COMMISSION 10: SOLAR ACTIVITY (ACTIVITE SOLAIRE)

COMMISSION 12: SOLAR RADIATION AND STRUCTURE (RADIATION ET STRUCTURE SOLAIRE)

Report of Meetings, 24, 25, 26, 29 and 30 July 1991

PRESIDENT (10): E. Priest SECRETARY (10): B. Schmieder
PRESIDENT (12): J. Harvey SECRETARY (12): J. Stenflo

This report was prepared jointly by Commissions 10 and 12 and reflects the combined nature of the activities of these commissions at the 21st General Assembly. In addition to the report of activities given here, readers should consult reports of Joint Commission Meetings co-sponsored by Commissions 10 and 12 (JCM 1, 3, 6) found elsewhere in this volume or in Highlights of Astronomy (Volume 9). Also, a meeting entitled "Nonlinear and Turbulent Processes in the Solar Wind and Astrophysical Plasmas" was held jointly under the sponsorship of Commission 49.

1. Joint Business Meeting (25 July 14:00 - 15:30)

The meeting was opened by E. Priest with greetings to the members of both commissions. J. Harvey then read a list of deceased members of both commissions. The members rose and observed a moment of silence. Commission 10 held an election for new officers with the results for the period 1991-4: President: V. Gaizauskas. Vice-President: O. Engvold. Organizing Committee: Ai G., E. Antonucci, A. Benz, T. Forbes, A. Galal, E. Hildner, J. Jakimiec, M. Karlický, I. Kim, M. Machado, E. Priest, T. Sakurai, B. Schmieder, M. Schüssler, V. Stepanov, and E. Tandberg-Hanssen. Commission 10 then elected 69 new members. Next, Commission 12 held its election for new officers for the 1991-4 period with these results: President: J. Stenflo. Vice-President: F. Deubner. Organizing Committee: T. Ayres, J. Harvey, V. Karpinsky, E. Landi Degl'Innocenti, Å. Nordlund, J. Pasachoff (Chairman, Working Group on Solar Eclipses), K. Sivaraman, J. Staude, Wang J.-X., P. Wilson and H. Yoshimura. Commission 12 then elected 37 new members.

E. Priest reported on the state of Commission 10. He noted the vigor of solar research in many countries as evidenced by new projects both on the ground and in space. The aims of Commission 10 are to sponsor meetings and encourage international cooperation in the study of solar activity and to facilitate cooperation between observers and theorists. In order to inform members he had sent out a regular newsletter during the previous three years. Four goals for the future were suggested: to maintain high standards of scientific research, to inspire young scientists to study the Sun, to develop links with other astronomers, and to help break down barriers of prejudice and deepen warmth and collaboration in our international community.

J. Harvey reported on activities of Commission 12. He noted the healthy state of solar research by reference to the Commission 12 contribution to Reports on Astronomy (Vol. XXIA). Disappointment was expressed about failure to obtain IAU sponsorship of all proposed solar meetings. On the positive side, some of these meetings were held without IAU sponsorship with very successful results. The issue of merging Commissions 10 and 12 was raised during the 20th General Assembly. The memberships of both commissions were polled with a

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clear result to not merge the commissions. At the same time, the idea of name changes was also tested by poll. There was no strong sentiment for a change of the name of Commission 10 but a small majority favored a change of the name of Commission 12. After discussion with Commission 35, the name Solar Radiation and Structure was submitted to the IAU Executive Committee and approved.

1.1. WORKING GROUP AND REPRESENTATIVE REPORTS

1.1.1. *Working Group on Solar Eclipses* (E. Hiei). The Working Group was quite active during the previous three years in preparation for the total eclipses of 22 July 1990 and the extraordinary one of 11 July 1991. National coordinators and committees were identified for both eclipses in a number of countries. During the business meeting held at the General Assembly, the total eclipse of 30 June 1992 was discussed. A resolution concerning publication of eclipse information was discussed and adopted. This resolution was also discussed at the general business meeting and was accepted as given below. J. Pasachoff was elected the new Chairman of the Working Group.

1.1.2. *Quarterly Bulletin on Solar Activity* (E. Hiei). With IAU sponsorship, the QBSA is published by the National Astronomical Observatory (Japan) in five sections. More than 135 observatories are contributing data to this valuable compilation which now covers five solar activity cycles.

1.1.3. *International Ursigram and World Days Service* (E. Tandberg-Hanssen for H. Coffey). The IUWDS is a permanent service of URSI, IAU and IUGG which alerts the world scientific community about transient events and helps coordinate scientific observations that cannot be carried out continuously. The backbone of the IUWDS network is a group of Regional Warning Centers and World Data Centers. A move toward digital recording and dissemination of data is a strong trend of the past three years. An important issue that has not resolved is how to distribute such data to researchers not yet equipped with suitable digital facilities.

1.1.4. *Sunspot Index Data Center* (based on a written report by A. Koeckelenbergh and P. Cugnon). The SIDC is responsible for preparation of the International Sunspot Number Ri. The forecast for sunspot maximum made three years ago at the Baltimore General Assembly proved to be quite accurate. More than 115 stations provide data to the SIDC of which about 80 are regularly used for the preparation of the index. Compilations are mailed to about 450 sites and telefax and telex messages are sent to additional subscribers. Electronic mail is becoming an important new way for distributing data products.

1.1.5. *Federation of Astronomical and Geophysical Data Analysis Services* (E. Tandberg-Hanssen). The FAGS is an umbrella organization established by ICSU to oversee and help fund the activities of 10 services including the QBSA, IUWDS and SIDC of particular interest to Commission 10. The IAU Commission 10 representative is E. Tandberg-Hanssen, who is also president of FAGS. At the Grenoble General Assembly, Commission 10 asked the Debrecen Heliophysical Observatory to continue the work of the Greenwich Photoheliograph program. One year of data was published but a backlog has built up. To continue the service requested by Commission 10, Debrecen has applied to FAGS for funding assistance. The IAU has agreed to grant Debrecen $500 per year for each year of data that is reduced and published for ten years of data. To provide more flexibility in the future, it was agreed to concentrate all of the solar services supported by FAGS in a single panel named International Services on Solar Activity. The panel membership would be the President or Vice-President of Commission 10, representatives of QBSA, SIDC, IUWDS, Debrecen, IAU representatives to FAGS, and archiving experts. The terms of reference are: (i) to ensure the services are responsive to the needs of the community, (ii) to make a recommendation to the Commission 10 business meeting at each IAU General Assembly on the apportionment of funds provided by FAGS, (iii) to request reports as necessary, (iv) to consider modern formats for archiving data. A meeting is planned prior to April 1992.

1.1.6. *SCOSTEP* (S.T. Wu). The Solar-Terrestrial Energy Program (STEP) is a major program of SCOSTEP that started in 1990 and will continue through 1995. This program has focussed work on process that couple energy from the Sun to Earth. SCOSTEP sponsored a Solar Terrestrial Symposium in 1990 and another major symposium is scheduled during 1992.

1.1.7. *Flares 22* (V. Gaizauskas for M. Machado). This program is described in section 2.2.4.

1.1.8. *Commission 10 Representatives to Organizations*. The following representatives to organizations were elected: E. Tandberg-Hanssen (FAGS), H. Coffey (IUWDS), T. Hirayama (QBSA), S.T. Wu and E. Priest (SCOSTEP), and O. Engvold (COSPAR).

1.2. RESOLUTIONS

Resolutions were proposed by V. Gaizauskas and J. Harvey during the business meeting. After extended discussions, amendments and changes, both were adopted by Commissions 10 and 12. They were submitted to the IAU Executive Committee and the final General Assembly and were adopted. The text of these resolutions follows.

Commissions 10 and 12,

considering long-term observations are essential to understand the behaviour of such quasi-periodic phenomena which characterize solar and stellar activity and which link the Sun to our terrestrial environment;

The IAU, meeting in General Assembly,

recommends (1) strong support for the continuation of data-gathering programmes and observational facilities that are essential to long-term research; (2) optimization of data-gathering enterprises in order to improve services to the research community.

Commissions 10 and 12,

considering that the United States Naval Observatory has for more than forty years generously provided crucial information to assist scientists who observe solar eclipses for scientific purposes (in the form of the Central Solar Eclipse Circulars and other specialized calculations) and,

recognising that the USNO plans to cease publication of the Eclipse Circulars due to programmatic changes and plans to continue to support scientific observations by publishing eclipse circumstances in the Astronomical Almanac, and by providing specialized eclipse calculations to scientific researchers,

commend on behalf of past and present eclipse researchers, the management and staff of the USNO responsible for the preparation and publication of the calculations and,

request that the USNO continue to provide advance calculations for a variety of sites in order to aid site selection and to publish this information in Circulars or by other means and,

further commend all national organizations that prepare eclipse calculations and urge that they continue their efforts.

2. Scientific Meetings

In the following reports, authors and coauthors of presentations are listed with the actual presenter underlined.

2.1. RESULTS OF 1990 AND 1991 ECLIPSES (24 July 09:00 - 12:30; E. Hiei)

Approximately 60 people attended presentations of results from the 1990 and 1991 total solar eclipses. I. Kim reported that an effort to record coronal fine structure using 3 cameras widely spaced along the 1990 path of totality in the USSR was frustrated by poor weather at two of the sites. At the same eclipse P. Kaufmann used the 13.7m Itapetinga radio telescope to detect Fresnel fringes at 22 GHz. He concluded that the fringes were caused by hot, quiescent spots in the corona.

The 1991 eclipse occurred just days before the meeting, so only very preliminary reports were available. This eclipse will long be remembered for its passage across the large telescopes on Mauna Kea (Hawaii) and for the outstanding beauty of the corona for those lucky enough to see it. It was also the first eclipse studied intensively with CCD detectors both in the visible and infrared.

J. Pasachoff presented an extensive list of observations planned to be done in Hawaii. He reported that weather conditions were unsettled at the time of the eclipse and that Mauna Kea was affected by cirrus clouds and dust from the eruption of Mount Pinatubo. J. Vial reported on successful recording of coronal fine structure and rapid changes using cameras at the focal plane of the 3.6m CFHT. J. Harvey read reports from several experiment groups on Mauna Kea: Sub-millimeter and millimeter observations of the chromosphere and prominences by two groups using different facilities were successful. The chromosphere was observed to be much higher than predicted by models. IRTF observations of the 12μm Mg I emission line indicated that the line is formed in the upper photosphere. Video and CCD recordings using the 2.2m Hawaii telescope showed a wealth of fine structure in various emission lines. Three experiments were attempted to observe thermal emission from dust around the Sun. All operated successfully but no reports of dust were made.

S. Isobe reported on four Japanese experiments done from Mexico. These were a timing measurement by the Hydrographic Office, a Kyoto University measurement of the thermal balance of coronal loops, an NAO experiment to detect cool material in the corona and an heroic infrared measurement of coronal structure by Isobe and collaborators at very high altitude. J.

Stohl reported on successful observations of the polarization of the coronal green line and high resolution images made by Skalnate Pleso observers at La Paz (Mexico). T. Jurriens and J. Fierro described popular level observations made by 15 international groups at La Paz. I. Kim reported that the USSR expedition to Brazil was successful in obtaining high resolution images of the corona as part of an international set of cameras stationed along the eclipse path. Sites in Mexico and Hawaii were also successful. A highlight of the meeting was E. Hiei's showing of video recordings of the eclipse made on Mauna Kea using the latest high-resolution video equipment.

2.2. COLLABORATIVE PROGRAMS IN SOLAR ACTIVITY STUDIES (25 July 16:00 - 17:30; V. Gaizauskas)

2.2.1. *Radiative Inputs of the Sun to Earth - The RISE Project* (J. Pasachoff for P. V. Foukal). The aim of the RISE project is to measure and understand the variable radiative outputs of the Sun at the present time. Its ultimate goal is to respond to mounting concern over changes in Earth's climate and atmospheric chemistry by supplying precise information on changes due exclusively to the Sun's variability. Trends over astronomical time scales will be clarified by extending photometric studies to nearby sun-like stars.

Although it has been conceived in the USA as a national effort, RISE depends on international collaboration for 24-hr coverage of key parameters. Workshops held in 1987 and 1989 led to the formation of 6 working groups concerned with: multi-wavelength measurements, data analysis, theory, and space observations of the total irradiance as well as the EUV and UV spectral irradiances. Design for a precision solar photometric telescope has been completed. One instrument will be located in Tucson, Arizona; an identical twin will be operated at a site suitably displaced about 12 hr in longitude. Funds totalling $11.1 million (US) for a 5-yr programme have yet to be approved by the National Science Foundation.

2.2.2. *Collaborative Solar Radio Programmes* (M.R. Kundu). The application of supersynthesis arrays to arc-sec imagery of solar structures at microwave frequencies has promoted strong collaborations between radio and optical astronomers for over a decade. Now that pulse-like emissions have been detected from some flares at both microwave and hard X-ray wavelengths, links have been forged between groups of astronomers with instruments responding to an extremely broad energy band. A major collaborative effort is underway to identify the accelerative process leading to this 'fragmentation' of flare emission. One of the more unusual collaborations made possible by technological advances involves detection of flare emission from very high energy particles at opposite ends of the electromagnetic spectrum - gamma-rays with the Gamma Ray Observatory (GRO) and mm-waves with the large Berkely-Illinois-Maryland (BIMA) interferometer.

The loss in recent years of the Culgoora and Clark Lake radioheliographs has been a serious blow to investigations of transient coronal emission. Fortunately the gap will soon be filled by the construction, now underway at Pune (near Bombay, India) of the Giant Meter-Wave Radio Telescope, a radioheliograph operating between 28 and 1410 MHz.

2.2.3. *Collaborative Magnetographic Studies: China - USA* (Ai Guoxiang and S.F. Martin). The existence of similar videomagnetographs at Big Bear (Caltech) and Huairou (Beijing) Solar Observatories makes it possible to conduct collaborative studies of solar magnetic structures on a round-the-clock basis. The evolution of active regions and of the photospheric network can now be tracked for days in succession with few interruptions. Video movies were presented which show the immense possibilities now opening for studying flare build-up in active regions. Most magnetic structures change slowly over a period of days, but some important changes occur on shorter time scales and would be missed without the extended coverage.

2.2.4. *FLARES 22* (V. Gaizauskas for M.E. Machado). FLARES 22 is a project sponsored by SCOSTEP's Solar Terrestrial Panel (STEP), endorsed by COSPAR and by the IAU. It is also designated an official International Space Year (ISY) project by the Space Agency Forum for ISY. The scientific aims of FLARES 22 are: (a) to identify and prioritize problems for individual and cooperative research on solar flares during the maximum phase of Solar Cycle 22; (b) to assign active-region targets for collaborative observing campaigns by participating observatories in co-operation with MAX '91 (a national program in the USA supported by NASA); (c) to conduct workshops in which theory is confronted with observations of flare-relevant phenomena.

The first FLARES 22 campaign (Aug. 10 - 25, 1990) was initiated by solar scientists in the USSR. A joint FLARES 22/MAX '91 campaign ("Energetic Solar Phenomena") was held 07 Dec 1990 - 26 Jan 1991 in conjunction with a long-duration circumpolar (Antarctic) flight of a high altitude balloon for observing high-energy solar X-rays. The VLA was dedicated for solar observations during the same period. Another joint FLARES 22/MAX '91 campaign ("Gamma-Ray, Hard X-ray and Neutron Studies of Solar Flares") is scheduled for 03 - 17 October, 1991 in conjunction with NASA's Gamma-Ray Observatory satellite.

The first FLARES 22 workshop, attended by 83 participants in Chantilly, France, from 16 to 19 October 1990, had its proceedings published in February 1991 (editors: E.R. Priest and B. Schmieder). The proceedings contain the results gathered by 5 working groups assigned to each of the following topics: energy storage; rapid fluctuations in flare emissions; microflares; flare loops and giant arches; material ejections. The main priorities for future campaigns and workshops include:

- Magnetic Field Configurations (e.g. monitoring the vector magnetic field; measuring electric fields in active regions).
- Rapid fluctuations (e.g. determining whether fragmentation of the energy process or modulation of the emission process is the cause).
- Material Ejections (e.g. investigating the relationship of large-scale coronal structures to flares and coronal mass ejections).

A second FLARES 22 Workshop is planned for October 1992 in the Crimea (USSR).

2.3. DYNAMICS AND STRUCTURE OF PROMINENCES (26 July 09:00 - 12:30; E. Tandberg-Hanssen)

This meeting was organized in two parts with a break between them. Four invited talks were given according to the following program:

E. Tandberg-Hanssen: Introduction and definition of the subject.
B. Schmieder: Structural Elements of Filaments.
O. Engvold: Dynamic Nature of Filaments.
J. C. Vial: Structural Characteristics of Eruptive Prominences.
T. Forbes: The Eruption Mechanisms.

The four invited speakers gave excellent and up-to-date reviews of our understanding of the nature of quiescent prominences, both in their quiescent stage and during disparition brusque

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(eruptions). The format of the session allowed considerable and valuable discussion on most topics raised. In addition to the invited talks a number of interesting poster papers were presented on the prominence topics, viz.

Mein, P. and Mein, N. "Fine Structure of a Quiescent Prominence"
Moore, R.L., Hagyard, M.J., Davis, J. M., and Porter, J.G. "The MSFC Vector Magnetograph, Eruptive Flares, and the Solar-A X-Ray Images"
Oliver, R. and Ballester, J.L. "The Effect of Coronal Magnetic Arcades on Prominence Properties"
Pande, M.C. and Bondal, K.R. "On the Rotational Motion in Quiescent Prominences"
Schmieder, B., Dere, K.P. and Wiik, J.E. "Dynamics in the Prominence-Corona Transition"
Wiik, J.E., Schmieder, B., Noens, J.C., and Heinzel, P. "Fine Structure Analysis of Prominences in Hα and Coronal Lines"
Gopalswamy, N., White, S.M., and Kundu, M.R. "A Study of Solar Radio Filaments at 20 cm"
Zhang, H., Ai, G., and Shi, Z. "The Observations of Magnetic and Velocity Fields with Video Vector Magnetograph in the Filaments of the Active Regions"
Martin, S.F. "The Essential Role of Rotational Discontinuities in the Formation of Filaments"

2.4. HIGH-RESOLUTION OBSERVATIONS AND THEORY OF SOLAR MAGNETISM AND CONVECTION (29 July 09:00 - 12:30; J.O. Stenflo)

2.4.1. *High Resolution Observations of Solar Magnetic Fields* (C.U. Keller). Recent improvements of instruments and data reduction techniques make it possible to reach 0.3 sec of arc resolution in spectrograms and magnetograms of small-scale solar magnetic structures. Some of the most puzzling observations of the last few years are reported in the present review. While variations of the longitudinal velocity and the magnetic field strength of penumbral filaments are not related to brightness variations, there exist indications that the brightest filaments are associated with more vertical fields. Magnetic elements, which can be detected down to the diffraction limit, may appear bright as well as dark in the continuum. Some examples of network bright points do not show any measurable polarization. Oscillations in magnetic elements as determined by the shifts of the Stokes V zero-crossing correspond to the ones seen in the quiet Sun in Stokes I but with a reduced amplitude. There are no indications from spatially resolved observations for the large amplitude oscillations required by high spectral resolution observations to explain the width of Stokes V profiles.

2.4.2. *Results from the La Palma Observations by the Lockheed Group* (P.C.H. Martens , A.M. Title, Z.A. Frank, R.A. Shine, T.D. Tarbell). High resolution observations of photospheric velocity and magnetic fields obtained with the Swedish optical telescope and Lockheed tunable optical filter at La Palma have been Fourier analysed. The 2-D Fourier spectra of the horizontal velocity field and the line-of-sight magnetic field are found to be isotropic, forming power laws as a function of the absolute wave vector. The relation between the power law indices of the magnetic and velocity field is consistent with the predictions for passively advected scalars in Kolmogorov type turbulence.

In addition it is found that the power-law index of the Poynting flux that enters the corona and presumably causes coronal heating is consistent with the power law dependence of the Fourier transformed X-ray emission observed with the rocket-borne NIXT instrument. These results suggest that MHD turbulence theory is the correct theoretical framework for the analysis of photospheric magnetic motions and coronal heating.

2.4.3. *Stokes V Diagnostics in the Infrared* (I. Rüedi, S. K. Solanki, W. C. Livingston, and J. O. Stenflo). Information on the intrinsic properties of solar magnetic elements beyond the attainable spatial resolution can be obtained by indirect methods, e.g. using the line-ratio method or observing the complete Zeeman splitting in the infrared. The most powerful method is to apply a line-ratio method in the infrared, which has been done in the present work by analysing the Stokes V line profiles of two Fe I lines near 1.56 μm, having greatly different Landé factors (3.0 and 1.5). This allows the Zeeman broadening (due to a distribution of field strengths) to be separated from the Doppler broadening. The analysed spectra have been obtained with the McMath spectrograph and a 3×3 $arcsec^2$ sampling aperture in a large number of locations near the center of the solar disk.

The analysis shows that the Zeeman broadening can be fully accounted for by the field-strength variation along the line of sight due to the height divergence of self-consistently modelled magnetohydrostatic fluxtubes. There is no need for any horizontal field-strength distribution, except for the need of using two distinctly different fluxtube components instead of one within the sampling aperture. The traditional approach has been to use a two-component model, with one magnetic and one non-magnetic component, and this is sufficient for reproducing many of the infrared Stokes V spectra. For a considerable number of cases, however, a three-component model is necessary (two magnetic and one non-magnetic component), but no case has been found for which more than three components are needed (note that without the height divergence of the field, many more components would be required to obtain a good fit).

Most of the magnetic elements have field strengths of 1.5-1.6 kG, but many components are found to be intrinsically weak (well below kG), although about 90% of the flux in the present data set is in kG form. The plasma β is typically 0.3 in the magnetic elements, but for the intrinsically weaker components the values are higher.

2.4.4. *Size Distribution of Solar Magnetic Flux* (T. Bogdan). Statistical analysis of the sizes of sunspots, sunspot groups, and active regions have led to the following conclusions:
(1) Sunspot umbral area measurements seem to be the most unambiguous selection-independent data. Their areas are distributed lognormally over a range of areas from 2 to 141 millionths of a solar hemisphere. Little (if any) variation in the shape of this distribution with solar cycle is evident. It is suggested that their origin is connected with the (complete) fragmentation of large regions of magnetic flux. Whether this distribution obtains for smaller structures like pores, knots, and elements is an open question due to observational impediments, chiefly lack of good spatial resolution and contrast.
(2) Sunspot groups *seem* to have a distribution of sizes similar to the sunspots from which they are constructed. Their decay rates are distributed lognormally, and there is some preference for them to decay at a rate proportional to their circumference.
(3) Active regions area distributions show mixed results suggesting that they are not free from measurement biases. While Tang et al. have found an exponential distribution at solar maximum but a somewhat different distribution at solar minimum, the results of K.L. Harvey indicate no apparent variation with solar cycle, and the log dN/dA vs. log A plot requires terms up to a cubic in log A for a reasonable fit.

2.4.5. *Selfsimilar Magnetic Fields* (K. Galsgaard and Å. Nordlund). Recent numerical simulations of the solar convection zone have indicated that the convection zone may have a selfsimilar structure, with similar patterns repeated over a range of scales. By inference, such a selfsimilar structure would carry over to the magnetic field, which is convectively controlled in the subsurface layers of the convection zone. This is supported by observations of the horizontal distribution of the magnetic fields by Tarbell et al., who have shown that the surface distribution of solar magnetic fields is selfsimilar, with a fractal dimension of approximately 1.6 over several decades in size.

A fully dynamic treatment of a magnetic field which is selfsimilar over a large range of scales is beyond the capabilities of even the fastest supercomputers of today. Therefore in the present work an approach has been chosen where semianalytical models of stressed magnetic fields are built. Fourier series with complex coefficients are used to generate scalar and vector potentials representing spatially complicated magnetic fields, which are selfsimilar over a limited range of scales. The external stress is simulated by applying analytical deformation-transformations to the fields, and the potential for dynamic and catastrophic events in these toy-fields is explored by numerical and graphical means.

2.4.6. *Correspondence between X-Ray Bright Points and Evolving Magnetic Features in the Quiet Sun* (D.F. Webb , S.F. Martin, D. Moses, J. Harvey). Coronal bright points, first identified as X-ray Bright Points (XBPs), are compact (about 20-30 sec of arc), short lived (about 8 hr), and associated with small-scale bipolar magnetic flux features in the quiet Sun. Several studies have yielded contradictory results suggesting that coronal bright points are either primarily a signature of emerging flux in the quiet Sun, or of the disappearance of pre-existing, opposite-polarity flux. Results are presented, based on the use of coordinated data obtained during X-ray sounding rocket flights on 15 August and 11 December 1987 to determine the correspondence of XBPs with time-lapse ground-based observations of evolving bipolar magnetic structures. These results indicate that, at least during this phase of the solar cycle, XBPs are much more frequently associated with random encounters of pre-existing magnetic flux of opposite polarity which are cancelling than with emerging flux regions. It is suggested that this type of XBP is prevalent around solar minimum because of the dominance of mixed polarities leading to random flux cancellations, and that these XBPs are the result of reconnection involved in the cancellations.

2.4.7. *A Quiescent Filament and Associated Supergranulation Network* (Zhang Yi, O. Engvold). A quiescent filament and its association with the adjacent photospheric regions has been studied from high-resolution filtergram observations obtained with the Swedish solar telescope at La Palma using the Lockheed tunable, narrow-band filter. The observations include time series at 7 positions in Hα, for studies of the fine structure of the filament and chromosphere, 3 positions in the line Fe I 5576 Å for determination of the photospheric Doppler velocities, and two orientations of circular polarization in the line wing of Fe I 6302 Å , for determination of the photospheric magnetic field. Continuum images of the photospheric granulation are used to determine photospheric flows. The relations between the chromospheric and photospheric network and the presumed foot points of the filament are demonstrated and discussed.

2.5. STATUS OF NEW GROUND AND SPACE SOLAR PROJECTS (29 July 14:00 - 15:30; E. Antonucci)

The program of presentations was as follows. Solar-A was successfully launched after the meeting and renamed Yohkoh. Both it and Ulysses are returning excellent data. The other projects remain further in the future.

2.5.1. *Status of the LEST Project* (O. Engvold).
2.5.2. *Physics of the Corona with Ulysses* (G. Noci).

2.5.3. *Physics of the Active Corona with the Solar-A Mission* (E. Hiei).
2.5.4. *Physics of the Solar Corona with SOHO* (M. Huber).
2.5.5. *The Orbiting Solar Laboratory* (J. Harvey for D. Spicer).

2.6. PROGRESS IN HELIOSEISMOLOGY (29 July 16:00 - 17:30; J. Harvey)

2.6.1. *Solar Oscillations, Solar Opacities, and the Solar Convection Zone Helium Content* (J. Guzik and A. Cox). A model of the Sun with improved opacities and equation of state was constructed. The model predicts frequencies in good agreement with observations at degrees up to 200; above this value discrepancies are larger, probably due to larger observational errors. Modes with degrees 300-600 are sensitive to the helium abundance (Y) of the convection zone to about 0.01. Comparison with observation favors a Y of 0.24, 0.03 less than the primordial value, and consistent with that expected due to element diffusion and settling.

2.6.2. *Comparison of the Acoustic Spectrum of the Sun and the Standard Solar Model* (D. Guenther). A set of solar models has been constructed, each based on a single modification to the physics of a reference model. Additionally, a 'best' solar model was produced that incorporates improved nuclear reaction rates, equation of state, opacities, and treatment of the atmosphere. A comparison of the new solar model with observed p-mode frequencies at low degrees shows agreement within errors associated with uncertainties of the model physics (primarily opacities).

2.6.3. *Solar G-Mode Signatures in P-Mode Signals* (J.R. Kennedy, S.M. Jefferies and F.Hill). An internal g mode should induce oscillatory perturbations in the thermodynamic parameters of p-mode cavities. This will cause frequency modulation of the associated p modes and will result in a pair of sidelobes symmetrically placed about the p-mode frequency by an amount equal to the g-mode frequency. Their amplitudes will be proportional to the ratio of the p-mode frequency deviation to the g-mode frequency. Thus, a replica of the integrated light g-mode spectrum should appear about each p-mode signal. The amplitude of a single g-mode sideband is about 10% of that expected for a direct observation of the g mode, however, averaging many sidebands may improve the sensitivity of g-mode observation attempts over direct methods.

2.6.4. *G-Mode Research at SCLERA* (H. Hill). A brief summary of g-mode detection using SCLERA data was presented. The benefit of g-mode observations is the strong diagnostic potential of the deep interior. The intriguing possibility of detecting solar g-mode oscillations by means of gravitational wave detection systems under consideration was discussed.

2.6.5. *BISON and Some Recent Results* (G. Isaak). The Birmingham Solar Oscillation Network (BISON) has been operating for more than one sunspot cycle at several sites around the world. Measurements of unimaged sunlight provide data about low degree oscillations. Particular emphasis has been given to studies of the cycle variation of frequencies of p-modes and to comparison of low degree frequencies with models that posit mixing of the solar core during the evolution of the Sun. Cycle variation of p-mode frequencies is small but is well established. The issue of possible mixing of the solar core is still not resolved.