

## SHAHBAZIAN 123: A NEW DISTANT COMPACT GROUP OF COMPACT GALAXIES\*

L. V. MIRZOYAN†

Byurakan Astrophysical Observatory, Armenia, USSR

AND

J. S. MILLER AND D. E. OSTERBROCK

Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California,  
 Santa Cruz

Received 1974 September 3

### ABSTRACT

Image-tube scanner spectrograms were taken of seven objects in two Shahbazian compact groups of compact objects. The three brightest objects in Shahbazian 78 are all late-type stars. On the other hand, three of the brightest objects in Shahbazian 123 are luminous compact galaxies with  $z = 0.115$ , while a fourth is likely also to be a galaxy in the group.

*Subject headings:* galaxies, clusters of — redshifts

After Robinson and Wampler (1973) showed that the cluster Shahbazian 1 is a distant compact cluster of compact galaxies, a search for additional groups of compact galaxies was begun at the Byurakan Astrophysical Observatory. Shahbazian and others (Shahbazian 1973; Shahbazian and Petrosian 1974; Baier *et al.* 1974; Petrosian 1974), using Palomar Sky Atlas prints, and also direct photographs obtained with the 40-inch (1 m) Schmidt telescope of Byurakan Astrophysical Observatory, found more than 175 groups of objects classified on the basis of their appearance as of similar nature to Shahbazian 1. Most of these so-called compact groups of compact galaxies do not show any concentration to the center and have unusual configurations such as rings and chains, and many members of the groups have starlike images and very red colors (Shahbazian and Petrosian 1974).

In order to investigate further the nature of these groups, we selected two for observation: Shahbazian 78 ( $\alpha = 15^{\text{h}}12^{\text{m}}1$ ,  $\delta = +40^{\circ}15'$ ; 1975) and Shahbazian 123 ( $\alpha = 11^{\text{h}}43^{\text{m}}3$ ,  $\delta = +57^{\circ}39'$ ; 1975). These groups were selected on the basis of their location in the sky on the dates of observation, 1974 June 22–24 and June 29–July 1, and the objects observed appeared to be the brightest in each of these two groups. A total of eight objects are known in Shahbazian 78, and 11 objects in Shahbazian 123. Spectrograms were taken with the image-tube scanner (Robinson and Wampler 1972) and the new spectrograph attached to the Cassegrain focus of the 120-inch (3 m) telescope of three objects in Shahbazian 78 and four objects in Shahbazian 123. The wavelength range covered was approximately 3600–6000 Å. Because of limitations in observing time, the quality of the spectrograms was not as high as those obtained by Robinson and Wampler (1973), but nevertheless it was possible to

determine the nature and redshifts of six of the seven objects observed; some information was also obtained about the seventh object (Shahbazian 123, No. 2).

The three brightest objects in Shahbazian 78, Number 1, 2, and 3, had a stellar appearance on the television monitor under conditions of good seeing ( $\sim 1''$ ), and their spectra confirmed that they were indeed galactic stars. Objects 1 and 2 are definitely M dwarfs, and object 3 was observed only long enough to ascertain that it, too, was a late-type star of approximately M-type. Objects 4 and 5 did not appear stellar, but they appeared considerably fainter and were not observed, so it is possible that they are indeed galaxies. However, the identification of objects 1, 2, and 3 as stars makes it clear that the group as a whole does not constitute a group of compact galaxies.

The spectra of objects 1, 4, and 5 in Shahbazian 123 resemble those of E-type galaxies and are generally similar to the spectra obtained for the galaxies in Shahbazian 1 by Robinson and Wampler (1973). The spectral features most clearly identified were the characteristic sharp break in the continuum slope just longward of H and K of Ca II and the G-band. The K line itself was located near the nightsky Hg I  $\lambda 4358$  line, and the spectra were too noisy in this region to permit reliable measurement of this feature and the nearby H line, but it was possible to measure with confidence the break in the continuum slope just longward of these lines and the G-band. The rest wavelength adopted for the break was 4002 Å and for the G-band 4305 Å after Miller, Robinson, and Wampler (1973). None of these galaxies showed emission lines in their spectra. Independent spectra of each object were obtained through each of the two entrance apertures of the spectrograph alternately and were measured and reduced separately. Table 1 gives the average measured redshift,  $z$ , of three galaxies observed in Shahbazian 123. From a consideration of the quality of the spectra, it was estimated that the accuracy of  $z$  for each object is about 0.004, so the

\* *Lick Observatory Bulletin*, No. 681.

† Visiting Astronomer at Lick Observatory under the Exchange Program between the Academy of Sciences of the USSR and the National Academy of Sciences of the USA.

TABLE 1  
GALAXIES IN SHAHBAZIAN 123

Galaxy No.	$z$	$m(\lambda 5480)$
1.....	0.114	19.0
4.....	0.115	18.8
5.....	0.115	19.1

agreement to within 0.001 in  $z$  measured for the three objects is fortuitous. Table 1 also contains an estimate of the magnitudes of the galaxies at  $\lambda 5480$  determined by comparison observations of standard stars. Since each of the galaxies appeared larger than the entrance aperture used,  $2''.9$  by  $4''.0$ , these magnitudes are definitely upper limits, and it is possible that the total magnitudes could be as much as 1 mag brighter. Adopting the magnitudes listed in table 1 and a Hubble constant of  $55 \text{ km s}^{-1} \text{ Mpc}^{-1}$  gives absolute magnitudes of  $-20.0$ ,  $-20.2$ , and  $-19.9$  for objects 1, 4, and 5, respectively. Since the brightnesses are lower limits, it is evident that these galaxies are very luminous. Object 2 in Shahbazian 123 was not observed long enough to provide a spectrum of quality sufficient to provide a reliable redshift, but the spectrum obtained shows a continuum break near  $4450 \text{ \AA}$  as in objects 1, 4, and 5, and it is likely that this object is

also a galaxy in the group. The angular size of the group is approximately  $2'$ .

The above considerations suggest that the Shahbazian groups are likely to be a mixture of genuine groups of compact galaxies similar to Shahbazian 1 and 123 and chance groupings of stars and galaxies. The similarity between Shahbazian 1 and 123 is evident, as they are both compact groups containing luminous compact galaxies, though additional observations of Shahbazian 123 are required in order to determine if the velocity dispersion in this group is as low as that reported for Shahbazian 1. It does not appear that Shahbazian 1 is a unique cluster, as Arp, Burbidge, and Jones (1973) have supposed. Additional observations of a sample of other groups in the Shahbazian lists are desirable in order to ascertain what fraction of the groups are actually similar to the very interesting groups 1 and 123.

We are very grateful to Dr. E. K. Shahbazian for giving us data on the compact groups in advance of publication. We are also grateful to the National Science Foundation for partial support of this research under grants GP-29684 and GP-39505X. The first author wishes to thank the staff of Lick Observatory for hospitality and assistance during his visit.

#### REFERENCES

- Arp, H. C., Burbidge, G. R., and Jones, T. W. 1973, *Pub. A.S.P.*, **85**, 423.  
 Baier, F. W., Petrosian, M. B., Tiersch, H., and Shahbazian, R. K. 1974, *Astrofizika*, **10**, in press.  
 Miller, J. S., Robinson, L. B., and Wampler, E. J. 1973, *Ap. J. (Letters)*, **179**, L83.  
 Petrosian, M. B. 1974, *Astrofizika*, **10**, in press.  
 Robinson, L. B., and Wampler, E. J. 1972, *Pub. A.S.P.*, **84**, 161.  
 ———. 1973, *Ap. J. (Letters)*, **179**, L135.  
 Shahbazian, R. K. 1973, *Astrofizika*, **9**, 495.  
 Shahbazian, R. K., and Petrosian, M. B. 1974, *Astrofizika*, **10**, 13.

J. S. MILLER and D. E. OSTERBROCK: Lick Observatory, University of California, Santa Cruz, CA 95064

L. V. MIRZOYAN: Byurakan Astrophysical Observatory, Armenia, USSR