25. STELLAR PHOTOMETRY AND POLARIMETRY

(PHOTOMÉTRIE ET POLARIMÉTRIE STELLAIRES)

1. INTRODUCTION

Three items of special importance should be noted at the outset for they necessarily involve changes in the format of this text as compared with reports of previous years: 1) With the improvement in techniques for automatic data collection, conservation and reduction plus the successful extension of photometric studies to new domains of the electromagnetic spectrum through space studies and advances in infrared research, the results achieved in photometric and polarimetric studies have undergone a very large expansion; 2) Advice and suggestions from the members of Commission 25 in the course of the past three years point out to the Organizing Committee the importance of limiting the activities of Commission 25 to those service facilities and techniques connected with the observation, recording and processing of photometric and polarimetric data. This means that we must leave to other Commissions of the Union the discussion and analysis of data obtained; so, for example, multicolour data obtained by the techniques proper to Comm. 25 will be discussed and intercompared rather by colleagues of Commission 45; similarly we must leave the exciting discussion of conclusions from photometric and polarimetric studies to other Commissions and specifically to those concerned with Galactic Structure and Dynamics (Comm. 33), with Variable Stars (Comm. 27) and with Interstellar Matter (Comm. 34). 3) The final item is a practical one but must, with regrets, be mentioned here: the general deterioration in communication of world postal services has made interchanges with members of the Commission much more difficult during the past triennium; on the other hand we have witnessed the improvements in the abstracting services of our colleagues in Heidelberg and the growth and splendid development of data centers in many parts of the world: Strasbourg, Moscow and Washington.

In Section 6 we bring to the attention of the Commission some of the new techniques developed during the triennium, plus an adequate sample (which cannot be complete) of references to the various kinds of methods being employed in photometric and polarimetric studies of stars. Even here, for reasons of space, a cryptic reference system but one easily understood by members will be adopted. Thus in the listed references we shall list first the number (Volume, Section and Running Serial Number) of entries in Astronomy and Astrophysics Abstracts, then the name of the first author listed, with an asterisk attached in the case of multiple authors, and then a sometimes shortened version of the title. Given the purpose of this reference system, which is to point out to the members important references which might otherwise be missed, it is hoped that the abbreviations will be understood by our colleagues. Normally no references will be made to individual astronomical objects; details concerning Variable Stars, galactic and globular clusters, peculiar stars, stars embedded in emission nebulosity, etc. will be found in other sources. An exception will sometimes be made here when in the opinion of the author some specific aspect or item of importance to the methodology of photometric research is discussed. The references given here will refer normally to articles and not to abstracts. With these preludes we come to the substance of the triennial report.

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2. ADVANCES IN TECHNIQUES OF STELLAR PHOTOMETRY

During the triennium since the Grenoble Assembly the changes in stellar photometry which had been foreseen in previous reports have become a reality; this report will reflect certain of these and will try to outline the salient features of some of them. Many of the improvements have been a growth careful and planned following the advances of the classic photometries of the 1950's, while others are associated directly with the tremendous breakthroughs in recording and detection techniques which characterized the later years of the decade of the 1970's. We summarize some of these as follows:

1. The influence of techniques developed for other purposes which incidentally but substantially forward the progress and quality of stellar photometric studies. Among these we include the recent improvements in the sensitivity in receiver design involving a most reliable and stable discernment and measurement of the S/N ratio of radiation from the stars.

2. The marked extension of the range of photometric sensitivity into the regions of the space ultraviolet and into the optical and radio regions of the infrared. The extension into the far UV has been achieved largely through the successful launching of orbiting space observatories whereas the work in the near IR is to be attributed rather to the improved photographic emulsions and their sensitization by a variety of new techniques and in the far IR to the development of detectors of increased sensitivity and stability such as the doped crystals of germanium which have lead to the Germanium-arsenide receivers.

3. A parallel development of software for reducing the numerous observations secured with exactness and ease. In many cases these advances allow observations of stars on nights of less than perfect photometric quality provided only that observations of star and of star plus sky can be made simultaneously. This development of the supplementary software refers both to improvements in counting techniques and in automatic data recording and reduction; one thinks of the programs of recent introduction in many observatories such as the popular photometric program (PPP) devised by W. Kunkel and associates at Cerro Tololo; this program involves a kind of running dialogue between the master programmer and the astronomer at the telescope; it places at the disposal of the observer the "instant aids" of a "first look" at his photometric results by providing a rough solution for a color observation; this can after examination be consigned to its place in the recorded data bank for later elaboration and refinement or as necessity may demand can induce the observer to repeat, while there is time those observations which later might have to be abandoned and discarded.

4. Perhaps the major advancement in the past three years is due to the developments of the panoramic detectors in ever larger arrays. Developments here bid fair in the 1980's to revolutionize photometry by giving it a sound observational basis for the detection and measurement of very faint sources. This with the limited resources available earlier was hardly possible.

5. Parallel to these developments in space and at ground stations in the far UV and in the near and far IR has been the growth and availability of electronic technologies which allow for reliable interfacing with photometers and with photon counters. We mention here at the same time another by no means minor contribution to the photometric 'risorgimento' we enjoy today; this is the development in the theory and practice of the photographic process, which has provided us with emulsions of much increased sensitivity and with a wealth of hypersensitizing and filtering techniques so indispensable for photometric success especially with extremely faint sources.

6. Certainly an outstanding feature of the advances in the growth of present day photometry has been the increased availability of so many new light gathering facilities. One thinks at once of the numerous new large reflectors which have become available in the past triennium; many are equipped with Ritchey-Cretien optics and field correctors which permit deep penetration of space plus a wide field of observation available for photometry. This has opened serious photometry

of faint sources to our colleagues throughout the world. Along with these improvements in large reflecting telescopes one notes the presence at high altitude observing stations of new or improved fast wide angle cameras of the Schmidt and Matsukov types with a variety of new recording devices for stellar photometry and polarimetry.

For these improvements on the ground and in space (one thinks here of the works in progress now in the preparation of photometers and polarimeters for the Space Telescope and for the ESA and other laboratories in space) we are most grateful and ready to accept the challenges presented for future photometric and polarimetric research.

3. BOOKS AND CONFERENCES ON STELLAR PHOTOMETRY

Photometric progress and problems have been covered extensively and well in several books published during the triennium, among which we list the following:

1. Multicolour Stellar Photometry by V. Straizys (Russian) Vilnius 1977. An English Version of this book is in preparation and the Russian original has a full Table of Contents and excellent summary in English. This book together with the Introduction to Astronomical Photometry by M. Golay 1974, D. Reidel, Dordrecht provides a firm background for one entering the field of stellar photometry or preparing to teach a course in this subject.
2. Light by R. W. Ditchburn 1976, Academic Press, London.
3. Image Science, by R. Shaw 1976, Academic Press, New York.
4. Detection and Spectrometry of Faint Light by J. Meaburn 1976, Reidel, Dordrecht.

Several printed books are the product of international and national conferences, symposia and colloquia, study weeks and summer courses. We list some of these which have treated topics of interest to members of Comm. 25.

Two IAU conferences have a direct connection with problems of stellar photometry. Since the introductions to the texts of each conference provide full organizational details and other structural items of these meetings we omit further elaboration here.

In Nov. 1977 IAU Symposium No. 80 was held at the U. S. National Academy of Sciences in Wash., D. C. in honor of the centennial of the birth of H. N. Russell. The title of the Symposium was The HR Diagram. The editors of the proceedings, published in 1978 by Reidel Co., Dordrecht are A. G. Davis Philip and D. S. Hayes. A study of the index will point up many of the photometric topics treated including a discussion of the combination of different photometric systems and specifically the Geneva and the Vilnius photometries through a considered selection of receiver-filter combinations.

In July 1978 IAU Colloquium No. 47 sponsored by Commissions 25 and 45 was held at the invitation of the Pontifical Academy of Sciences and of the Vatican Observatory in the Synodal Hall of the Aula Nervi in Vatican City State. The title of the Colloquium was Spectral Classification of the Future and it honored the centennial of the death of Angelo Secchi, S.J. Editors of the proceedings published by the Vatican Observatory in 1979 are M. F. McCarthy, S.J., A. G. Davis Philip, and G. V. Coyne, S.J. Here the interaction between stellar spectroscopy and stellar photometry were explored; the role of panoramic detectors and prospects for automatic data collection and reduction of both photometric and spectroscopic observations were discussed. It is becoming increasingly evident that with the arrival of new detectors, photometric systems may be established throughout the spectrum and that these may have a wide variety of different wavebands. The importance of communication and cooperation among researchers was stressed: standard systems must be preserved and extended, while new problems will require new experiments but should not lead to a proliferation of a host of new systems, photometric or spectroscopic. A specific point commended to Comm. 25 for discussion was the importance of designating a spectral type which is derived from multicolour

photometry rather than from the examination of spectral images with a different nomenclature than the one used in the MK system.

Another conference which concerned problems of stellar photometry led to the publication in 1977 of The Distribution of Stars in the Direction of the Galactic Polar Caps. This was a Joint Discussion at the Grenoble Assembly which was edited by M. F. McCarthy, S.J. and A. G. Davis Philip and is published in Highlights of Astronomy Vol. 4, Part II; by D. Reidel Co., Dordrecht; Gen. Ed. is E. A. Muller. Of specific interest to stellar photometrists were the discussions of faint photometry made with large Schmidt cameras and the plate errors and colour corrections to be encountered together with the problems of transfer of magnitudes and photometric interpolation.

The Proceedings of a meeting of the Society of Photo-optical Instrumentation held at Reston, VA in Mar. 1976 has been published in 1977 by Palos Verdes Estates in California; Ed. C. Freedman (20.012.060). The title of the conference is Low Light Level Devices for Science and Technology.

Photo-electronic Image Devices is the title of the symposium held at Imperial College, London in Sept. 1974; Eds. B. L. Morgan, R. W. Airey, D. McMullen and published by Academic Press, NY in two parts, A and B.

Attention of photometrists is called to the publication of the Proceedings of the Working Group on Photographic Processes which met in May 1978 at ESO in Geneva under the Chairmanship of R. West of ESO. Discussions of problems of plate hypersensitization were excellent.

Another Union sponsored conference of interest to photometrists was held at Paris-Meudon Sept. 6-8, 1976 on Astronomical Applications of Image Detectors with Linear Response. The proceedings are published by the Obs. of Paris-Meudon in 1977; Eds. M. Duchense and G. Lelievre, as IAU Coll. No. 40.

Commission 25 in cooperation with Commission 30 on Radial Velocities and with Commission 45 on Spectral Classification and Multicolour Photometry requested the approval of the Executive Committee of the Union for a Symposium or Colloguium to be held in Halifax, Nova Scotia at the time of the Montreal General Assembly 1979. The title suggested was Automatic Collection and Reduction of Data from Photometric, Polarimetric, Spectroscopic and Radial Velocity Observations. The Presidents of the Commissions invited Dr. R. West of ESO to serve as Chairman of the Scientific Organizing Committee. The Executive Committee did not grant approval for this conference. The Commissions concerned express their gratitude to Dr. West for the labours he undertook in the preliminary planning stages.

A workshop on Problems of Calibration of Multicolor Photometric Systems will be held at Dudley Observatory in March 1979. A. G. Davis Philip is the Chairman of the Organizing Committee. The workshop will consider the problems of calibrating multicolor photometry with astrophysical parameters such as temperature, gravity and abundance. It is planned to publish the proceedings before the time of the General Assembly in Montreal in 1979.

Attention was called above to improvements in the bibliographical aids available for studies in stellar photometry and polarimetry. Advances here have been as exciting as those in the fields of instrumentation.

We cite with appreciation the bibliographic references and lists of catalogues available as contained in the publications of CDS (Stellar Data Centre at Strasbourg) and edited by C. Jaschek.

An extensive bibliography which presents a listing of 775 papers concerned with the Stromgren four colour photometry and the H Beta photometry from the years from 1950 to 1976 has been prepared by A. G. Davis Philip and C. L. Perry and published in Vistas in Astronomy, 1978 Pergamon Press, London, Ed. A. Beer. A figure in this paper well illustrates the growth in the number of articles published per year and the "publication explosion" mentioned at the beginning of our current report.

The full gamut of problems and prospects for future data reduction in astronomy was treated at IAU Colloquium No. 35 on the Compilation, Critical Evaluation and Distribution of Stellar Data held at Strasbourg, France in August 1976. Edited by G. Wilkins, it was published by D. Reidel Dordrecht in 1977.

4. REPORTS ON STELLAR PHOTOMETRY FROM MEMBERS

W. Buscombe (Northwestern Univ.)

The results of observations made at Cerro Tololo by H. J. Augensen to secure UBV photometry for selected high velocity stars are presented. Three objects: LTT 3987, LTT 5334 and HD 123598 have excess ultraviolet flux δ (U - B) greater than 0.15 mag. Of these, only LTT 5334 has a very unusual galactocentric orbit with an eccentricity of about 0.5. Also the space motion exceeds 150 km/sec for LTT 2575, LTT 2744, LTT 3709, LTT 3834, LTT 4822, LTT 6061. Of these LTT 2744 has the largest space motion ($\backsim$ 300 km/sec relative to the sun) and a highly elliptical orbit (e = 0.9).

H. Eelsalu (Astrophysical Observatory of Tartu)

An Observational Check on a Theoretical Constraint Imposed on the Photometric Curve for Faint Photographic Stellar Images (Tartu Astr. Obs. Publ. 46, 1978) by H. Eelsalu, et. al. A rigorous photometric and statistical processing of faint out-of-focus stellar images on a non-sensitized photographic plate has been carried out. The darkening law confirms that predicted by V. Riives and tested by us earlier.

A. Feinstein (Observatorio Astronomico de La Plata)

J. C. Muzzio (1978, submitted to the Astron. J.) found small differences between the main wavelengths of the wide and narrow filters of the Hβ filter sets give rise to important color effects on the β index. A difference of 10 A changes the β index about $0^m.01$ for every 1 mag. of (B - V).

H. Marraco has been obtaining BV polarimetry of southern stars in R Associations, OB stars in HII regions and field Be stars.

A. Feinstein and H. Marraco reported that through the measures with interference filters of the Hα , Hβ , and Hγ lines in Be stars, (the emission indices e_α and e_β) were obtained. Both indices describe the amount of the emission and are very well correlated with spectroscopic data. The absolute magnitude of the Be stars can be obtained through the β index corrected for emission (subtracting e_β).

J. A. Graham (Cerro Tololo Inter-American Obs.)

Graham is engaged in a long-term program for setting up standard stars in the Harvard E-regions for UBVRI photometry on the Kron-Cousins system. The standards will reach 16th magnitude and are based on Cousins' photometry of brighter stars in the field. Special attention is being paid to covering a large magnitude range within a small area of the sky so that the standard stars can be used to check the calibration of area detectors. A supplementary list of stars is planned to cover a large color range at magnitudes between 10 and 12.

B. Hauck
(Institut d'Astronomie de l'Universite de Lausanne
et Observatoire de Geneve)

The group of our Institute has continued its efforts to collect all photometric data. The list of catalogues can be found in the Information Bulletin of the CDS. However, we would mention in particular the catalogue of Mermilliod and Nicolet (Astron. Astrophys. Suppl. 1977, 29, 259) giving all measurements in the UBV system and that of Nicolet giving (for the UBV) a mean value for 53,000 stars (in press). A new version of the uvby β catalogue ($\backsim$ 16,000 stars) is now in preparation and will be ready at the time of the General Assembly.

Mermilliod is working on comparative studies of young open clusters and has

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found (18.153.029) a new gap in the main sequence between spectral types B7 and B8. He is now working on a better definition of the observational isochrones in various photometric diagrams, using for this purpose the new edition of his catalogue on UBV and MK types for star clusters (18.153.023).

Hauck has continued his study of the Ap stars and a photometric parameter of peculiarity has been established for the Ap stars measured in the Geneva system (18.113.015, and Astron. Astrophys. in press).

North has made a preliminary study with a view to using a system (following a proposal by Straizys) employing the U, B1, B2 and V filters of the Geneva system and P, Z and S of the Vilnius system. With these filters many properties of both systems are conserved and it also seems to be very good for the study of the cool stars.

A. U. Landolt (Louisiana State Univ.)

Landolt is observing secondary UBVRI photoelectric standard stars around the celestial equator. On the order of 400 stars in the range $7 < V < 17$ and $-0.2 < (B - V) < +2.0$ between $+10^{\circ} < \delta < -10^{\circ}$ are being observed at Cerro Tololo. The photomultiplier is a RCA 31034. This is an expansion of work published (Astron. J., 78, 959, 1973).

E. Rybka (Krakow)

Among activities in stellar photometry in the past three years are the following:

1. Catalogue of magnitudes of HR stars in the uniform P_{44} and V systems. Uniwersytet Jagiellonski, Krakow 1977, p. 74. Magnitudes of 9110 HR stars have been reduced to the system of E. C. Pickering (Harvard Annals Vol. 44) and then expressed in Johnson's V system. The average mean error of one entry was diminished from $\pm 0^{m}.10$ to $\pm 0^{m}.07$.

2. A review article in Polish concerning the UBV photometric system: Problem standardow w szerokopasmowej fotometrii UBV. Postepy Astronomii, 26, No. 1, pp. 19-30 Warszawa 1978.

3. The final catalogue of 229 photometric standards in the UBV system near the Selected Areas 1 - 115. This work is in press in Acta Astronomica Warsawa. It contains the completion of the author's investigations concerning the determination of photometric standards distributed uniformly over the sky in the northern hemisphere.

5. STELLAR POLARIMETRY

(G. V. Coyne)

Summary

Significant advances have been made in technique for high resolution polarimetry. Moderate resolution ($\backsim$ 2 A- 20 A) has been achieved with the technique of tilt-scanning with narrow band interference filters. The highest resolutions (less than 0.5 A) have been obtained by coupling an echelle spectrograph to various types of panoramic detectors.

These techniques have been used to study intrinsic polarization in various types of stars including: 1) rapidly rotating early type stars with extended circumstellar envelopes and emission-line spectra (Be stars) and Wolf-Rayet stars; 2) close dynamical systems in which stars are distorted by their close proximity or are losing mass into gas streams or some common envelope; included here are dwarf novae and X-ray binaries; 3) cool red stars with very extended atmospheres or those with circumstellar dust shells, including the regular pulsating variables of the Mira type, carbon stars, R CrB stars and other cool giant and supergiant stars.

Techniques

In recent years considerable effort has been made to increase the spectral resolution with which the intrinsic polarization from various types of stars is measured. At each increase in spectral resolution further significant detail has been revealed in the polarization. These observations have contributed to the study of the stratification in the extended atmospheres about early and late type stars.

A few spectropolarimeters have been designed by using the tilt scanning properties of narrow band interference filters (the process is similar to tilting a Fabry-Perot etalon) to enable limited spectral regions ($\backsim$ 60 A) to be scanned and polarimetry to be performed sequentially at many wavelengths in the scan range (Clarke and McLean 1975). More recently wavelength scanning instruments have been used in which the polarizing optics have been coupled with the standard grating monochromators and multi-channel Cassegrain scanners. One such instrument is in use by the Royal Observatory Edinburgh. Early fears of severe instrumental polarization effects when using gratings have been overcome by always locating the polarimeter ahead of the spectrometer in the optical train. Using some birefringent device as an optical retarder (sometimes variable) followed by a fixed, perfect polarizer, ensures that the spectrometer is fed with fully polarized light having a constant direction of vibration, only the intensity of the light is modulated by the operation of the retarder. The most commonly used "fixed" retarders are achromatic wave-plates (made for example from quartz and magnesium fluoride) which have a great advantage, especially for spectropolarimetry, of giving a wavelength independent modulation as they are rotated. Pockels cells (electo-optic crystals) and photo-elastic modulators (piezo-optic crystals) are the best known variable retarders. Although they are not achromatic they have the advantage of having no moving parts. They also have higher modulation frequencies. A Pockels cell is used with a spectrograph and Reticon panoramic detector at Steward Obs., Univ. of Arizona. In addition, the photoelastic modulator has a wide field of view. However, because of readout limitations, these advantages are minimized for the detector arrays discussed below.

Undoubtedly, the most significant innovation in astronomical spectropolarimetry has been the recent development of multi-channel instrumentation, made possible by the application of linear and two dimensional photon-counting detector arrays. One such device, employing a Digicon image tube has been constructed at the University of Arizona according to a design by K. Serkowski (McLean, et. al. 1979). In the Digicon, photoelectrons, emitted by an S-11 photocathode on which the optical spectrum is imaged, are magnetically focussed onto a linear array of 106 silicon diodes. Magnetic stepping over half diode intervals gives effectively 214 channels. A rotating superachromatic half-wave plate and a fixed prism in front of the spectrometer are used for measuring the linear polarization Stokes parameters simultaneously in all channels. This instrument may be used in a low or high resolution mode. The low resolution mode uses a grism giving a resolution of 30 A between 3000 A and 7000 A; the high resolution mode uses an echelle which gives a resolution of $\backsim$ 0.3 A around Hβ. A CID will also be employed as a detector with this system. It is expected that all new spectropolarimeters will be designed to use two-dimensional photon counting image detectors with high quantum efficiency, such as Vidicons, Reticons, CID and CCD arrays.

Observational Results

A general review of new developments in the polarimetric study of Be stars has been given by Coyne (1976). More recently, variations have been found in the linear polarization at a resolution of $\backsim$ 0.5 A across the Hβ line of the Be shell stars γ Cas, ϕ Per, ψ Per and ζ Tau (McLean, et. al. 1979). At the line center the polarization increases and there are secondary minima in the polarization in the extreme line wings. The flux profile, obtained simultaneously

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with the polarimetry, have double emission peaks separated by a central absorption. The variations in polarization are due to differential effects of Doppler broadening of spectral lines on the polarized flux produced by scattering in an oblate circumstellar envelope which is expanding and/or rotating and is not viewed exactly edge-on. These observations have assisted in the modelling of stratification effects in the circumstellar envelopes (Poeckert and Marlborough 1978, McLean 1978).

The latest review of polarization in late type stars was given by Shawl (1974). Landstreat and Angel (1977) have measured a number of late type variables at a resolution of about 40 A. The polarization varies across all of the strongest absorption features, principally the TiO and ZrO molecular bands. Coyne and Magalhaes (1977) have detected changes in the polarization of the semi-regular variable V C Vn in the H β spectral region. The maximum polarization shifts to shorter wavelengths as the star approaches minimum light. A detailed study of Mira has recently been made by McLean and Coyne (1978). The spectrum from 3500 A to 7000 A has been studied with a spectral resolution of 50 A. The polarization decreases across each of the TiO bands. Changes in the polarization have been studied at a spectral resolution of 0.5 A across the H β line in emission near maximum light. The emission flux is polarized about four times more than the continuum. Models employing fluorescent radiation at the moving shock front to explain these remarkable changes are being explored.

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6. SELECTED REFERENCES TO STELLAR PHOTOMETRY

As indicated earlier we present here a list of abbreviated references to research in stellar photometry. References have been grouped under the following main topics: I. Photometers and II. Photometric Reduction Techniques. Papers are identified by the index number from Astronomy and Astrophysics Abstracts published during the past two years; this Volume Number, followed by the author's name and then a sometimes very shortened version of the title. Use of the following symbols allow this abbreviated presentation to be made:

PM (Photometer or Photometry)
PEP (Photoelectric Photometry)
* (et. al., the names of other authors are not listed here)
... (the full formal title has been abbreviated for lack of space)

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I. PHOTOMETERS

17.032.012	E. Spiller*	Coatings for the Far UV Region
17.034.004	A. Gur'yonov	Investigation of PMs...
17.034.016	R. Schielicke	On a Semi-automatic Iris-type PM
17.034.018	V. Ivanov*	Electro PM - Computer System...
17.034.035	B. Ozak*	A Device for Automatic Sensitivity Regulation...
17.034.036	N. Lebedev*	...Photomultiplier for Recording Weak Light Signals
17.034.043	M. Torr*	PM Calibration Error...
17.034.048	M. Abbas*	Infrared Upconversion for Astronomical Applications
17.034.052	J. Davidson*	A Sky Compensating Filter PM
17.034.063	T. Moss	Infrared Detectors
17.034.068	A. Avotins*	Two Channel Electrophotometer
17.034.070	S. Krawczyk*	The Three Channel Microphotometer
17.034.078	C. Cosmovici*	A High Resolution Fabry-Perot Tilting Filter...
18.034.006	W. Furtig	A New Universal Stellar PM
18.034.014	M. Pehk	An Amplifier for an Infrared PM
18.034.016	E. Burke*	A New PM Design...
18.034.020	S. Babichenko*	High Sensitivity Wide-Band Stellar PM
18.034.023	O. Maksumov	Control Unit of a PM...
18.034.041	G. Paturel	New Direct Sensitometer for Photographic PM
18.034.054	J. Kizla	A Two Channel Infrared PM
18.034.060	G. Lygna*	Calibrations
18.034.061	D. Dawson*	Testing a PEP
18.034.063	J. Oliver	Fast Electrometer Amplifier...
18.034.080	C. Coleman*	Electronographic PM
18.034.081	R. Altenhof	Design of a Large Aperture Infrared Optical System
18.034.085	J. Horak*	Automatized PEP...
19.032.556	M. Laget*	Ultraviolet 3 Channel PM in S183 Experiment
19.034.056	E. Olsen	On the Stability of the PM System...
19.034.058	A. Bukach*	Intensity Micro PM with Step Drive
19.034.064	E. de Lara*	A PM Using Silicon Diodes...
19.034.082	W. Feibleman	Ultraviolet Response of In Ga As P Photocathodes
19.034.084	J. Dobrowolski*	Colored Filter Glasses...
19.034.085	K. Fritze*	A Scanning Micro PM with an On-Line Data Reduction...
20.031.272	B. Barlow	Ground Based Low Light Level Astronomy
20.031.300	J. Lorre*	Recent Developments at JPL in the Application of Digital Image Processing...
20.034.016	P. Boyce	Low Light Level Detectors...
20.034.024	G. Holah*	Far Infrared Interference Filters
20.034.025	S. Babichenko*	Use of Absorption Filters in UV Spectro PM...
20.034.028	K. Shivanandan*	Recent Advances in Far Infrared Detectors...
20.034.029	F. Vescelus*	A Large Imaging Array CCD Program
20.034.030	R. Aikens*	Astronomical Applications of Charge Injection
20.034.032	G. Carruthers*	Low Light Level Imaging Devices...
20.034.041	D. McMullan*	The Electronographic Camera
20.034.042	G. Taylor*	...Large Area CCD Imaging Systems
20.034.048	E. Kellogg*	The Photicon
20.034.051	C. Coleman	High DQE Detectors
20.034.058	P. Rybski*	The McDonald Obs. Digital Area PM
20.034.059	B. Campbell	The DDO Diode Array Spectrometer
20.034.064	S. Furlani*	The Multifunction PEPM of the Torino Obs.
20.034.065	A. Kubicela*	A D. C. PEPM
20.034.066	R. Tull	Making Every Photon Count...
20.034.067	M. Res*	Filter Glasses with Bypass Characteristics...
20.034.072	C. Baddiley	A Wide Field Infrared PM
20.034.074	M. Kimmitt	Recent Development of Infrared Detectors
20.034.077	D. Lemke	Infrared Instrumentation at Calar Alto
20.034.084	H. Tsunemi*	A High Speed PEPM...

I. PHOTOMETERS (continued)

20.034.085	W. Weiss	A Project Study for a Continuum PM
19.034.001	N. Maseyk	A PIN Diode PM
19.034.002	A. Corney	Silicon PIN Diodes in Astronomical PM
19.034.005	R. Gehrz*	A Low Resolution Infrared Array Spectrometer...
19.034.016	I. Aslanov*	...Application of Electronographic Image Converter...
19.034.017	A. Lallemand*	Developments of Electronographic Lallemand Cameras...
19.034.018	G. Kron	The Kron Electronographic Camera
19.034.019	P. Felenbok	...Electrostatic and Electromagnetic Lallemand Cameras
19.034.020	J. McGee	Present Status of the Spectracon
19.034.021	D. McMullan*	The RGO Electronographic Cameras
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7. CONCLUDING NOTE

In this Report Sections 1, 2, 3 and 6 were prepared by M. F. McCarthy; Section 4 contains the Communications received from Commission members; Section 5 gives the Summary on Stellar Polarimetry prepared by G. V. Coyne

ADDENDUM

The following Report on Photometry and Polarimetry has been received from J. Tinbergen (Leiden Obs.).

The Leiden Light Collector and five colour photometer is being moved from Hartebeestpoortdam in S. Africa to La Silla (ESO) in Chile; it will be known as the Dutch National Telescope.

Leiden Observatory is putting into service a 12 channel photometer-polarimeter, optimised for the study of stellar absorption lines, but capable of most other types of photometry or linear polarimetry.

J. Lub and J. W. Pel have given a detailed discussion of the properties of the Walraven 5 colour photometry, which is a very useful companion to that of Stromgren (Astron. and Astrophys. 54, 137, 1977). They have applied their results to large scale studies of classical Cepheids (Pel) and RR Lyrae variables (Lub) in the Galaxy. Van Genderen has used the five colour system to study Cepheids in the Magellanic Clouds and X-ray binaries in the Galaxy.

Tinbergen has nearly completed a polarimetric study of stars in the solar neighborhood (35 pcs.). The local dust content is even lower than earlier studies indicated. A region of regular magnetic field can be seen but it does not extend over the whole volume studied. Byproducts of this investigation are a list of about