buted essentially to the success of our observing run. Furthermore we gratefully acknowledge the financial support from the Swiss National Foundation for part of this work.

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Deep Photometry of Far Globular Clusters

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Introduction

It is well known that our Galaxy can be represented by a flat disk and an extended approximate spherical halo.

The observed halo population consists of old, sparse stars, somewhat more than one hundred globular clusters and, in the peripheral part, some dwarf spheroidal galaxies.

While the nearest, classical globular clusters, like M 3, M 13, M 15, are the subject of extensive literature, the data concerning the outer halo clusters are sparse.

With a few exceptions these outer halo objects seem systematically different from the inner halo ones in concentration and in brightness. Their low intrinsic luminosity, combined with their large distance, explain why most of them were discovered only by the material collected during the wide field surveys with Schmidt telescopes (mainly Palomar and ESO).

While the role of the white spheroidal galaxies in the evolutionary picture of the Galaxy is not completely clear, the outer halo clusters seem the only presently observable samples of the external regions of the halo. Considering the large galactocentric distance and the low density of their environment, we may suppose that they are good "archeological relicts" of the primeval Galaxy.

About twenty star systems of this kind are known, but only four have been studied in detail. The importance of a systematic survey of them for the study of the early galactic evolution seems evident.

Observations

A general survey of distant and faint globular clusters, specifically the Palomar-Abell clusters, has been undertaken at the Asiago Observatory since 1957 under the direction of Prof. L. Rosino. However, more detailed studies require high photometric accuracy and very good sky conditions (seeing, transparency).

Thus, when Italy joined ESO in 1982, the possibility of using the ESO instrumentation at La Silla appeared very promising. The exploration of the possibilities of the new CCD detector at the Danish 1.5 m telescope seemed particularly interesting for B, V stellar photometry.

About 50 frames were obtained, under excellent sky conditions, during a four-night run in January 1983. Very good B, V pictures of the clusters Am-1, Pal 3 and GLC 0423-21 were the main results of these observations (Fig. 1–3).

The reduction was carried out at ESO's Garching computer centre using VAX/MIDAS and HP/IHAP systems. The results show that a very good photometric accuracy was achieved at very faint magnitudes ($\Delta m = 0.1$ at $m_V = 22$).

The quality of the results is guaranteed by our tests on standard stars showing very good stability (better than 0.03 mag.). The linearity is very good, giving deviations smaller than 0.03 magnitude over a 6-magnitude interval ($17 < m_V < 23$).

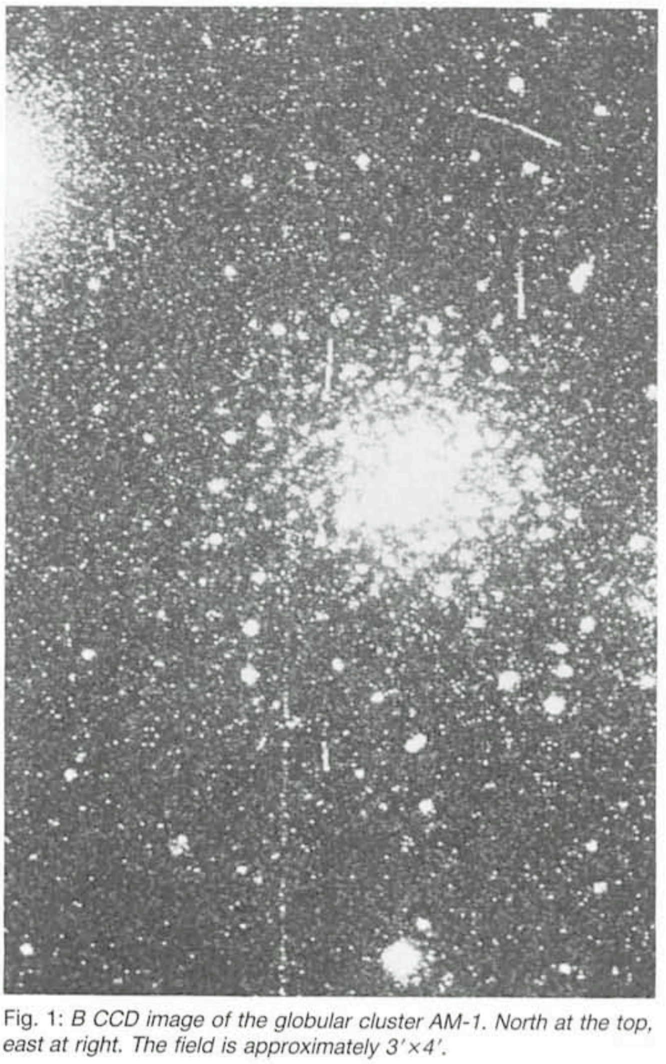

Fig. 1: *B CCD image of the globular cluster AM-1. North at the top, east at right. The field is approximately 3′×4′.*

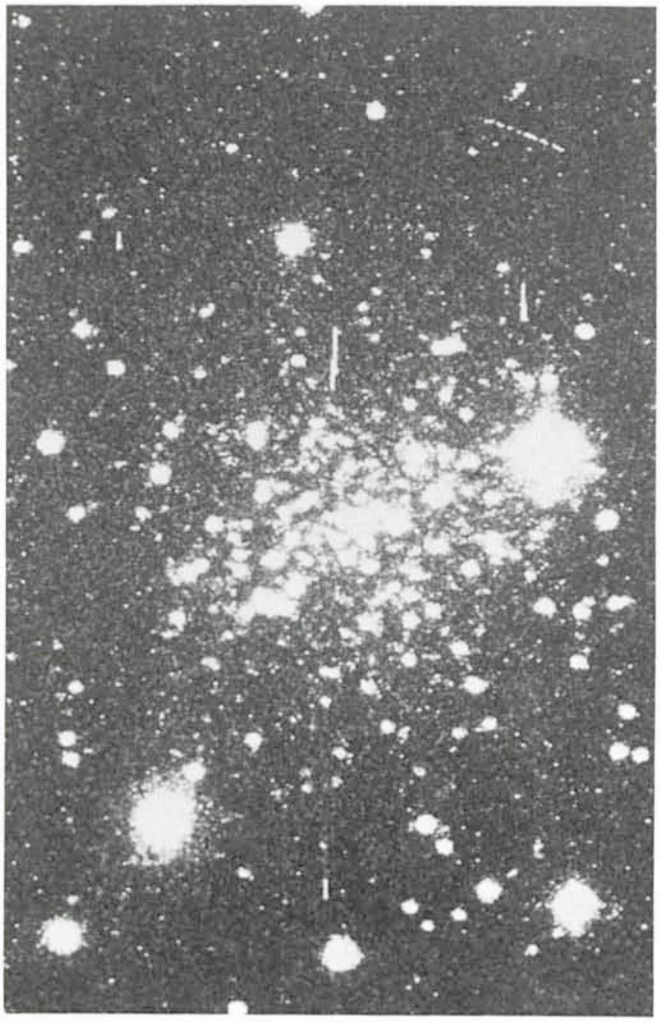

Fig. 2: *V CCD image of the globular cluster Pal 3. Orientation and scale as in Fig. 1.*

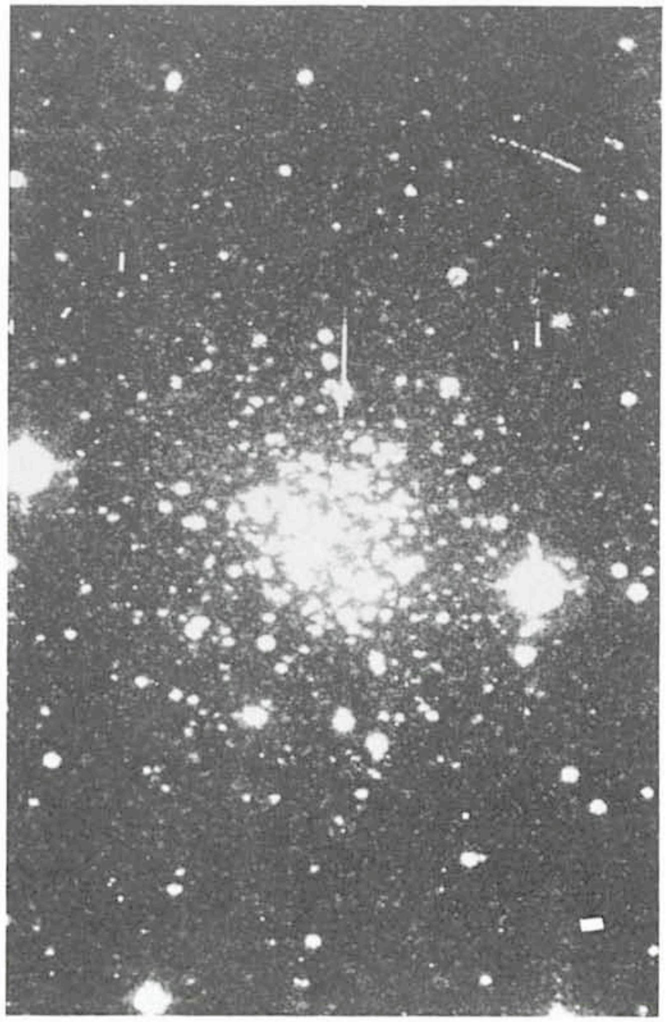

Fig. 3: *The globular cluster GLC 0423-21. Orientation and scale as in Fig. 1.*

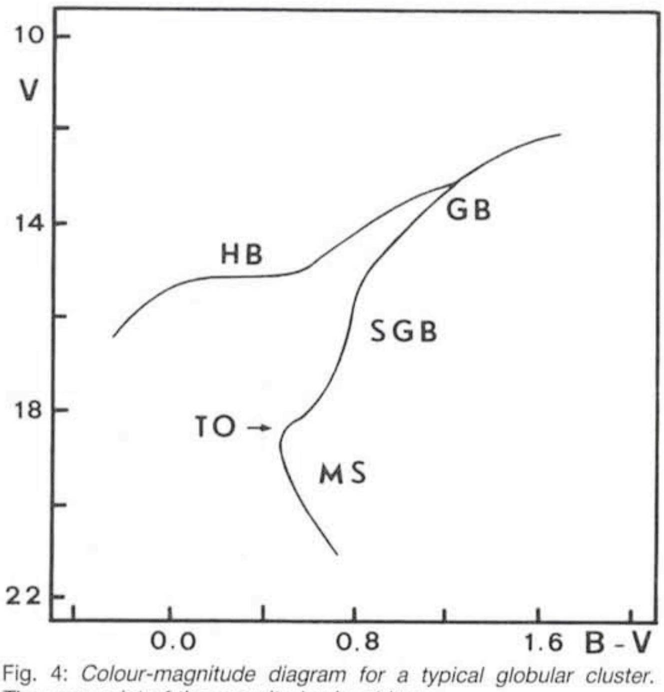

Fig. 4: *Colour-magnitude diagram for a typical globular cluster. The zero point of the magnitudes is arbitrary.*

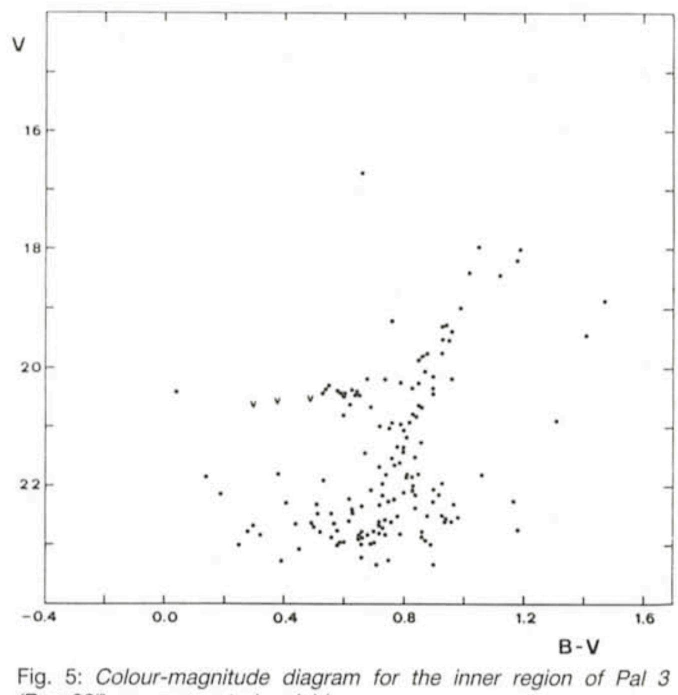

Fig. 5: *Colour-magnitude diagram for the inner region of Pal 3 ($R \leq 82''$); v = suspected variables.*

Results

Usually B, V photometric results on star systems are displayed through a colour-magnitude diagram (V, B-V). In a similar diagram globular clusters are characterized by the presence of a red giant branch (GB), a horizontal branch (HB) and an almost vertically descending subgiant branch to the turnoff (TO) point and main sequence (Fig. 4).

The most characteristic part of the upper region of the diagram is the HB which crosses the RR Lyrae instability strip. Its structure may strongly differ from cluster to cluster.

A change of the metal abundance was found for the inner halo clusters, in the sense that more metal poor clusters have the blue side of the HB more populated, while metal rich globular clusters have more stars in the red part.

However, a number of significant exceptions seem to indicate that factors other than the metal abundance are playing an important role (the "second parameter effect").

Fig. 5 shows the colour-magnitude diagram of Pal 3. Well defined GB, SGB and a short, predominantly red HB are present with some RR Lyrae variables, indicated by "v" symbols. Similar results have been obtained for the other two clusters. The HB structure is anomalous for intermediate metal-poor clusters like these ones. This anomalous behaviour seems to be quite frequent among outer halo clusters (Pal 14, Da Costa, Ortolani and Mould, *Astrophysical Journal*, **257**, 633, 1982; NGC 7006, Sandage and Wildey, *Ap. J.* **150,** 469, 1967) giving evidence for the importance of this mysterious "second parameter effect".

Another important result is a good distance estimate for these systems which lie at about 100 kpc from the Sun, at the frontiers of the Galaxy.

The exceedingly good quality of the data and the unexpected character of the results indicate the importance of extending our survey to other unstudied clusters at the edge of the Galaxy.

Comet P/Crommelin 1983n

A.C. Danks, ESO

Comet Crommelin has a period of approximately 27.4 years and consequently a well-studied orbit. It has an orbital excentricity $e \simeq 0.92$, taking Crommelin on its excursions through the solar system out to a distance of 9.09 AU and in to a perihelion distance of approximately 0.73 AU. The precise orbit details are given in IAU circular No. 3886. A comet's predicted brightness is unreliable, a function of distance from the sun, earth and albedo and naturally it is the albedo which is poorly known. But predictions for a comet with many previous passages are more reliable and the integrated visual brightness of Crommelin was predicted to be in the order of 7 to 11. It was recognized that Crommelin would serve nicely as a test object for the International Halley Watch network (IHW), i.e. its participating observers, equipment and data compatibility. Obviously the closer the comet to the sun the brighter it becomes but of course the more it moves into day. It is usual then when the comet is brightest to catch it either in the early morning as it rises before the sun, or just above the horizon in the early evening after the sun has set.

In April and March Crommelin was well placed for observations in the southern hemisphere, reasonably bright and above the horizon in the early evening for approximately 40 to 90

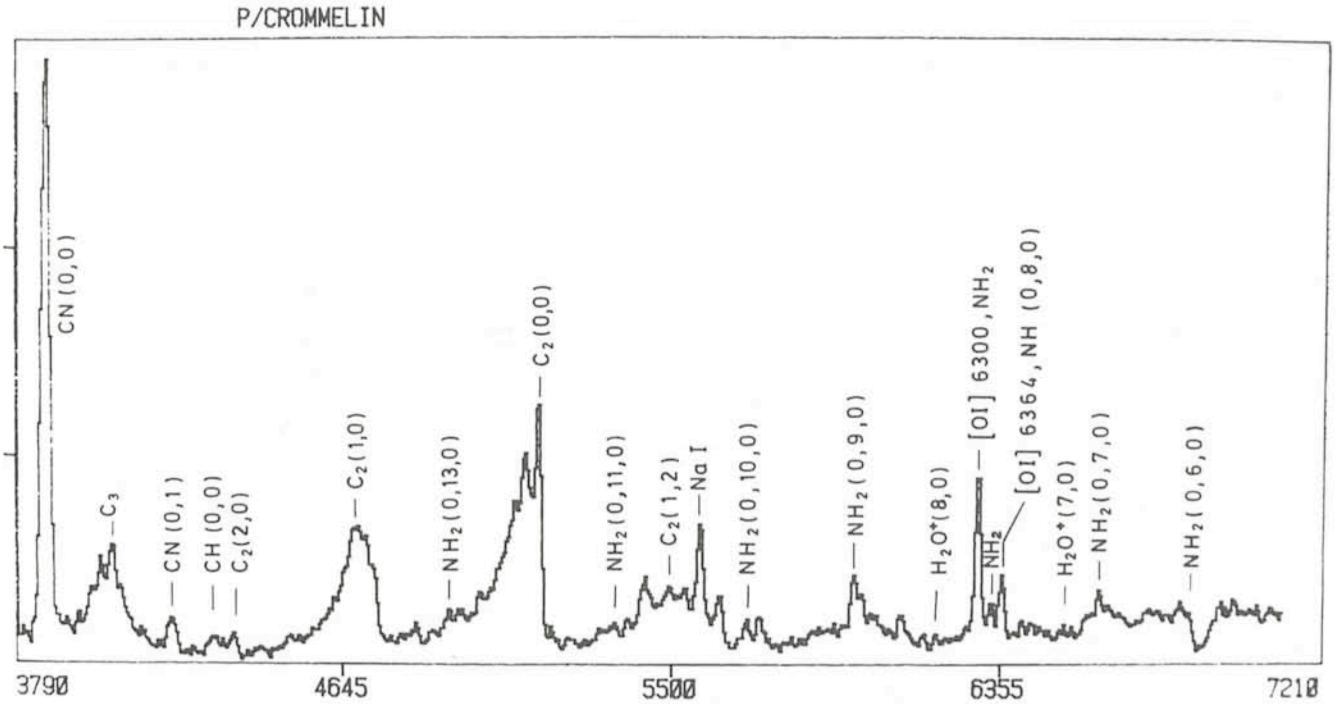

Fig. 1: *A 6 minute integration on Comet P/Crommelin taken at the 3.6 m telescope on March 9, 1984 (by J. Lub and R. Grijpe), using the Boller and Chivens spectrograph and IDS detector.*