Halley Back to Normal

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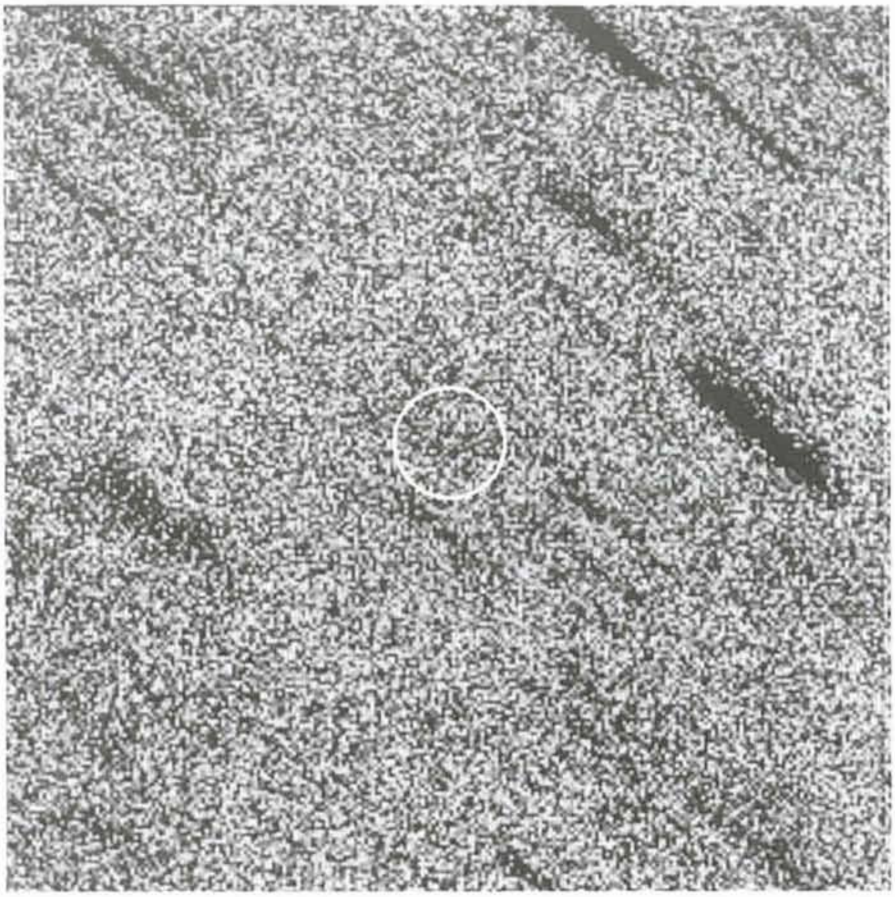

This photo shows a small sky area in the direction of Comet Halley, obtained with the ESO 3.5-metre New Technology Telescope (NTT) in the morning of April 6, 1992.

It is a composite of 10 individual exposures in the standard V-band, obtained between UT 2:33 and 4:58 with a total integration time of 130 minutes. They were combined in such a way that the image of the moving comet remains at the same position and the stars are therefore seen as trails. The position of Comet Halley is at the centre of the circle and is located only 2 arcmin north-west of a magnitude-7 galactic star. Its strong light introduced a very skew background illumination which was removed by fitting a 3rd-degree and subtracting.

At the time of the observations, Comet Halley was 15.67 AU (2343 million km) from the Earth and 16.22 AU (2424 million km) from the Sun. The predicted mean magnitude of the nucleus alone is V = 25.95, with variations from about 25.5 to 26.5 due to the rotation. A careful analysis indicates that there may be a very faint image near the limit of the combined frame at the predicted position, and with magnitude $V = 25.8 \pm 0.4$. However, it is hardly visible and this value must rather be considered an upper limit of the present brightness of the comet. But in any case, the magnitude cannot be much brighter than what is expected from the nucleus alone.

This observation therefore shows that the large dust cloud which was ejected during a dramatic eruption in late December 1990 and first observed at La Silla in mid-February 1991, has now effectively disappeared. At the present time, 16 1/2 months after the 19-mag outburst, there is very little, if any dust left near the nucleus.

The ESO observations of comet Halley will continue.

The photo covers an area of 85×85 arcseconds; north is up and east is to the right.

Spectroscopic Observations in the Cluster of Galaxies Abell 151

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Introduction

Redshift surveys in clusters of galaxies are needed to study their dynamical and evolutionary states, estimating parameters such as the mass, shape and distortion of the velocity field, presence of substructures or projected galaxies and groups, strength of dynamical friction and two-body processes and, in general, the present stage of their dynamical evolution. This information is useful not only to test scenarios of galaxy formation, but also of the formation and evolution of large structures.

In clusters, the mean velocity is a key factor in deriving distances, permitting the study of matter distribution over very large scales. Within clusters the analysis of the velocity field can lead to an estimate of the virial mass, constraining models of the dark matter content. Galaxy velocity measurements provide information complementary to that obtained through X-ray observations of clusters. Both form basic pieces of information for the understanding of clusters. However, reliable parameters are derived from analysis of large samples of velocities. These are laborious to obtain, a task made more efficient by the

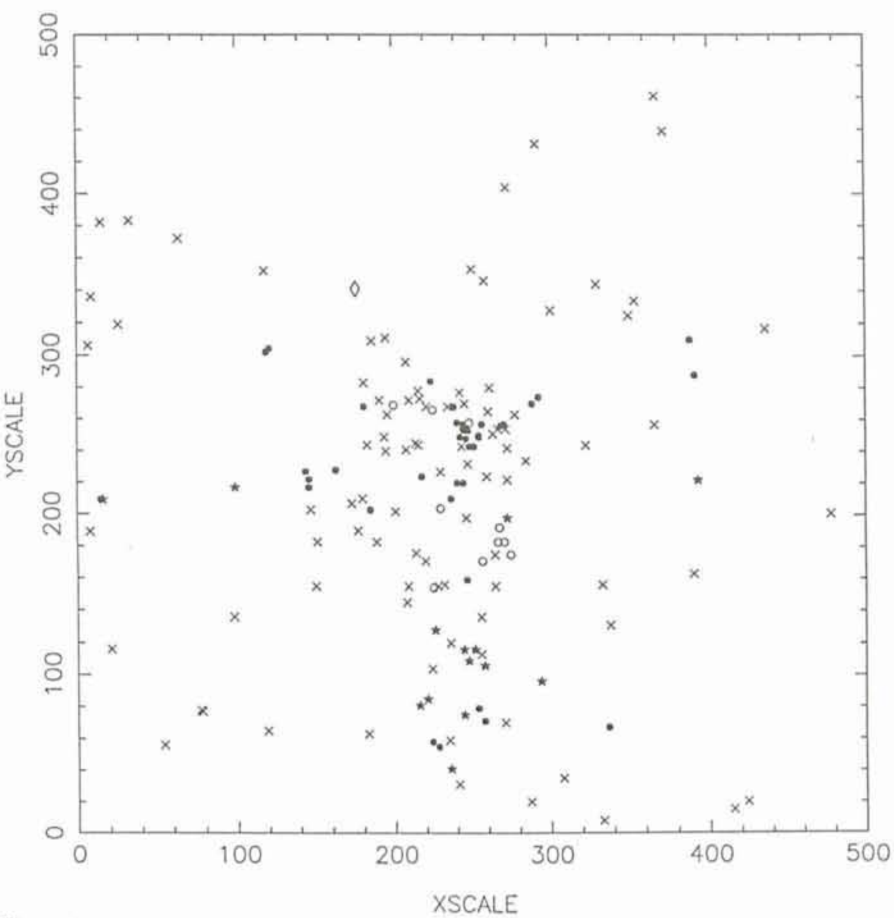

Figure 1.

wider use of multiobject spectroscopy. Here we study the velocity and galaxy distribution in the cluster A 151 which is a richness 1 one and a cDs RS-type for which 105 objects have been listed in Dressler's catalogue (1980).

Observations and Data Reductions

The programme of radial velocity measurements was carried out in December 1985 at the ESO 3.6-m telescope and in October 1990 at the ESO 1.52-m. We used the multiobject spectrograph OPTOPUS in its "old" configuration at the 3.6-m Cassegrain focus equipped with 35 separate optical fibers for collecting the ligth from galaxies spread over a field of 33 arcminutes diameter in the telescope focal plane. With the use of the F/1.9 dioptric spectrograph camera, each fiber output was projected onto an RCA CCD (512 × 320 pixel) detector with a fiber image size of 85 μm (2.8 pixels). A dispersion of 114 Å/mm was used, providing spectral coverage from 3800 to 5570 Å. The preparation of the drilled OPTOPUS plates was made by measuring positions of galaxies on the glass copy of the Palomar Sky Survey with the OPTRONICS machine at ESO-Garching, with respect to 20 reference SAO stars.

Observations with the 1.52-m telescope were carried out in October 1990. We used the Boller and Chivens spectrograph at the Cassegrain focus, equipped with the 600 lines/mm grating blazed at 5000 Å and coupled to an RCA CCD (1024 × 640 pixels) detector with pixel size of 15 μm. A dispersion of 129 Å/mm was used, providing spectral coverage from 3750 to 5700 Å.

The data reduction of the OPTOPUS data was carried out using the IRAF package, while the 1.52-m one was reduced at Garching using IHAP. The radial velocities were derived from the cross-correlation procedure developed at Meudon in the eVe software. Wavelength calibration was performed using the He-Ar lamp reference.

Results

With previous measurements in the same cluster (Proust et al. 1988), and few other data from literature, we obtain for A151 a total of 65 velocities. Ten galaxies with velocities greater than 20,000 km s^{-1} are background objects. During the preparation of the OPTOPUS observations, 158 galaxies were selected after inspection on the Palomar glass plates, considering suitable magnitudes in the central 40′ diameter field, approximately. Figure 1 shows all the galaxy positions symbolized with a circle for objects with $V_r > 20{,}000$ km s^{-1}, filled dot with $14{,}000 \leq V_r < 20{,}000$ km s^{-1}, and filled star with $10{,}000 \leq V_r < 14{,}000$ km s^{-1}. Non-measured objects are represented with a cross; A very

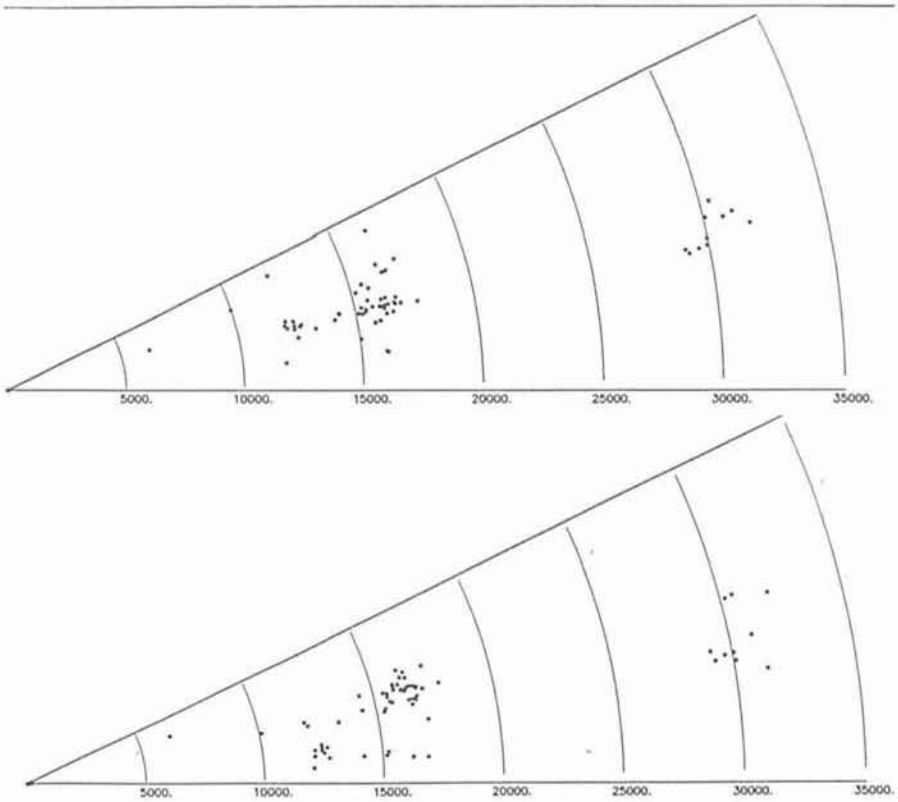

Figure 2.

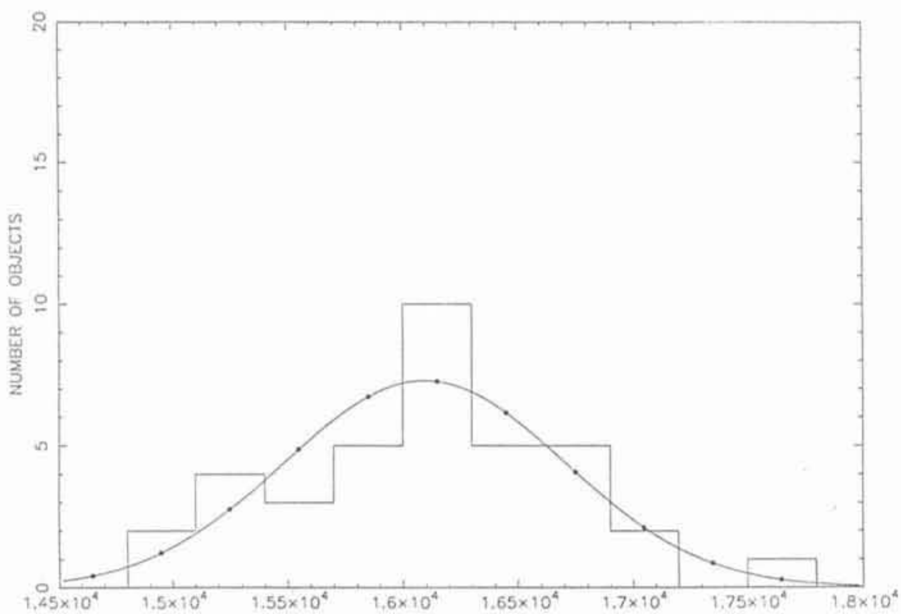

Figure 3.

foreground galaxy is symbolized with a diamond.

Figure 2 shows the velocity wedge diagrams in right ascension, and declination. From Figures 1 and 2 one can see the presence of a foreground structure in the southern region. Considering that in the 30 arcmin. central region the sampling is fairly homogeneous, we can estimate that the central D galaxy is located 5.2 arcmin. from the main cluster centre.

Figure 3 shows the histogram of radial velocities for the main cluster with a fitted Gaussian centred at the mean velocity $\bar{V} = 16090 \pm 94$ km s^{-1} with a corrected velocity dispersion $\sigma = 587^{+85}_{-61}$ km s^{-1}. From the standard Friedman cosmology (Mattig 1958) with:

$$D = \frac{c}{H_0 q_0^2 (1+z)} \left(q_0 z + (q_0 - 1)[\sqrt{2 q_0 z + 1} - 1] \right)$$

we obtain a mean cluster distance of 148 Mpc assuming $H_o = 100$ km s^{-1} Mpc^{-1} and $q_o = 0.1$ and an Abell radius of 35 arcmin. (1.51 Mpc); the foreground structure has a mean distance of 115 Mpc.

The dynamical mass estimations are tabulated below for the main cluster and for the foreground substructure:

Dynamical Mass Estimation	Main Cluster (10^{14} $M_\odot$)	Substructure (10^{14} $M_\odot$)
Virial Mass	2.05	0.28
Projected Mass	5.44	0.36
Average Mass	4.43	0.28
Median Mass	3.15	0.40

In order to check if the substructure is bound to the main body of the cluster, we have used the procedure which assumes radial orbits. The newtonian criterion for gravitational binding can be stated in terms of the observables as:

$$\frac{V_r^2 R_p}{2GM} \leq \sin^2\alpha \cos\alpha$$

where V_r is the relative velocity along the line of sight of the cluster and its substructure, R_p the projected separation between the cluster and the substructure, M the total mass (cluster + substructure) and α the angle between the cluster and the substructure with the plane of the sky. A necessary condition for bound solutions is that the left quantity in the above equation must be less than 1. Our computations lead to the conclusion that the substructure is not bound to the main cluster. Therefore, it is a projected foreground cluster.

The velocity data show 3 structures, the main cluster at $z = 0.0537$, a foreground group at $z = 0.041$ and a background population at $z = 0.1$. The nearest cluster with known z close to A 151 is A 133 ($z = 0.0604$). No close companions at the same z are apparent within 5 degree of A 151. However, the background galaxies have similar z as A 166 at $z = 0.11$. Moreover, the 4 clusters A 131, A 148, A 157 and A 159 have similar distance class = 5 and similar Abell radii $Ra_o = 0.28$ within 2 degrees of the centre of A 151. It seems likely that the background grouping belongs to a supercluster at $z = 0.11-0.12$. Within 6 degrees, there are three other clusters in this redshift range; Figure 4 shows the positions of the nearest clusters on the sky.

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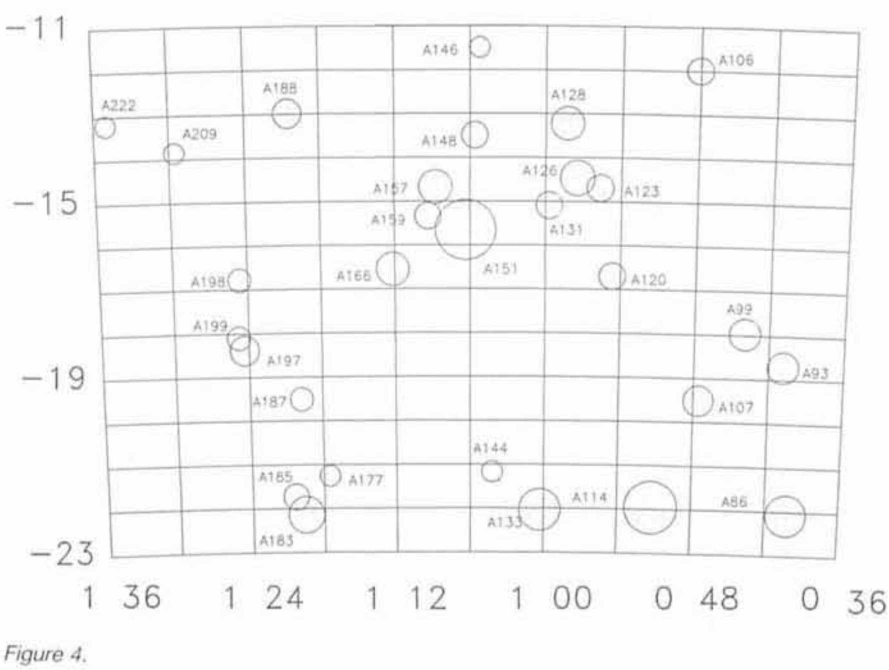

Figure 4.