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Seyfert galaxies and environment: Seyferts in galaxy pairs and groups⋆

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Abstract. The occurrence of Seyfert galaxies in 6 samples representative of different cosmological environments (i.e. isolated pairs, compact and loose groups) is analysed. To avoid biases linked to subjective sample selection criteria only canonical samples, taken from the literature, are considered.

It is found that the average frequency of Seyferts in all samples, is near 2%. Most Seyferts lying in pairs and compact groups show disturbed morphological appearance, whilst in loose groups disturbed and "isolated" Seyferts have roughly the same proportion.

Then, within each sample, structures which host a Seyfert are compared to structures which do not. No appreciable differences regarding dynamical properties are found.

Key words: galaxies: interactions – galaxies: Seyfert

1. Introduction

Galaxy interaction triggers thermal emission properties (Bushouse et al. 1990). It is not known whether interaction plays a dominant role in activating a Seyfert nucleus, or whether it is only marginally linked to the presence of active phenomena. Several studies have been carried out on this topic giving somewhat conflicting results (see e.g. Kelm 1996 and Kelm & Palumbo 1996).

QSO's, powerful radio galaxies and the most luminous IR sources nearly always show peculiar optical morphology or nearby companions, but for Seyferts any result pro or against an interaction-activity relation still seem to be sample biased (Petrosian 1983; Dahari 1985; Keel et al. 1985; Fuentes-Williams & Stocke 1988; MacKenty 1989; Kollatschny & Fricke 1989; for a discussion see Barnes & Hernquist 1992).

Among recent studies Rafanelli et al. (1995) reveal an excess of Sy 1 and Sy 2 in physical pairs, Monaco et al. (1994) show that although not all Seyferts inhabit high density regions, the most luminous and early-type spirals definitively do, and Laurikainen & Salo (1995) conclude that while some Sy 2 inhabit regions denser than average, Sy 1 do not. In Keel's (1996) investigation of Seyferts in pairs no preferred sense of orbital (direct/retrograde/polar) interaction is identified and kinematic disturbances in Seyferts are shown to be smaller than in non Seyfert spirals.

A major difficulty when dealing with these studies consist in defining a fair Seyfert sample and a control sample of "normal" galaxies, matching the Seyfert sample in everything except nuclear activity. Unfortunately no big Seyfert sample exists, at present, which can be considered homogeneous and/or complete in any sense. As a consequence no fair control sample can be built, either.

In what follows an attempt is made to collect statistical evidence for the activity-interaction relation using 6 well known catalogues of pairs and groups and looking for the frequency of Seyferts within each. Even though the 6 samples are not mutually comparable, and not always complete, this kind of approach overcomes the "control sample" problem, since both, Seyferts and "normal galaxies" are extracted from the same sample.

Furthermore within each sample, differences between structures containing and not containing Seyferts have been investigated. In Sect. 2 the samples which constitute the data-base are presented, in Sect. 3 Seyferts within each sample are listed. Sect. 4 deals with the frequency of Seyferts in each of the 6 samples, in Sect. 5 the reliability of the frequency found is discussed, and in Sect. 6 the behaviour of type 1 and type 2 Seyferts is compared. In Sect. 7 dynamical patterns of pairs and groups are analysed, and in Sect. 8 it is investigated whether there are differences between structures which host a Seyfert and structures which do not.

2. The samples

In order to achieve a clear understanding about the role environment plays in the activation and evolution of an AGN within a galaxy's nucleus, occurrence of Seyfert galaxies in:

- isolated pairs
- compact groups
- loose groups

has been evaluated.

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⋆ Tables 1 to 6 are only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

To accomplish the aim the following large available compilations have been considered : Karachentsev's (1987) and Reduzzi & Rampazzo's (1995)(hereafter R&R) catalogues of isolated galaxy pairs, Hickson's (1993, HCG) catalogue of compact groups, Ramella et al.'s (1989,1995 RGH), Maia et al.'s (1989, MdCL) and Garcia's (1993) catalogues of loose groups.

Karachentsev (1987) original compilation contained 585 isolated pairs of galaxies belonging to the northern hemisphere. The number was reduced to 487 after the redshift survey had been completed and more stringent criteria (i.e. $\Delta v < 1000$ km/s and ($M/(L_1 + L_2) < 100$) on the true physical nature of the systems had been applied (Karachentsev, Keel and Sharp unpublished, KKS).

Following Karachentsev criteria, R&R (1995) compiled a catalogue of isolated pairs in the southern hemisphere. Their original compilation contained 409 candidate pairs subsequently reduced to 301 after pairs in high density regions and galaxy-pairs within a common envelope had been excluded. R&R's catalogue is not complete in redshift; only 169 pairs have recession velocity measured for both members . After redshift completion some pairs might turn out to be optical and not physical, however the fraction of optical pairs is expected not to exceed 10% of the original sample.

HCG are compact, isolated systems of about 4 to 5 galaxies with projected separation comparable to the dimension of the galaxies. Hickson's catalogue (1993) lists 92 physically real compact groups, over a total of 100 candidates. Gravitational interaction among HCG galaxies is likely to be rather strong as suggested by the low velocity dispersion of the groups and by the large fraction of HCG galaxies showing signs of interaction. A large debate is open on the true dynamical nature of these groups and about their lifetime. Still, whichever the nature of these structures, they represent a peculiar environmental situation on which to investigate the influence of interaction on nuclear activity.

RGH's (1989, 1995) groups were found applying the Huchra & Geller (1982) group-identification algorithm to galaxies belonging to the first two complete slices of the CfA redshift survey. By this method 33 "rich" groups with at least 5 members were found. The sample is built with a magnitude-limit selection. It is therefore biased towards elliptical galaxies, and thus, indirectly towards clustered regions.

MdCL's catalogue (1989) contains 87 southern groups of galaxies (with at least 3 members) obtained applying the Huchra & Geller (1982) algorithm to the

Southern Sky Redshift Survey (SSRS, Da Costa et al. 1988) data. This sample is a diameter-limited one, as opposed to RGH's it favours spiral galaxies and is biased against compact objects.

Finally Garcia's (1993) catalogue contains 485 groups extracted from the Lyon-Meudon extragalactic database (LEDA) (Paturel et al. 1989a,b) through application of both, percolation and hierarchical algorithms. Like Hickson's sample, it covers the whole sky. It is limited to galaxies with radial velocity cz $\leq$ 5500 km/s and magnitude $m_B \leq 15.5$. It has the magnitude completeness limit of LEDA ($m_B = 14.0$).

3. Seyferts in the 6 samples

Galaxies in each of the above listed samples have been cross-checked with type 1 and 2 Seyfert listed in Veron-Cetty & Veron's AGN catalogue (1996, hereafter V&V). Each time a galaxy was found to be a Seyfert its spectral classification as type 1 or type 2 was taken from V&V.

V&V's catalogue is a compilation of galaxies which have been claimed to be Seyfert, and thus is by definition not complete and homogeneous. Nevertheless it contains a large number of Seyferts whose spatial distribution does not appear to be severely affected by "survey-biases" (i.e. there are not large regions in which the absence of Seyferts can be attributed to lacking of data). It can therefore be safely considered a reliable collection of Seyferts at least for a preliminary analysis. The choice of V&V might appear hazardous, since a complete spectroscopic survey of galaxies, from which Seyferts can be easily extracted, has become recently available (Ho et al. 1997 and references therein). However this survey is limited to the northern hemisphere and to $B_T \leq 12.7$. It is especially this last limit which is too strict for the purpose of our investigation.

For every Seyfert found to belong to each of the previously mentioned samples nearby environment has been visually inspected in order to look for a peculiar morphological appearance, if any. Peculiar means that the Seyfert presents one or more of the the following patterns : disturbed morphology, bridges, tails, double nuclei, rings. Seyferts belonging to loose groups have been looked also for the presence of one or more nearby companions which may eventually have not been included as group members because of magnitude faintness and/or lacking of redshift information. Inspection has been performed on DSS images and, for Seyferts belonging to Karachentsev couples also on CCD R images obtained at Loiano 1.52 m telescope (scale 0.56 "/pxl, field size 9'.6 x 9'.6).

Table 1 lists Seyferts found in northern isolated pairs; only true isolated pairs, 487 in Karachentsev's catalogue, have been considered. Together with Seyfert's name (column 1), V&V's spectral classification (column 2) (where n.c. means that no spectral classification is available in V&V), equatorial coordinates (column 3 and 4, epoch 1950) and the pair number to which each Seyfert belongs (column 5) are reported. Cases in which claimed isolated pairs were found to reside in loose or compact groups are also reported; the group identifier (as in the original reference) and the number of galaxies per group are shown, this last within parenthesis. Column 6 classifies, as peculiar or not peculiar, the morphological visual appearance of the Seyfert.

Table 2 is a list of Seyferts included in R&R's isolated pairs catalogue, Table 3 of Seyferts in HCG's catalogue, and Tables 4, 5 and 6 of Seyferts found in RGH's, MdCL's and Garcia's groups catalogues respectively. Entries in these tables have the same meaning as the ones in Table 1. Seyferts in loose groups have an additional column (column 7) in which the number of close companions is listed. This is to check for presence of companion galaxies to Seyferts within loose groups, as tidal interaction of

Table 7. Seyfert occurrence in pairs and groups. Column 1 lists the samples, column 2 the size of each sample, column 3 the number of Seyferts per sample, column 4 the fraction of Seyferts in each sample. Column 5 lists the number of structures (pairs or groups) per sample, column 6 the number of structures hosting a Seyfert and column 7 the fraction of structures hosting a Seyfert over total number of structures.

sample	N galaxies	N Sy	%	N struct.	N struct. with Sy	%
Karachentsev	974	18	1.8	487	18	3.7
R&R	602	7	1.2	301	7	2.3
Hickson	383	7	1.8	92	7	7.6
RGH	483	7	1.4	33	7	21.2
MdCL	540	15	2.8	87	11	12.6
Garcia	2703	72	2.7	485	61	12.6

other group member could be ininfluent, but a nearby neighbour could indeed stimulate an active nucleus.

There are 19 Seyferts (8 Sy 1, 10 Sy 2, 1 Sy n.c.) belonging to Karachentsev's sample of isolated pairs and 8 Seyferts (1 Sy 1, 6 Sy 2, 1 Sy n.c.) belonging to the R&R's one. The redshift information for Sy's companion galaxies still lacks in 4 R&R pairs, but images reveal interaction signs in 3 of them, strongly supporting physical connection with neighbours.

There are 7 Seyferts (2 Sy 1 and 5 Sy 2) belonging to HCG, 7 Seyferts in RGH's loose groups (3 Sy 1 and 4 Sy 2) and 16 Seyferts (5 Sy 1, 10 Sy 2 and 1 Sy n.c.) in MdCL's groups. Garcia's groups host 73 Seyferts (34 Sy 1, 38 Sy 2 and 1 Sy n.c.)

Three Seyferts in the samples are unclassified in V & V. Inspection of NED (the NASA/IPAC Extragalactic database) for recent available literature, has shown that none of these galaxies is classified as Seyfert. In fact: NGC1672 is a starburst galaxy according to Pastoriza et al. (1994) and a Liner according to Storchi-Bergmann et al. (1996), NGC 3169 is a Starburst galaxy (Devereux 1989) or a normal spiral galaxy showing nuclear activity similar to that seen in Seyferts (Keel 1983) and NGC 824 is a ringed galaxy (Buta 1995). Therefore these galaxies can safely be excluded in the subsequent analysis.

Concerning loose groups it must be stressed that RGH is a " rich group" sample, if compared with MdCL where most (57 %) groups are 3 members groups. The 16 Seyferts identified in MdCL groups, however, belong mostly to rich groups (only 4/12 are 3 members groups).

4. Occurrence of Seyferts in pairs and groups

Pairs and groups should in principle be the most suitable site for interaction to occur. Interaction can then induce Seyfert activity in those galaxies where, thanks to self gravity, enough matter collapses onto the innermost nucleus.

Table 7 shows the frequency of Seyfert in the 6 pair and group samples which have been considered. The table contains the sample id (column 1), the total number of galaxies for each sample (column 2), the total number of Seyferts (column 3), the percentage of Seyferts with respect to the total number of galaxies (column 4), the number of structures (pair/group) per sample (column 5), the number of structures containing one (or more) Seyfert (column 6) and the percentage of structures with Seyferts compared to the total number of structures (column 7).

The frequency of Seyferts over the total number of galaxies is quite similar in all samples ($\approx$ 2%) and slightly larger than Seyferts' spatial density (1.3%) among all CfA galaxies at integrated absolute magnitude -20.0 (Huchra & Burg, 1992). Comparison of the two percentages however does not allow the draw of any conclusion regarding an hypothetical Seyfert excess in pairs or groups with respect to isolated systems, as the CFA survey contains galaxies belonging to a wide-spanning range of environments.

To look for differences between dense structures and loose groups the frequency of structures containing one (or more) Seyferts over total number of structures (column 7, Table 7) has been computed as well.

Data reveal that 10 to 20% of loose groups harbour a Seyfert as compared to 2 to 6% found in compact systems (isolated pairs/compact groups).

If one considers however that there are roughly 4 times as many galaxies in loose groups as in pairs and compact groups (Geller & Huchra 1983) it appears that isolated pairs, compact and loose groups seem equally likely candidate environments for a spectroscopic survey aiming at finding new Seyferts.

The overlap among the samples is not relevant and should not affect the statistical results. One might argue whether the spectroscopic quality of the data is the same for all six samples. The peculiar morphological appearance of galaxy pairs and HCGs has attracted attention and therefore spectroscopic data on these objects are, generally, of better quality and resolution than for other objects.

Figure 1 shows Seyfert's frequency (N (%)) in each of the samples (1 to 6). The frequency in panel **a** refers to the number of Seyfert galaxies divided by the total number of galaxies included in each of the samples, the frequency in panel **b** refers to the number of pairs or groups hosting a Seyfert divided by the total number of pairs or groups in each sample.

5. Frequency of Seyfert galaxies: a discussion

The frequencies quoted in Table 7 are possibly only an indication of what one would obtain dealing with complete samples. A number of biases enter the samples all contributing at keeping Seyfert's frequency low.

In fact, within each sample a cut in luminosity increases Seyfert's frequency, as active nuclei are much more common among galaxies of high absolute luminosity. This is especially

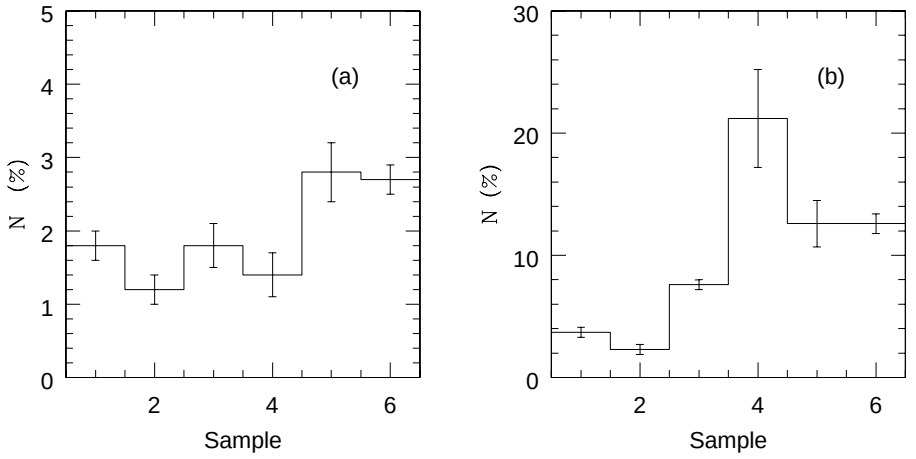

Fig. 1a and b. Occurrence of Seyfert galaxies (N (%)) and Poisson error within each sample. Numbers from 1 to 6 correspond to Karachentsev's, R&R's, HGC's, RGH's, MdCL's and Garcia's samples respectively. Panel **a** shows Seyfert's occurrence with respect to all sample galaxies, panel **b** shows the occurrence of structures (pairs/groups) hosting a Seyfert with respect to all structures.

true for Sy 1 galaxies in which nuclear brightness accounts for even 90 % of the total galaxy luminosity (Granado et al. 1993, Kotilanen et al. 1993). Nevertheless a check on the six galaxy samples shows that Seyferts are not usually the most luminous galaxies within each structure which allows to conclude that the luminosity bias should not significantly affect the data.

A second bias entering the computation is linked to a morphological effect. As Seyferts are more common among Spirals, one can test how figures change when early type galaxies are excluded from the original samples. The frequency of spiral Seyferts over spiral galaxies is the following: 2.5% in Karachentsev's pairs, 3.3 % in R&R's pairs, 3.9% in HCG's and 3.4% in Garcia's. RGH and MdCL samples have been excluded from the above analysis since morphology is already affecting the sample selection criteria.

A different aspect which might contaminate the computation of Seyfert's frequency in the samples is the exclusion of a morphological criteria able to distinguish between pairs (either isolated or within a group) presenting clear interaction patterns and pairs with no signs of distortion.

In fact samples used in the present analysis have been derived by means of objective criteria based on the local numerical density of galaxies (down to a magnitude limit). Visual inspection of Seyferts lying in groups and pairs has been performed to check whether and how often an active nucleus within these structures is associated to any specific pattern.

Seyferts in isolated pairs and compact groups have been classified (Table 1 to 3) as morphologically peculiar or not peculiar, Seyferts in groups also on the basis of the presence of one (or more) nearby companion. This scheme is rather simple, it does not attempt to distinguish among the different types of interaction patterns, but articulated enough to seek for a relation between Seyfert activity and interaction.

It turns out that the fraction of disturbed Seyferts is larger in galaxy pairs than in galaxy groups (even if the fluctuation is quite large). It is, in fact, 95% for Karachentsev's sample, 88% for R&R's , 57% for HCG's, 43% for RGH's, 67% for MdCL's and 38% for Garcia's.

Concerning Karachentsev's sample the fraction of disturbed Seyferts over the total Seyfert sample (95 %) can be compared with the total fraction of disturbed pairs over the total sample (59% as reported by KKS). The excess however should be taken with caution since pairs with a Seyfert component have been examined on CCD or DSS images while morphological classification of remaining pairs has been derived from PSS prints.

The fraction of "isolated" Seyferts within loose groups (i.e. galaxies having N in column 6 and 0 in column 7) is 29% in RGH's sample, 27% in MdCL's sample and 43% in Garcia's sample. The fluctuation in the fraction of disturbed and "isolated" Seyferts in loose groups get reduced if only "big" groups are considered. If only loose groups with 10 or more members are considered the fraction of peculiar Seyferts is 40 % in RGH, 44 % in MdCL and 34 % in Garcia; the fraction of "isolated" galaxies within the group becomes extremely stable too : 40 % in RGH, 44 % in MdCL, 45 % in Garcia's. The result is quite comforting as loose group samples have been drawn from different galaxy catalogs and with different selection criteria. What does this finding mean ?

These samples are not directly comparable, as selection criteria are different so no indication can be drawn as to what concerns the relative frequency of interacting Seyferts in isolated pairs vs. loose groups. One is just allowed to interpret these data as an indication that a majority of Seyferts in samples of isolated pairs and compact groups presents morphological distortion, while in loose groups the fraction of peculiar and isolated Seyferts is quite similar.

6. About the revealed excess of Seyferts 2 over Seyferts 1 in structures

The frequency of Sy1 and Sy2 is similar in Karachentsev's, RGH's and Garcia's samples, but very different in the remaining 3 samples, thus prohibiting any firm conclusion concerning the difference or similarity of Sy1 and Sy2's global environment.

To correctly evaluate the matter one should compare the number of Seyferts in pairs and groups within a given volume and with definite Hubble type and brightness constraints, to the total number of Seyferts fulfilling the same constraints keeping type 1 and type 2 objects separate. Unfortunately, as far as our samples are concerned, this kind of test cannot be easily accom-

Table 8. Pairs and groups: statistical dynamical parameters. Column 1 lists the sample name, column 2 the number of structures (pairs/groups) per sample, column 3 and 4 mean and median galaxy-galaxy separation **R** and column 5 and 6 mean and median velocity dispersion σ**.**

sample	N	R_{kpc}^{mean}	R_{kpc}^{median}	$\sigma_{km/s}^{mean}$	$\sigma_{km/s}^{median}$
Karachentsev	487	26.3	18.1	146.4	104.0
R&R	301[1]	54.5	34.0	191.2	116.0
Hickson	92	44.8	39.8	216.5	204.2
RGH	33	743.9	690.0	271.0	228.0
MdCL	87	565.2	530.0	218.6	187.0
Garcia	485	908.1	664.0	163.0	148.1

[1] Computed values for R&R's sample refer to the 169 pairs with redshift coverage for both members.

Table 9. Separation R and velocity dispersion σ for pairs and groups with and without a Seyfert component. For each sample (column 1) the number of Seyferts (column 2) and of non Seyferts (column 3) is tabulated. Column 4 and 5 show the mean galaxy-galaxy separation **R** for structures which contain and do not contain Seyferts and similarly column 6 and 7 give the mean velocity dispersion σ**.**

sample	N_{Sy}	N_{noSy}	R_{Sy}	R_{noSy}	σ_{Sy}	σ_{noSy}
Karachentsev	18	469	26	27	126	146
R&R[1]	7	294	48	55	321	187
HCG	7	85	41	45	181	219
RGH	7	26	811	726	304	263
MdCL	12	75	792	529	269	211
Garcia	61	424	980	892	199	158

[1] Computed values for R&R's sample refer to the 169 pairs with redshift coverage for both members.

plished. Only for Seyferts in Garcia's sample (limited in redshift and magnitude) the fraction of Sy 1 and Sy 2 contained within groups could be computed and compared to the total number of Sy 1 and Sy 2 fulfilling similar redshift and magnitude limits. The "complete" comparison Seyfert sample was drawn from the V&V compilation. The result indicates that 53% of all Sy 1 (with cz $\leq$ 5500 and brighter than m_B = 14) and 48% of all Sy 2 are in groups. Thus, according to these data, Sy 1 and Sy 2 do inhabit nearby groups with similar occurrence. Furthermore as Garcia claims that 43% of all galaxies in her original sample are in groups, the above result also implies that in the nearby Universe Seyferts are distributed in loose groups with roughly the same occurrence than in normal galaxies.

7. Pairs and groups: dynamical patterns

Galaxies approaching at velocities much higher than the stellar velocity dispersion are not perturbed by close encounters, while one expects interaction to have spectacular consequences on close pairs approaching at low velocity . If interaction is responsible for the activation of a Seyfert nucleus one expects that those pairs/groups which host a Seyfert have lower separation and velocity difference/dispersion than those without. Fast encounters would produce smaller disturbances (Barnes & Hernquist 1992, Combes et al. 1988)

Therefore, if interaction produces activation of a Seyfert nucleus one would expect systems hosting a Seyfert having somehow particular patterns, not to be found in those systems which lack an active component. If these patterns are identified, they constitute a set of constraints which could be used to discriminate, a priori, between systems which host a Seyfert, and systems which do not.

As a first step dynamical parameters of pairs and groups have been compared to see whether these structures are actually representative of different dynamical environments.

In Table 8 galaxy separation **R** and velocity dispersion σ are reported for each sample. Distributions are not gaussian, median and means are tabulated; differences, however, are only marginal.

Galaxies in loose groups have a much higher mean separation than pair members, but similar velocity differences. The large difference in **R**, however, is just the consequence of a bias intrinsic to two dimensional pair selection, as one has to introduce a maximum distance between pair members in order to discriminate against optical pairs.

From dynamical data only it seems that galaxies in compact or loose structure do not really experience a different environment.

Groups are not well defined entities, they are not homogeneous and not dense in the usual sense. Within one same group there might be a close pair with galaxies at 100 kpc separation, and galaxies with no neighbour within a 500 kpc radius area.

In a group comparison of mean separation and mean velocity dispersion computed considering all group members might oversee a link on smaller scales. Maybe one should not look at the whole of the group, but just at the nearest neighbour of a Seyfert. For the loose groups in the RHG and MdCL samples, it was therefore also investigated whether Seyferts were member of close pairs within the groups. Focardi & Kelm (1997) found that Seyferts are often components of pairs with a separation lower than the mean group galaxy-galaxy separation, which they thought could be a point in favor of the interaction-Seyfert triggering paradigm. But then they also found that usually Seyferts are not components of the very closest pairs in a group, and,

moreover, that most of the groups do host a close pair, without however hosting a Seyfert.

8. Is there any difference between systems with and without a Seyfert?

Looking for dynamical discriminant favoring Seyfert activity, velocity dispersion and galaxy separation in groups and pairs, belonging to the 6 samples described before, have been compared. Pairs and groups hosting a Seyfert are kept separated from those which host no active members; Table 9 lists mean linear separation and mean velocity dispersion.

Figures in Table 9 show that structures hosting Seyferts do have dynamical properties similar to structures without, implying that mean linear separation and mean velocity dispersion are not adequate parameters to discriminate between systems with or without active members. Comparison of means could be misleading, but one gets the same result, at a ($3\ \sigma$) level, when the Kolmogorov-Smirnov test is applied to the distributions. Only when applied to velocity dispersion in Garcia's groups, the KS indicates a difference between structures with and without Seyferts.

Thus it can be stressed that, as far as dynamical patterns are concerned, no statistically significant difference is observed between groups and pairs hosting a Seyfert member and those which do not.

9. Conclusions

Seyferts belonging to 6 large samples of galaxies in pairs and groups have been identified. The frequency of Seyfert phenomena in the different environments has been investigated and differences between structures containing or not an active member have been looked for. It has been found that:

1. the occurrence of Seyfert components among galaxies in isolated pairs or groups is near to 2%.
2. Sy 2 are nearly as numerous as Sy 1 in Karachentsev's, RGH's and Garcia's samples, in the remaining 3 samples Sy 2 are more numerous.
3. Most Seyferts in isolated pairs and compact groups are morphologically disturbed, while in large loose groups roughly half are disturbed and half are well separated from the remaining group members.
4. The mean velocity dispersion and the mean linear separation of groups and pairs are not a function of their hosting a Seyfert member.
5. Seyferts are not associated to close pairs/groups with low velocity dispersion.
6. Seyferts in groups are not member of the very closest pairs within the groups.

From the result of the present work one is lead to conclude that environment's dynamical parameters of structures hosting a Seyfert are not directly linked to the mechanism able to activate it. Thus, if the environment is likely to play a role in activating a nucleus, different parameters, other than dynamical, have to be analysed.

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