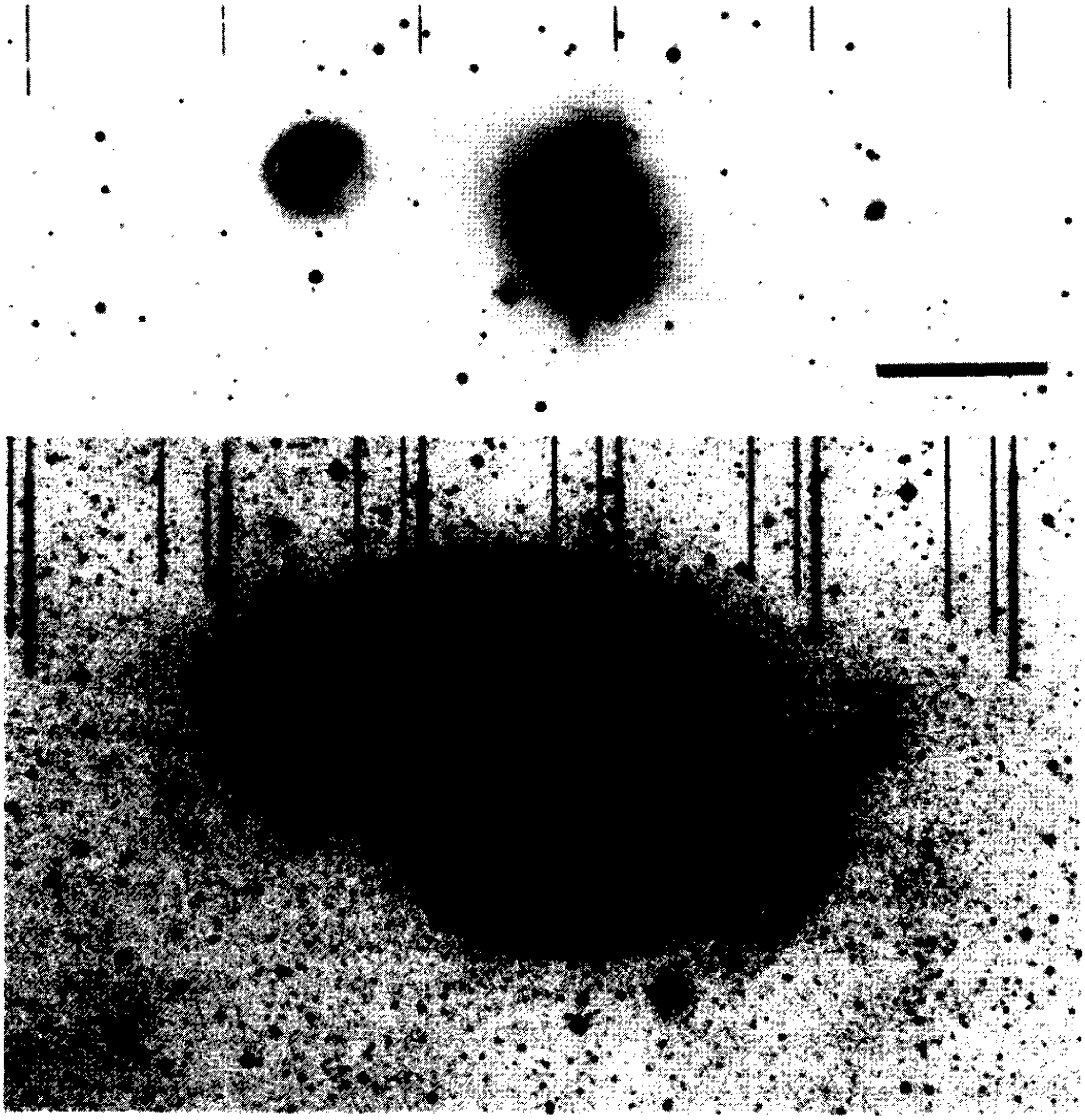
International Astronomical Union
Commission 9



Working group
on
"Wide-field imaging"

Newsletter 5

IAU WORKING GROUP
ON
WIDE-FIELD IMAGING

Newsletter No. 5

March 1994 **Editor: H.T. MacGillivray**

Typeset by E.B. Thomson

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Editor's Note

These past six months since the last Newsletter (No. 4) have seen a great deal of activity as far as the Working Group on Wide-Field Astronomy is concerned.

Firstly, the highly successful IAU Symposium (No. 161) on 'Astronomy from Wide-Field Imaging' was held in Potsdam, Germany, from 23-27 August 1993. Some 200 persons attended from all over the world, and it was particularly encouraging to see such a high percentage of participation from the Eastern European countries. Our Working Group can claim to be truly 'International' in this respect. Just under 200 papers have now been gathered for inclusion in the Proceedings, which have been retyped in a unified form and are currently being finalised. It is hoped that the Proceedings will be sent to the publisher (Kluwer Academic Publishers) by the end of February, and should appear in print during July 1994. All participants at the meeting will receive a copy.

Secondly, there has been a great deal of concern over the recent announcement by Eastman Kodak that they are to discontinue the production of certain of their astronomical emulsions. The participants of IAU Symposium No. 161 prepared a resolution providing a united voice of concern to Eastman Kodak. You will see a copy of the resolution included in this Newsletter, together with a response from Gordon Brown of Kodak.

Thirdly, we now see a threat to the Sonneberg Observatory and its very valuable plate collection. This too evoked a strong protest from the IAU Symposium, and the resolution produced, together with responses from various authorities in Germany, are included also in this Newsletter. The very valuable plate archive of the Sonneberg Observatory is an extremely important legacy for future astronomical research work, and we **must** ensure that the authorities involved are made aware of the extreme concern of the astronomical community to see that this rich treasure is properly safeguarded.

Finally, the Organising Committee of the Working Group is also now in the process of change. With the end of the 1st 3 years of the WG, it is now time to elect a new Organising Committee, and at the present time the process of electing new committee members is taking place. Both Richard West and I are standing down from our respective rôles (Richard as Chairman, and I as Secretary). In August of this year, you will see a new Organising Committee in place, with a new Chairman, new Secretary, and 8 new ordinary members. The 'official' changeover of the committees will take place at the time of the XXII General Assembly meeting of the IAU at the Hague.

We are also taking this opportunity to update our records for membership of the WG. Due to movement of persons, either from one institute or another or out of astronomy completely, our records may now be out-of-date or incomplete. Hence we bring the reader's attention to the extremely important announcement on the next page. If you wish to continue to be a member of the WG, you **must** return to me the completed questionnaire that will be sent to you in the next few weeks. Failure to do so may mean that your name is not retained on the list of active members.

H.T. MacGILLIVRAY
Royal Observatory
Blackford Hill
Edinburgh EH9 3HJ
Scotland
U.K.

!! Important Announcement !!

Renewal of Membership for the Working Group

By August of this year, the Working Group will have been going for 3 years. It is, therefore, now time to begin formulating the membership for the next 3 years (i.e. 1994-1997). Moves are currently underway to arrange for a new Organising Committee of the WG to be in place from August 1994 (essentially to take over from the existing Organising Committee at the time of the General Assembly meeting of the IAU at the Hague — see Editor's note on the previous page). Accordingly, it is also appropriate that we at the present time update our records as to the list of active members of the WG for the coming 3 year period.

In the next few weeks, your editor will be circulating to all persons on the present mailing list a questionnaire to be filled in. This should be returned to the editor so that our records can be updated. The questionnaire will ask whether you wish to continue to be a member of the WG or not. We also need to have up-to-date and correct mailing addresses.

Please note that to continue to be a member of the WG and hence to continue to receive correspondence concerning WG activities, then you must return the questionnaire to the editor duly filled in. If you do not return the questionnaire, then it cannot be guaranteed that your name will continue to be included on the list of members, and hence it also cannot be guaranteed that you will receive future issues of the Newsletter, nor announcements of future scientific meetings.

IAU WORKING GROUP ON WIDE-FIELD IMAGING

COMMISSION 9

Statement of Goals

The IAU Working Group on Wide-field imaging is concerned with astronomical research projects which are based on simultaneous and/or successive large-scale observations of substantial numbers of objects, normally but not exclusively involving fields covering a substantial fraction of the sky. It furthers such projects by providing a forum for:

1) integration of related technologies and scientific methods;
2) coordination of the work of different groups and with different techniques;
3) recommendations about standardization of procedures, formats and archival media etc.; and
4) dissemination of information about this field of astronomy to all interested parties.

Minutes of the Second Meeting of the Organising Committee

Sunday, 22 August 1993, 15:30

Astrophysical Institute Potsdam, Brandenburg, Germany

1. Opening and Adoption of Agenda

The Chairman opened the meeting and welcomed all present:

R. Kron
B. Lasker
H. Lorenz
D. Malin
N. Reid
M. Tsvetkov
R. West

He regretted that the following members of the Scientific Organizing Committee were unable to be present:

J. Guibert
R. Humphreys
K. Ishida
H. MacGillivray

2. Minutes of the Baltimore Meeting (April 1992)

The minutes of the First meeting of the OC had been published in Newsletter No. 2. The Chairman had received from R. Humphreys a letter indicating disagreement with the discussion about the site for the next meeting in Section 7 of these minutes. By letter of 26 October 1992 the Chairman had informed Prof. Humphreys that this matter would be brought to the attention of the SOC during the present meeting. Following an extensive discussion, the SOC requested the Chairman to ask Prof. Humphreys to specify (in the form of a few sentences) the exact changes she wished to be made in the minutes. These would then be circulated to the members of the SOC for agreement by mail.

3. Report by Chairman

The Chairman briefly reported about the preparations for IAU Symposium 161 and mentioned that an official report by the Working Group will be submitted to the President of IAU Commission 9, Prof. J.C. Bhattacharyya, soon after the Potsdam meeting. The WG report will be included in Commission 9's report which will be published together with other Commission reports in the next volume of the IAU Transactions.

4. IAU 1994 GA Programme of WG WFI

The Chairman informed that no business sessions had been foreseen for the WG WFI during the 1994 IAU General Assembly in The Hague and were also not planned for any other WG of the IAU. However, it might be possible to obtain a room for such a meeting if the OC so wished. After some discussion, the SOC decided that this would not be necessary, since the business of the WG might equally well be conducted in a continuous fashion by e-mail and normal mail.

The Chairman further informed that the WG WFI is involved in the preparation of 1/2 day of the IAU Symposium 167 'Advances in Array Technology and Applications' which will take place in The Hague at the time of the next IAU General Assembly on August 15-19, 1994. The title of the session organized by WG WFI is 'Large Field Imaging with Array Mosaics'. A preparatory meeting will be held by the SOC for IAU Symposium 167 in early October at ESO, Garching, in which it is expected that the Chairman will represent the interests of the WG WFI.

5. Elections

The Committee discussed at some length election procedures for Chairman, Secretary and OC members (1994-97). It was decided that it would not be reasonable to involve at this time all members of the WG, but only the OC members. There should be rotation in the OC so that new ideas and directions in wide-field work could always be represented on the OC. Normally, there should be no more than one person from the same institute on the OC. In order to ensure continuity, it seems reasonable that the Secretary would continue as Chairman during the next three-year term. The OC agreed that Dr. Okamura, at the request of Dr. Ishida, would act as his representative during the OC meetings in Potsdam. R. West does not wish to continue as Chairman after 1994.

The OC decided to revert to this entire issue during the meeting on Thursday, August 26, 1993.

6. Future WG Activities

The OC members were of the opinion that future meetings organized by the WG would most probably take the form of more topical workshops and that the present symposium might be the only one of this width.

It was decided that one of the OC members present at the Bandung Meeting on Schmidt Telescopes in early 1994 should present a summary of IAU Symposium 161.

The OC further discussed the dramatic situation following the intended discontinuance by Kodak of a number of classical emulsions of great use to astronomers. This issue would be further discussed during the emergency meeting in the evening of August 23. The question of survey instruments connected to the future 8 m class telescopes was also brought up, as was the recent implementation of a 2° field at the AAT. The OC was of the opinion that there are plenty of exciting subjects within its area which could form the basis for future meetings under its auspices.

7. Other Matters

There were no other matters.

8. Next Meeting

The next meeting will be held on Thursday, 26 August 1993 at 19:00.

R.M. WEST
European Southern Observatory
Karl-Schwarzschild-Str. 2
W-8046 Garching
Germany

Minutes of the Third Meeting of the Organising Committee

Thursday, 26 August 1993, 18:30

Astrophysical Institute Potsdam, Brandenburg, Germany

1. Opening and Adoption of Agenda

The Chairman opened the meeting at 18:30 and welcomed Dr. Okamura as representative for Dr. Ishida. The agenda were adopted.

2. Information from Local Organising Committee

The LOC informed that the final number of participants was just below 200 and that the number of posters was approximately 120. The OC members expressed their admiration of the excellent LOC arrangements for this meeting. It was suggested that it might be a good idea to have mail boxes for individual participants at similar large meetings in the future.

3. Proposed Resolutions

The OC thoroughly discussed the proposed resolutions on photography and the future of the Sonneberg Observatory. It agreed to the presentation of the Photography Resolution to the Symposium with a few minor changes, but decided to request a small committee consisting of N. Reid, M. Tsvetkov, R. Kron and H.-J. Braeuer to re-formulate the Sonneberg Resolution (this was duly done and the resolution was presented to the Symposium the next day).

4. Preparation of Proceedings

Sheets with detailed information to authors had been circulated early during this week and all participants were fully informed. Some manuscripts received during the conference would be transmitted directly to H. MacGillivray immediately following the meeting.

5. Election: Procedures and Candidates (1994-1997)

After a thorough discussion of election procedures, candidates etc., the following approach was adopted:

1) The Chairman will send a circular letter to all OC members requesting:
   a) nominations for new OC members;
   b) an indication of willingness or interest in stepping down;
   c) nominations for Chairman, and
   d) nominations for Secretary.

2) Based on the replies, the Chairman would make a list of:
   a) Chairman candidate(s);

b) Secretary candidate(s), and

c) OC candidates.

and submit it for vote by mail to all OC members.

3) The persons receiving the most votes will be elected.

An OC with 9-12 members is aimed at, but this would depend on the number of OC members willing and prepared to step down. The future OC would be requested to establish proper election procedures, preferably involving all members of the WG WFI which could be put into action in the 1994-1997 period.

The Secretary is requested to prepare a circular letter to all WG members (not later than early 1994), asking whether they are interested in continuing as such during the next three-year term (1994-1997). Only those who respond positively will remain members of the WG.

6. WG Presence at Bandung Conference

It is expected that D. Malin, N. Reid and B. Lasker will be present. The Chairman will make sure that one of them will present a summary of IAU Symposium 161 on that occasion.

7. Other Matters

There were no other matters.

The Chairman closed the meeting at 20:00.

R.M. WEST
European Southern Observatory
Karl-Schwarzschild-Str. 2
W-8046 Garching
Germany

IAU SYMPOSIUM 161

Minutes of the Joint SOC/LOC Meeting

Sunday, 22 August 1993

Astrophysical Institute Potsdam, Brandenburg, Germany

1. Opening and Adoption of Agenda

R. West opened the meeting at 14:00 and welcomed the members of the Local Organising Committee and Scientific Organising Committee of IAU Symposium 161.

Present were: R. Kron
B. Lasker
H. Lorenz
D. Malin
N. Reid
M. Tsvetkov
R. West

He regretted that the following members of the SOC were unable to be present:
J. Guibert
R. Humphreys
K. Ishida
H. MacGillivray
M. Mayor

Many LOC members were now busy receiving the participants and could therefore not participate either.

The agenda were adopted.

2. Status Report by LOC

On behalf of the LOC, H. Lorenz gave a brief report about the preparations for this meeting. A total of approximately 200 participants was expected and 135 poster papers, which together with the oral presentations would bring the total to approximately 200 contributions. There were no particular problems and the SOC congratulated the LOC members on the excellent preparations made for this meeting.

3. Scientific Programmes

A few speakers and chairpersons had indicated their inability to come to Potsdam. The scientific programme was changed accordingly.

The LOC had prepared photo copies of late abstracts which would be available to the participants in the poster room.

In view of the recent problems with the supply of photographic materials to astronomers from Kodak, it was decided to have an additional session on the salvage of astronomical photography on Monday, 23 August, 19:00-20:00.

The appropriate announcement about these changes and additions would be made to the participants at the beginning of the symposium.

4. Conference Proceedings

Information had been received from H. MacGillivray about the preparation of the conference proceedings. The offer by H. MacGillivray to continue to act as the Chief Editor of the proceedings was gratefully accepted. The SOC members responsible for the individual sessions of the symposium would act as Sub-editors. The importance of publishing all contributions was stressed, implying that some contributions might have to be brought into a better shape by the editors. Everybody welcomed the intended philosophy, namely to have in the end a uniform, high-quality set of proceedings, even if this would involve quite some work by the editors.

5. Other Matters

There were no other matters and the Chairman closed the meeting at approximately 15:30.

R.M. WEST
European Southern Observatory
Karl-Schwarzschild-Str. 2
W-8046 Garching
Germany

IAU SYMPOSIUM 161

'Astronomy from Wide-field Imaging'

23 - 27 August 1993

Astrophysikalisches Institut Potsdam, Brandenburg, Germany

RESOLUTION

Photographic Plate Supply

The participants of IAU Symposium 161:

considering that the photographic emulsion, due to its still unique size and archival properties, will continue to be of great use in wide-field astronomy for several years to come, and

having learnt that Kodak is discontinuing with immediate effect the manufacture of several photographic emulsions of particular importance for various current astronomical projects, thus effectively implying the impossibility of bringing these projects to a successful end,

strongly urge Kodak:

1) to continue production of IIIa-J, IIIa-F and IV-N for some years, at least until the termination of current Schmidt-based major sky surveys, and
2) to provide a blue- or ortho-sensitive TECH PAN film to maintain the long established astronomical blue and visual passbands.

IAU SYMPOSIUM 161

'Astronomy from Wide-field Imaging'

23 - 27 August 1993

Astrophysikalisches Institut Potsdam, Brandenburg, Germany

RESOLUTION

The Future of Sonneberg Observatory

Imaging is a fundamental tool of astronomical research — a fact emphasised by the wide-ranging subject matter covered at the conference on 'Astronomy from Wide-field Imaging' (IAU Symposium 161), held under the auspices of the International Astronomical Union at Potsdam in August, 1993. The importance of providing adequate archives for astronomical images to allow for future scientific exploration was particularly stressed.

The participants of this conference are aware that an urgent matter has arisen concerning the future of wide-field astronomy in the Federal Republic of Germany with the threatened closure of the Sonneberg Observatory. With an unparalleled history of 60 years of continuous sky-patrol observations, Sonneberg has amassed a unique collection of 250,000 photographic plates forming a vital resource for many current astronomical research projects, notably the long-term study of variable stars — a subject crucial to our understanding of stellar evolution. The importance of this resource is underlined by the resolution passed at the 1991 IAU General Assembly in Buenos Aires (*IAU Inf. Bull.*, **67**, 39, 1992).

Plans for the re-organisation and relocation of astronomical resources in Germany suggest that the Sonneberg archive should be closed and re-housed elsewhere. Such a move, involving the creation of a new archive facility, is both expensive and extremely dangerous for the fragile (and irreplaceable) plates.

In view of the importance of the Sonneberg archives, we, the participants in IAU Symposium 161:

request that the government of the Federal Republic of Germany and other responsible authorities ensure the preservation of these archives in a manner such that they are readily accessible to the world-wide research community;

believe that the most efficient method of achieving this aim is through maintaining the current computer-catalogued facility at Sonneberg; and

considering the past contribution by German observatories to sky patrols and their continued importance for scientific projects,

urge that all means of maintaining a presence in this area of astronomical research be explored.

Reply from Eastman Kodak — Photographic Plate Supply

I would like to reply to the IAU Resolution to Eastman Kodak Company from the participants in the IAU Symposium 161. I will also update your information on the state of the Kodak Astronomical plate business. The situation is still in a state of flux, and has changed since I last wrote. Since then, we have taken additional steps to see that the plate business remains viable, but we cannot foresee with certainty if they will be sufficient. As always, our intent is to manage the situation so that we can continue to stay in the plate business in a way that will benefit both of us.

Even so, we may be forced to discontinue products because of manufacturing and raw material difficulties, regardless of the demand for them. In principle, a Research and Development program might be undertaken to develop replacement emulsions that would give similar performance characteristics to the current or discontinued plates, but the small volume and low profitability of the market make this improbable. Even though there were no funds for research, we have been able to 'save' some of the plates, particularly the IIIa-J and IIIa-F sky survey plates, by experimenting with alternate gelatin supplies.

We have performed other experiments, but with disappointing results. We have already spent more money than the sales of these products can support. With our estimated minimum costs to investigate ten emulsions, the cost of our experiments could easily exceed our sales for the entire U.S. market. This is not the direction we want to pursue to increase our value to our shareholders.

It has been suggested that outside agencies supply the R & D money required to 'fix' these emulsions. Our experience shows that our estimated cost per experiment may be the minimum and could easily triple before we have an answer — and there is no guarantee that an answer would be forthcoming. In addition, this effort would tie-up the valuable time and resources of emulsion engineers who are currently engaged in more profitable ventures.

With that preamble, I now address myself to the details of the IAU resolution:

Sky Survey Emulsions:

IIIa-J and IIIa-F Emulsions

I feel that we have corrected the gelatin supply problem, at least with the sky survey IIIa-J and IIIa-F plates by making a newer formulation that is acceptable for use in the surveys. These gelatins are currently in good supply, and the sensitometric effects seem to be the same as those obtained with the previous emulsions.

IV-N Emulsions

We have not been so fortunate with the IV-N emulsion, but we probably will have sufficient emulsion to complete some of the needs for the sky surveys. When we announced that we only had a two years' supply of gelatin for the IV-N emulsion, we immediately received two years' supply of orders. Fortunately, after further inspection of our gelatin supplies, we were able to find a small quantity of the old gelatin. Based upon our sales estimates, we believe that this will be sufficient to make the IV-N plates until mid-year 1994. After that time, the IV-N plate will be discontinued.

Blue-sensitive Technical Pan Emulsion

It may be possible to perform some low-level coating experiments of an unsensitized (Blue) Kodak

Technical Plates. We would coat plates since it is much more economical to experiment with plates than films. However, we still cannot predict how successful our efforts will be, and we are not in a position to provide extended experimentation. We would try this experiment on a one-time basis, and provide Dr. David Malin with the plates to determine if they meet his needs. If the plates are not close to his aims we will not be able to provide further experimentation.

U.S. person to contact for plate supplies:

We have recently streamlined our plate operations. There is now one person to contact for all KODAK Glass Photographic Plates ordered in the U.S. by calling **1-800-648-5199** or **716-722-3005.** (Export orders will be handled through the originating country in the usual manner.) This number will be used exclusively for ordering all glass plates for the following purposes:

- delivery status information;
- product pricing;
- billing and accounts receivable information;
- technical inquiries.

The toll-free '800' number accepts voice and data (FAX) calls. The line will be staffed from 9.30 a.m. to 2.30 p.m. U.S. Eastern Time, Monday through Friday. A voice mail system and the FAX machine are in operation 24 hours a day, seven days a week. When you place FAX orders to the above number you will receive confirmation of your order within two business days. Mail orders to the following:

Eastman Kodak Company
Customer Service — Glass Plate Manufacturing
Building 49, Room 510
1669 Lake Avenue
Rochester, New York 14652-3713

ATTN: Ms Barbara Seils

Current plate supplies:
Plates that will remain in the line for the foreseeable future are:

KODAK High Speed Holographic Plate, Types 131-01/02
KODAK Projector Slide Plate (Contrast)
KODAK Projector Slide Plate (Medium)
* KODAK Special plate, Type 101-05
KODAK Special plate, Type 153-01
KODAK Spectroscopic Plate, I-N
KODAK Spectroscopic Plate, Type IIIa-F
KODAK Spectroscopic Plate, Type IIIa-J
KODAK Spectrum Analysis Plate, No. 1
KODAK Spectrum Analysis Plate, No. 3
* KODAK SWR Plate
KODAK T-MAX 100 Professional Plate
KODAK Technical Pan Plates
KODAK Process Plate

* We are currently experiencing some difficulty in manufacturing these plates.

Discontinued plates:
The following plates have been discontinued recently:

KODAK Holographic Plate, Types 120-01/02
KODAK Special Plate, Type 098-01/02/04
KODAK Special Plate, Type 156-01/02 (formerly IIa-D)
KODAK Spectroscopic Plate, Type IIa-D/F/O
KODAK Special Plate, Type 157-01/02
KODAK Spectroscopic Plates, Type 103a-O/F/G/D
KODAK Spectroscopic Plates, Type 649-O/F

Note: We will be discontinuing KODAK Spectroscopic Plates, Type IV-N in approximately one year.

I hope that this information has been useful to you. It is never an easy decision to discontinue products that loyal customers have used successfully for years, regardless of the situation behind those decisions. It is my sincere hope that we have arrived at the best decision possible. By discontinuing the plates listed above we have been able to continue manufacturing plate emulsions rather than exiting the plate business altogether. We hope that you will be able to extract meaningful science from the remaining plates.

G.P. BROWN
Eastman Kodak Company
343 State Street
Rochester
New York 14650

Letter to Eastman Kodak

Mr. Gordon Brown
Professional Imaging
U.S. Marketing Operations
Eastman Kodak Company
343 State Street
Rochester, NY 14650, U.S.A.

January 24, 1994

Dear Gordon,

Thank you for your letter of January 4, 1994, in reply to the Resolution about Kodak products which was passed by the participants of IAU Symposium 161 last year. Your comments provide a clear statement about Kodak's intentions in our field of science which, though sad, is very welcome.

The long history of association between your company and the astronomical community has clearly been most successful and mutually beneficial, and has ensured until recently ready availability of those special products that continue to be essential for wide-field astronomical work. Regrettably, however, this is obviously no longer the case and, as you realize, the present Resolution is a loud expression of the current, deep worries of our colleagues and ourselves.

The message of your letter is clear: we may count on having *IIIa-J and IIIa-F* emulsion on-glass available until further notice, but all other traditional 'astronomical' Kodak emulsions already have been or will soon be discontinued. We will have the red-sensitive *Kodak Tech-Pan* on-glass and on-film and provided the announced 'low-level' experiments are successful, we may also get a blue-sensitive *Tech-Pan* emulsion on-glass.

The most regrettable loss to astronomers is undoubtedly the future lack of any Kodak materials for the 'V-' and 'I-' bands, which means abandoning wide-field work in these two, astrophysically important wavebands, originally provided by the 'D' and 'N' sensitized materials.

Various long-term projects are now being prematurely discontinued because of this. Moreover, some astronomers, especially the astrometrists, are deploring the lack of II-a type emulsions which were particularly useful for their type of work.

It may be a small consolation that un-hypered IV-N lasts some years at low temperature and that the major users of this emulsion may be able to stock enough plates to complete the current northern and southern sky surveys before this, too, is discontinued.

We know of other suppliers of photographic emulsions which have expressed interest in developing and marketing some of these emulsions, but this may take some time to become effective. However, in view of the importance to astronomy, we are presently exploring these avenues on behalf of the world-wide community of photographic astronomers.

We look forward to testing any new Kodak products that appear, and ask if Ms. Barbara Seils is the person with whom we should continue this dialogue, or if you personally will continue to address technical queries from astronomers.

In this connection, we should like to inform you that Dave Malin will be in the U.S.A. in June 1994 and would welcome a meeting with interested parties at Kodak in Rochester, if that would be useful.

With kind regards,

DAVID MALIN
Section Leader (Photography)

RICHARD M. WEST
Chairman

IAU Working Group on Wide-field Imaging

Reply from the German Federal Ministry — the Sonneberg Observatory (Translated from German)

Dr. Richard M. West
Chairman of the IAU Working Group on Wide-field Imaging
European Southern Observatory
Karl-Schwarzschild-Str. 2
85748 Garching bei München

2.11.1993

Ref: Sonneberg Observatory

Dear Dr. West,

The Minister for Research and Technology has asked me to thank you for your letter of 22nd October 1993.

Based on the results of a survey carried out by the Scientific Council in 1994, Sonneberg Observatory was not connected to the (meanwhile newly established) Astrophysical Institute Potsdam. The Observatory became a division of the restructured State Observatory of Thuringia in Tautenburg. Consequently, all requests and suggestions regarding the Sonneberg Observatory must be addressed to the Government of Thuringia. The Federal Ministry for Research and Technology is not in a position to discuss possible ways for continuation of the research work at Sonneberg after the planned closing of this institute at the end of 1994.

Any decision in favour of scientific activities after 1994, can only be made by the country of Thuringia. I therefore propose that the IAU Resolution regarding the astronomical plate collection in Sonneberg be presented to the authorities in Thuringia.

With kind regards,

Dr. BLASK
Bundesministerium für Forschung und Technologie
53170 Bonn

Reply from Bavaria — the Sonneberg Observatory (Translated from German)

Dr. Richard M. West
Chairman of the IAU Working Group on Wide-field Imaging
European Southern Observatory
Karl-Schwarzschild-Str. 2
85748 Garching bei München

3rd November 1993

Dear Dr. West,

Prime Minister Dr. Edmund Stoiber has requested me to acknowledge with thanks receipt of your letter dated 22 October 1993 regarding the continuation of astronomy at Sonneberg Observatory.

With its systematic sky surveys and the resulting second largest collection of photographic plates in the world, the Sonneberg Observatory has gained undisputed international importance. For this reason, the former Bavarian Prime Minister, Dr. h.c. Max Streibl, was in favour of supporting Sonneberg financially in order to ensure continued scientific research there. However, the Scientific Council† has concluded that it would not be scientifically feasible to maintain the Observatory, and the Thuringian Minister of Science, Dr. Fickel, has expressed his intention to follow the vote of the Council.

Thuringia, being fully aware of the local historical significance of this institution, is planning to utilize it as a public observatory with facilities for teachers' and students' seminars as well as for educational tourism. In this case the photographic plate collection will have to be transferred to another location, thus depriving Sonneberg Observatory of a basis for scientific research.

In view of this decision by the Thuringian Government, financial support from Bavaria to maintain research work in Sonneberg must now be considered impossible, also in collaboration [with Thuringia; RW].

Prime Minister Dr. Stoiber sincerely regrets that this important research facility cannot be continued within the original concepts of its founder, Cuno Hoffmeister. He is, however, also sympathetic to the efforts of the Government of Thuringia to find a financially reasonable solution, following the negative vote of the Scientific Council.

With kind regards,

H. HUBER, MdL
Staatssekretär
Leiter der Bayerischen Staatskanzlei
Franz-Joseph-Strauss-Ring 1
80539 München

† The 'Wissenschaftsrat', a committee of eminent German Scientists which was set up by the German Government immediately after the reunification in 1990 in order to evaluate all scientific institutes on the territory of the former German Democratic Republic. [RW]

Report on IAU Symposium 161
to IAU General Secretary
IAU Secretariat

'Wide-field Imaging in Astronomy'

August 23-27, 1993

Astrophysikalisches Institut Potsdam, Brandenburg, Germany

IAU Symposium 161 was sponsored by IAU Commissions 5, 9, 24, 27, 28 and 33. Additional sponsorship was provided by Ministerium für Wissenschaft, Forschung und Kultur des Landes Brandenburg, Deutsche Forschungsgemeinschaft, Astrophysikalisches Institut Potsdam, International Science Foundation, CONVEX Computer GmbH, ORWO Filmfabrik Wolfen AG, and VIP Verkehrsbetrieb Potsdam.

The Meeting was held at the Residence Hotel in Potsdam, Land of Brandenburg, Germany. The Scientific Organising Committee was chaired by R.M. West, and the Local Organising Committee by H. Lorenz. The Meeting attracted about 200 participants from 29 countries and was opened by the Minister for Science, Research and Culture of the Land of Brandenburg, Mr. H. Enderlein, who held the official patronage. A total of 68 reviews and contributed papers were presented and approximately 120 poster papers were displayed during the entire Meeting.

This Meeting, which was organised by the IAU Working Group on Wide-field Imaging (established in 1991 under Commission 9) was the first of its kind ever held and successfully brought together the many diverse areas of technology and science within current wide-field research. The sessions were organised in a logical way, beginning with comprehensive overviews of work in the optical, infrared and X-ray regions, followed by thorough discussions of wide-field detector techniques (photography and CCD mosaics), cataloguing, classification, calibration, archiving and retrieval of the very large data sets that result. During the second half of the meeting, scientific results from solar system surveys, investigations of the structure of the Galaxy, the Magellanic Clouds, local group dwarf galaxies, low surface brightness galaxies and nearby galaxies were presented. Finally, reviews were given of the present status of the mapping of large-scale structure in the Universe, including red-shift surveys, clustering of galaxies and the properties and clustering of objects at very large red-shifts. The enormous amount and great width of information presented was most ably summarized by V. Trimble.

The Symposium participants passed two resolutions about:

1) photographic plate supplies to astronomers, now in danger because of the recent decision by Kodak to discontinue the production of certain emulsions; and
2) the future of Sonneberg Observatory, until now very active in wide-field work, but now in danger of being closed. The text of these resolutions will be found on pages 10 and 11 of this Newsletter.

The social programme organised by the LOC included a beautiful boat trip on the lakes and rivers around Potsdam, a delightful barbecue party in the grounds of the Babelsberg Observatory, and an exciting, richly illustrated, public talk by D. Malin.

The proceedings will be edited by members of the SOC (Chief Editor H.T. MacGillivray) and published by Kluwer Academic Publishers.

R.M. WEST
European Southern Observatory, Karl-Schwarzschild-Str. 2, W-8046 Garching, Germany.

IAU WORKING GROUP ON WIDE-FIELD IMAGING

Report to Commission 9 (1993)

The IAU Working Group on Wide-field Imaging (WG WFI) was established at the 1991 General Assembly in Buenos Aires. It is the successor to the WG on Astronomical Photography, but covers more areas, including *Sky Surveys and Patrols, Wide-field Detectors* (e.g. *Photographic Techniques and CCD Mosaics*), *Digitisation Techniques, Archival and Retrieval of Wide-field Data*. By the end of June 1993, it had about 200 members and consultants. The Organising Committee (OC) consists of: J. Guibert (Paris, France), R.M. Humphreys (Minneapolis, U.S.A.), K. Ishida (Tokyo, Japan), R. Kron (Chicago, U.S.A.), B.M. Lasker (Baltimore, U.S.A.), H. Lorenz (Potsdam, Germany), H.T. MacGillivray (Edinburgh, U.K.: Secretary), D. Malin (Epping, Australia), N. Reid (Pasadena, U.S.A.), M. Tsvetkov (Sofia, Bulgaria), and R.M. West (Garching, Germany: Chairman). The WG WFI issues a semi-annual Newsletter (Editor: H.T. MacGillivray).

Wide-field Imaging is characterised by the rapid and efficient acquisition of very large data sets. This leads to considerable handling problems, concerning both the initial extraction of relevant information for scientific interpretation, as well as the time-robust data storage and easy retrieval at a later date. It is a major goal of the WG to bring together all available expertise on the related, rapidly progressing technology (e.g. panoramic detectors and storage media) and those major research projects which are dependent on large-scale observations (e.g. cataloguing and structural studies). The WG is particularly concerned with:

1) *integration* of techniques and science;
2) *coordination* (e.g. of the photography and CCD groups);
3) *standardisation* (procedures, formats, etc.); and
4) *dissemination and sharing of information* to the larger community.

The WG activities have included the organisation of IAU Symposium 161 on 'Astronomy from Wide-field Imaging' (Potsdam, Germany; 23-27 August 1993) with about 200 participants. A major WG project (WFPA) is the registration in a computer-readable form of the plate-catalogue data for all photographic plates extant in observatory archives all over the world (in charge: M. Tsvetkov); about $3{\cdot}10^5$, out of an estimated $\sim 2{\cdot}10^6$ plates in storage, are now on-file. The possibility of large-scale digitisation of (a subset of) these plates is being studied.

The recent decision by KODAK to discontinue the production of several important astronomical emulsions, notably IIa and 103a, has led to severe problems for various current large-scale projects. The WG now attempts to ensure the continued availability of at least the IIIa and IV-N emulsions, and also to further the development of a blue-sensitive Tech-Pan film, similar to the 4415 red-sensitive emulsion, which has recently been shown to reach DQE ~ 10%. It is expected, however, that for most astronomical uses, large CCD mosaics (up to 20-30 2000 x 2000 pix now planned) will replace the photographic emulsion within the next decade. The construction of a new generation of wide-field CCD-mosaic telescopes (e.g. Sloan, LITE and others) implies that much improved observational capabilities in terms of limiting magnitude and hence depth over a large field will soon become available. This will also provide important support for the work with the future 8-metre class telescopes.

R.M. WEST
European Southern Observatory
Karl-Schwarzschild-Str. 2
W-8046 Garching
Germany

New Photographic Plates from ORWO

Two new types

The manufacturer of photographic glass plates, Filmfabrik Wolfen GmbH in Germany, introduce two new types into its running product range:

1) Orthochromatic Plate ZO

   Highest spectral sensitivity in the range 520-600 nm.
   High contrast (gamma 1.5).
   Base-plus-fog density max. 0.20.

2) Technical Pan Plate TP

   Fine grain.
   Extremely high contrast (gamma > 4).
   Base-plus-fog density max. 0.10.
   Sensitive up to 680 nm.

The two new products can be ordered in all common sizes and thicknesses directly from the manufacturer.

Processing chemicals (like developer, stopp bath, fixer and wetting agents) can also be supplied.

If you would like to have more detailed information, please contact:

Filmfabrik Wolfen GmbH
Industriepark Wolfen/Thalhelm
P.O.B. 12 59
D-06755 Wolfen
Germany

Phone: +49-34 94-63 62 84 (Mr. Klaus Schnelle)
Fax: +49-34 94-63 66 83

Automatic Star Image Identification on Astrographic Plates

1. Introduction

Our group at Valencia Observatory is working actively on the development of algorithms for the automatic measurement of astrographic plates. This project is carried out in close collaboration with Pulkovo Observatory, who help us in hardware and software improvement.

This work has a great interest for the preliminary analysis and the automatic measurement of crowded star fields, the search for asteroids, comets and supernovae, high proper motion determination and other similar topics.

2. Plate Measurement Process

Our instruments and working programs have been described elsewhere (Lopez 1991). The algorithms are applied in the central window of the CCD camera field of our measuring machine, whose images are digitized to 512 by 512 pixels and analyzed by a PC computer.

The plate holder of the measuring device is moved in X, Y directions by stepping motors under computer control and plate fields of several mm wide with a resolution of a few microns per pixel can be analyzed in real time (Lopez 1993).

The scale and tilt of the pixel array x, y versus stage coordinates can be determined using one selected image. A central square region (working window) is defined and the whole process is applied in it (Ortiz 1993).

Several parameters can be modified during the automatic measurement process, thus allowing the handling of different measuring conditions.

3. New Algorithm Steps

We present some new results on the process of automatic detection of objects on crowded field plates. Many automatic classification algorithms for cluster analysis can be found in bibliography (Murtagh 1987) and our method is an original and efficient one, based on hierarchical considerations.

Our stellar images have a circular pattern, corresponding to sidereal tracking. Other objects (asteroids, comets, galaxies) can present a peculiar aspect and will be analyzed by special routines.

Our algorithm, as described in Lopez (1994), has been partially modified. The actual version can be summarized in the following steps:

a) The ACTIVE SQUARES definition:
   1) the signal to noise ratio is estimated in each window and the local ground signal and threshold are obtained;
   2) a small squares mosaic is defined and those ones with signal above threshold (active squares) are selected.
      The size of the squares is smaller than star images and it can be modified if necessary. The intensity in each square is sampled in a few pixels in order to save computing time;
   3) selected squares are ordered by total intensity and several auxiliary intensity and position vectors and a matrix are defined for quicker manipulation.

b) The ACTIVE ZONES definition:

Active zones are plate regions with isolated stellar images or star groups that cannot be solved automatically. Its analysis includes the steps:

4) the maximum active square in the window (active centre) is selected;
5) the image limits in sixteen symmetrical directions around the active centre are searched for. This defines a compact polygonal area filled with active squares (active zone);
6) the active squares inside the active zone are annulled one by one;
7) steps 4 to 6 are repeated until no more active squares remain in the window.

c) The IMAGE IDENTIFICATION and SEARCHING process is applied in each ACTIVE ZONE:

1) a centring process is applied to the maximum signal and the image is checked. The first image of each active zone is considered the main image. Marginal active zones are eliminated;
2) the maximum and mean image radius are determined;
3) the image profile in the mean radius direction is obtained. It is assumed that this image profile is free from the influence of other images. If the image is partially saturated, the central radius is obtained;
4) a gaussian model (Lindegren 1978) is fitted to this profile and the mean value of the sigma is obtained. If the profile is very noisy, an iterative smoothing process is applied first;
5) the image is eliminated up to its radius, subtracting to the pixels value the gaussian model. In case of saturation a central disk with ground signal is drawn.
   If the image profile is not gaussian-like, a ground signal disk is applied over the whole image;
6) a new maximum intensity pixel is sought in the active area around the main image. It is done in the 16 radial directions inside the polygonal region of the active zone.
   If a new maximum is obtained and accepted by intensity and distance to main image criteria, steps 1 to 6 are repeated. Otherwise, the process begins with a new active zone or continues to the next steps.

d) An IMAGE SELECTION process is done for each individual image:

1) the image contrast and shape are determined;
2) an image relative distances control is applied.
   Images are finally selected by their radius, contrast, shape of distances.

e) The IMAGE POSITION is obtained from the centre of its marginal distribution in X and Y directions inside the image radius. A double process is applied in order to estimate the position error.

4. Observations and Results

For the completion of our algorithm we simulated several artificial star fields, with gaussian profiles. A maximum 255 intensity value is used and different ground level and random noise were added.

We present our results obtained with several stars of different central intensity (I) and size (sigma value, S). Rather high values of ground level (30) and random noise (25) are considered.

I1 = 250	S1 = 10	I4 = 225	S4 = 6
I2 = 210	S2 = 6	I5 = 195	S5 = 4
I3 = 135	S3 = 4	I6 = 230	S6 = 8

The results of the algorithm steps are shown and explained in Figs. 1 to 9.

The algorithm has been tested also with real plate fields, stored in the same computer format, with similar results.

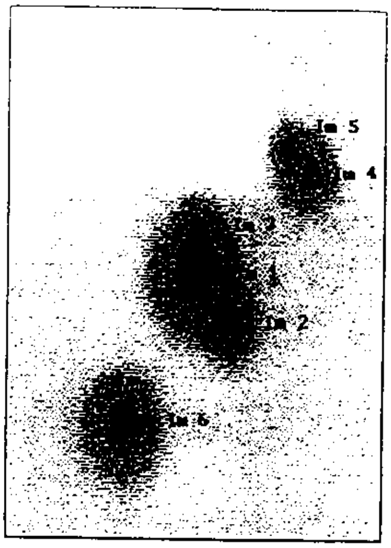

FIGURE 1. Gauss ian like images used in this study.

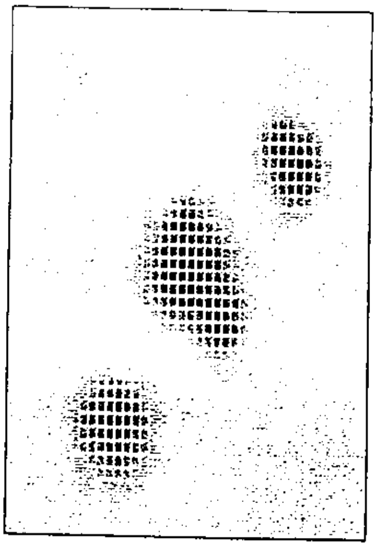

FIGURE 2. Active squares in image regions.

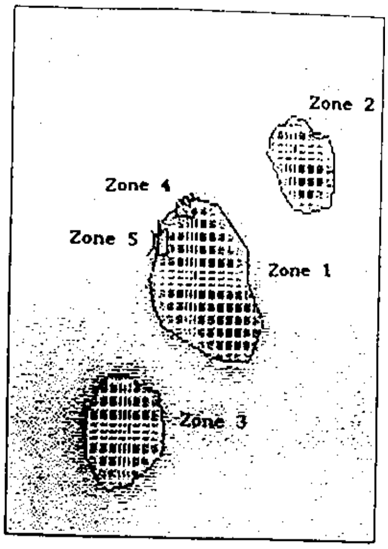

FIGURE 3. Active zones around local maxima.

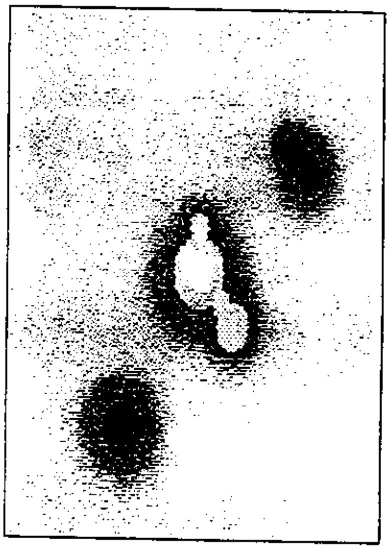

FIGURE 4. Image identification in zone 1.

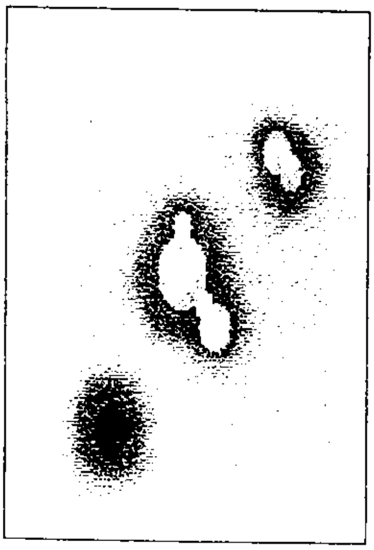

FIGURE 5. The same process for the second active zone.

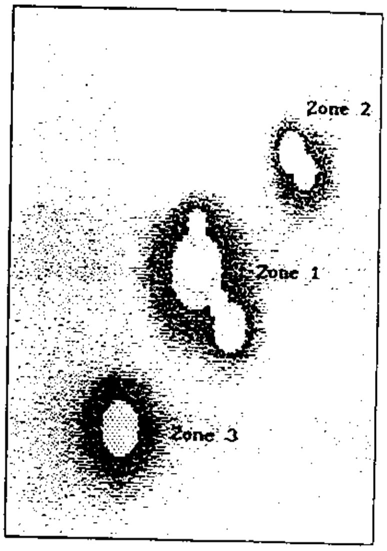

FIGURE 6. Final result of identification process.

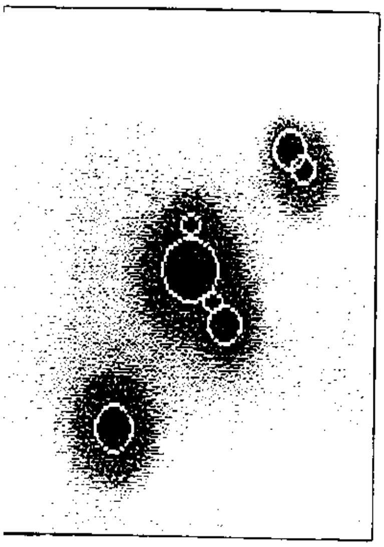

FIGURE 7. Images detected in the identification process.

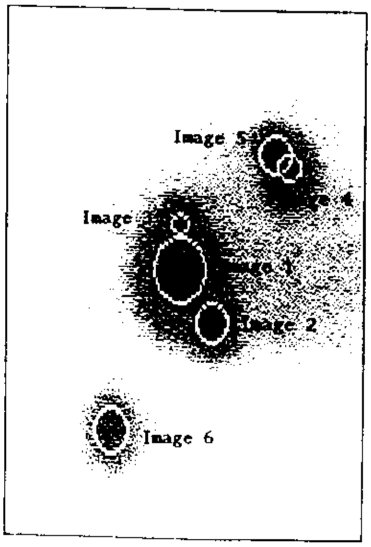

FIGURE 8. Final selected images.

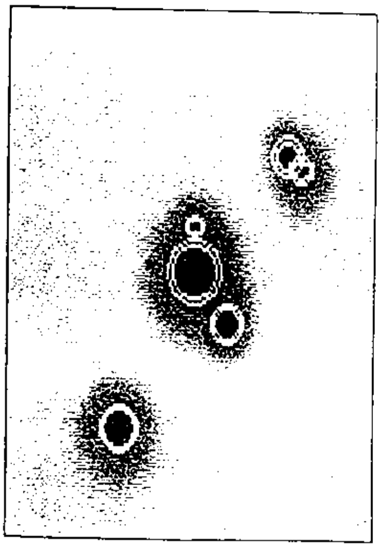

FIGURE 9. Stars positions got by marginal distributions.

5. Conclusions

We describe some improvements of our computer software for the automatic analysis and measurement of astrographic plates.

Our algorithm is implemented in the spatial domain. Other special routines (filters, masks and histogram modification in space domain, FT and filters in frequency domain) will be added if necessary.

This algorithm can be applied to many different situations with little change and will be implemented in the software of the measuring machines at Valencia and Pulkovo Observatories.

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A. LOPEZ GARCIA[1], A. ORTIZ GIL[1], J.M. MARTINEZ GONZALEZ[1] and E. POLIAKOV[2]

[1] Astronomical Observatory, Department of Applied Mathematics and Astronomy, University of Valencia, Spain.

[2] Pulkovo Observatory, 196140 St. Petersburg, Russia.

Systematic Astrometric Errors on Schmidt Plates

1. Background

With the advent of highly accurate multifibre spectrographs covering between one to two degrees of sky and with fibre diameters down to 1.5 arcsec in size, the accuracy of positions from the input object catalogue is becoming a significant limiting factor in fibre throughput (e.g. Cannon 1993). Most input catalogues for fibre based observations are derived from measures of wide field Schmidt survey plates. With the imminent arrival of a one degree fibre field on the William Herschel Telescope (WHT) and a two degree fibre field on the Anglo-Australian Telescope (AAT) it is clear that it will not necessarily be the random measuring/recording error (0.1-0.2 arcsec on a modern emulsion) that limits the coordinate accuracy of the catalogue but perhaps more subtle non-linear systematic errors over the 10 cm or so of plate covered by the fibres. These might either be intrinsic to the telescope/plateholder/filter combination or introduced during the measuring/reduction stage.

To get the most out of the fibres the catalogue coordinates should ideally be accurate to better than 0.25 arcsec over the whole field. Naturally, even with accurate coordinates at the plate epoch it is still possible to go wrong, if, for example, the chosen guide stars have a non-negligible proper motion over the years between the plate being taken and the observations being made. However, let us concentrate only on systematic plate errors and in particular on those that are repeatable from one plate in a series to another, since in principle these should both be measurable and also removable.

The standard procedure for astrometrically calibrating Schmidt plates consists of two stages. First the astrometric standard stars from a suitable astrometric catalogue, for example PPM (Röser & Bastien 1988), are located on the plate and accurate x,y plate coordinates derived. Second a least-squares solution, with suitable iterations to reject outliers, is made between projected standard coordinates ξ, η relative to the plate centre for the astrometric standards and their measured plate x,y positions. It is also usual to fold into the least-squares solution a Schmidt radial correction term of the form tan(r)/r, where r is the distance from the plate centre in radians. This term is purely due to the optical geometry of a Schmidt telescope and as such is a fixed known quantity. The least-squares solution usually takes either a linear 6 plate constant form or sometimes a more general quadratic 12 plate constant model is used. Further refinements of this technique due to Taff and co-workers (1992) involve partitioning the plate into various virtual sub-plates and solving separately for each sub-plate in order to try and reduce systematic errors left over from the global plate solutions. (It is worth noting, however, that this latter procedure if not carefully controlled could introduce as much error across sub-plate boundaries as it was designed to take out.)

That there are significant systematic repeatable astrometric errors left over from global plate modelling, in at least some series of Schmidt plates, is clear from Fig. 1 of Taff et al. (1992). However, now that we have available on-line APM catalogues of large numbers of both POSS I O and E plates, UKST J and R survey plates and first tranche of POSS II J plates, it is convenient and timely to extend Taff's work to other plate series and see what the problems are.

2. Constructing Error Maps

If we assume the systematic errors are constant for a particular plateholder/filter/telescope configuration then we can effectively co-add many plates to beat down the random contribution and reveal the constant systematic component.

The method is simple. Start with a convenient astrometric catalogue; the PPM catalogue is ideal since it has between 200-300 stars per plate with positions accurate to 0.3 arcsec. Locate all the PPM stars on each plate. For each field a simple 6 plate constant linear model is computed using the standard Schmidt geometry radial correction term. This is the normal APM astrometric fit and basically takes out global scale errors, rotation and position of centre. This leaves any non-linear pattern intact. Furthermore, since there are typically 200 or so PPM stars per field and we are only fitting 6 constants, the deviations from fit are a genuine combination of random PPM catalogue errors (0.3 arcsec rms) + measuring errors (up to 0.3 arcsec rms for the brightest heavily saturated stars) + systematic errors on the plate.

In order to reveal repeatable systematic errors to an accuracy of 0.1 arcsec, with a spatial resolution of one to a few cm, it is necessary to stack around 100 or more plates to beat down the random errors enough to see the effect. After stacking, the residuals in PPM -v- fitted plate coordinates for each field are binned into 1 cm x 1 cm regions of plate, giving an average of 15 or more PPM stars per bin. Individual star residual errors are typically 0.5 arcsec. After averaging the residuals in each bin, 3 x 3 bilinear median and boxcar filters were used to lightly smooth the raw version thus ensuring that the final binned errors were less than 0.1 arcsec.

Figure 1 illustrates the end product of this process, a vector residual map of PPM stars for an 'averaged' UKST second epoch R survey plate. The map was constructed using 15000+ PPM stars taken from 120 UKST fields in the equatorial region. The plot essentially represents a picture of the 'average' plate taken from APM 5.8° x 5.8° scans with N at the top and E to the left. Bin coordinates are in cm from the plate centre. The SE corner has a few points missing due to the 16 level density wedge prominent on UKST plates. The residuals are scaled such that a 1 arcsec vector residual corresponds to 1 cm on the plate. It is immediately apparent that most of the systematic residuals are less than a few tenths of an arcsec in size and that the only seriously distorted region is at the S within 1 degree of the plate edge. Even here the largest residual is 'only' 1 arcsec. Further investigation is needed to decide on the cause of these systematic patterns but favoured candidates would be plateholders and/or filters.

We can easily rule out the filter causing the effect by constructing a similar diagram from the UKST J survey plates. This is shown in Fig. 2 and essentially shows identical systematic errors to those in Fig. 1, proving that it is not the filter causing the problem. It is worth noting too that the R plates measured were originals whilst the J plates were glass copies of originals, highlighting the fact that careful copying does not degrade the overall astrometry either.

Before further speculation as to other possible causes let us look at the Northern sky catalogue data. Figure 3 is a residual plot derived from APM 6.2° x 6.2° measures of POSS I E glass copies of the Northern sky survey. This plot was derived from 400 plates using some 75,000+ PPM stars (splitting the dataset into 3 groups sorted by various criteria also reveals exactly the same pattern). There is clearly a much more significant systematic component of typical size 0.5 to 1 arcsec, with significant variations over regions a few cm in size. The mainly radial/square symmetry of the pattern strongly suggests that this is likely to be a function of the telescope/plate holder. This global pattern of systematic errors is very similar (bar sign) to that shown by Taff et al. (1992) in the DOSS II workshop (Fig. 1). Since Taff's data were taken from the quick V survey also done on the Palomar Schmidt in the 1980s this also points to a telescope/plate holder problem.

3. A Possible Cause

I am grateful to Neill Reid for pointing out that both the POSS I and quick V survey were carried out using the same design of plate holder and that before commencing POSS II the plateholder assembly was redesigned. He suggested that this might be the cause of the systematic errors.

The original Palomar plateholder system was a straightforward mechanical design with the plate directly clamped into the mandrels. This should be contrasted with the UKST J and R surveys which both made use of a vacuum clamp system. As part of the upgrades prior to starting the POSS II survey a vacuum clamp system was installed in several iterations starting May 1987. Initially this started out as a four hole system but later grooves were added connecting the holes to give better clamping over the whole plate. Moreover, the mandrels had originally been ground to the wrong

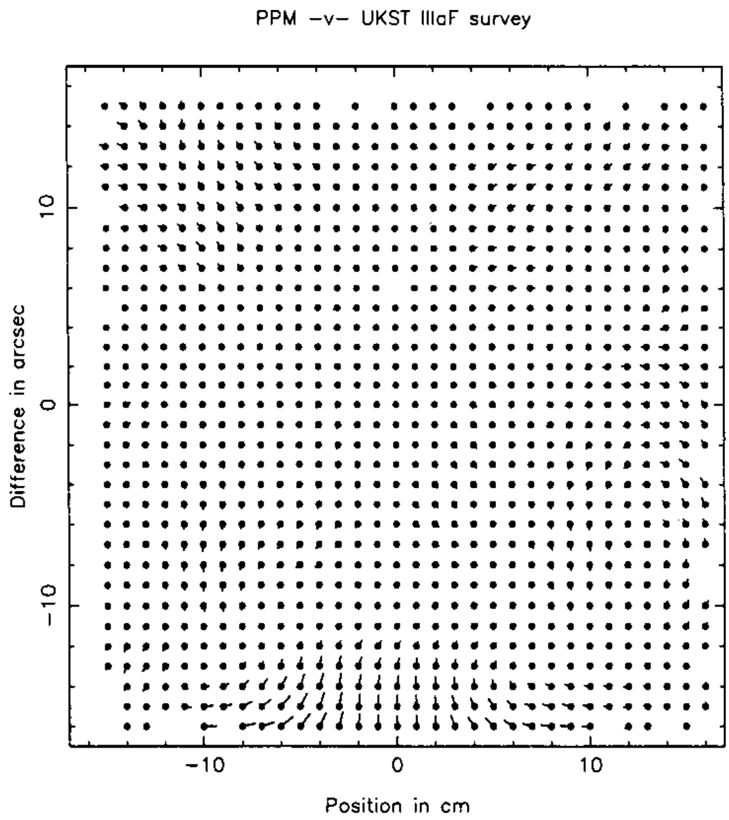

Figure 1. A vector residual map of PPM stars for an 'averaged' UKST second epoch R survey plate with N at the top and E to the left. Bin coordinates are in cm from the plate centre. The SE corner has a few points missing due to the 16 level density wedge prominent on UKST plates. The residuals are scaled such that a 1 arcsec vector residual corresponds to 1 cm on the plate (see text for more details).

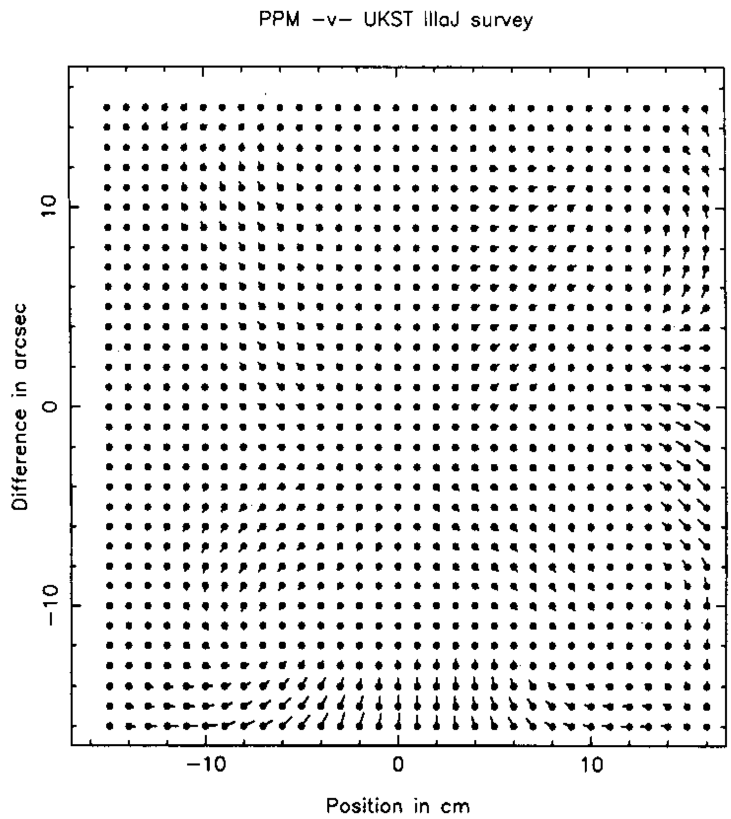

Figure 2. A vector residual map for an 'averaged' UKST J survey glass copy plate.

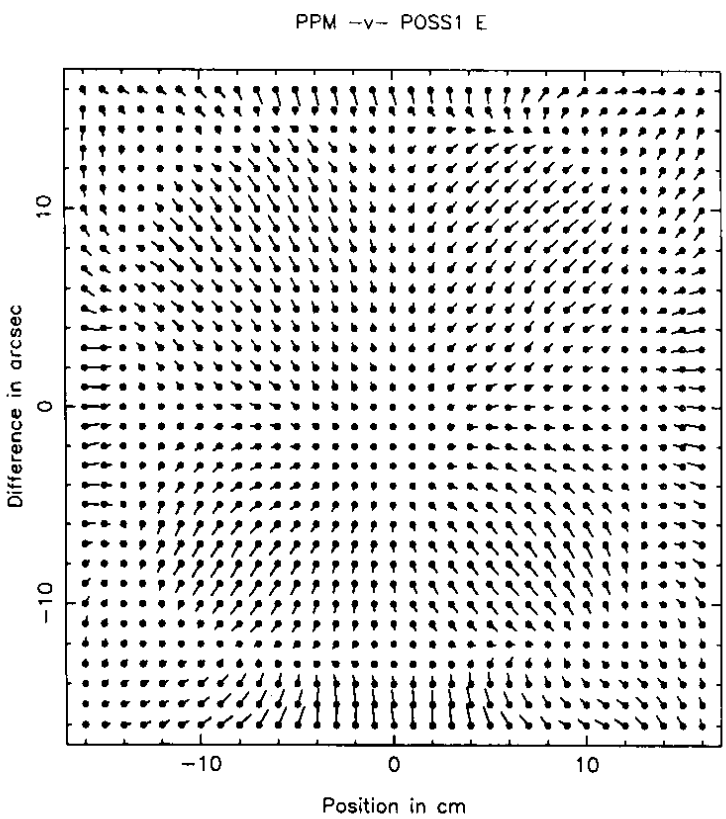

Figure 3. A vector residual map for an 'averaged' POSS I E survey glass copy plate.

radius of curvature — presumably to compensate for bulging air pockets in a mechanically clamped plate assembly. These were reground during early 1989. Since then the plateholder system has remained stable.

It is relatively straightforward to calculate the expected astrometric distortion for an incorrectly clamped plate. Altering the radius of curvature of the mandrels from 120.1 inches to 120.9 inches has a negligible effect on the derived astrometry if the plate surface is everywhere smoothly matched to the mandrels. However, if for example a plate contours the surface in some parts but clears it by, say, 1 mm in other parts with typical scale length 10 cm, then differential non-linear systematic astrometric errors of order ±0.5 arcsec will result. It seems quite plausible that this was the cause of the problem on the E, O and quick V plate series. The plates were clamped such that their focal surface reflected the symmetry of the clamps rather than the mandrel surface and this is reflected in the symmetry of the systematic errors.

With the recent changes in plateholder design we would predict that the POSS II survey plates should not show the same systematic error pattern and should have a much smaller residual error.

Although we currently have only scanned around 50 plates from the POSS II J survey it is sufficient to see that the systematic error pattern of Fig. 3, typical of pre-POSS II Palomar plates, has now almost vanished. Figure 4 shows a preliminary vector residual map for the POSS II J plates. At the moment we do not have enough plates scanned to know if the systematic errors have been completely eliminated but it is already clear that the modifications to the plate holder assembly seem to have both identified and significantly reduced the problem. Note also that some of the plates used in the series were taken whilst the plateholder modifications were still ongoing. Unfortunately we do not yet have enough plates measured that were taken after the final modification date to unambiguously say whether the systematics have completely vanished.

Given that plateholder problems seem to be a good candidate for the systematic astrometric errors, it is worth considering the possibility that the systematic errors seen at the centre of the Southern edge

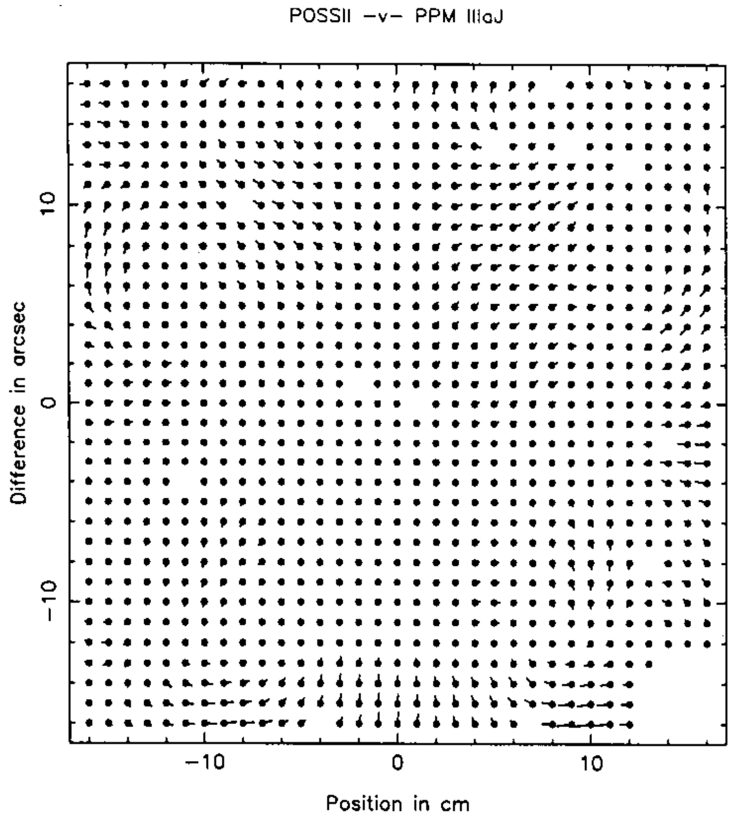

Figure 4. A preliminary residual map for an 'averaged' POSS II J survey glass copy plate (some plate holder modifications were still being made in the series coadded to form this map).

of UKST plates are caused by the plate surface not being correctly vacuum clamped onto the desired focal shape near this region.

4. Correcting for the Repeatable Systematic Errors

Since the shape of the repeatable systematic errors has a rather complex non-linear structure the most straightforward method to remove the effect is simply to subtract/add the appropriate correction derived directly from the table of errors making up the smooth vector residual plots. Bilinear interpolation from the table suffices to estimate the error correction at any desired plate coordinate. After applying this correction to UKST plates the residual between PPM positions and derived positions drops from 0.50 arcsec to 0.43 arcsec for a global linear 6 plate constant model; whilst POSS I plates show a significant improvement with the residuals falling from 0.79 arcsec to 0.59 arcsec. In all cases the residual error was calculated by fitting a Gaussian independently to the x and y error distributions and taking the average Gaussian sigma as the measure.

Considering that the PPM catalogue errors are of order 0.3 arcsec and the photographic errors can be at least as large for heavily saturated stars this suggests that any remaining systematic component in the global plate solution is now well below 0.5 arcsec. However, without independent external coordinates, such as VLA radio positions for faint sources accurate to 0.1 arcsec or better, it is difficult to know if the 0.25 arcsec level has been achieved. Work to do this external check for the Northern sky is in progress. In the south we already know from matching UKST plates taken on the same field that differential systematic effects between plates are generally small, and certainly less than 0.25 arcsec, over the central 5° x 5° field.

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M. IRWIN
Royal Greenwich Observatory
Madingley Road
Cambridge
U.K.

Wide-Field CCD-Imager on the Burrell Schmidt Telescope at Kitt Peak

Kitt Peak National Observatory has had a CCD-imager on the 0.6 m Burrell Schmidt Telescope of Case Western University since 1989. This telescope is located on Kitt Peak and half of its observing time is allocated by the Kitt Peak Time Assignment Committee in the same way as for other Kitt Peak telescopes. The deadlines for proposals on the standard forms are March 31 and September 30.

Currently the imager has a thick STIS/Tektronix 2048 x 2048 CCD with 21 micron pixels. The CCD has been coated with Metachrome II to extend its blue sensitivity. The scale is 2.0 arcsec per pixel. A wide variety of broad and narrow-band 2 x 2 inch filters are currently available which with the present shutter assembly give an unvignetted field that is 63 arcmin in diameter. We will very soon be installing a new 4 x 4 inch filter wheel and shutter assembly which will increase the size of the unvignetted field.

Data is acquired using a Sun SparcStation and Kitt Peak's ICE CCD acquisition software. The focus is motor controlled and an automatic guiding system is available on an auxiliary refractor. The system has primarily been used for direct imaging but some work using objective prisms has also been done. Please get in touch with either of the undersigned for further information or telescope or instrument manuals.

T. ARMANDROFF and T.D. KINMAN
Kitt Peak National Observatory
P.O. Box 26732
Tucson, AZ 85726-6732
U.S.A.

Adaptation of CCD Cameras to Schmidt Telescopes

ABSTRACT. An optical design concept for the adaptation of a CCD system to a Schmidt telescope is studied. Considerations on the use of filters and the wish to achieve a modular design led to the principle of a focal reducing optics as an optical standard interface. A cheap realization at the 35 cm Schmidt telescope of Hoher List will be introduced.

1. Introduction

The study of very extended H-II regions demands observations of wide fields at very low surface brightnesses. This is a task suitable for smaller telescopes on account of the availability of observing time. The theoretical limiting magnitude for extended deep-sky objects depends only on the relative aperture of the telescope optics

$$N = \frac{D}{f}, \tag{1}$$

where N is the relative aperture, D the aperture diameter, and f the focal length of the optics. Thus the Schmidt telescope is ideal for such purposes. Schmidt telescopes originally were developed for wide-field imaging using photographic plates. Their disadvantage is the field curvature, which plays an important role at large fields.

Today the CCD detector is the preferred imaging system with a very linear response and a high quantum efficiency. It also produces images in digital form. The easiest way to adapt a CCD system to a Schmidt telescope could be the exchange of the photographic plate holder by the CCD detector. But this would result in some disadvantages.

2. An Optical Standard Interface

Actually there exist two different principles of CCD devices: liquid gas cooled and Peltier cooled devices. Although the Peltier cooled devices can be minimized in their size, they still need additional cooling like ventilators. It is not very useful to install such a CCD device inside the tube of a small Schmidt telescope. We decided to use an available Newtonian secondary mirror for the adaptation of a CCD outside the tube of the Schmidt telescope. In this case, however, polarization observations are not possible.

Astrophysical investigations usually need wavelength separation for the physical study of the celestial objects. For the further design we have to think about the use of filters, prisms, and other additional optics with the Schmidt telescope. Filter plates or prisms in a convergent beam of an optical system always cause errors like spherical aberration or shift of the focal plane. However, the use of filters or prisms in the entrance pupil of an optical system avoids these problems. The principle of a focal reducing system enables the use of small filters. It projects the entrance pupil to a smaller real image — the exit pupil. This can be used as well as the entrance pupil (Geyer & Hoffmann 1993). Generally the effective focal length can be scaled by any factor. Thus we will call this the principle of an *optical standard interface* (OSI).

The first optical component of the OSI is the field lens collimator, which corresponds to the eyepiece in visual observations. The second component is the camera lens with the detector, according to the human eye. The advantage of the OSI is its modular design. As in visual observations the 'eye' can be exchanged. So it is very easy to use different camera lenses for various observation techniques.

CCD detectors are flat detectors. But the design of additional optics like the OSI permits the correction of the field curvature of the Schmidt system.

3. The 35 cm Schmidt at Hoher List

Today it seems to be old-fashioned to use a small Schmidt telescope for wide-field imaging. But, as we have seen, a telescope with a low relative aperture can be very powerful for investigations on very faint and extended objects.

The Schmidt telescope at Hoher List has an effective aperture of 350 mm, 500 mm mirror diameter, and a focal length of 1370 mm (relative aperture of about 1:4). As mentioned above, a secondary plane mirror is used to bring the prime focus outside the tube. The field collimator of the OSI consists of an achromatic lens with focal length of 80 mm having the same relative aperture as the telescope. A plano-convex field lens of 200 mm focal length close to the prime focus defines the exit pupil of the collimator at a distance of 50 mm behind the achromatic collimator lens. A simple achromatic lens identical to the collimator lens acts as camera lens (see Fig. 1). This yields a scale of 1:1. A filter box between the collimator and the camera lens allows the selection of different spectral bands.

We use a CCD detector with the new low dark current technology from Kodak. The detector size is about 7 x 5 mm^2 divided into 768 x 512 pixel. The squared pixels are 9µm in size. The total field of view gives 17.6′ x 11.7′ at a resolution of 1.3″/pix. As a number cruncher for the image processing an ATARI TT030 computer with 12MB RAM and 240MB harddisk storage capacity is used.

The current optical design is not yet perfect. We have an additional field curvature, coma and also astigmatism. The field curvature (defocus) and coma can be recognized because it spreads beyond the unusual small pixel size of the new CCD detector. The astigmatism can be found only in the calculated spot diagrams of the optics. But it is possible to operate on imaging and also photometry with pixel binning. Optical calculations showed that a meniscus lens immediately behind the prime focus (instead of the plano-convex field lens) will be able to correct the additional field curvature and also residual coma and astigmatism. These and further improvements would enable the use of the larger Kodak CCDs with 1536 x 1024 pixel with this equipment.

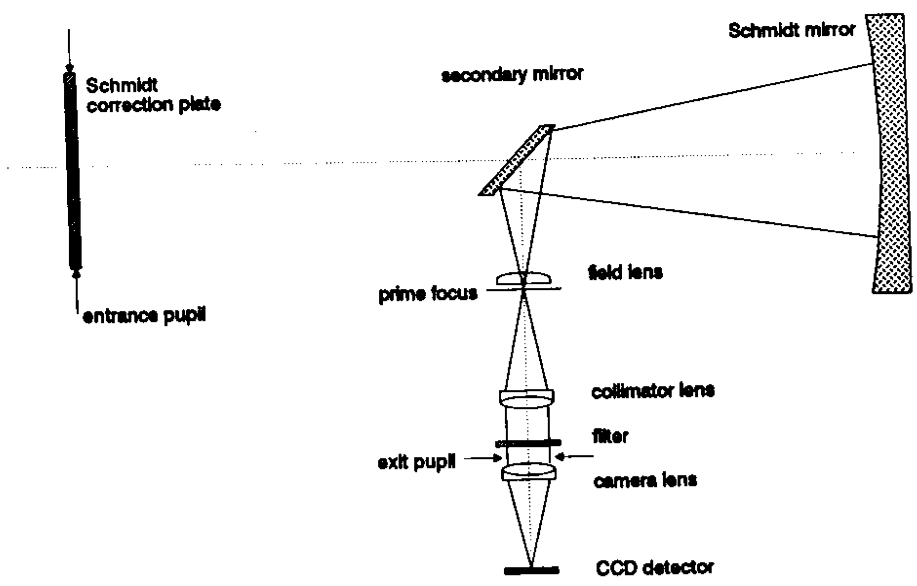

Figure 1. The principle of the Schmidt telescope with the optical standard interface.

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T. BAUER
Observatorium Hoher List der Universitätssternwarte Bonn
D-54550 Daun
Germany

The Hoher List CCD Focal Reducer System: a Versatile Instrument for Fieldspectroscopy and Direct Imaging

With the introduction of CCD detectors in the astronomical observing technique about 10 years ago, dioptric focal reducer systems (FRS) became essential equipment for direct imaging, polarimetry, Fabry-Perot-interferometry and field spectroscopy (also named 'multi-object spectroscopy' [MOS]) at the larger telescopes of many observatories. The reason is that the 'field efficiency'

$$2\theta = d/(N_{ef} \cdot A) = d/F_t \text{ [rad]}$$

(d = linear diameter of the detector, N_{ef}, A, F_t are the F-number, the aperture and focal length of the telescope, respectively) is very small for present day CCD sizes used in the direct focus of the telescope.

An 'afocal FRS' consists of a field lens collimator, similar to a Kellner ocular, and a camera lens, the entrance pupil of which has to be matched with the real exit pupil of the afocal telescope-collimator combination. The diameter of the exit pupil δ is given by

$$\delta = f_{coll}/N_{ef}$$

In an optically well designed FRS the collimator and camera should be de-coupled, so that camera optics of different f-ratio can be used. If the focal length of the camera lens is smaller than that of the collimator, a reduction of the telescope focal length by the factor

$$m = f_{coll}/f_{cam}$$

takes place. Therefore the field efficiency of the telescope is increased now by the factor m:

$$2\theta = d\ m/F_t$$

The advantages, principal techniques and possibilities of FRS have been shown and developed by us, about which we reported at several occasions already in the pre-CCD-times (Geyer 1979; Geyer 1981; Geyer, Hoffmann & Nelles 1979; Geyer & Nelles 1984).

The Hoher List Observatory Zeiss-FRS at the 1.06 m f/14.5 Cassegrain telescope has a field lens collimator of 720 mm focal length. The free distance between the telescope focus and the fieldlens system is 253 to 257 mm (longitudinal chromatic aberration!) and a relevant one of 150 mm between

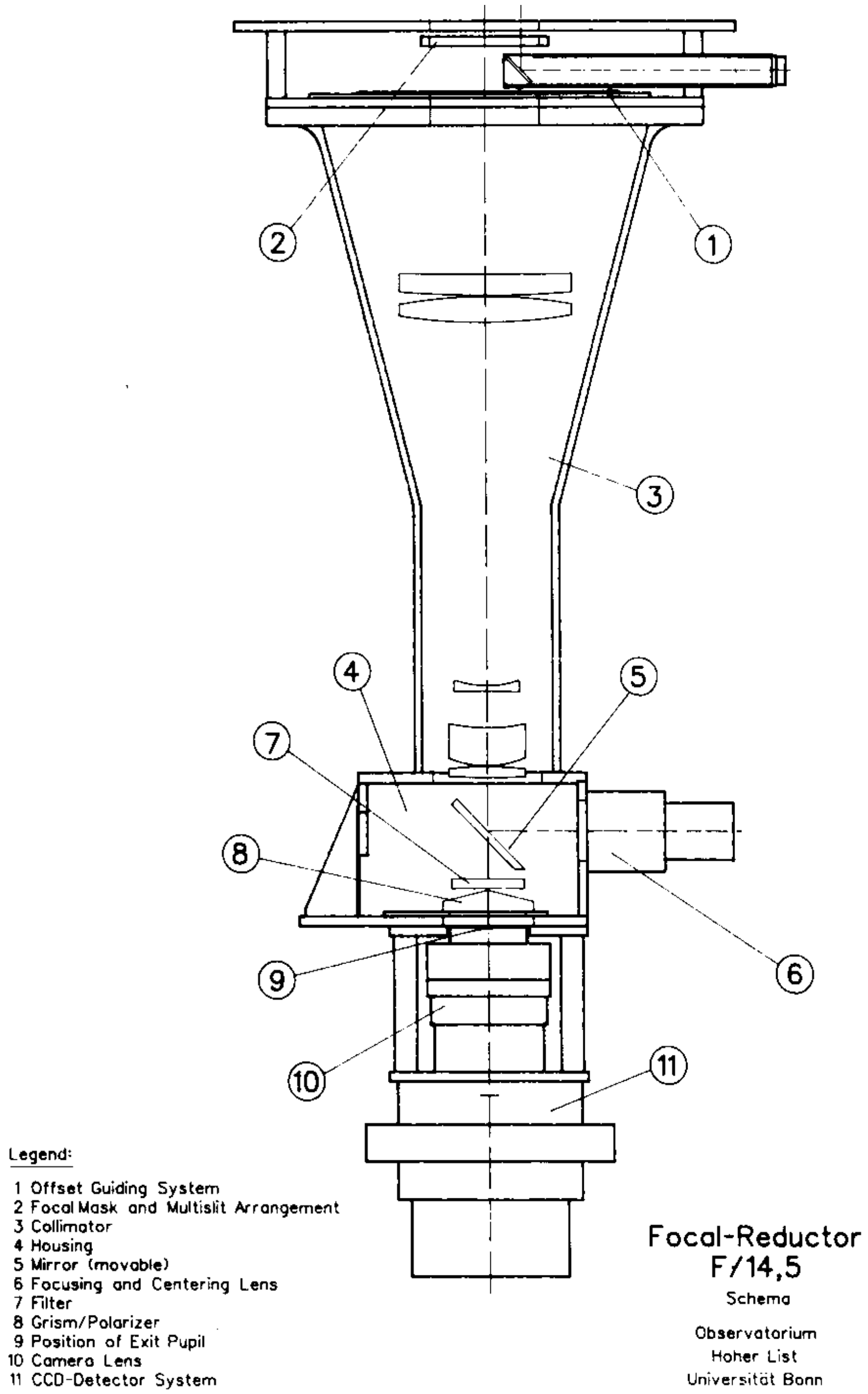

Figure 1. The schematically layout of the Hoher List Focal Reducer System.

the collimator lens and the exit pupil, which has a diameter of about 50 mm. The whole telescope field of 27 arcmin (given by the central hole at the primary mirror) yields a field angle of the parallel bundles of 5.6° in the exit pupil, which must be fully covered by the camera optics (Fig. 1).

For the past two years this FRS has been equipped with a CCD-detector system (CCDS) of the firm ASTROMED Ltd/Cambridge UK. The detector is a P8603 chip of EEV Ltd/England with 385 x 578 active pixels of 22 x 22 μm^2 size. It is thermo-electrically cooled with a 3-stage Peltier element in a high vacuum fully sealed dewar, allowing a minimum temperature of about 183° K at an ambient temperature of 283° K. Under these conditions the dark current is 8 e/pixel/hour with a readout noise of 6-8 e. This CCDS is under complete control of a 386 UNIX-RISC-PC.

The CCDS is optically coupled with the FRS-collimator via four camera lenses. Two of which are commercially available (Zeiss-Planar f=85 mm, f/1.5 and Zeiss Sonnar F=180 mm, f/2.8), having their entrance pupil within their lens system. They are quite well chromatically corrected in the wavelength range 480 nm - 660 nm. As their entrance pupil cannot be matched with the exit pupil of the FRS, field-silhouetting up to 30% (Planar) occurs.

The other two camera lenses are of special Zeiss design, having their entrance pupil 10 mm in front of their first lens. Thus they can be optimally matched with the FRS exit pupil. They are chromatically corrected for 365 nm - 436 nm (Z-B-lens), and 425 nm - 656 nm (Z-V-lens), respectively. These camera lenses are on loan from MPI-Aeronomie. The Table gives the optical data for the different FRS-CCDS combinations at the F/14.5-1.06 m Cassegrain telescope of the Hoher List Observatory. As with the reduction factor m also the chromatic aberration of the FRS-collimator is reduced, the camera lenses are optimally only usable within the limits of their best chromatic correction. This is essential for spectroscopy.

Table 1. Optical data of the F/14.5 HL-FRS

Cam. lens	f [mm]	F_{eff} [mm]	m	N_{eff}	PixRes. [arcs]	CCD-Field [arcmin]
Planar	85	1775	8.47	1.67	2.6	24.2 x 16.5
Sonnar	180	3750	4.00	3.53	1.2	12.5 x 7.8
Z-B-lens	140	2918	5.14	2.75	1.6	14.7 x 10.1
Z-V-lens	140	2918	5.14	2.75	1.6	14.7 x 10.1

Figure 2. A typical longslit spectrum of the Ring Nebulae M 57, showing its faint halo in the [OII]- and Hα-/[NII]-lines, and the night sky lines.

For direct imaging in the B-, G-, V-, R-colour system limiting magnitudes > 21 mag are reached within 5-10 min exposure time with the Sonnar- and Z-B/V- camera lenses. Very faint surface luminances are obtained (> 25 mag/arcs^2) with interference filters (5 - 10 nm HWFM) outside the night sky line wavelength regions.

For slit spectroscopy we use a longslit of 13.2 arcmin length and 3 arcs width as well as masking slits of 1 to 3 mm width for slitless spectroscopy. These slit arrangements are moveable over the telescope field, so that the different spectral ranges of grating prisms must not be separated by colour filters. With the 1 mm slit mask we observed in the red spectral range an asteroid of 17th mag with an S/N ≈ 10. The long slit spectroscopy is especially effective for faint extended emission objects (Fig. 2).

Acknowledgements

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E.H. GEYER and M. HOFFMANN
Observatorium Hoher List der Universität Bonn
D-54550 Daun
FR-Germany

Wide-field CCD Astrometry at Hoher List Observatory — First Results

1. Introduction

Over the past twelve years CCDs have become more and more important for astrometric work. The first attempts demonstrated that parallaxes of stars can be measured more efficiently with this new technique (see Tinney 1993 and references herein). Later, also the measurement of angular separations of double star components with classical methods was nearly completely replaced by measurements with CCDs (e.g. Sinachopoulos 1988). Further applications of CCDs in astrometry are the determination of optical positions of extragalactic objects (Argue 1984; Wei et al. 1989) and of x-ray sources in the cores of globular clusters (Geffert et al. 1989, 1994).

At Hoher List observatory two new independent facilities with CCD detectors, which are also usable for astrometry, became available last year. We will present here the first results of the astrometric tests.

2. SBIG ST6 CCD at the Visual Tube of the Double Refractor

The visual tube of the Double Refractor has been equipped with a 242 x 375 pixel ST6 CCD camera. In this configuration, the usable field is 5′ x 6′ and the scale is about 1″/pix. B,V,R,I,G filters may be used. The same equipment but with a ST4 CCD camera was already used for the development of a new method for the determination of separations of visual binaries (Müller & Geyer 1993). First tests with the ST6 have shown that objects of 17^m can be reached within 4 minutes, which is a gain in exposure time of about 15 with respect to the photographic plates at the Double Refractor. In March 1993 we have taken six frames of the core of the open cluster M67. Rectangular coordinates of all stars of our field which form also the catalogue of Girard et al. (1989) were determined using IRAF software. From the intercomparison of the different CCD frames we obtained a mean internal accuracy of better than 0.″1 for one star on one frame. The deviations of the catalogue of Girard et al. (1989) were of the same order. These results indicate that the visual tube of the double refractor may be usable for astrometric work, although the designation 'wide field' for this instrument is only partly justified.

3. WWFPP at the 1.0 m Cassegrain Telescope

The WWFPP (Weit Winkel Flächen Polarimeter and Photometer) was developed by the Radioastronomisches Institut and the Sternwarte of the University of Bonn (Reif et al. 1993) mainly for surface photometry and surface polarimetry. It uses a nitrogen cooled 2048 x 2048 Loral CCD chip. In combination with the focal reducer system at the 1 m telescope of the Hoher List Observatory the WWFPP has a field diameter of 25 arcmin and a scale of 0.″8/pix. In addition to the applications mentioned above, the system is now going to be used partly for photometry of open clusters (Herkendell et al. 1993) and astrometric projects (see below). During test runs at Hoher List Observatory in 1993, frames of the globular cluster M53 were taken. Three V and three R frames were used in this investigation with exposure times of 60 sec, 300 sec, and 600 sec for each colour. We were able to identify 80 stars of the catalogue of Geffert et al. (1993) on our frames. Rectangular coordinates were determined using DoPHOT and MIDAS software. We have analyzed the astrometric accuracy by intercomparison of the positions of the stars on different frames and comparison with the catalogue. For the latter a reduction model with terms up to the third order in rectangular coordinates x and y had to be used. No indication of magnitude and coma terms has been found. The following results were obtained:

1) using frames of the same colour yields an accuracy of 0.″07;
2) using frames of different colours gives an accuracy of 0.″08;
3) the comparison with an independent catalogue yields 0.″09.

The values are mean accuracies for one star on one frame. Since the major part of the stars used is located near to the globular cluster M 53, we cannot rule out systematic effects due to crowding and blended images especially in the construction of the catalogue from the photographic plates. These effects may cause the slightly higher deviations from the catalogue.

4. Future Projects

Our future projects may be summarised as follows:

1) a more extensive astrometric test of the WWFPP will be performed by comparing overlapping frames and using additional fields of open clusters;
2) observations will be performed of close pairs of extragalactic objects and stars from the HIPPARCOS input catalogue. A combination of these data with measurements of old photographic plates may contribute to the calibration of the HIPPARCOS proper motion system;

3) due to the gain in exposure time the CCD technique is very suited for the astrometric observations of asteroids. Precise positional differences of asteroids and radio sources or HIPPARCOS stars may improve the astrometric accuracy of the measurements for the mass determination of asteroids and the link of the dynamical reference frame to other reference frames;
4) observations of open and globular star clusters with small angular sizes will be used for combined photometric and astrometric studies of these clusters. Membership probabilities of single stars may be calculated which may also lead to a better determination of the turnoff point in the colour-magnitude diagram of these clusters.

Acknowledgments

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M. GEFFERT and C. FORNER
Sternwarte der Universität Bonn
Auf dem Hügel 71
D-53121 Bonn
Germany

Wide-Field Electronographic Camera with the Imaging Plate as a Detector: Call for the Test of the Imaging Plate

The purpose of this paper is to point out that an electronographic camera in which the photostimulable phosphor (Imaging Plate) is used as a detector is possibly a new tool for wide-field imaging.

The imaging plate developed by Fuji Film Co. is a film coated with the photostimulable phosphor ($BaFBr:Eu^{2+}$) (Amemiya & Miyahara 1988; Amemiya et al. 1988). When X-rays, or electrons expose the imaging plate, the absorbed incident energy is temporarily stored in the form of quasi-stable colour centres; when later stimulated by a scanning He-Ne laser beam ($\lambda \sim 632.8$ nm), the imaging plate emits photostimulated luminescence ($\lambda \sim 390$ nm) with an intensity proportional to the absorbed energy, which can be measured with photomultiplier tubes. High-resolution imaging-plate readers with pixel sizes of 25 x 25, 50 x 50, and 100 x 100 μm^2 have been developed, of which the scanning speed is ~ 14 μs per pixel (Amemiya et al. 1988; Mori et al. 1990). The imaging plate is also repeatably usable. Irradiation with white light completely erases the residual image on the imaging plate. It is therefore possible to read the imaging plate through a glass window from outside the camera within which the imaging plate is moved between the focusing plane and the readout glass window.

The imaging plates are now widely used in the fields of medical radiography, X-ray diffraction experiments (Amemiya et al. 1988), transmission electron microscopy (Mori et al. 1990), and so on. These experiments reveal superior imaging capabilities of the imaging plates for the detective quantum efficiency, dynamic range, linearity, uniformity, storage capacity, and format size. The dynamic range of ~ $1:10^5$ and large format size (the size of 35 x 43 cm is available) are of particular interest for wide-field imaging astronomy.

Since the imaging plate has no sensitivity in visible light, the imaging plate has to be exposed to accelerated electrons (~ 10-50 keV) within an electronographic camera. Until about a last decade, various types of electronographic cameras had been developed to realize both high sensitivity and large format. The Lallemand camera with an 81 mm field in diameter was successfully developed by the Paris Observatory (Lallemand et al. 1970; Wlérick et al. 1984; Servan et al. 1985). The 5-cm Mark II camera with the barrier membrance was built and routinely used by the McDonald Observatory (Griboval 1979a, b), and the 9 cm Mark III camera was tested (Jia & Griboval 1985). Holm & Griboval (1986) described the design of a 9 cm Mark IV camera. McMullan (1972) also described the design of an 8 cm I.N.T. prime focus camera.

However, development of such large format electronographic cameras has been abandoned because of the availability of CCDs. Alternatively, development of mosaic CCD cameras are now in progress. Nevertheless, wide-field astronomy demands a detector size much larger than the biggest CCD chip or reasonable mosaics of CCDs. A 20-50 cm field in diameter is required by Schmidt telescopes, Ritchey-Chrétien telescopes for sky surveys, astrographs, and patrol cameras.

As mentioned by Griboval (1979a), there are no technical problems in producing electronographic cameras with a 20 cm field in diameter. Development of cameras larger than this may require a uniform focusing magnetic field much better than that of the focusing magnet or coil. Such a highly uniform magnetic field can be provided by a superconducting solenoid (Carruthers 1979). Furthermore, its strong magnetic field enables us to use a non-flat photocathode matching to the focal surface of a Schmidt or Ritchey-Chrétien telescope. New techniques of superconducting magnet and matching curved photocathode being adopted, it seems feasible to develop an electronographic camera with a ~ 30 cm field in diameter.

The imaging-plate electronographic camera (IPEC) proposed here is supposed to have the following characteristics:

1) the IPEC is a wide-field imaging device, whose detective quantum efficiency is comparable with photocathode-based detectors. The IPEC may also provide excellent imaging capabilities in the UV;

2) the IPEC is an intensifier device. Acceleration of photoelectrons reduces the effect of CR events;
3) the dynamic range is very high, ~ $1{:}10^5$, which is not the limit of the imaging plates but the limit of imaging-plate readers. Further increase in the dynamic range may be possible;
4) a low non-uniformity (~ 1.3%) of the imaging plates simplifies flat-fielding;
5) a readout pixel size suitable for the purpose can be chosen;
6) readout of the imaging plates has no process in internal transfer of signal-like CCDs, and no traces due to after-images of bright stars appear. This is very important for the measurements of crowded fields;
7) when exposed to electrons, the imaging plate does not emit gas and vapour which damage a photocathode of the tube. No frequent replacement of the photocathode may be needed for the IPEC.

Unfortunately, I have no laboratory for a trial manufacture of an electrographic camera with which the imaging plates are tested. I wish to propose testing of the imaging plates to the groups which have available electronographic cameras. I hope that the superiorities mentioned above are not over-stated.

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N. KANEKO
Department of Physics
Faculty of Science
Hokkaido University
Sapporo 060
Japan

Wide-field TV Observations of Galactic and Solar System Objects: Facilities at the Crimean Astrophysical Observatory

The TV complex of the Crimean Astrophysical Observatory is used for fast identification and observation of different Galactic and Solar System objects: for example, the optical counterparts of X-ray sources, asteroids and comets, having brightness from 10 up to 20 stellar mag. There are wide-fields of about 50 x 50 arcminutes for identification and about 10 x 10 arcminutes for more precise identification and observation; the limiting magnitude seen on the TV monitor is 15 and 20 respectively. The convenient visual control of images on the TV monitor allows the observer to rapidly find objects in the field of stars and to guide on them during the observation. The recording of the full TV frame information, which has about 1000 x 1000 pixels, must be made photographically on account of limited computer memory. Only strobe selected regions of the field can be recorded directly in the mini computer. The accuracy of the photometric measurements is 0.08 - 0.05 mag. when data are photographically recorded and 0.01 - 0.02 in the case of direct computer data acquisition when the object is bright enough.

Various observations of asteroids and comets have been made in recent years. Three observing programmes are carried out: asteroid photometry, astrometry of the faint asteroids and comets and research into the structure of cometary nuclei. A search for the optical counterparts of X-ray sources is being carried out and subsequently their photometric behaviour studied.

The wide-field detector is very useful for investigating these objects. It is desirable to have high quantum efficiency, high signal to noise ratio, good photometric and astrometric accuracy in the wide field and comfort while making the observations. The price of apparatus must be low and observations inexpensive. The TV complex attached to the small telescope at the Crimean Astrophysical Observatory has satisfied these requirements for the most part.

Two channels are available with the small telescope TV complex: 0.2 metre (f 1/8) and 0.5 metre (f 1/13) telescopes mounted on the same base. The first (the guide) is used for searching for objects and taking pictures of field about 50 x 50 arcminutes, the second for taking pictures of the target fields about 10 x 10 arcminutes and making photometric measurements of each object under consideration. The two highsensitive peak up television tubes (I-Isocon) are used as detectors. The tube used for photometric measurements operate under air conditions and with temperature near 0°C during the night. The temperature of the tube mounted on the guide is about +10°C.

The limiting stellar magnitude which is seen on the TV monitor is 15 for the guide and about 20 for the halfmetre telescope. The reason for the limitation is the night sky background. Low temperature peak-up-tubes permit optimum sensitivity of the detector. We can change the integration time from 0.08 to 10 seconds. The signal to noise ratio increases in proportion with the integration time. In addition we use the integration of the TV frame. The full information of 1000 x 1000 pixels is integrated on the photoemulsion using automatically operated film. The mini computer incorporated into the complex allows us to have digital integration of the part of frame's information that is cut by special strobe. The strobe is located along the frame (vertical) scan. The information in the strobe area is converted into digital form and accumulated in the computer. The digital videosignal gives photoelectric accuracy.

The most important investigations recently carried out using the method described above are the discovery of the optical counterpart of the soft X-ray transient GRO J0422+32 and obtaining its UBVR lightcurves during the 3 month period after outburst; the 3-year photometric study of the strong black hole candidate V404 in quiescence; and multicolour photometry of the asteroid Toutatis at different distances from the Sun.

V.V. PROKOF'EVA, E.P. PAVLENKO, V.P. TARASHCHUK and L.G. KARACHKINA
Crimean Astrophysical Observatory
p/o Nauchny, 19-17
Crimea, 334413, Ukraine

A Deep CCD Survey for Field Low Surface Brightness Galaxies

Despite strong selection effects which hinder their detection, low surface brightness galaxies (LSBGs) are now known to exist with surface brightnesses down to 1 percent of that of 'standard' giant disc galaxies. Surveys of galaxy clusters (e.g. Turner et al. 1993) have shown that LSBGs can easily dominate, numerically, the whole galaxy population. A number of LSBGs are also known in the general field, but the detected ones are inevitably the largest members of their class (including such objects as Malin 1). In clusters, on the other hand, it is known that the numbers of LSBGs increase rapidly towards smaller physical sizes (e.g. Irwin et al. 1990). To enumerate the field LSBG population properly we therefore need to investigate samples complete to very small apparent sizes. (For comparison, note that even the nearby Fornax Cluster has only 15 LSBGs with scale sizes above 10").

We have therefore attempted a very deep CCD survey using data, from the Thomson CCD on the Anglo-Australian Telescope, which was previously used for deep galaxy number counts and galaxy clustering studies (see Couch et al. 1993). We have used 17 1024 by 1024 pixel frames covering a total of about 1.1 square degrees, imaged in the very broad VR bandpass.

In addition to the standard reduction procedures we have removed local changes in background (which obviously hinder efforts to detect objects at very low isophotal thresholds) via spatial median filtering. We must remember, though, that any very large LSBGs, of order of the size of the filter box, will be smoothed away too. We cannot get the best of everything! Objects of interest here, though, have scale sizes 2" to 15", so this is in fact not a serious problem for our filter size of about 1′. After the median filtering the backgrounds are very uniform and show only 0.3 percent pixel-to-pixel fluctuations. Detection thresholds used were typically 26.5 V magnitudes per square arc second. In total some 40,000 objects were found with areas above 4 square arc seconds. To cut these down to LSBG candidates only requires various cuts in our observational parameter space of isophotal magnitude against isophotal size. It is clearly going to be virtually impossible to distinguish any differences in profile for the very smallest objects detected, since they are only marginally resolved. We therefore first restrict ourselves to objects with isophotal areas of 9 pixels or more. Inter alia, this guarantees that all the sample have signal-to-noise ratios of at least 7.5, which has been shown to be a reliable criterion of 'reality' in such data (see Driver et al. 1994). Next we determined the loci of galaxies (with exponential profiles) with central surface brightness 22.5 V mag/sq arc sec and with scale lengths 2". We are only interested in objects more diffuse and of greater size than these two limits, which leaves a total of about 730 potentially interesting LSBGs. An eyeball check reveals that about 20 percent of these are actually spurious, generally artifacts in the outer halos of bright stars. This then leaves about 35 LSBG candidates per field on average. This is in very good agreement with the numbers estimated by Turner et al. (1993) from their off-cluster comparison field.

If these are all genuine fairly nearby LSBGs, as opposed to cosmologically dimmed 'normal' galaxies in the background, then we can estimate a rough number density for them. The larger Fornax and Abell 3574 LSBGs have scale sizes of order 2 kpc, so we will only be able to detect these out to distances of 200 Mpc or so. This gives a density around 0.5 LSBGs per cubic Mpc. This can be compared to the canonical density of bright galaxies of around 0.05 per cubic Mpc (brighter than a blue magnitude -17.5). This would indicate an order of magnitude more LSBGs than 'normal' galaxies, a result consistent with that found for the spiral rich low density cluster A3574 (i.e. one with a fairly 'field-like' galaxy population) by Turner et al. (1993). This of course requires that there is not too much contamination by more distant giants. We are currently attempting to estimate this contamination from the clustering of and between the different galaxy populations and from simulations of the expected appearance of very distant normal galaxies.

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J.M. SCHWARTZENBERG and S. PHILLIPPS
Department of Physics and Astronomy
University of Wales College of Cardiff
P.O. Box 913, Cardiff CF2 3YB
Wales

Dwarf Galaxies at Moderate Redshifts

Redshift Surveys have shown that there may be very large populations of dwarf galaxies at moderate redshifts, say 0.2 to 0.5, which are probably absent today. Various pictures of galaxy evolution have been envisioned to account for this apparently dramatic secular change in the field galaxy luminosity function. However, while it is known that many rich nearby clusters possess large dwarf galaxy populations today, surprisingly little is known directly about the low luminosity galaxy population in clusters at earlier epochs (i.e. at higher redshifts). Attention in these clusters, as far as evolution goes, has generally been concentrated on the Butcher-Oemler effect, i.e. the fraction of blue galaxies among the brighter members, and on the spectroscopy of objects such as the so-called post-starburst galaxies, again among the brighter cluster members.

To try and remedy this situation, we have utilised data obtained as part of the Hitchhiker CCD Sky Survey (see Newsletter No. 3, p. 6) for a detailed examination of a moderate redshift cluster. Hitchhiker operates on the William Herschel Telescope on La Palma in parallel with scheduled spectroscopic observers (see Newsletter No. 1, p. 37) and is one of the few CCD survey instruments so far in operation. The data in question here was a rare pointed observation, made in discretionary time, rather than the usual serendipitous operation of the instrument, of the cluster Abell 963 ($z = 0.206$). Simultaneous 40 minute exposures in the B and R bands were obtained for a field approximately 3′ by 5′ (400 by 650 kpc) centred about 3′ (400 kpc) from the central cD galaxy (which thus appears in a corner of the frame).

Hitchhiker's CCDs are much more efficient in the red than the blue, so we will henceforth concentrate on the R band data. After carefully flat fielding the data (see Driver et al. 1994a for details), objects were detected using the FOCAS package. The detection limit was set at 12 contiguous pixels (1 square arc second) above a limiting isophote of 27 magnitudes per square arc second and a minimum S/N of 7.5. The data are complete down to a (total) magnitude limit $R = 24.5$, corresponding to an intrinsic red magnitude around -16.5 at the cluster. Magnitudes were corrected from isophotal to 'total' using realistic simulated frames to determine empirical correction factors. (Notice that the isophotal magnitudes can be as faint as 26 given our selection criteria). Comparison of our photometry with existing data in the range $R = 18$ to 21 (the brightest 50 Hitchhiker galaxies) indicates a scatter of around 0.10 magnitudes and no scale error (see Driver et al. 1994b for more details).

To subtract the expected background contamination we have used the corresponding mean counts taken from the random field survey of Driver et al. (1994a), allowing both for Poisson errors in the counting statistics and possible 20 percent field to field variations due to clustering. Even with the largest allowable background subtracted, we still see a strong excess signal (of order of a factor 2) in the counts right down to the faint limit of the survey. We can fit this excess (i.e. the magnitude distribution for the cluster galaxies) very well by a conventional flat Schechter function at the bright end plus a turn up at fainter magnitudes due to a second, dwarf, population with a steep luminosity function slope (around -1.8). Notice that the R band k-corrections are more or less independent of morphological type (unlike those in the blue) so that the observed magnitude distribution maps directly to the true (rest frame) red luminosity function.

The shape of the LF thus determined turns out to agree very closely with that seen at faint magnitudes in the nearby rich clusters Coma and Abell 1367. This suggests that contrary to the situation in the field and among bright cluster galaxies, there has been little evolution in the faint cluster galaxy population over the lookback time of a few Gyr. However, this remains to be tested with a larger sample of clusters at a range of redshifts. Such a programme of observations is now in hand on the Anglo-Australian Telescope.

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S. PHILLIPPS and S. DRIVER
Department of Physics and Astronomy
University of Wales College of Cardiff
P.O. Box 913, Cardiff CF2 3YB
Wales

New Photographic Plates made in Russia for Astronomical Observations

Although during the past few years astronomers have often made use of CCD-detectors for observations of weak celestial bodies, this does not mean that photography is no longer of great use in astronomy. On the contrary, it is unsurpassed for wide-field applications.

During the past four years the JSC 'Slavich' has produced plates of type NT-1A for astronomical observations with long exposure times. New technology has been used for manufacturing these plates: special emulsion, polished glass with thickness 1.7 or 2.6 mm and improved coating. The plates have an antihalation layer. The special emulsion contains quasi-T AgBr-crystals, the ratio of the diameter to their thickness being equal from 3 to 5. After chemical-photographic treatment the sizes of the grains are equal approximately to 1.1 mkm.

Immediately after making the plates NT-1A have low sensitivity and they may be kept at room temperature for a long time. Before use, the plates must be hypersensitized by hydrogen soaking. The hydrogen hypersensitization reduces photographic reciprocity law failure and the sensitivity grows significantly, especially for long exposure times (Brejdo et al. 1993). After hypersensitization the plates must be preserved at low temperature, and then their safety is equal to 2-3 months (Michailova 1989).

The results of comparative laboratory tests of plates NT-1A, Kodak 103a-O and ORWO ZU-21 are given in the Table. There are: sensitivity (Speed) S (for density D = 0.2 above fog) for several exposure times; Contrast G (gamma); Resolving power R; and Minimal threshold contrast K. The last evaluates the ability of photographic material to record the faintest stars on the night sky background (Brejdo 1980). The value of K is very important for astronomers. The smaller it is the fainter the stars (with optimal exposure) that can be recorded (Brejdo & Michailova 1975).

Plates			**S**			**G**	**R**	**K**
	t exp.	**10s**	**100s**	**10m**	**50m**			
'Slavich' NT-1A		60	50	45	40	2.0	120	0.15
Kodak 103a-O		75	50	45	40	1.8	100	0.3
ORWO ZU-21		55	45	35	30	1.7	90	0.2

One can see that sensitivity is approximately equal for all these plates, but Resolving power R and Minimal threshold contrast K is better for plates NT-1A than for Kodak 103a-O and ORWO ZU-21.

The laboratory tests show also that the spectral sensitivities of all these plates coincide. JSC 'Slavich' intends to develop ortho and panchromatic plates also.

Since 1991 the plates NT-1A have been used for the photographic observations with the normal astrograph at Pulkovo Observatory (sizes of plates 16 x 16 cm). In 1991 plates were taken of the Coma cluster with exposure time 20 min: 3 plates on NT-1A and 3 plates on ORWO ZU-21. The photometric measurements showed that the limiting magnitudes of stars were the same for all plates.

The observations of Pluto were fulfilled in 1991-1993 with exposure time 30 min and of the Pleiades cluster with exposure time 10 min. In 1993, 6 plates were taken of radiosources. On plates with the Pleiades the improvement in limiting magnitude is 0.5 in comparison with ORWO ZU-21. The images of stars and Pluto are more sharp on the plates NT-1A, than on ORWO ZU-21.

Conclusion

The plates NT-1A are well suitable for astrometric work. After hydrogen hypersensitization they can be preserved for 2-3 months in the refrigerator. The unhypersensitized plates can be kept for a long time at room temperatures.

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I.I. BREJDO[1], N.M. BRONNIKOVA[1], O.M. MICHAILOVA[1] and D.K. MICHAILOV[2]

[1] Pulkovo Observatory, SU-196140 St. Petersburg, Russia.
[2] JSC 'Slavich', Pereslavl-Zalessky, Russia.

News about the Wide-field Plate Database

ABSTRACT. Since Symposium 161 of the IAU 'Astronomy from Wide-field Imaging', held in Potsdam, a lot of new information concerning the completeness and correctness of the Wide-field Plate Archive List and the Wide-field Plate Database (WFPDB) has been received. This note presents the latest progress in the presentation of the WFPDB. (For previous results see Tsvetkov & Tsvetkova 1993 and Tsvetkov et al. 1993).

1. New Information in the WFP Archive List

The very successful WFI meeting in Potsdam gave us the possibility for personal contacts and discussions resulting in the supplementing and making more precise the data in the WFP Archive List.

Due to the kind cooperation of M. Hazen from Harvard (U.S.A.), a supervisor of the world biggest wide-field plate collection, a complete list of the instruments used in Cambridge has been made, including corrections for the time of instrument operations and precise amount of plates. Part of the Harvard plate collection is already in computer-readable form, namely the plate catalogue for the 0.60 m Bruce telescope (27504 plates) and partly for the 0.40 m Metcalf telescope (40591 plates). In accordance with M. Hazen's information we are about to change slightly the list form, marking the telescopes, which have been replaced in different observatories (locations), as well as the archives for these telescopes, which are still located in other institutes.

E. Griffin pointed out that the RGO plate archives are located in Cambridge (UK) and that the whole plate collection contains more than 50,000 plates but many of them are still kept in boxes.

S. Tritton sent us the new updated computer-readable version of the UKSTU catalogue (see Table 1) which contains 1795 new plates received in Siding Spring during the last several years. 1320 from all UKSTU plates belong to the objective prism survey.

With the help of R. Hudec and J. Borovichka who supported the visit of A. Mutafov from the Bulgarian team in the Czech Republic a list of the observatories and instruments involved in the Wide-field Sky Imaging Programmes in this country was prepared. As a result 16 new instruments used in 11 observatories in the Czech Republic were included in the list. We would like to mention especially the 12 FE-cameras used in 10 different Czech stations which produced 22,000 plates covering the northern sky. The WFP collection (72,960 plates) of the Czech Sky Patrol is partly in computer-readable form.

With the help of L. Hric and J. Svoran the plate archives in Slovakia containing more than 11,000 wide-field plates taken with two telescopes, 0.30 m astrograph and 0.60 m reflector, since 1946 have been included in the List.

Both plate archives in Czechia and Slovakia are stored very well and are successfully used for searching for Gamma-ray bursters (GRBs) and small planets and comets.

The astrometric programme of the Yale University was discussed in Potsdam with W. van Altena and the wide-field plate information was included in the List: there are more than 62,000 plates existing in Bathany Observatory (New Haven), Johannesburg and Mr. Stromlo in the period 1926-1962 for the Yale Parallax Catalogues. All plates from New Haven are published in the Yale Transactions. The Yale programme in San Juan Observatory (Argentina) with the 0.51 m double astrograph started in 1965 resulting in 3000 *pg*- and *pv*-plates described already in a computer-readable catalogue.

A. Woszczyk kindly sent to us the computer-readable version of the Torun Schmidt plate catalogue and corrected the location of the plate collection: in Torun instead of Pivnice Observatory.

M.F. McCarthy corrected the number of the plates received with the 0.40 m astrograph in the Vatican Observatory to about 4000.

Additional information has been received from N. Bondar from the Crimean Observatory (Ukraine) about the Simeis and Nauchny plate catalogues already in computer-readable form. They contain the data for 1350 plates taken during the period 1947-1985 with 0.17 m and 0.40 m telescopes at both sites.

N. Bronnikova sent us detailed information about the Pulkovo Observatory archives. At present the plate collection in Pulkovo contains more than 55,600 plates and very soon N. Kanaeva will finish the computer version of the plate catalogue for the normal astrograph (17,000 plates). There are difficulties in the archiving work in Pulkovo because of the shortage of computational hardware.

We have been informed by Song-zhu Lan that from the beginning of 1993 the Beijing Observatory terminated direct-photography observations with the Schmidt telescope and continued only with CCD-observations.

The new, fourth in order, updated WFP Archive List will be distributed during the joint discussion on the status of archiving astronomical data at the IAU General Assembly in the Hague, this year.

Table 1. List of new plate catalogues included in the WFPDB after August 1993

No.	Observatory	Instrument Aperture (m)	type	Number of plates	Years of Operation	Astronomer in charge	Notes
1.	Bordeaux	0.33	Ast	4307	1893-1993	J. Colin	1
2.	Crimea-Nauchny	0.17	Ast	49	1951-1953	N. Bondar	
3.	Crimea-Nauchny	2 x 0.40	Ast	507	1951-1984	N. Bondar	
4.	Crimea-Simeis	0.17	Ast	570	1948-1965	N. Bondar	
5.	Crimea-Simeis	0.40	Ast	222	1947-1965	N. Bondar	
6.	Krakow/Palomar	1.24	Sch	122		J. Machalski	2
7.	Ondrejov	10 x 0.04	Cam	10600	1955-1977	J. Borovicka	3
8.	Ondrejov	10 x 0.04	Cam	16060	1958-1975	J. Borovicka	4
9.	Torun	0.60	Sch	2826	1962-1985	A. Woszczyk	
10.	Turku-Tuorla	0.50	Ast	≈8000	1938-1949	L. Takalo	5

Notes:

1) The catalogue was obtained from Ch. Ducourant.
2) The list of the plates was obtained from P. Flin. It contains two sets of data for plates i) Nos. 9787-9991 and ii) Nos. 20002-21113.
3) Plate archive of the 10 x 0.04 m stationary cameras.
4) Plate archive of the 10 x 0.04 m guided cameras.
5) The catalogue published in the Annales Universitatis Turkuensis (Oterma 1951) is in preparation in computer-readable form in Sofia. It contains the data of two plate archives for two telescopes: 0.50 m and 0.34 m reflectors. The data will be separated in different archives after the preparation of the computer-readable version.

2. Development of the Wide-field Plate Database

At present with the newly received 10 catalogues in computer-readable form, containing 43256 plates, the WFPDB enlarges up to 350837 entries, i.e. 12.3% increase in the total number of plates. The total number of the plate catalogues included now in the database is 61. The new catalogues received after August 1993 are listed in Table 1 containing the location of the plate archive (observatory/institute), aperture of the instrument (m), type of the telescope, years of operation, name of the astronomer responsible for the plate archive, and notes. The WFPDB in the form of WFP Index Catalogue is now installed on an IBM 4381 computer at the Computer Centre of Physics, Bulgarian Academy of Sciences, and soon it will be also installed on the IBM 4381 computer at the Main Computer Centre of the Academy. Next the procedure for information search in the database will be organised.

Requests for information for the plates from the WFPDB can be sent to:

WFPA@BGEARN.BITNET

3. General Comments

Since November 1993 the Wide-field Plate Archive Project has been recognized by the National Science Foundation in Bulgaria and supported under a grant F-311 for a three year period. With funds from this grant a personal computer 486DX2-66MHz/340 MB HDD has been bought which will facilitate the current work on the database.

Last year the work on the WFPDB was supported mainly by the Alexander von Humboldt Foundation (Germany) and the Astronomical Institute of the Muenster University (Germany). The Alexander von Humboldt Foundation approved our proposal for advanced computer technique (complex of SUN/SPARC Station 10 and two PC486 computers) dedicated to the work on the WFPDB and to the image processing and flare star search in stellar aggregates. We expect that this hardware will be provided in Sofia from Germany in 1994 and its installation will help us in the development of the database.

In September 1993 we were visited for a week by Elizabeth Griffin (Cambridge, U.K.), with whom the problems of the WFP database preparation and the future cooperation with the IAU working group on photographic spectral archives were discussed.

Acknowledgements

We would like to express our deep thanks to all colleagues who support the WFPA project and send us data for their WF plate archives. M.K.T. and K.P.T. thank especially Prof. Dr. W. Seitter for the help and the possibility to work on the WFPA database project in the Astronomical Institute of the Muenster University during their AvH and DFG stay in 1993.

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M.K. TSVETKOV, K.Y. STAVREV, K.P. TSVETKOVA and A.S. MUTAFOV
Department of Astronomy
Bulgarian Academy of Sciences
Tsarigradsko Shose Blvd. 72
BG-1784 Sofia
Bulgaria

Databases for Radio/Optical Objects: Radio Stars, Extragalactic Radio Sources, and Intermediate Reference Stars

A CONFOR Program (CONnection of Frames in Optics and Radio, see Gubanov, Kumkova & Tel'nyuk-Adamchuk 1990) has been undertaken to determine relative orientation of the radio interferometric reference coordinate system with respect to the fundamental optical system for the goal of establishing a universal radio/optical coordinate frame. For this purpose the method of astrophotographic reduction with two steps was used. Fixed systems of intermediate reference stars in the fields with extragalactic radio sources (ERS) has been chosen. This allowed us to obtain more reliable astrometric reduction of photographic plates with ERS images.

Within the framework of the CONFOR program:

1) two star lists of intermediate reference stars (both for meridian and astrographic observations) in 238 fields with extragalactic compact radio sources have been prepared;
2) observations of these stars have been organized and fulfilled with meridian circles and several astrographs of Ukraine, Russia, Romania and Yugoslavia;
3) data of both optical and radio interferometric observations of RS, ERS have been compiled as well as optical observations of stars in the fields centred in ERS (see Tel'nyuk-Adamchuk & Kryvdyk 1991; Tel'nyuk-Adamchuk, Kryvdyk & Pasechnyk 1991);
4) observations of ERS were carried out with several powerful telescopes.

The databases of radio stars (RS), ERS, available for precise radio interferometric observations and intermediate reference stars around ERS have been compiled at the Astronomical Observatory of Kyiv Taras Shevchenko University and at the Institute of Applied Astronomy, Russian Academy of Sciences. There are mostly astrometric data and brief astrophysical description. All the available published data were used as well as original results of the CONFOR Program.

The database on optical and radio interferometric positions of radio stars contains about one hundred objects. The optical proper motions of RS in number about 40 have been determined (Tel'nyuk-Adamchuk, Duma & Smidunovich 1991) as well as the relative orientation angles using available published positions. An example of RS data is shown in Table 1.

Table 1. Example of radio star database structure

021649 -031221				**maser**	
49.076	-22.60		88.1	88.1	40
49.073	0.007-21.22	0.13	80.99	80.99	34
49.082	0.013-22.57	0.09	86.78	86.78	37
49.087	0.003-22.42	0.05	86.80	86.83	38
49.084	0.004-22.35	0.05	86.81	86.89	43
021915 +582133				**maser**	
15.09	33.400		85.5	85.5	38
15.061	0.004 33.560	0.080	86.320	86.320	37
15.100	0.006 33.550	0.050	86.880	86.880	38
15.082	0.011 33.600	0.08	85.70	85.70	43

Notes: Line 1 — approximate R.A. and Decl.

Line 3, 4, 5, ... — seconds of R.A.; m.r.s.e. of R.A.; arcsec of Decl. and m.r.s.e. of Decl.; epochs of R.A. and Decl.; references. All data are from optical observations.

Line 2 — data of radio observations (weighted means).

The database on ERS contains around two hundred sets of optical and radio interferometric positions. An example of ERS data is shown in Table 2. Both the RS and ERS optical positions have been obtained in different reference systems and transformed to the FK5 system using known systematic differences between convenient systems.

Table 2. Example of extragalactic radio source database structure

0006		**-0623**				
13.893255	0.040	35.33307	0.072	88.04	88.04	53
40.296	13	17.23	20	83.	83.	41, 24
0011		**-2612**				
01.246736	0.204	33.37549	0.285	81.97	81.89	48
28.894	11	14.68	21	78.60	78.60	5

Notes: Line 1 — hours and minutes of R.A., degrees and arcmin of Decl.
Line 2 — seconds of R.A., m.r.s.e. of R.A.; arcsec of Decl. and m.r.s.e. of Decl.; observation epochs for R.A. and Decl.; references. All data are from radio observations.
Line 3, 4, 5, ... — data of optical observations.

Combining the data from both RS and ERS allows us to determine the orientation angles and deviation of the FK5 equator relatively to the radio interferometric system one with an accuracy 0.02 arcsec (m.r.s.e.) (see Tel'nyuk-Adamchuk, Molotaj & Kumkova 1992). These results are given in Table 3. To bring the FK5 and VLBI reference frames into coincidence, FK5 should be turned clockwise around the X, Y and Z axes by the angles i1, i2 and i3. The FK5 equator is found to be displaced southwards by angle i4. It is necessary to note that enlargement of RS radio coordinate determinations and improving of the coordinate random accuracy produce more accurate results, as well as adding of optical observations of faint ERS. At present the databases of RS and ERS are in the process of being completed by new data available from astronomical publications.

Table 3. Angles of relative orientation i1, i2, i3, 6 and shift i4 of the FK5 equator obtained from observations of radio stars (RS) and extragalactic radio sources in units of 0.01 arcsec.

Objects	i1	i2	i3	i4	M.r.s.e.	Number of objects
RS	-4	+8	+2	-4	5	59
ERS	+6	+6	-0	-2	3	192
RS + ERS	+0	+7	+2	-3	2	251

There are two sets of data for intermediate reference stars. The first one is the data of 2575 stars in the vicinity of ERS and selected radio stars. The fields centred in ERS contain 9-12 stars in 1-3 square degrees approximately up to 9.0 mag attainable for visual meridian instruments (RRS2 list). The mean brightness is equal to 8.6 visual mag (see Tel'nyuk-Adamchuk & Molotaj 1989). The observations, reductions and compilation of these stars are in progress now. The meridian observations of RS and stars in the vicinity of ERS carried out within framework of similar programs are collected and included in database.

The second set (Photographic Intermediate Reference Star list, PIRS) contains the 12-14 mag stars located around ERS no further than 15-20 arcmin from the centre. That list has been compiled using the HST Guide Star Catalogue. The stars are being observed at present with astrographs of Kyiv University Observatory and Institute of Astronomy, Bucharest, Romania. In this list there are about seven thousand stars over both hemispheres. We plan to prepare the compiled catalogues of RRS2 stars as well as PIRS stars using collected data including our original observations.

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V. TEL'NYUK-ADAMCHUK[1], J. BABENKO[1], I. KUMKOVA[2], S. PASECHNYK[1] and O. VERTYPOLOKH[1]

1 Astronomical Observatory of Kyiv Taras Shevchenko University, Observatorna Street 3, Kyiv, 254053 Ukraine.

2 Institute of Applied Astronomy of Russian Academy of Science, Zhdanovskaja 8, St. Petersburg, 197042 Russia.

Availability of the Digitized Sky Survey on CD-ROMs

The Space Telescope Science Institute (STScI) has carried out a digitization of Schmidt survey plates covering the entire sky. This was done primarily to obtain the image data needed for construction of the *Guide Star Catalog* (GSC) and to pursue a number of related research programs. Copies of the GSC were made available to the scientific community through the Astronomical Society of the Pacific (ASP).

The digitized versions of the plates are also of great utility in astronomical research, but it has previously been impossible to distribute the scans because of the massive volume of data involved (a total of about 600 Gbytes). However, use of the *H*-transform wavelet compression technique now makes such a distribution feasible. With funding from NASA Headquarters, compression of 1477 digitized plate images began in June 1992. The STScI and the ASP are now pleased to announce the availability of this digitized sky survey on CD-ROMs.

Two versions of the sky-survey data will be produced — one at a compression factor of 10, which is virtually indistinguishable from the original data, and one at a compression factor of about 100 which, while not suitable for some professional research activities, will provide an invaluable tool for the educational and amateur communities. Software to decompress the data, as well as an astrometric calibration data base that supports the generation of accurate coordinates for objects in the images, will be provided with the CD-ROM set. A photometric calibration data base, which will allow photographic densities to be converted to standard magnitudes, will eventually be provided as well (circa 1995).

The southern-hemisphere plates, obtained with the UK Schmidt Telescope while it was operated by the Royal Observatory Edinburgh with funding from the UK Science and Engineering Research Council, are primarily from the ESO/SERC Southern Sky Atlas and from an advance copy of the SERC Equatorial EJ Sky Atlas (see Table III in Lasker et al. 1990, hereafter Paper I). These are deep IIIa-J exposures obtained through a GG 395 filter, except for the few short *V*-band exposures used at low galactic latitudes (Paper I). The northern-hemisphere data are digitizations of the E plates from the first National Geographic Society-Palomar Observatory Sky Survey (NGS-POSS), conducted with the Oschin Telescope on Palomar Mountain during the 1950s. The NGS-POSS was funded by a grant from the National Geographic Society to the California Institute of Technology.

The digitizations were made using the STScI scanning microdensitometers, which are described in Paper I. A pixel size of 25 microns (1.7 arc seconds) with a 50 micron apodized aperture was used throughout. The scan configuration for the northern plates is essentially identical to that used for the southern plates, except that somewhat slower scan speeds were used. Both the SERC J and NGS-POSS E images have undergone extensive quality assurance checks, including the correction of scanning-related artifacts such as chopping and shearing.

A series of tests conducted at STScI (White, Postman & Lattanzi 1992) indicate that identical photometric measurements made on uncompressed digitized sky survey images and images which have been compressed by a factor of 10 agree to within 0.03 mag down to $J = 19.5$ mag and to within 0.10 mag to $J = 21.5$. An analysis of astrometric residuals between objects on uncompressed and 10x compressed images shows that relative positions agree to within 0.02 arc seconds for bright objects ($J < 16$) and to within 0.46 arc seconds for fainter objects ($J < 19$). These photometric and astrometric residuals are less than the intrinsic errors of the original data.

The cost of the entire 101 CD (10x compressed) set will be $2,900 if ordered prior to February 15, 1994. After February 15th the price will be $3,500. (There will be a small additional charge for airmail shipments to non-US addresses.) Manufacture of the first 61 CDs from the southern SERC J survey will occur as soon as sufficient presale payments have been received, with distribution following immediately. The remaining 40 CDs from the NGS-POSS E survey will be produced and distributed by early 1995. Separate purchase of the north and south sets is not possible. All CDs are formatted according to the ISO 9660 standard. The 100x compressed data will be made available in 1995, when the NGS-POSS E-band data are ready.

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SAN FRANCISCO, CA 94112-1787, U.S.A.

Visa or Mastercard orders will also be accepted by telephone at (415) 337-2624 between 9 am and 3 pm PST, Monday to Friday only. Alternatively, credit card orders may be FAXed to (415) 337-5205; be sure to include expiration data and authorizing signature.

References

Lasker, B.M. et al., 1990. *Astron. J.*, **99**, 2019. (Paper I).
White, R.L., Postman, M. and Lattanzi, M.G., 1992. In 'Digitised Optical Sky Surveys', eds. H.T. MacGillivray and E.B. Thomson, Kluwer, Dordrecht, p. 167.

M. POSTMAN
Space Telescope Science Institute
3700 San Martin Drive
Baltimore
MD 21218, U.S.A.

Front cover:

David Malin has combined several photographically-amplified deep IIIa-J plates of the Virgo cluster, producing stunning pictures of low surface brightness features associated with the galaxies. The photograph on the front cover of this Newsletter shows shell-type structure in NGC 4382 (M 85). The most likely candidate for causing the disturbance in M 85 is the dwarf SO galaxy IC 3292 which is 7.5 arcmins to the West (to the right of M 85 in the photograph — scale bar is 5 arcmins). Its isophotes are clearly seen to be obviously distorted. Further examples of faint extensions to Virgo Cluster galaxies are given in Malin's article in the Proceedings of IAU Symposium No. 161.