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A DISTANT STAR CLUSTER IN HYDRA, AM-4

BARRY F. MADORE

Department of Astronomy, David Dunlap Observatory, University of Toronto,
Richmond Hill, ON L4C 4Y6, Canada

AND

HALTON C. ARP

Mount Wilson and Las Campanas Observatories, 813 Santa Barbara Street, Pasadena, California 91101

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A new apparently very sparse star cluster has been discovered on the ESO/SRC IIIa-J Southern Sky Survey. The system is probably another intergalactic globular cluster similar in distance to AM-1 (Madore and Arp 1979). The discovery of a second representative of this class of objects and especially the circumstances of its discovery raise considerable question as to the true density of these systems within the Local Group.

Key words: star cluster—sky survey

I. Background and the Discovery

In the course of our survey of peculiar galaxies and associations (see Arp and Madore 1977) using plates from the ESO/SRC Southern Sky Survey we have attempted to keep a record of any new distant star clusters such as those found earlier by Abell (1955) in his analysis of the Palomar Observatory (northern) Sky Survey. Similar, but more directed searches, have been conducted by the ESO staff and by the U. K. Schmidt Unit. In all, the results have been somewhat disappointing. Few truly new systems have been discovered and even among these there has been considerable overlap. (Lauberts 1976; Holmberg et al. 1978; Madore and Arp 1979) indicating, at first sight, that undiscovered distant clusters are extremely rare indeed.

This conclusion seemed to be underscored by the recent survey of Elson and Hawarden (1982). Using a low-power magnifier, Elson scanned about 30% of the entire sky as defined by the IIIa-J survey. She found no new clusters. She did however recover all previously known systems including AM-1.

Coincidentally, at the time that the Elson-Hawarden survey was being finalized we were also in Edinburgh concluding our search for peculiar galaxies. With our standard low-power scan (magnification 5X) of field 510 completed we switched to high power (20X) to reinspect the galaxies, confirm classifications, and measure characteristic dimensions. Two-thirds of the way through our list of objects an error occurred in setting up the position of the microscope; it was pointed quite by accident at a sparse cluster consisting of about two dozen stars and subtending an angular radius of just under one arc minute. We had not even vaguely noticed this object at low power. Elson had not seen this object in her extensive survey. And it has not yet appeared in the published ESO lists. We feel that even if there were a substantial number of similar objects on each of the other plates in the survey we would have missed them.

II. The Cluster Am-4

A reproduction of the field around AM-4 is given in Figure 1 made from the original ESO/SRC IIIa-J Southern Sky Survey which has a nominal plate limit of $m_J \simeq 23$ mag. Close inspection yields approximately 50 stars above the plate limit within a circle 110 arc seconds diameter. Glass copies of the POSS show relatively good resolution of the twelve brightest stars on the red plate and only incipient resolution of perhaps the seven brightest stars in the blue.

If it is assumed that the brightest stars are red giants appearing at $B \simeq 21^{m}.0$ then with $M_B \simeq -1.0$ and $A_B \simeq 0^{m}.5$ the first rough indication of the distance to AM-4 is 200 kpc. The visibility of high surface brightness galaxies around AM-4 indicates the absorption may be lower than the cosecant law predicts in which case the distance would be even larger. We are aware of the many uncertainties in the above estimate especially those inherent in assuming that the brightest stars in an apparently sparse cluster are red giants. Zwicky's (1955) original estimate of 80 kpc for the distance to the "Capricorn Dwarf" = Pal 12 was based on this premise and was quite wrong. In the case of Pal 12 the brightest stars are mostly near the horizontal branch and the distance is now estimated to be 17 kpc (Harris and Canterna 1980). If the stars in AM-4 are likewise on the horizontal branch the distance may drop by a factor of two or three.

However even at this early stage several pieces of evidence would seem to favor the larger distance: (1) the relative resolution of AM-4 on the POSS plates indicates

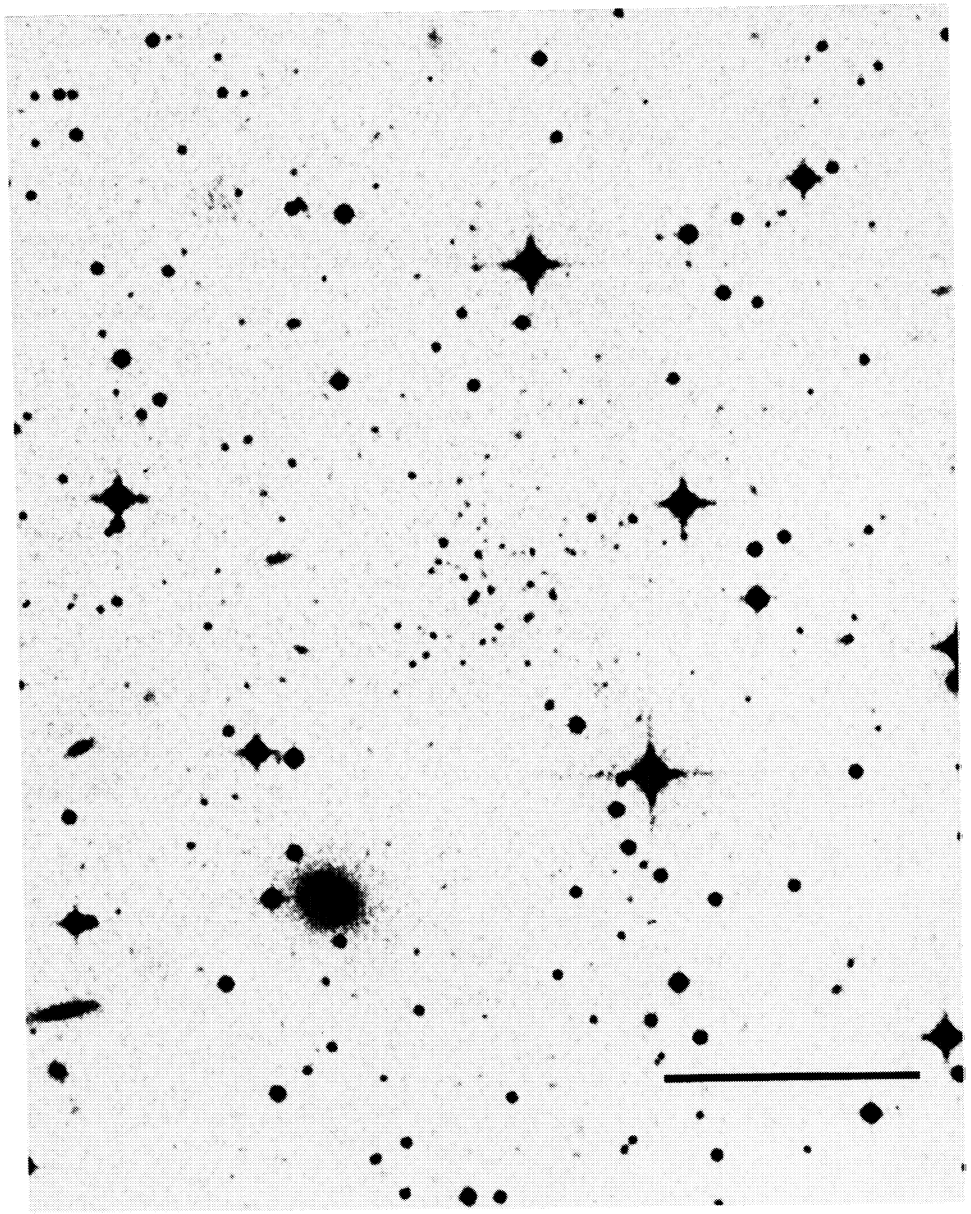

FIG. 1—A reproduction of the field around the star cluster AM-4. The horizontal bar in the southwest corner is two arc minutes in length. Note the high-surface-brightness galaxies to the southwest, indicating relatively low foreground obscuration. Photography by *Photolabs Royal Observatory*, Edinburgh, copyright © 1980.

that the stars are red, and (2) at extreme distances, even rich globular clusters with their brightest stars resolving close to the plate limit can *appear* very sparsely populated. AM-4 may be intrinsically rather rich. This is dramatically illustrated in Castellani's (1980) reproduction of a short-exposure plate of M92. Thus until large-scale reflector plates are available the status of AM-4 is far from clear.

III. Conclusions

While every reasonable effort was made to note new star clusters during our own and other inspections of the new Southern Sky Surveys the discovery process is by no means foolproof. An earlier impression was that few new clusters were to be found but now, unless the discovery of AM-4 proves to be a singular quirk of fate, many clus-

TABLE I

Characteristics of the Cluster AM-4

Position (1950):	RA = $13^h53^m00^s$	($\ell = 320°$)
	DEC = $-26°55'.7$	($b = +33°$)

Diameter = 110 arc sec

ters may have escaped undetected. The best that can be said is that somewhat deeper surveys and/or much more painstaking scans of available IIIa-J plates will be required before any definitive statement on the density of extreme halo or intergalactic globular clusters can be made.

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REFERENCES

Abell, G. O. 1955, *Pub. A.S.P.* **67**, 258.
Arp, H. C., and Madore, B. F. 1977, *Quart. J.R.A.S.* **18**, 234.
Castellani, V. 1980, in *Globular Clusters*, D. Hanes and B. F. Madore, eds., (Cambridge, England: Cambridge University Press), p. 65.
Elson, R., and Hawarden, T. 1982, *M.N.R.A.S.* (preprint).
Harris, W. E., and Canterna, R. 1980, *Ap. J.* **239**, 815.
Holmberg, E., Lauberts, A., Schuster, H. E., and West, R. M. 1978, *Astr. and Ap. Suppl.* **34**, 285.
Lauberts, A. 1976, *Astr. and Ap.* **52**, 309.
Madore, B. F., and Arp, H. C. 1979, *Ap. J. (Letters)* **227**, L103.
Zwicky, F. 1957, *Morphological Astronomy*, (Berlin: Springer-Verlag).