: 1987, Solar Physics 107, 397.
Rayrole, J.: 1985, II, 219.
Rayrole, J., Ribes, E.: 1985, I, 1227.
Richter, P.H., Zeldin, L.K., Loftin, T.A.: 1985, II, 202.
Roca Cortes, T.: 1984, JOSO Ann. Rep., p. 42.
Rosch, J., Yerle, R.: 1984, ESA Spec. Publ. 220, 217.
Rust, D.M.: 1985, II, 141.
Rust, D.M., Burton, C.H., Leistner, A.J.: 1986, SPIE 627, 39.
Scharmer, G.B., Brown, D.S.: 1985, Appl. Opt. 24, 2558.
Schroter, E.H., Soltau, D., Wiehr, E.J.: 1985, V, 519.
Scholiers, W., Wiehr, E.: 1985a, Solar Physics 99, 349.
Scholiers, W., Wiehr, R.: 1985b, II, 153.
Semel, M.: 1987, Astron. Astrophys. 178, 257.
Smith, M.A., Jaksha, D.B.: 1984, Cool stars, stellar systems and the Sun, p. 182.
Smithson, R.C., Marshall, N.K., Sharbaugh, R.J., Pope, T.P.: 1984, Small-scale dynamical processes in quiet stellar atmospheres, p. 66.
Sofia, S., Chiau, H.Y., Maier, E., Schatten, K.H., Minott, P., Endal, A.S.: 1984, Appl. Opt., 23, 1235 ; see also Appl. Opt. 23, 1226 and 1230.
Stenflo, J.O.: 1985a, I, 1139, 1272, 1275.
Stenflo, J.O.: 1985b, V, 571.
West, E.A.: 1985, II, 160.
Winter, J.G.: 1984, Optica Acta, 31, 823.
Winter, J.G.: 1985, J. Phys. E.: Sci. Instr., 18, 505.
Wyller, A.A., Scharmer G.: 1985, V, 467.

II. Spots and Intense Flux Tubes
(J.C. Henoux)

The development of research on starspots, stellar activity, and the suspected relationship between coronal heating and magnetic field have reenforced the interest of the study of the solar magnetic field and the study of the associated thermodynamic

https://doi.org/10.1017/S0251107X0000691X Published online by Cambridge University Press