Intrinsic Redshifts in Quasars and Galaxies

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ABSTRACT

We report a cluster of quasars that has 21 of its members at redshift $z = 2.149$ within a range of only $\pm.019$. It has an extension across the sky of ≥ 3.2 degrees. At its conventional redshift distance it would have a huge diameter of 249 Mpc. The front and back should reflect the expansion of space of about $13,700\ km/s$, but measured velocities within the cluster are only of the order of $1,000\ km/s$.

A previously catalogued, compact galaxy lies near the cluster center. When transformed into the rest frame of this galaxy of origin the quasar cluster redshift is $z_0 = 1.96$, which is exactly the most prominent Karlsson peak redshift! We explore bright galaxies in this region and find they typically have companions at the Karlsson peak periodicity, including NGC 7361 with many physical companions at the lowest Karlsson peak periodicity of $z_K = .06$. A sampling of similar groupings of companions around other bright spirals shows the same abundance of redshifts, $z_K = .06$ ($\pm.01$). From the large numbers in this transition stage from quasar to galaxy they could be said to form a major constituent of the universe.

Most importantly, it is found that when high redshift quasars are linearly paired across a galaxy that their intrinsic redshift can be measured directly as it splits into two oppositely directed components. The intrinsic redshift of the ejected quasars falls uncannily close to the predicted Karlsson peaks - within $\pm.01$. It is argued that data going back to 1968 confirm that quasars are ejected and evolve in luminosity and redshift into normal galaxies which lie on or near the classic Hubble relation.

Subject headings: galaxies: active - galaxies: individual (AM 2230-284, NGC 7361, NGC 7793, NGC 4410, UM 341, NGC 4151) - quasars: general

1. Introduction

Since the discovery of quasars in 1963 they have been generally viewed as compact objects with high redshifts. Those redshifts are assumed to be due to their recessional velocities in an expanding universe where they are viewed as highly luminous objects. Over the years, however, observations have accumulated which indicate that high redshift quasars can be associated with (at the same distance as) low redshift, relatively nearby galaxies.

In the following investigation we encounter a new kind of extra galactic object: It has the redshift of the lowest redshift quasars, $z = .06$, or about $18,000\ km/s$ and a luminosity ranging between that of a compact dwarf galaxy and a supergiant star. We will discuss this further later in Section 10.

The necessary data comes from analysis of the complete survey of galaxies and quasars in the 2dF deep field, covering about 740°^2} (Outram et al. 2003) on the sky (Fulton & Arp 2009). Two advances in astronomical data handling are crucial in attempting such a broad change in astronomical concepts. One is the depth of the 2dF redshift survey and the other is redshifts of so many new quasars, galaxies and intermediate objects.

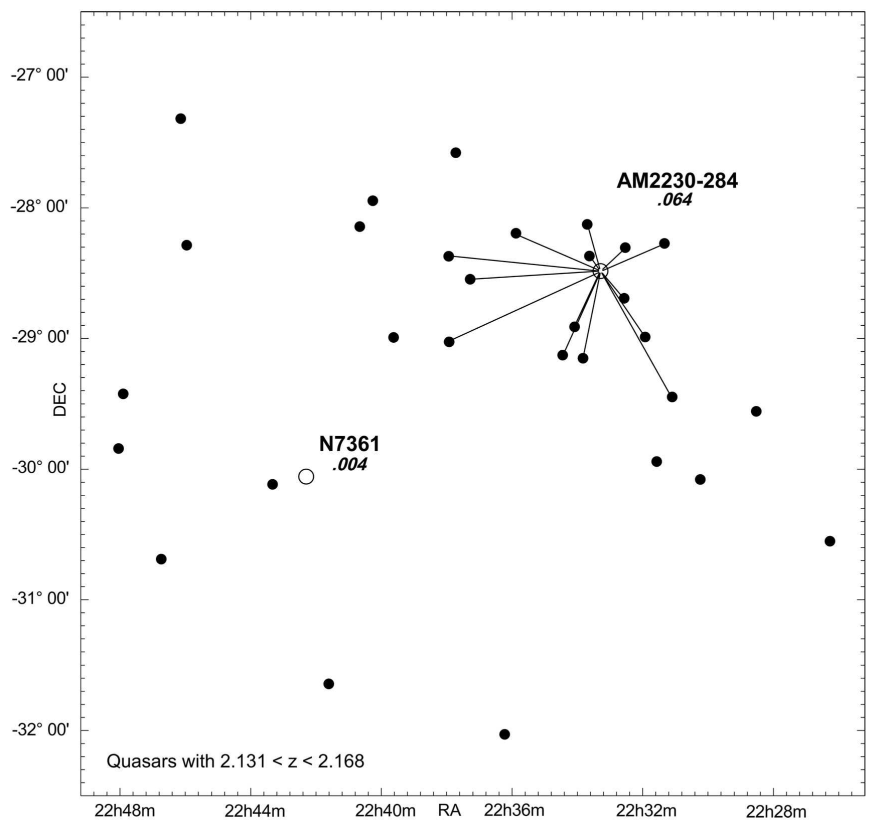

Fig. 1.— Plot of catalogued quasars $2.131 < z < 2.168$. The central 14 quasars are shown connected back to the compact galaxy.

There are three kinds of evidence for the existence of non-velocity redshifts:

1) Statistical association of objects having much different redshifts. (See e.g. analysis by C. Fulton (Fulton & Arp 2009) of the 2dF deep field, and Burbidge & Napier (2009).)

2) Interaction between objects of different redshift (including high redshifts aligned across active galaxy

nuclei).

3) Quasars occurring preferentially at certain specific redshifts.

The latter precludes redshifts caused by recessional velocity because it would require matter distributed in shells and receding velocities in discrete steps.

The observed, periodic values for redshifts have received relatively little attention but are very important for the discussion following in this paper. We make the following short comments on this situation:

1.1. A Cluster of $z = 2.14$ Quasars

During analysis of the relation of quasars to galaxies in the 2dF deep field (Fulton & Arp 2009) a concentration of quasars was noted. Most striking was the closeness in redshift of 14 central quasars about the mean redshift $z = 2.149$ with a range of $\pm .019$. The cluster in spite of its high redshift subtended an area of diameter 2.3 degrees on the sky. At conventional redshift distance its diameter would be 180 Mpc (Arp & Fulton 2008b).

When first discovered the cluster was traced out to $70'$ and that was the extent for which the initial calculations were made. When a larger area was plotted, however, it became clear that there were 4 more quasars at this precise redshift range in the NE direction and 3 more in the SW - apparently outlining a cluster now of at least 21 quasars covering a diameter on the sky of 3.2 degrees (see Figure 1).

In the conventional assumption that redshift indicates distance in an expanding universe the derived size of this cluster of quasars, 249 Mpc, would be unprecedentedly larger in extent than any previously known. (E.g. the Virgo supercluster of galaxies is ~ 30 Mpc in diameter if we are on the outskirts.) Moreover this much larger size cluster would occur in an expanding universe much smaller than the present one. If one uses the Sandage & Tammann (1981) smaller definition of the Virgo Cluster as having a radius of 6 degrees on the sky, this leads to physical dimensions of the Virgo Cluster of about 3 Mpc versus 250 for the present quasar cluster.

1.2. The Cluster as an Entity

If we plot the histogram of quasar redshifts inside $r = 70'$ we find about a 5 sigma spike at the redshift of the cluster (see the announcement of the discovery in Arp & Fulton (2008b)). More accurately, the 4.28°^2} area which encloses the 14 innermost cluster members has a background count of 3 for the redshift interval immediately on either side of the spike. This gives a $(14 - 3)/(\sqrt{3}) = 6.4$ sigma result.

Because the term "cluster of quasars" is unfamiliar, the question arose as to how to treat the boundaries and probability of the observed object density. Visually, as stated above, we took the innermost 21 quasars as the apparent 3.2° extension on the sky. In our analysis of cluster quasars, however, we choose an area of maximum density. The area within $r = 70'$ contains 14 of the $z = 2.194 \pm .019$ variety of quasars in an area of 4.28°^2}.

Outside the circle around the cluster depicted in Figures 1 and 5 is an area S, E and SE of the cluster. This is the region with minimum association with the cluster and we have measured its area of 15.4°^2} together with the upper limit of 9 quasars as the best value for the background to measure the cluster quasars against.

An area of $4.28^{\circ 2}$ should contain $(9/15.4) \times 4.28 = 2.50$ background quasars. This gives a probability of $S/N = (14 - 2.50)/(\sqrt{2.50}) = 7.3$, a 7 sigma result that the cluster cannot be due to an accidental density fluctuation.

The signal consists of real quasars in their real positions with apparent magnitudes of the same order and moderate individual probabilities. There should be no Poisson complications or manufactured noise levels. One expert in talking to us noted that if the signal was well above the noise, its Gaussian properties were not of great concern. Our result is robust in that even if we double the number of background sources in our test circle we still get a 4.0 sigma result.

Statistically then the cluster confirms the visual judgement from Figure 1 that it is an independent aggregation of similar quasars. The most exciting possibility is then raised - finding out how this cluster had originated and/or its relation to other objects in the vicinity.

1.3. Considerations for AM 2230-284 Being the Origin of the Quasar Cluster.

Fortunately many years before anything had been known about this particular area a "Catalogue of Southern Peculiar Galaxies and Associations" (Arp & Madore 1987) had recorded a compact (high surface brightness) galaxy, listing it as AM 2230-284. In the current computer analysis of galaxies with the most associated quasars that peculiar galaxy (mag 17.33) emerged as the strongest association among the top 44 families (Arp & Fulton 2008a). We make the following points:

(1) The property of high surface brightness has come to be associated with star forming and ejecting galaxies. The fading time after an internal event in the galaxy must be rather short, as indeed must also be the case for the very compact quasars.

(2) The radio map of AM 2230-284 confirms activity and repeats the compact, sharply edged, optical appearance (see Figure 7 here).

(3) The quasars surround a region with small redshift displacements symmetrically toward and away from the observer. Only ejection from a recent event near the center of the cluster would seem explicable (see Figure 2).

(4) The redshifts of all 14 quasars, when corrected to the frame of reference of AM 2230-284, yield exactly $z_K = 1.96$, the major Karlsson redshift periodicity!

The brightest quasar is apparent mag. 19.5b and the faintest mag. 20.8b. Its 21 members would place it as poorer than the Abell (1958) criterion of richness of 50 or more brighter than 2 mags. fainter than the third brightest member. It would be of great interest to get very deep optical images to see if there were fainter potential members which could be evolving toward brighter galaxies with time.

1.4. Quantitative Evidence for Ejection Origin of the Quasar Cluster

Quasar redshifts are very large, positive and, as we have seen, discretized and/or periodic. All of these observed properties militate against their acceptance as recessional velocities. The remaining possibility is that extragalactic redshifts are intrinsic. In Narlikar (1977), Narlikar & Arp (1993), and Arp (1998a) the redshifts are interpreted as age effects with younger matter having the greater excess. Regardless of what causes the non-velocity redshift, however, there may be small velocity effects which impose a negative or positive component on the main redshift.

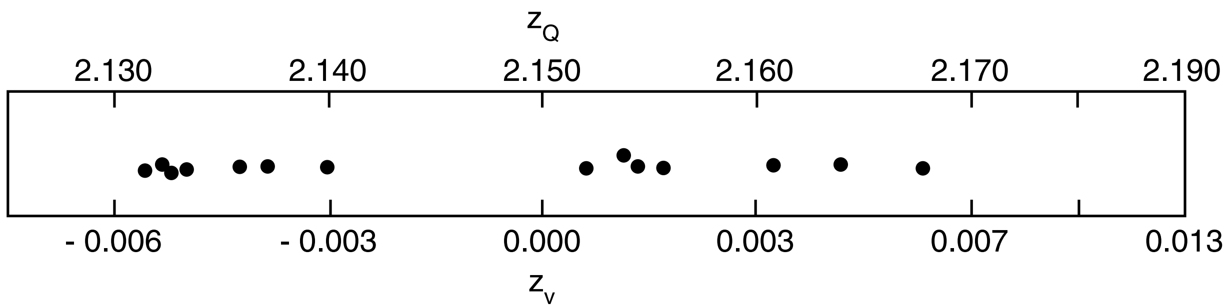

Fig. 2.— The Redshifts (z_Q) of the 14 QSOs within 70′ of AM 2230-284. Their mean is $z = 2.148$.

In Figure 2 we display the residual redshifts from the mean cluster redshift of each of the innermost 14 quasars. The first result that attracts the eye is that 7 quasars have slightly higher redshifts than the mean and 7 quasars have slightly lower. This is exactly what one would expect from the empirical evidence over the years of ejection of *oppositely directed pairs from parent galaxies and AGNs.* The Figure 2 observations should demonstrate quantitatively that quasars are ejected from active galaxies as follows:

These small observed red and blue shifts enable us to measure the current velocities of ejection, z_v, as described in Appendix B. The net shift toward lower z_v is .027/7 = .0039 and to higher is .021/7 = .0030. This translates into −1200 and +900 km/s average current outflow velocity. An even smaller gap between the inner plus and minus velocities is shown when the central peak splits just at its maximum into two components. This same effect is observed in the active galaxy UGC 8584 (Arp & Fulton 2008a) and it supports both the ejection and pairing of initially small, proto quasars.

1.5. The Quasar Cluster Redshift Falls Exactly on a Major Karlsson Peak

As areas around large, nearby galaxies were explored it became obvious that when quasars fell closer on the sky to low redshift galaxies than expected by chance that the Karlsson series was accurately defined (Arp et al. 1990). There was one important requirement, however, that the redshift of the companion quasar had to be transformed into the reference frame of the parent galaxy whenever the latter was appreciable.

In the present case we calculate what the redshift of the cluster quasars would be in the reference frame of their apparent galaxy of origin, AM 2230-284. We use the standard formula for transforming frequency shifts: (See Appendix A).

$$(1 + 2.149)/(1 + .064) = (1 + z_0)$$

Numerically the mean redshift of the cluster is 2.149 and the redshift of the AM galaxy is .064. We solve for z_0, what the redshift of the quasar looks like to the parent galaxy:

z_0 **= 1.96 Cluster Quasars** as seen by parent galaxy (AM 2230-284)

z_K **= 1.96 Major Karlsson Peak** for corrected quasar redshifts.

The mean quasar redshift turns out to be exactly on a Karlsson peak when transformed to the reference frame of AM 2230-284. *The exactness of the transformation would seem to rule out its being accidental.* It is also notable that $z_K = 1.96$ is the most accurately known and the most populated of the quasar, high periodicity peaks (see later Figure 12.)

(In the general case it turns out that if a parent galaxy has the right redshift its companion quasar will land accurately on a Karlsson peak. This furnishes one test of whether any given quasar is associated with a given galaxy. (Some quasars could be caught evolving between peaks or slowed by interaction with the galaxy medium.)

2. Fainter Galaxies - Background or Companions?

Figure 1 describes the discovery of a cluster of high redshift quasars centered on a compact galaxy which had been catalogued as AM 2230-284 in the "Catalogue of Southern Peculiar Galaxies." In Figure 5 here, the lower redshift galaxies, $.058 < z < .065$, are plotted over the same area. It is seen that there is an elongated concentration from NGC 7361, a bright Shapley-Ames spiral, out past AM 2230-284. These galaxies over a length of about 5 degrees also form narrow lines emerging from the galaxies of interest in the center of this broad swath of objects. These lines and connections consisted of fainter galaxies of just the $z = .06$ redshifts of the Karlsson lowest preferred redshift peak. In order to make the physical connection with the principle galaxies in this physical association completely clear we introduce here Figures 3 and 4.

In Figures 3 and 4, sampling out to radii 30, 60, and 120$'$ from NGC 7361 shows that the $z_0 = .06$ companions fall off in density away from the central, bright galaxy. If they are associated, the redshifts are intrinsic and they would be closer to the observer than currently supposed. An additional significant result is apparent, however, from the plot in Figure 5. There the most conspicuous line of low z galaxies emerges SE from the region of NGC 7361. This, the brightest galaxy in the pictured area, is active (radio lobes) and has a redshift $z = .004$. If NGC 7361 has ejected AM 2230-284 then the transformed redshift of the latter is $z_0 = .060$, a near perfect match with the lowest Karlsson peak. The implication would be that NGC 7361 had ejected essentially all the low z companions in the pictured field and one of them, AM 2230-284, later ejected the 21 quasars of $z = 2.149$.

To summarize: In order to falsify the conclusion that NGC 7361 possessed a large family of considerably higher redshift companions it would be necessary to argue that this nearby galaxy accidently projected onto the center of a more distant galaxy cluster. In addition we would have to hypothesize that the redshift of this background galaxy cluster just accidently falls so close to the value of the Karlsson peak at $z_0 = .06$.

So the main purpose of the remainder of this section is to test arbitrarily chosen low redshift spirals to see if their fields have properties which support the criteria for physical association of the kind observed around NGC 7361 and AM 2230-284.

3. Testing Fields around Nearby Spiral Galaxies

Moving the quasars closer than their redshift distance would reduce their physical size towards that of known clusters of bright apparent magnitude galaxies. If the quasars were evolving more rapidly at

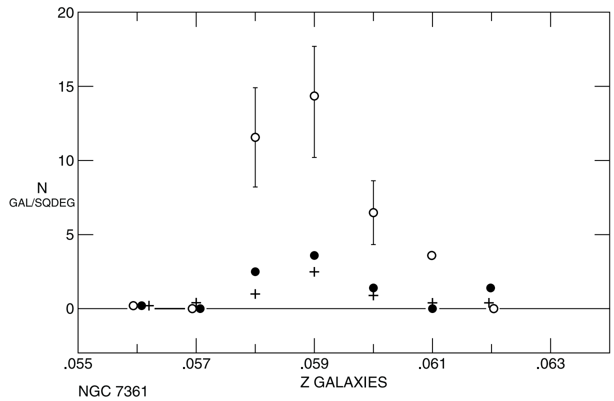

Fig. 3.— Densities of galaxies with redshifts from .056 to .062 in annular rings ($r = 0'-30', 30'-60', 60'-120'$) around the Shapley-Ames spiral NGC 7361.

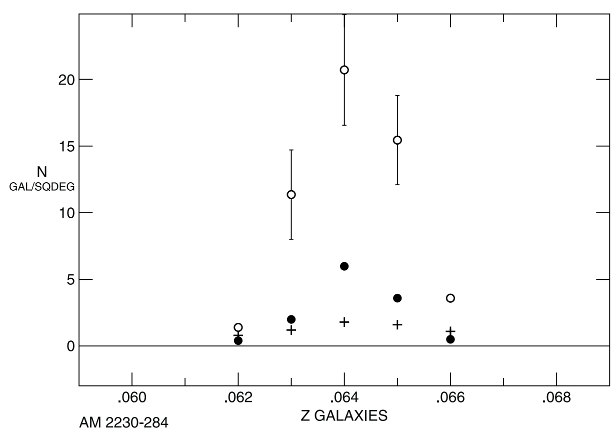

Fig. 4.— Densities of galaxies with redshifts from .062 to .066 in annular rings ($r = 0-30', 30'-60', 60-120'$) around AM 2230-284.

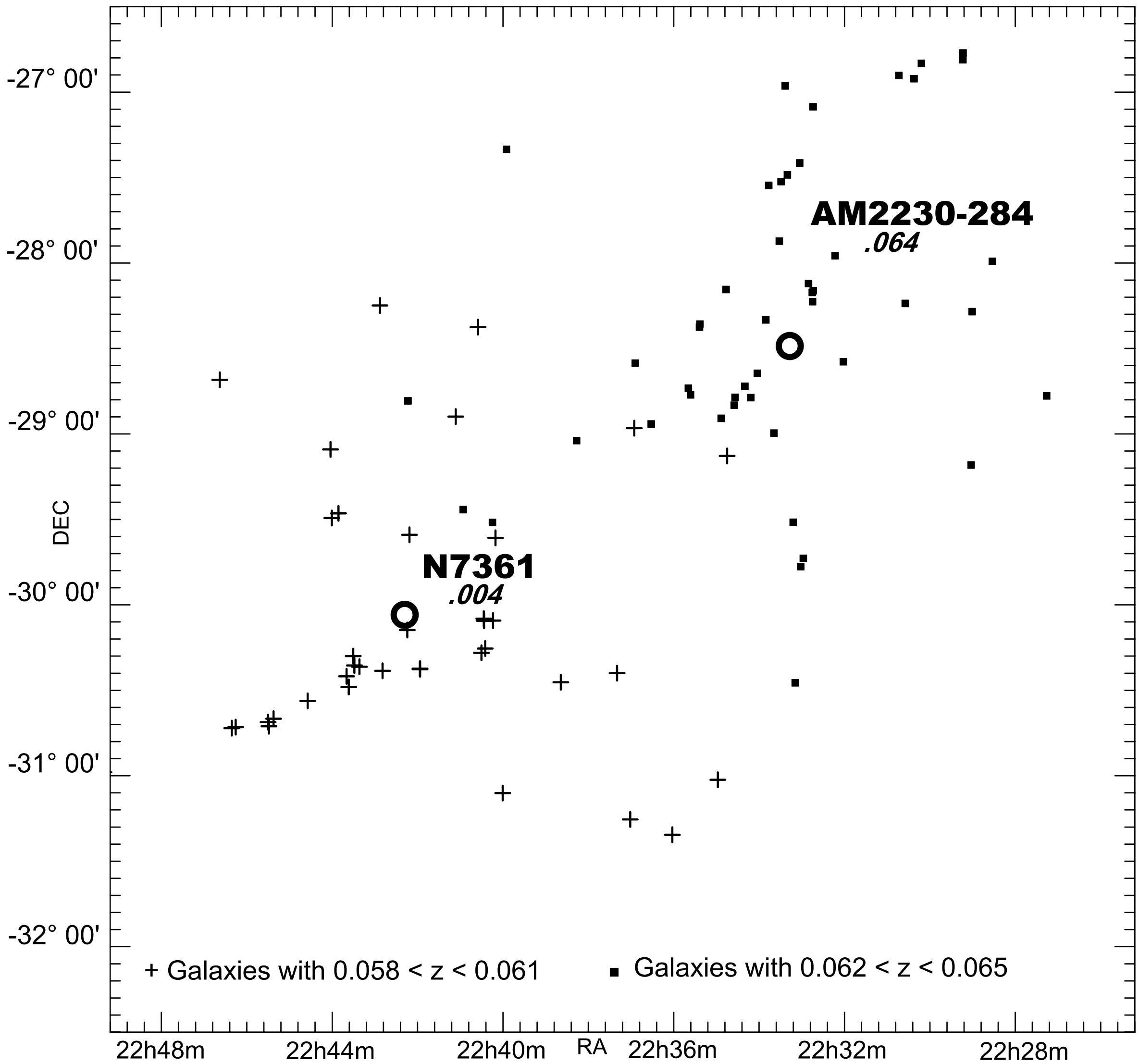

Fig. 5.— Fainter galaxies with $z = .06 = 18,000$ km/s aligned through NGC 7361 with 1200 km/s.

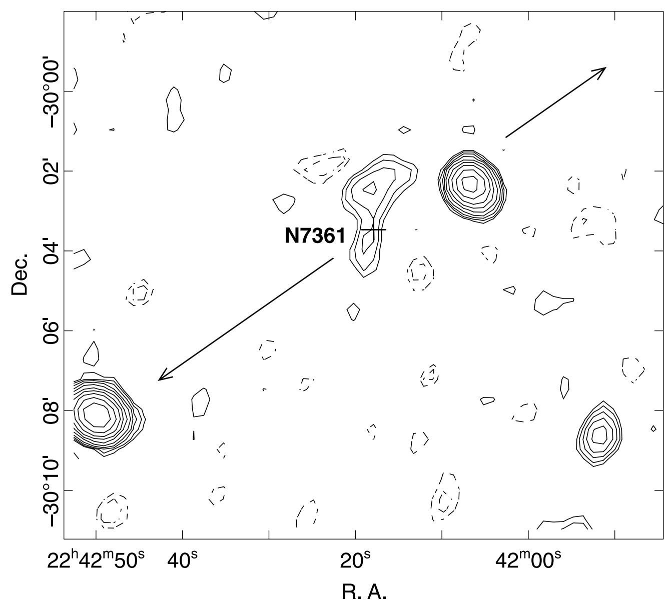

Fig. 6.— NVSS radio map of region around NGC 7361. AM 2230-284 is at p.a. 305 degrees.

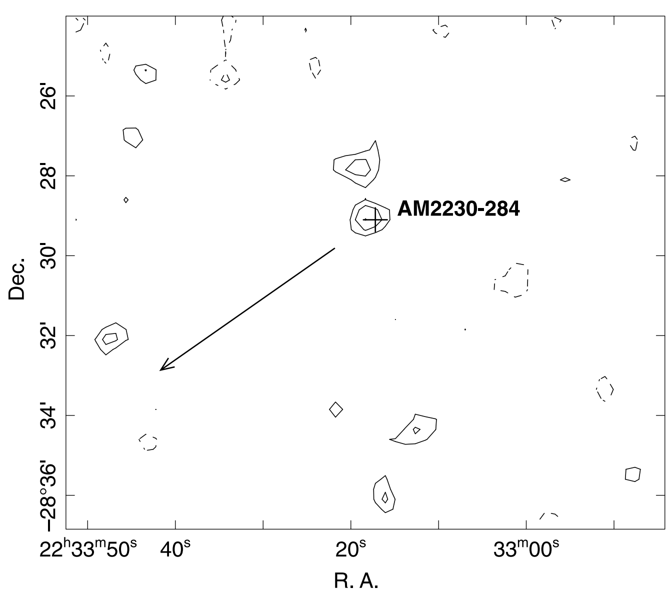

Fig. 7.— NVSS radio map of region around AM 2230-284. NGC 7361 is at p.a. 125 degrees.

this stage into brighter apparent magnitude galaxies it would also explain why so many clusters of galaxies have been recorded as opposed to so few clusters of quasars. Moreover evidence favoring this interpretation might be obtained if ejection of quasars is intermittent from active galaxies. In this case we should find quasars/galaxies in later stages of evolution in clusters in the vicinity. We therefore explore here the possible relations between lower redshift galaxies, quasars and the fields around bright and/or active galaxies.

Since we are dealing with 2dF surveys which reach fainter apparent magnitude galaxies we are restricted to a 5 degree strip at Dec. $= -30$ degrees. in the SGH and 0 degrees in the north. We use the NED selection programs and investigate in circular areas around bright apparent magnitude spirals, principally from $r = 30'$ to $60'$, and their companion redshifts $.050 < z_G < .100$.

If we see a peak of redshifts near $z = .06$, the lowest Karlsson peak, around that candidate parent, we plot that interval and flanking intervals in a histogram as shown here in Figure 8. The results for five of the sample of 7 fields are shown in the montage. The arrow marks the mean redshift which characterizes the group and Table 1 lists the z_0 for the group after correcting for the redshift of the parent. NGC 7361 is shown for many companions ($z = .0595$) and quasar cluster parent ($z = .064$).

3.1. NGC 7793

Within the 2dF survey strip in the southern hemisphere at Dec. $= -30$ degrees there is a very low redshift, Shapley/Ames galaxy. It has an appearance of radio filaments emerging from it. (A catalogued quasar appears associated with one protuberance.) It is densely surrounded by companion galaxies which have redshifts which are close to the lowest Karlsson peak. The redshift of NGC 7793 itself is very small, $z = 21\ km/s$. Therefore it should need no redshift transformation.

As the first panel in Figure 8 shows, the companion galaxies have a very narrow distribution around a value $z = .0595$ for NGC 7793.

The upshot is that there are 49 galaxies within $60'$ of NGC 7793 that fall within $z = .057$ to .062 of NGC 7793's redshift. This number of Karlsson peak companions easily matches the large number found around NGC 7361 in the beginning of this analysis. Even more impressive is that the mean redshift of these NGC 7793 companion galaxies can be read very accurately as $z_G = .0595$. So this cloud of companions has a mean redshift $z = .0595$, less than $-.005$ from that same lowest Karlsson peak.

Table 1: Peak Redshifts of Companions

Parent	z (comp)	z (parent)	z_0	$z_0 - z_K$
NGC 7361	.0595	.0041	.055	-.005
NGC 7361	.0640	.0040	.060	.000
AM 2230-284	2.1490	.0640	1.960	.000
NGC 7793	.0595	.0007	.059	-.001
NGC 7755	.0715	.0099	.061	+.001
NGC 4063	.0780	.0164	.061	+.001
NGC 3952	.0635	.0053	.058	-.002
NGC 4030	.0645	.0044	.059	-.001

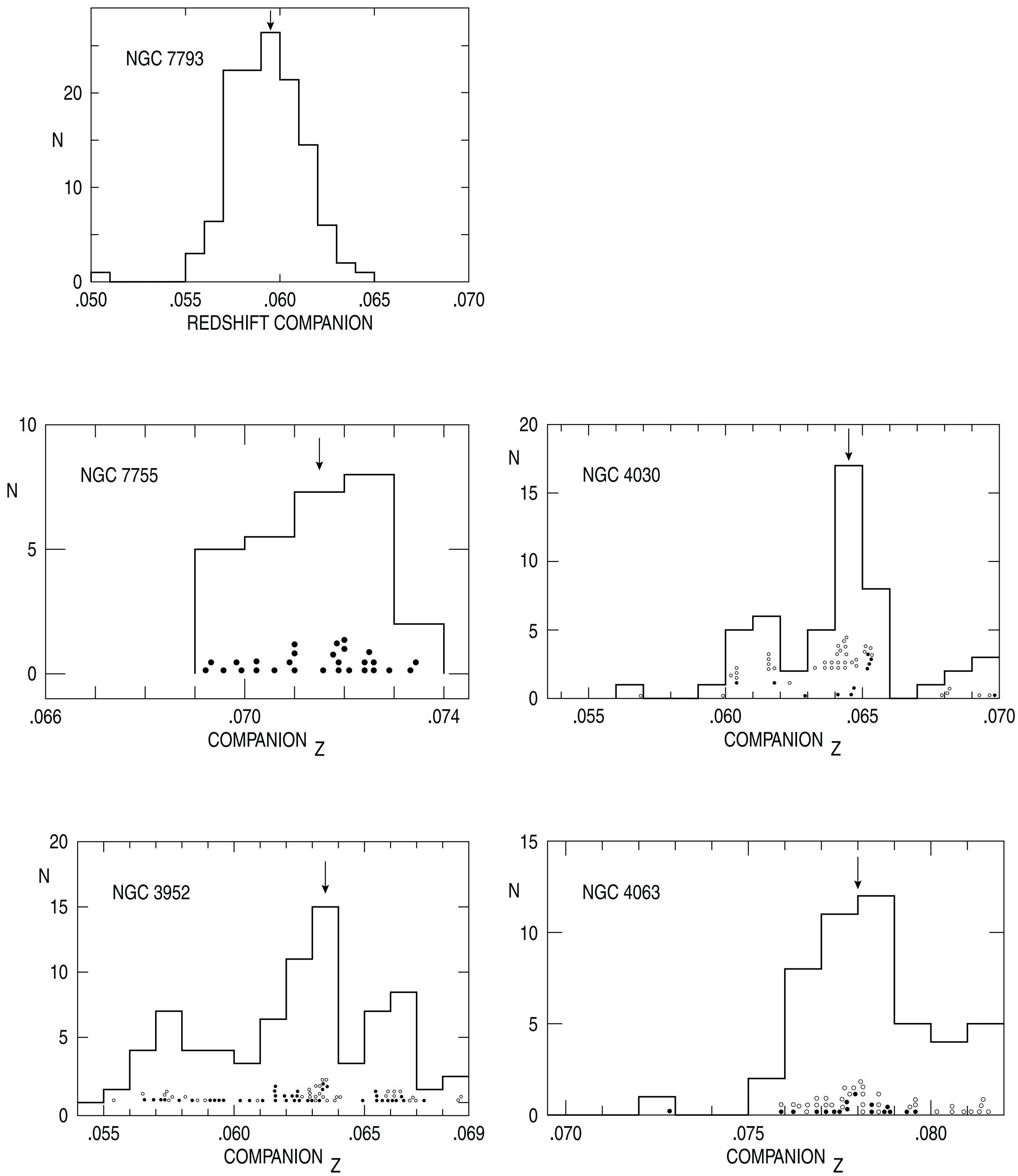

Fig. 8.— Redshifts of companions around 5 test galaxies.

This is a surprisingly large number of companion galaxies - 171 within a radius of $60'$ - a central density of 47/sq. degree. In this respect it resembles a classic galaxy cluster. But on a conventional redshift assumption there is a surprisingly small velocity dispersion of the galaxies. The small dispersion around the mean value of their redshifts, however, enables a very accurate comparison to the lowest Karlsson peak redshift. The remaining test galaxies listed in Table 1 are in smaller groups but exhibit the same extreme accuracy of agreement with the predicted Karlsson peak redshift. (See high resolution color picture in ESO Messenger, No. 137, page 25, Dec. 2009.)

3.2. NGC 7755

The next test case has two advantages: 1) it is in the same general region of the sky as the previous two so that one can confirm the result in this region of the sky even if it turns out to be different elsewhere; 2) the redshift of the parent galaxy is appreciable at $z = .0099$, making it mandatory to transform the companion redshifts to the frame of the parent before the comparison to the Karlsson peak. As Figure 8 and Table 2 show, the measured redshift of the companions is .0715 and when corrected to the parent it becomes .061, only +.001 from the predicted peak value. The correspondence with the Karlsson peak is not only now correct but accurate to a degree hardly obtained by accident.

3.3. NGC 4063

It would test the transformation calculation more strongly if we could find a candidate parent of even larger redshift. To this end we analyzed the region around NGC 4063, a fainter spiral with redshift $z_C = .0164$. There were many companion galaxies around NGC 4063 with redshifts from $z_C = .075$ to .08 (See Figure 8.) A clear maximum occurred at $z_C = .078$ and, as Figure 8 shows, the transformation to the parent reduced the mean companion z from .078 to .061, only +.001 from the Karlsson peak value.

3.4. NGC 3952

In order to get another reading on the behavior of galaxies in the NGH relative to the SGH we show NGC 3952. As Figure 8 indicates, there are three maxima but one is dominant which gives a mean companion redshift of .0635, which, transformed, is $z_0 = .058$.

Bright galaxies suitable for testing are not so easily found in the more crowded 12 hour region because of overlapping families of companions. NGC 3952 has peaks both before and after the main peak which suggests the presence of other such families. It would require additional analysis, however, to identify them.

3.5. NGC 4030

Finally a Shapely/Ames spiral in the 12 hour, Super Cluster direction, NGC 4030, furnishes a clear parent to a family of companions. The histogram of this association is shown in Figure 8. Essentially all the companions occur between $z_C = .060$ and .066 and a sharp peak is prominent at $z_C = .0645$. In fact, there are hardly any companions less than $z_C = .06$.

3.6. How Test Spirals Were Selected

Low redshift, spiral galaxies in non-crowded regions were sampled. When NED showed appreciable numbers of companions within 30′ of a galaxy, they were plotted in a histogram of redshifts, corrected for the redshift of the parent and compared to $z_K = .060$ as pictured in Figure 8. The test was discontinued after the seventh case. In two cases the histogram peak was uncertain. In the remaining five cases the peaks coincided to better than ±.001 (see Figure 8 and Table 1.) If, to those in Table 1, we also add the impressive numbers which follow here around NGC 4410 and the single success from UM 341, we then have 10 cases out of 12 tested which have $z = .06$ companions.

4. UM 341 - What Happens When the Parent Galaxy Has a Very High Redshift?

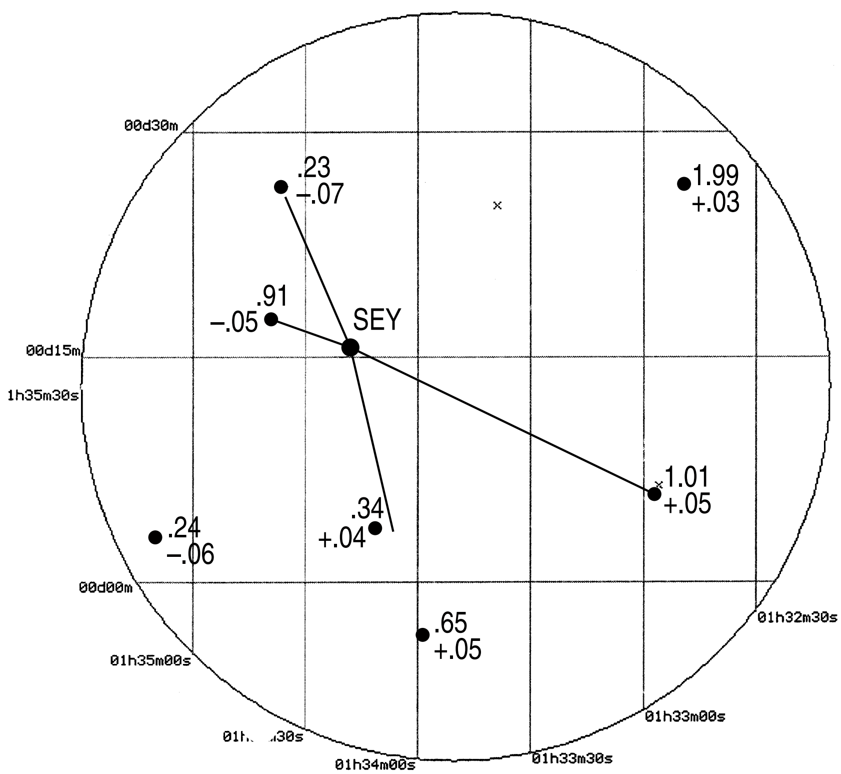

Fig. 9.— Emission line galaxy UM 341 (z = .399)(see Table 3) Quasar redshifts transformed to central rest frame. From Arp et al. (2005).

The emission line galaxy UM 341 is shown in Figure 9 with surrounding quasars transformed to the central rest frame. Identified in an objective prism survey by Univ. Michigan (UM) this active Seyfert galaxy is rather bright (16.6 mag.) for its redshift ($z = .399$). The challenge here is that if it were to have companions of the kind being discussed, those companions would have to have, uncorrected, relatively high redshifts and generally faint apparent magnitudes. It was very encouraging therefore when there was only one companion registered in this z, m area. Its redshift is $z = .488$ and in the rest frame of the $z = .399$ Seyfert is $z_0 = .064$! The latter is the same companion redshift as found around AM 2230-284, the galaxy first investigated in the present paper.

This association is a powerful one because, as the z values in Table 2 show, the central active galaxy is surrounded by some rather high redshift quasars which average plus on one side and minus on the other. Even stronger evidence in UM 341 for ejection in this direction is shown for the two innermost pairs in more exact numerical terms by the simple calculation: intrinsic redshift = (1.01 + .91)/2, and ejection velocity = (1.01 − .91)/2. The two intrinsic redshifts match almost exactly Karlsson peaks and the ejection velocities for both quasars are very similar.

z (intrinsic) = **.96** Karlsson peak = .96 ejection velocity = .050

z (intrinsic) = **.29** Karlsson peak = .30 ejection velocity = .055

Again the intrinsic redshifts come out to be almost exactly on a Karlsson periodicity peak (see Figure 12.)

Table 2: Quasars associated with UM 341

Name	mag. (g)	z	z_0	Δz peak	Remarks
UM 341	16.6	.399	...	...	Seyfert parent
SDSS	18.4	1.666	.91	-.05	
SDSS	18.6	.718	.23	-.07	
4C	V=21.7	.879	.34	+.04	PKS B–V=.84
SDSS	19.0	.745	.24	-.06	
UM 339	18.2	1.310	.65	+.05	
SDSS	19.3	1.805	1.01	+.05	
SDSS	21.9	3.183	1.99	+.03	
SDSS	19.1	.734	.25	-.05	
SDSS	19.1	.781	.27	-.03	

What do we make of the brighter mag., higher z values which are observed in this case? Later we will argue for evolution down in intrinsic redshift and brightening in luminosity to move it onto the Hubble relation.

5. NGC 4410 and Companions Abell 1541, 1541A, 1541C

NGC 4410 / Mrk 1325 has a disturbed, double nucleus and emission lines. This very active NGC galaxy is also surrounded out to about $30'$ by a strikingly large number of moderately bright galaxies. The number and disposition of fainter galaxies, X-ray and radio sources marks these objects as physically associated with NGC 4410 (see Figures 10 and 11). The region was first brought to our attention by G. Burbidge because of the apparent pairing of quasars across NGC 4410. In fact it turns out that the quasars furnish a nice confirmation of their intrinsic redshift and identity with Karlsson series peaks. But the association of the fainter galaxies and galaxy clusters with NGC 4410 turns out to be even more valuable in the extension of the Karlsson redshift peaks to lower redshifts.

Figure 1 and Table A of Arp (2006) and, Figure 10 here, show two pairs of quasars, one pair at $z = .722$ and .535 plus a pair at $z = 1.429$ and 1.471 (possibly including $z = 1.467$).

This object started out as a simple confirmation of two pairs of quasars across an active galaxy. Indeed one can see from Table 3 and from Figure 10, how the quasars are transformed in the reference frame of the central active galaxies and, moreover, yield $z = .59$ and 1.41 compared to .60 and 1.41 for the Karlsson formula peaks.

But the surprising and most valuable result was the great number of companion galaxies, along with a large number of radio and X-ray sources, associated with this active, low redshift galaxy.

5.1. Two More Intrinsic Redshifts on Karlsson Peaks

Table 3: Quasars Across NGC 4410

Quasar	mag.	z_Q	z_0
E 1224+0930	18.73	.722	.681
LBQS 1222+0901	17.87	.535	.498
LBQS 1222+0928	18.37	1.466	1.407
LBQS 1225+0836	17.83	1.471	1.412
SDSS 1222+0955	18.80	1.429	1.371

The redshift of NGC 4410 / Mrk 1325 was reported at 7440 km/s for A and 7500 km/s for B (Smith et al. 2003). Taking the mean for the center regions of NGC 4410 gives $z_G = .025$. Using this value we can calculate the quasar redshifts as seen from NGC 4410. The pair within $23.6'$ of NGC 4410 yields $z_0 = .498$ and .680. If as in the previous example we let z_v be the ejection velocity of a quasar and z_i be its intrinsic redshift then $z_i + z_v = .680$ and $z_i - z_v = .498$. Solving these two equations yields:

Intrinsic redshift = **.59** current ejection velocity = .092

Karlsson redshifts = .30, .60 , .96

Intrinsic redshift = **1.41** current ejection velocity = 0.0

Karlsson redshifts = 1.96, 1.41, .96

With remarkable accuracy the intrinsic redshifts of the first pair come within -.01 of the Karlsson peak at .60. The ejection velocity, at this stage, $27,600$ km/s if it is a velocity, is possibly in the process of slowing as its elementary particles gain in mass and their interaction cross sections slow down its velocity in the ambient medium.

Similar calculations on the pairs $z = 1.471$ and 1.429 and $z = 1.471$ and 1.467 yield $z_i = 1.39$ and $z_v = .021$ and $z_i = 1.41$ and $z_v = .0025$ (the last velocity being only 750 km/s). Here the intrinsic redshift components fall very close ($\Delta z = -.02$ and $-.01$) to the Karlsson peak value at $z = 1.41$ because the measured quasar redshifts are already close to a Karlsson peak. But in the first pair the ratios of the measured redshifts have to be correct, so it is an impressive confirmation of the Karlsson peak value of $z_K = .60$. Projection across the line of sight may also be a factor in the second pair.

Above are the first calculations of the intrinsic components and ejection velocities of quasars. It should now be possible to search the literature for the best aligned pairs and study the accuracy of the Karlsson peaks and the velocity changes of the quasars as a function of separation from the parent galaxy and, perhaps, measure some proper motion.

5.2. Galaxy Clusters/Clouds of Medium Redshift Companions

The most surprising result, however, now comes from measures of the redshifts of galaxies in this region: Figure 10 shows a high density of fainter, $z = .089$ galaxies reaching from NGC 4410 SE for about 20′ to the SE. It would seem difficult to not accept this as evidence for the physical association of the $z = .089$ galaxies as physical companions to the low redshift, active NGC 4410 galaxy.

Further strong evidence for the association comes from the transformation of the $z = .089$ galaxies to the reference frame of NGC 4410. The calculation is the following:

$$(1 + z_0) = (1 + .089)/(1 + .025) = (1 + .062)$$

The redshift of the companions around NGC 4410 compared to the Karlsson peak is .060 to .062. The companions to both NGC 7361 and NGC 4410 are essentially the same kind of galaxies. The medium brightness companions around NGC 7361 are the same redshift as around NGC 4410. Both systems contribute to the lowest Karlsson redshift peak.

5.3. Multi Redshift Galaxy Clusters?

It turns out there are three galaxy clusters, all listed at exactly the same positions. They are all clusters which were identified by the cataloguer, George Abell, who had no indication of their being special and was not, therefore, affected by any redshift bias,

Abell	1541	$z = .089$
Abell	1541A	$z = .0245$
Abell	1541C	$z = .0035$

The first thing we notice is that there are three different galaxy clusters with quite different catalogued redshifts for the same position in the sky. It seems much more likely that they represent different values of redshift in the same cluster than that they are independent clusters stacked up one behind the other in the line of sight.

Supporting evidence that the $z = .089$ cluster Abell 1541 was ejected from the NGC 4410 / Mrk 1325 active galaxy is to be found in Figure 10. Here we have plotted all galaxies catalogued in NED within $\sim 60'$ of NGC 4410. *It turns out that about 26′ NW from NGC 4410 is an elongated group of galaxies with* $z_{ave} = .091$. *They are strikingly paired with the Abell cluster 1541 at* $z = .089$ *on the opposite side of NGC 4410.* This is the canonical pattern of elongated clusters paired on either side of an active galaxy (see Arp & Russell (2001) for galaxy clusters associated with large, nearby galaxies). The physical nature of the pairing is further supported by Figure 11 where the concentration of X-ray sources SE of NGC 4410 is manifest. Since we know active galaxies eject X-ray material, the intermingling of companion galaxies and X-ray sources in the extension from NGC 4410 is strong evidence pointing to an ejection origin of these fainter, higher redshift companions from the relatively nearby parent galaxy.

In the Abell Catalogue, Abell 1541 at $z = .089$ is the rich cluster whose parent is Abell 1541A (probably the bright, active galaxy NGC 4410, as indicated by the quasars). Then Abell 1541C at $z = .003$ would be the candidate for having produced NGC 4410.

Fig. 10.— All galaxies with $.077 \leq z \leq .097$. Small circle shows center of Abell 1541 with $z = .089$.

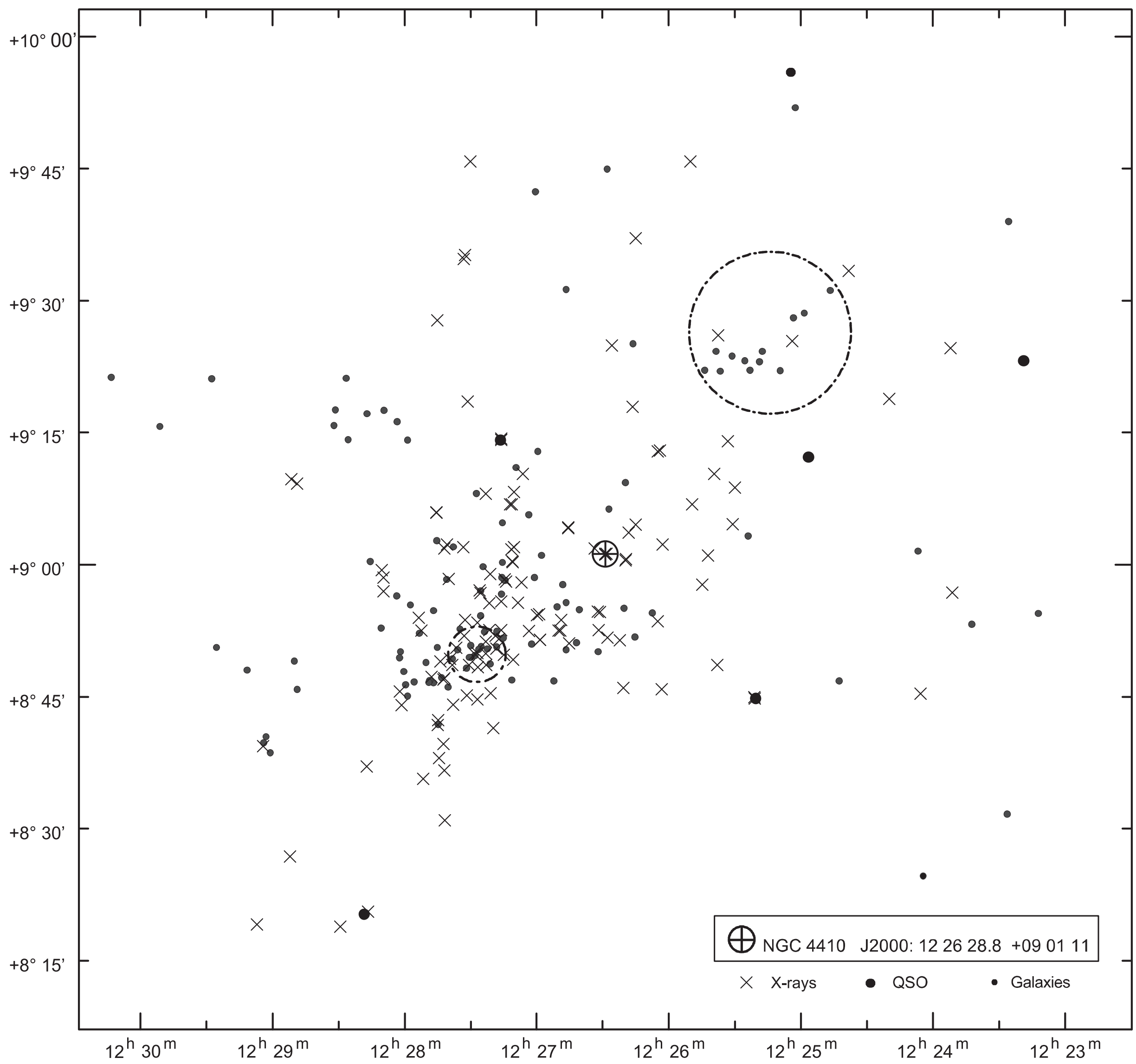

Fig. 11.— Same field as Fig 10 with X-ray sources added as X symbols. From ROSAT Web Browser.

6. New Evidence for Intrinsic Redshifts

The calculation of how the redshifts of the companions to NGC 4410 / Mrk 1325 would appear to their central galaxies was an immense step for this investigation. The accuracy with which the redshifts fitted the Karlsson predictions after the velocities were removed suggested that we were seeing pure intrinsic redshifts for the first time. It seems likely that the groups will be valuable models that can work for all forms of companions - from low redshift galaxies to high redshift quasars. The schematic diagram of Figure 12 enables us to appreciate at a glance how corrections are applied to the observed redshifts in order to compare them to Karlsson peaks over the range of the observations.

Analysis so far indicates that every active galaxy with aligned quasar companions will show very accurate Karlsson numbers. One thing is clear, however, namely that the mathematical manipulations required to confirm the observed Karlsson numbers prevent any accidental inclusion of unrelated background quasars if such existed. The point is that it would be improbable for an unrelated quasar to position itself just in line and equidistant from another across an active nucleus. In addition to that, the complexity of steps would preclude any accidental acceptance. removing exact velocity components would be difficult to circumvent. In view of this the numbers from these configurations can be used with confidence to study physics over a range of different parent galaxies.

In the following summary and review we would like to incorporate and comment on some important additional evidence that continued to emerge during the long review process.

6.1. The First Karlsson Peak at $z_K = .060$

Figure 12 shows that if the very active galaxy NGC 7361 is adopted as the parent of all the small companions pictured in Figure 5, its redshift of .004 will then cause the companion AM 2230-284, which is the parent of the cluster of quasars, to look to us to be $z = .064$, but to NGC 7361 it looks like $z = .060$.

Note: As explained in Appendix A, the detection of peak $z_K = .060$ was first made by Burbidge (1968) at .061 and later by Arp et al. (1990) at .062. In the mathematical series, however, it is given at .060 and this is the value we have used. The observed value moves around approximately within these bounds and this movement does not significantly affect the calculations.

6.2. Predicting Accurately All Values of the Karlsson Peaks

In Figure 12 the next to last column should represent the plasmoid after it has split in two with the parts traveling out in opposite directions. Even if they start out with the same velocity they will soon start to lose it in different amounts if they interact with material along their path. It is necessary, however, to know the galaxy which ejected it. The initial velocity appears, however, to be determined by the event in the nucleus of the ejecting galaxy. We begin to realize that we are observing events in the nucleus which are more like white holes than black holes. If we are dealing with ejected plasmoids perhaps they float out because of buoyancy. Or perhaps there in is a sling shot mechanism.

Finally we can answer the question, is the calculation only good for small values of source correction, i.e. the correction that gives us $(1 + z_0)$? The answer is found in the immediately preceding group, UM 341. From Figure 9 and Table 3 we learn that the central galaxy is a Seyfert with the remarkably high redshift

EXTRAGALACTIC NUMBERS

.004 NGC7361	0.064	$\frac{1.064}{1.004} = 1.060$	30 x = .060		.06
.399 UM341	.718, .879	$\frac{1.718}{1.399} = 1.23$ $\frac{1.879}{1.399} = 1.34$	$\frac{.57}{2}$	.29	.30
.025 NGC4410	.722, .535	$\frac{1.722}{1.025} = 1.680$ $\frac{1.535}{1.025} = 1.498$	$\frac{1.178}{2}$	.59	.60
.399 UM341	1.666, 1.805	$\frac{2.666}{1.399} = 1.906$ $\frac{2.805}{1.399} = 2.005$	$\frac{1.92}{2}$	.96	.96
.025 NGC4410	1.466, 1.471	$\frac{2.466}{1.025} = 2.406$ $\frac{2.471}{1.025} = 2.411$	$\frac{2.817}{2}$	1.41	1.41
.064 AM2230-284	2.149	$\frac{3.149}{1.064} = 2.96$	21 x 1.96	1.96	1.96

Fig. 12.— Extragalactic Numbers. The Karlsson values of peak redshifts are displayed down the right hand column. Immediately to the left are entered the redshifts of the ejected plasmoids which we call quasars. On the far left are the redshifts of their parent galaxies and quasars in descending order: NGC 7361, UM 341, NGC 4410, UM 341, NGC 4410, and AM 2230-284. Note that for NGC 7361 there are 30 quasars at the lowest Karlsson peak of $z = .060$ and for AM 2230-284 there are 21 quasars at the most prominent Karlsson peak of $z = 1.96$.

of $z = .399$. There are quite a few higher redshift quasars around it and Figure 9 is plotted relative to the redshift of the $z = .399$ central galaxy. In Figure 12, however, there are two pairs of aligned quasars. No difference is made in their calculation from the rest of Figure 12 and they both turn out near perfect Karlsson periods of $z_K = .29$ and .96.

6.3. The Continuity between $z = .06$ and 1.96

At the moment we may not know what causes the Karlsson peaks and periodicities but we do know that empirically the phenomenon treats quasars (e.g. $z = 1.96$) and active galaxies and galaxies (e.g. $z = .06$) equally. The .06 objects are mostly galaxies but they are preferentially centered around lower redshift parents in classic groups.

Having an empirical picture of continuity through spectrophotometric, spectrographic and morphological data it should be possible to start to understand an evolutionary model of the constituent objects in our universe. If the parameter of redshift does not indicate distance but rather age (time) then we should try explanatory cosmic theories of reproduction with competing forms of evolution.

If the empirical pattern of quasars and galaxies evolving through low redshift stages at relatively low luminosities is the means of obtaining empirical data on their constituent matter, the matter is arguably the main cause of their intrinsic redshift. It would seem important to program observations at all wavelengths in order to gain a full understanding of redshift periodicities.

6.4. Why No Recognition of Karlsson Peaks in 38 Years?

When observers first looked at quasars near galaxies the galaxies were bright and had negligibly small redshifts. As fainter galaxies were observed their redshifts had increased and should have been used to correct the quasar redshifts. They were generally not and the fainter quasars were too redshifted.

6.5. Redshifts in Previous Large Groups (Komberg et al. 1996)

As for clusters of quasars like the one described here in opening sections, previous investigations of large quasar groups have been reported by Komberg et al. (1996) and references therein. For their best 12 groups the range of redshifts present within each group averages to $\Delta z = .141$. In the cluster we report here, however, the range of the quasar redshifts is only $\Delta z = .038$, a range nearly 4 times smaller. If the redshifts in a large group as defined in Komberg et al. (1996) are taken to be velocities, then one has, for example, their LQG5 where the approaching side of the cluster is separating from the far side with a velocity of $\Delta v = .218c = 65,400\ km/s$. We agree generally with the Komberg et al. (1996) conclusion: "... quasar groups and superclusters can be evolutionarily related." But the cluster discussed here is a stronger example, which suggests that the evolution is much faster in the beginning.

7. Between Peaks

An important question is what to do with quasar redshifts which are not close to a Karlsson peak for an indicated parent. One could say their ejection velocities bring them into arbitrary relation to other Karlsson peaks for that galaxy. Alternatively one could note that with intrinsic, quantized redshifts quasars would have to evolve in steps. There would be at least some time spent between peaks. One could also say that in passage out through the parental and adjoining medium the low particle mass plasmoid is open to collisional ablation or slowing and deviation. In fact more evidence is coming forward concerning low mass radio plasmas in the outer surfaces of quasars which are stripped in their exits from ejecting galaxies. Rings also are beginning to appear around galaxies like UGC 8584 as described in Arp & Fulton (2008a) and galaxies mentioned therein. The implication of these rings is that they represent a shell blown away from the parent galaxy on which quasars impinge and lose their outward velocities. In point of fact there appears a ring around NGC 7361 in the U. K. Schmidt image available from Sky View. When stopped or slowed by such processes some galaxies could exhibit strong Karlsson peaks and others with the peaks washed away by higher velocities.

8. Lowest Karlsson Peak - Looking Back at a Famous Controversy

The above evidence for the apparent peaks near z = .059 to .064 in the NGC 7361 / AM 2230-284 alignment can now be related to a first and perhaps most important observation of discordant redshifts - viz. the quasar/galaxy Markarian 205, linked by a luminous bridge to the disrupted spiral galaxy NGC 4319 (Arp 2003).

	NGC 4319	Mrk 205
cz	$1,700$	$21,000$
z	.00567	.070
$\mathbf{z_0}$	...	**.064**

Listed as velocities they have $cz = 21,000\ km/s$ and $1,700\ km/s$, respectively. In redshift the values are $z = .070$ and .0057 and *the quasar Mrk 205 is seen to have a redshift of* $z_0 = .064$ *as seen from NGC 4319*. From connection in direct images the redshift of Mrk 205 has long been argued to be non-velocity but nothing special was attached to the numerical value of its redshift. But now we see that its redshift, as seen from NGC 4319, is $z_0 = .064$. In other words there is new evidence for physical association with its parent galaxy. In fact at $z = .070$ and $z_0 = .064$ Mrk 205 is quite similar to the association of NGC 7361 ($z = .004$) with $z = .064$ to .060 in the large number of companions identified earlier in this paper. A suggested history for this unusual association would then be an encounter with material in NGC 4319 on its way out which disrupted the galaxy and stopped the quasar from completely exiting the galaxy. It evolved through the Karlsson intrinsic redshift steps and now occupies the first peak on its way to become a low redshift companion galaxy of NGC 4319.

NGC 4319 / Mrk 205 was pictured on the cover of "Seeing Red" (Arp 1998a) with higher redshift quasars linked to Mrk 205 by luminous X-ray filaments. What gives bite to this ejection/evolution scenario is now the properties of AM 2230-284 and NGC 7361 (AM 2239-301) as shown here in Figures 3 and 5. They show that around different parent bodies there is a retinue of companions which have this first Karlsson peak near $z_K = .060$. The companions tend to be very close to this first Karlsson peak redshift. Moreover the peak belongs to the lower redshift companion only after being transformed into the parent reference frame.

Finally we notice that Mrk 205 was classified as an active galaxy but often called a quasar (Veron and Veron Catalogue 2000) and listed at absolute magnitude $M_V = -22.5$ when the arbitrary limit for a quasar was -23 mag. With its compact but well resolved image it is a striking example of a quasar evolving into a galaxy and identifying the cross over point in the very large population undergoing that evolution.

9. An Ejection Origin for a Large Number of Galaxies in the NGC 7361 Region

We have seen in preceding sections that the two galaxies most active in this region are related by a filament of galaxies of redshift ($.059 < z < .064$). Barring condensation along a preexisting track it would seem only ejection or ablation/stripping would be capable of forming the observed line of low redshift companions in the tail from NGC 7361 to the SE. Independent evidence that NGC 7361 actually ejects material is supported by the observation of radio lobes shown here in Figure 6. (It is unusual for a galaxy catalogued as spiral to exhibit ejected radio lobes.) Also conspicuous in the radio map in Figure 6 are the pair of strong radio sources which appear to have no optical identifications but fall along the line to AM 2230-284.

In Figure 5, AM 2230-284 shows the same association with some even closer, well defined lines of low redshift galaxies across the galaxy than in the NGC 7361 case. Added support for the role played by the associations in this region is shown in Figure 7. There it turns out that AM 2230-284 is also a radio source, albeit unusual in its compactness. With the oldest redshifts being the smallest we look at Figure 5 now as empirical evolution for three generations of galaxies.

10. A Major New Constituent of the Universe

When a low redshift galaxy has a concentration of fainter galaxies around it one usually notes the redshifts and if the fainter galaxies are appreciably higher in redshift it is concluded that they are more distant, unrelated objects. But when the companions keep coming up with the SAME value of higher redshift, then one has to question redshift as a distance indicator. This has happened in the region around NGC 7361 where the $z = .060$ galaxies are actually seen to have streamed out of the brighter galaxy (See Figure 5.)

But there lies an even stronger tie between that central galaxy and its companions. It is the actual value of the fainter galaxy redshifts, which is accurately $z = .060$ when transformed from the reference frame of the ejecting galaxy to the reference frame of the galaxy being ejected. The latter value is designated z_0, as defined in Appendix A, and, most excitingly, it is one of the well known Karlsson redshift peaks, $z_K = .06$.

This means that the companion redshifts behave the same way that the higher quasar redshifts do. They could slow down at some distance from the ejecting galaxy. From there they grow more like galaxies and evolve down through the Karlsson peaks. Although this might form an organized scheme on which to hang the observations the present paper is an observational one, not a theoretical one. So the empirical evidence should be pursued as far as possible.

The most crucial test, of course, was to pick a relatively representative group of low redshift parents and see what their companion galaxies were doing. We selected arbitrarily: 7 low redshift central galaxies. One turned up without companions and one had three peaks with no one in dominance. But the remaining 5 all had sharply defined redshift maxima, precise within $z_0 = \pm.001$. A clinching aspect is that when the central galaxy has a redshift greater than about .003 it begins to make a difference in the reference frame correction.

This correction has been used for the quasars from almost their inception and is a strong demonstration that the Karlsson numbers are significant! (Otherwise why would just the redshift of the parent galaxy give the correct answer in the above calculation?) This also places the quasars and the $z = .06$ galaxy redshift in the same mathematical/physical realm. It allows us to slow them at a distance from the central galaxy where they can mature into "normal" galaxies. Some of this has been known for a long time - Burbidge (1968); Karlsson (1971); Arp et al. (1990) - as the evidence for discrete redshifts grew. What has changed now, however, is the very large numbers of these interim galaxies. The 2dF survey is exceptionally deep and complete and it can be seen from the sample pictured in Figures 5 and 8 that the population of the $z = .06$ galaxies reaches numbers into the 50's or more per larger galaxy.

The situation at present seems to be that the redshift peak of $z_0 = .06$ was first recognized almost 40 years ago. As fainter quasars and galaxies were measured the $z_0 = .060$ to .064 objects grew in number. They were reported on most of the increasingly large telescopes. They were, for the most part, not followed up because they and the parents were fainter with higher redshifts, making the transformation corrections to the parent more difficult. It was easier thus to overlook them. It is clear that rapid advances in this important subject require investigators to use similar values and assumptions.

It is the primary aim of the present paper to show that when these corrections are met that the z_0 redshift results are too close to the well determined Karlsson series to be accidental. It is also a demonstrated technique now to find parent galaxies for high redshift associations which then reveal a much larger number of $z = .06$ associations.

A persuasive exercise is to glance at the three redshifts which are listed for the Abell Cluster 1541 in Section 5.3. What is the ratio of parent to companion which gives 1.063? When one looks at the plot in Figure 10 there is a mass of galaxies at around $z = .089$. Is this disproof of the major new constituent already? On the contrary, just slide them into the rest frame of the central galaxy, at $z = .0245$, and the entire field of galaxies turns into $z_0 = .063$, very close to the expected $z_0 = .060$.

The central galaxy in the above clusters is NGC 4410. It has two pairs of matched quasars across it (Section 5.1, Figures 10 and 11.) The point again of the present paper is that normal, high redshift quasars can now be routinely assigned their parent by opposed ejection or clear cut Karlsson values. These same families can have extensive middle age families of the $z_0 = .06$ type. Other examples in the present paper are NGC 4151, NGC 7361, UM 314, etc. Changing terminology to include this large, new population is desirable but would be difficult. Including aspects of quasars like that of young seed galaxies which grow into lower redshift active galaxies will probably help in gaining more understanding of creation of matter, elements and galaxy building.

Note that Karlsson peaks are usually quoted only to two digits, as in $z_0 = .06$. The series gives peaks to about $\pm.001$. But individual groups observationally give three digits, e.g. $z_0 = .061$ or .064 whereas the next nearest Karlsson peak is at .30. In addition there may be a small group variation with age or uncertainties in the redshift measures.

11. Ejection Tracks from the Nucleus of the Seyfert NGC 4151

At this point we would like to introduce an ancillary observation separately because, even as one single case, it powerfully establishes ejections of quasars and galaxies of different intrinsic redshifts.

While picking out nearby galaxies to study their association with higher redshift companions we encountered one of the first to be discovered as having a strongly ejecting nucleus, the Seyfert galaxy NGC 4151 (Demoulin & Burbidge 1968) (Arp 1968a). A cursory inspection now reveals a *line of galaxies running North-South through the center of NGC 4151* as shown in Figure 13. The five to the North average to $z_C = .0620$ and the six to the South to $z_C = .0627$. The midpoint of these 11 companions, both in extent and redshift, is the nucleus of NGC4151 as parent to the ejection ($z = .003$).

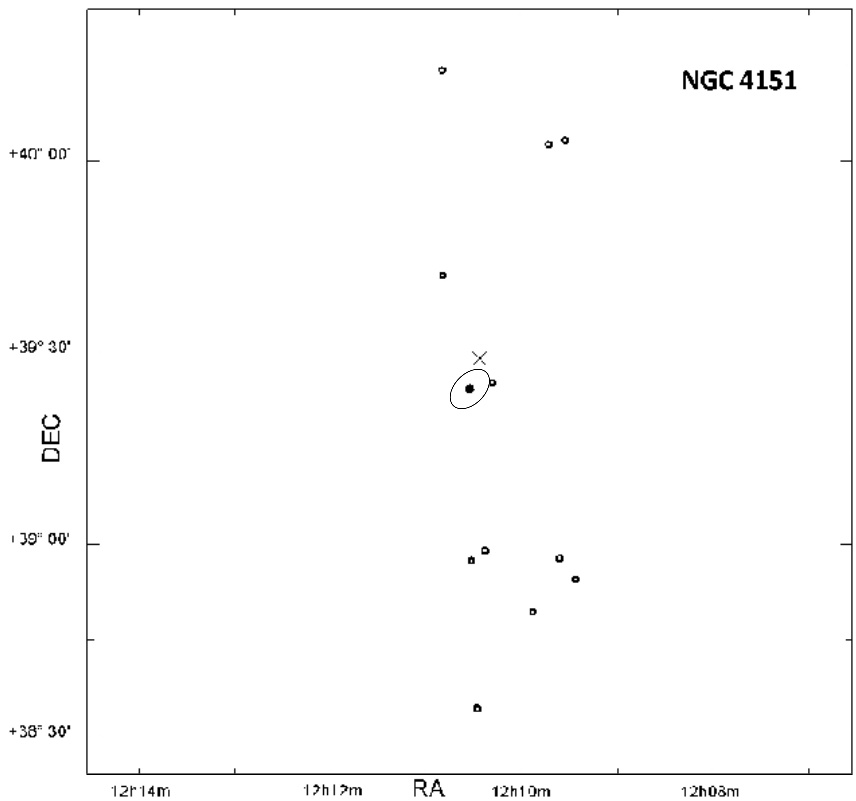

Fig. 13.— Companions within 50′ and $.055 < z < .068$.

(1) The line of 5 objects in one direction, 6 in the opposite direction emerging from the active nucleus of this famous galaxy poses the question: How, other than by ejection, could nature arrive at this configuration for 11 galaxies? How would it be possible to have stronger proof of their origin and distance.

(2) If the redshifts of these objects are $18,000\ km/s$ greater than that of the galaxy how could they be at the same distance in a redshift equals distance expanding universe?

(3) Why is the redshift of these objects falling within .001 of the quasar/galaxy Karlsson periodicities?

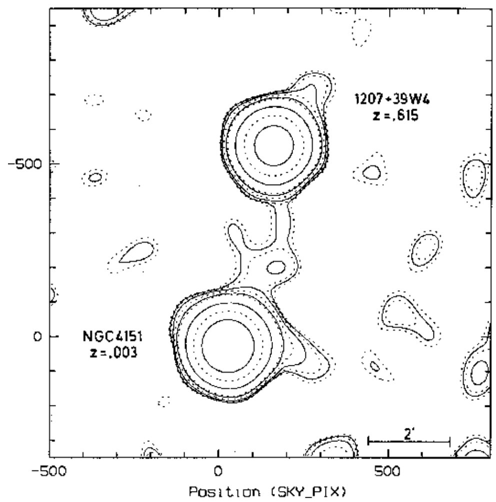

Fig. 14.— X-ray isophotes of BL Lac/quasar linked to nucleus of the active Seyfert NGC 4151.

11.1. Ultra Luminous X-ray Quasar along Line of Karlsson Objects

There is another noteworthy occurrence in that there is a very strong X-ray quasar disturbing the central region of the active Seyfert NGC 4151. As Figures 13 and 14 show, there is an X-ray filament connecting the quasar back to the galaxy nucleus *closely along the line of 11 $z = .06$ galaxies*, and attached back to the galaxy nucleus, with the quasar disturbing the central regions of this active Seyfert. It is a radio source and a very strong X-ray source but at faint apparent magnitude. Its redshift is .615, which is immediately recognizable as a Karlsson redshift peak in the quasar periodicity relation. If the redshift of the BL Lac is transformed to the $z = .003$ redshift of NGC 4151 then its redshift goes from $z = .615$ to $z_0 = .610$. That places the BL Lac only about 3% of the way to adjoining periodicity peaks, .30 and .96. In other words the BL Lac falls in a redshift peak in the Karlsson periodicity - the same periodicity that unites the normal quasars with the lowest peak redshifts which we have identified as the evolved, end stage of quasars.

11.2. A Common Origin for Quasars and Galaxies

Seeing the connections between NGC 4151 and the $z = .60$ quasar brings the sudden realization that the last three examples of active galaxies analyzed in the present investigation had high redshift quasars falling on Karlsson peak redshift values. They also had decisive associations with the lower redshift, $z_0 = .06$ companion galaxies, as shown in Table 4.

(1) The first conclusion is that the association of the $z_0 = .06$ companions makes it easier to establish the non-velocity character of their redshifts by giving many more examples per high redshift association. Note particularly the number of $z_0 = .06$ companions in Figures 5, 8, and 10.

(2) Numbers of z = .06 galaxies are needed as end products in the evolution of the high redshift companions. Otherwise the faster evolving high excess redshift quasars would have too few representatives in later evolution stages.

(3) The higher redshift quasars preferentially occupy discrete values of redshift. The .06 steps represent the same intervals as do the higher terms in the mathematical series. Regardless of whether we understand that series, its accurate delineation from the lows to the highest redshifts should imply that the physical process expressed by the series is applicable to all the redshifts.

Table 4: Quasars Associated with $z_0 = .06$ Galaxies

Parent Galaxy	High-z Quasar	$z_0 = .06$
NGC 4151	.61	11
UM 341	.96, .29	1
NGC 4410	59, 1.41	≥ 50
NGC 7361	21×2.149	≥ 40

11.3. Presence of Non Thermal Emitters in Galaxy Interiors

The alignments and connections between quasars and active galaxy nuclei strongly argues for the evolution of the proto quasar/galaxy as it emerges from the parent galaxy. Luminous bridges between stages of development are direct evidence. In the case of NGC 4151 the 6 + 5 line is a candidate for an ejection track,perhaps also the bridge from NGC 7603,or the plasmoids in the jet from M87.This may be direct evidence for morphological evolution. But given the current majority view, little testing of non-velocity redshift theory is taking place

The BL Lac, however, has been designated an Ultra Luminous X-ray source (ULX.) When placed at the distance of the large galaxy in which they were found, the ULX's were initially believed to be some kind of super X-ray binary star (Arp et al. 2004). After enough examples had been measured, however, it became clear that they were almost all high redshift quasars. López-Corredoira and Gutiérrez (Arp et al. 2004) published the analysis discussing the evidence that they were quasar members of nearby galaxies. Of course this corroborates earlier evidence by Radecke (1997) that bright X-ray sources were associated with Seyfert Galaxies at the 7.5 sigma level. Most of these X-ray sources were quasars (Arp 1997). Interestingly for NGC 4151 here, the study by Arp et al. (2004) showed generally that the BL Lac quasars were most strongly associated with large, low redshift parents.

It has been suggested (Arp 2006) that the smooth continuum spectra of the BL Lac was a result of stripping off of the strong emission line atmosphere of the usual quasar. This could happen in the ejection path, in collision with clouds or galactic medium in the parent galaxy or immediately beyond. This would slow down, and perhaps perturb from the exact line of ejection of the quasar from the proto galaxy. The evolution from quasar to galaxy could take place at various distances from the parent galaxy and probably with some deviations from linear, jet-like line locations.

The recent paper by Burbidge & Napier (2009) showed additional compelling evidence that the density toward the inner volumes of space around nearby galaxy nuclei is clearly enough to demonstrate the distance of these quasars to be also nearby.

12. Birth of Quasars

As yet it is not possible to look very far into the materialization and assembly of new quasars in the nuclei of parent galaxies. But we can start to tell when an object looks small because it is at a great distance and when it really is small because it is close by. The argument that fundamental particles obtain their mass by an exchange with the Universe in a Machian type theory has been advanced and serves as an example of a possible direction to explore.

13. Evolution of Quasars

For galaxies of a given type, as fainter apparent magnitudes are considered, their redshifts generally increase. This is the famous Hubble relation which supporters of the expanding universe theory consider unassailable evidence that the Universe is expanding faster as the distance from the observer increases.

As data on quasars accumulated, however, their values scattered widely so that a Hubble relation was not apparent. This negated any Hubble law evidence that the quasars were expanding with recessional velocities. The only remaining source for distances and luminosities was then with the quasars associated with low redshift galaxies previously discovered together with those discussed in this paper. The quasars are generally in the apparent magnitude range m 18 to 20 mag. The galaxies with which they are associated have distance moduli around m - M = 24 to 32 mag. and therefore the quasars have absolute magnitudes in the range M -14 to -9 mag. The many similar originating companion galaxies found in previous studies have the same range of brightness and lead to quasars with absolute magnitudes within a few magnitudes of the brightest stars in galaxies. Certainly we do not have quasars brighter than M_V -23 mag., which would already be by far the brightest objects known. Theory then offers us an arbitrary absolute magnitude, below which the quasar then becomes a galaxy. Quasars can be quite variable so their classification can switch back and forth with time. The latter is the penalty to be paid for using a non-operational definition based on the arbitrary limit based on a theoretical assumption.

13.1. What Is a Quasar?

If redshift should not be used to define a quasar what is a useful observational measure?. The property that set them apart from other celestial objects was their non-thermal radiation as evidenced in their flat continuum, ultra violet through infra red, radiation. If low redshift, active galaxies were ejecting synchrotron material and there were excess synchrotron sources in the vicinity there could not be much doubt where these quasars had come from.

The best example is M87 which has a series of radio "knots" coming out along a jet from the interior. They are visibly ablating along the edge of the ejection cone. They are radiating in ultra violet, visible, X-ray and radio. But no emission lines are present because the charged particles have not had time to assemble themselves into atoms. But they are, as Ambarzumian suggested in the 1950's, big galaxies giving birth to small galaxies. The ejected plasmoid out of which the new galaxies were evolving. Ambarzumian called it super fluid. Further along the line of the jet is a large, X-ray galaxy (z =.085).

A pair of quasars are aligned across it ($z = 1.28$ and 1.02). *The mean intrinsic redshift for the pair then is .98 - the Karlsson peak is at .96!*

The fact that the Karlsson peak values for intrinsic redshifts operates throughout all the observed redshifts, including the lowest, predominately low galaxy redshifts of $z = .06$, indicates that the evolution of the intrinsic redshifts is a fundamental property of the matter comprising these major constituents of our Universe. In this regard it is interesting to note that most theorists, in order to keep the protoplasmoids from rapidly evaporating, have called for dark matter. Narlikar & Arp (1993) called it Machian increase in particle mass which would start condensing the plasmoid and reducing the initially high intrinsic redshift at the same creation time.

When quasar-like companions are physically associated with a parent galaxy they tend to be smaller, higher surface brightness, and show emission line activity. In quasars large energies are packed into absurdly small initial volumes. As they evolve they have no place to go except to brighten toward being galaxies and lessening intrinsic redshifts with time. The important point, however, is that the excess redshift companions are in the process of evolving into more "normal" galaxies and it is the numerical value of the redshifts themselves evolving by steps to smaller values.

13.2. Evolution in the Hubble Plane

Figure 15 shows how the Hubble diagram looked a few years after the discovery of quasars. It was clear that there was a continuity of physical characteristics between the unresolved quasars, the compact galaxies, Seyferts with stellar nuclei, etc. In favor of their evolving along these states is Figure 2 from Arp (1968a). That diagram showed how these quasar and quasar-like galaxies were on tracks between blue (younger star components) and old (redder) stars. Of course, as ultra-violet - blue, optical synchrotron cut off progressively to the red, the integrated color also followed. Overall, we have a color magnitude diagram in which we can locate evolution tracks.

In this evolutionary change with age it does not matter so much where the active object is at any given time. It matters where it winds up when it comes to resemble the ordinary galaxies which make up what people take to be the normal Hubble relation. At this point we must ask how well do the evolutionary tracks in the z,m plane represent the situation.

Now, 40 years later, a very powerful diagram has been constructed by Bell (2007). Figure 16 shows that the quasars are seen first as a narrow band between redshifts $z = 6$ to 8. They then broaden out and descend essentially vertically in the z,m diagram until they dive below the normal galaxy Hubble line, then continue loosely under the line until very bright apparent magnitudes are encountered. Of course this requires evolution in redshift - diminishing redshifts along with evolution to brighter magnitude with time! This plot of 106,958 quasars and quasar-like galaxies fills in the slope and general location of the objects available in 1968 as shown here in Figure 15. There are two results of note in Figure 16:

(1) Between $m_V = 18$ and 20 mag. *the evolution is almost exclusively downwards* when compiled in redshift. Many pile up between these apparent magnitudes and do not finish their major reduction of intrinsic redshift until they are well below $z = .06$.

(2) Also important is *a sharp diminishing of tracks below* $z = .06$ *between* $m_V = 15$ *and* 18 *very close to* $z = .06$. This suggests a brightening of the tracks connected with the $z = .06$ evolution of the objects at the .06 Karlsson redshift peak. The objects are one of the major results of the present paper in finding the large number of galaxies with intrinsic redshifts. It would be of considerable importance to look at the region around the $z = .06$ redshift peak where higher resolution is more needed - especially

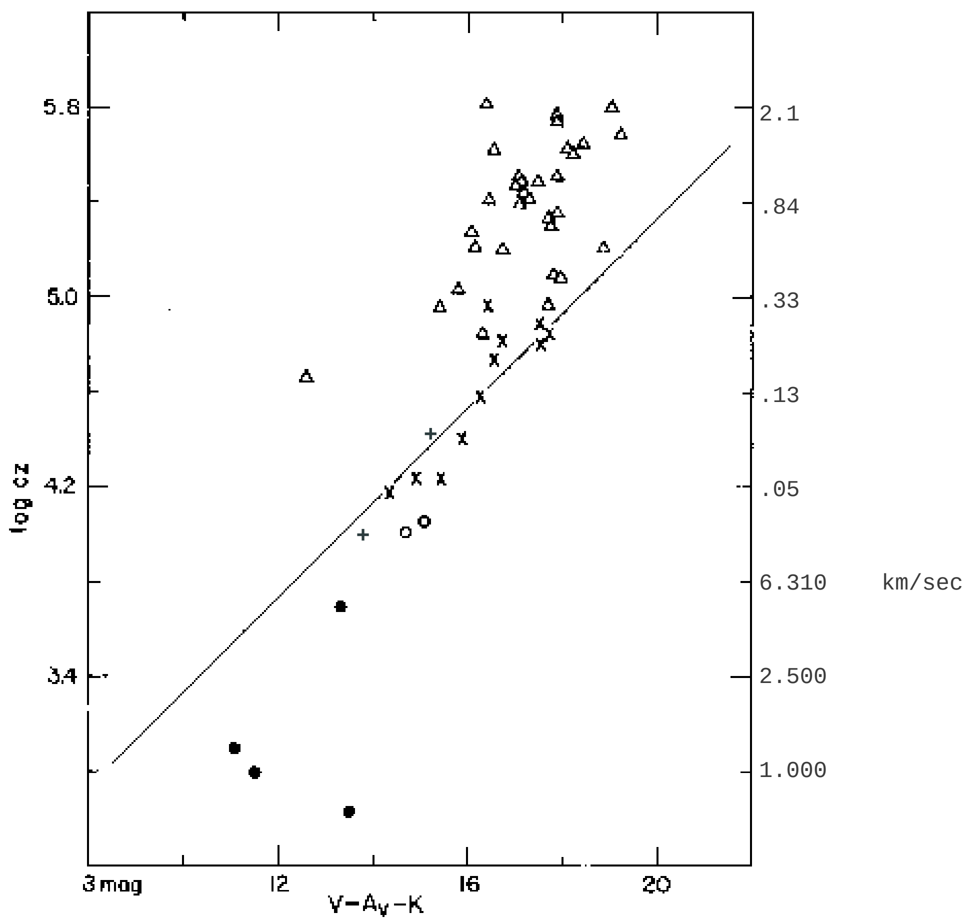

Fig. 15.— Quasars and quasar-like objects plotted in the z,m plane. Triangles are quasars, crosses are Seyfert spectra plus similar active galaxies (Arp 1968a).

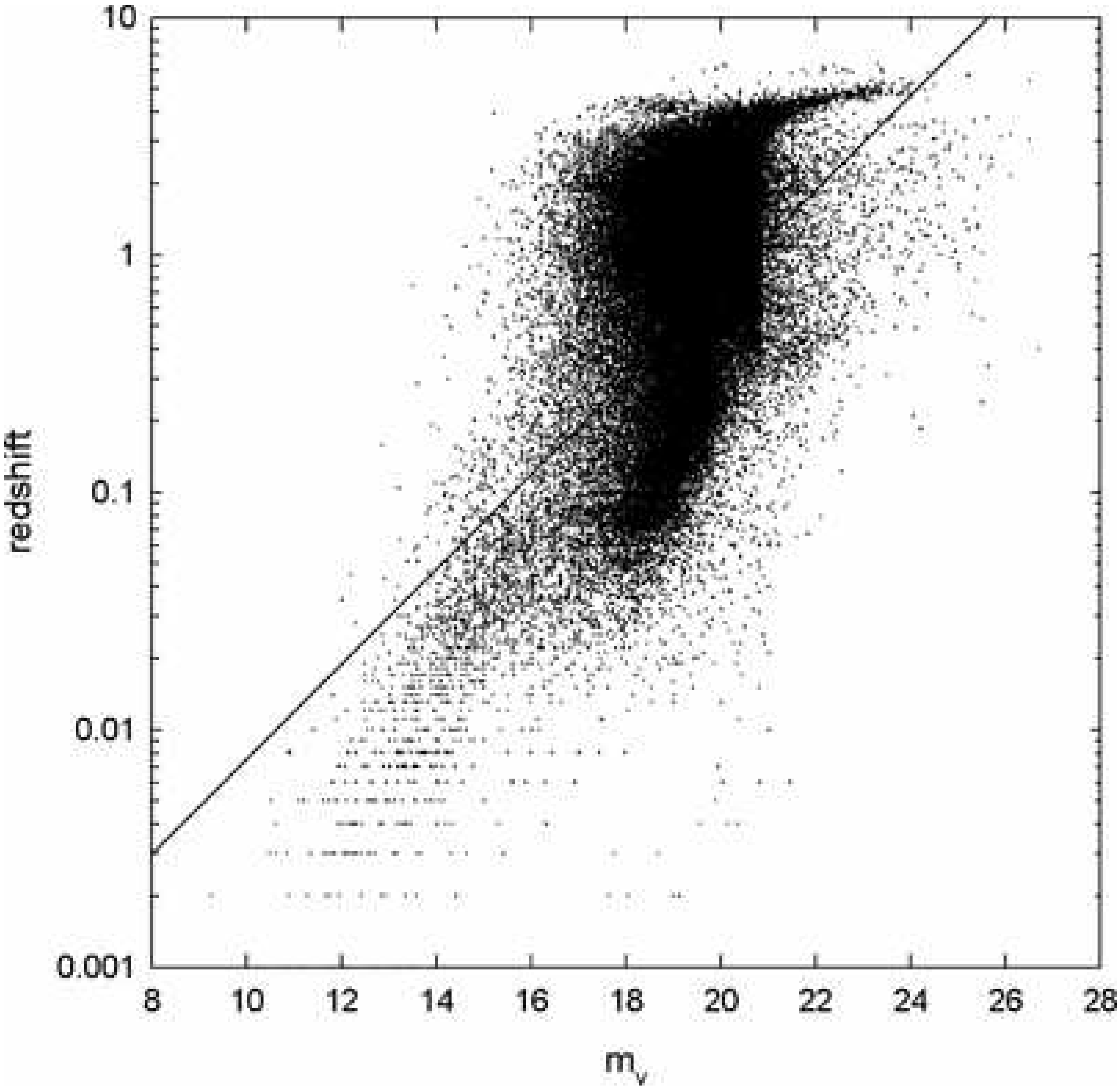

Fig. 16.— 106,958 catalogued quasars and active galaxies plotted in the z, m diagram by Bell (2007).

since there must be considerable selection effects on the objects in Figure 16.

The diagram in Figure 16 looks remarkably like the apparent mag.-color plot for clusters of stars (Hertzsprung-Russell Diagram). Those diagrams opened up the enormously rewarding subject of stellar evolution. They showed it was not the main sequence of low mass stars that evolved up the main sequence but the brighter, higher mass stars which took evolutionary tracks off the turning point and wound up on the sub giant and giant branches. The quasars appear to be injected at very high intrinsic redshifts and low luminosity, brighten a certain amount and then track almost straight down to lower redshift. Still fainter than the Hubble relation for more luminous galaxies, they gradually approach their appropriate Hubble line. We have surmised what the evolutionary tracks must be the same way we did for stellar evolution - we have looked at groups and clusters of different ages and noted the changes that take place as a function of time.

In short they have to move somewhere in the z, m plane and in Figures 15 and 16 we see quasar-like objects of all ages, pointing in favor of a more general solution of the General Relativity field equations, which for galaxies all created at the same time, give a Hubble law, without dispersion, near the current value with respect to the currently accepted age of the Universe (Narlikar & Arp 1993).

When stellar appearing objects with large redshifts began to be observed, there arose a spirited competition as to whether they could be acclaimed a "A major new constituent of the Universe." They came to be thought of in just those terms even though the alternative view that they were just an extreme version of an active galaxy was more correct. Ironically the vast numbers of young, intrinsic redshift companion galaxies discussed in this paper now unifies the quasar/galaxy classification at the same time it claims to establish the redshift as a property of younger age.

14. Another Pair of Ejected Quasars - Addendum

The preceding paper examines in some detail a representative sample of quasars which are paired across an active parent galaxy. It was shown that their properties strongly ruled out accidental occurrence of background objects. One of the most striking associations was not shown, however, because it had been published in a less well known journal (Arp 1968b).

That association is shown here in Figure 17. The two radio quasars are also very bright in X-rays and the galaxy has high surface brightness. Because of the strength of the X-ray sources and the relative paucity of prospective galaxy parents, the association of the quasar pair across the galaxy IC 1767 appears physically certain and in accordance with the previous ejection evidence of radio, X-ray and optical jets.

There are several additional features of this pairing across IC 1767 which are especially difficult to obtain by accident. We list them below with comments:

(1) The two quasars are exceptionally bright at all wavelengths and showed up as very probably associated early in preliminary evaluation of the region.

(2) The alignment across IC 1767 is within a few degrees of being completely straight.

(3) The central galaxy shows structure and high surface brightness.

(4) The quasars are emerging from the IC 1767 galaxy nearly along the minor axis.

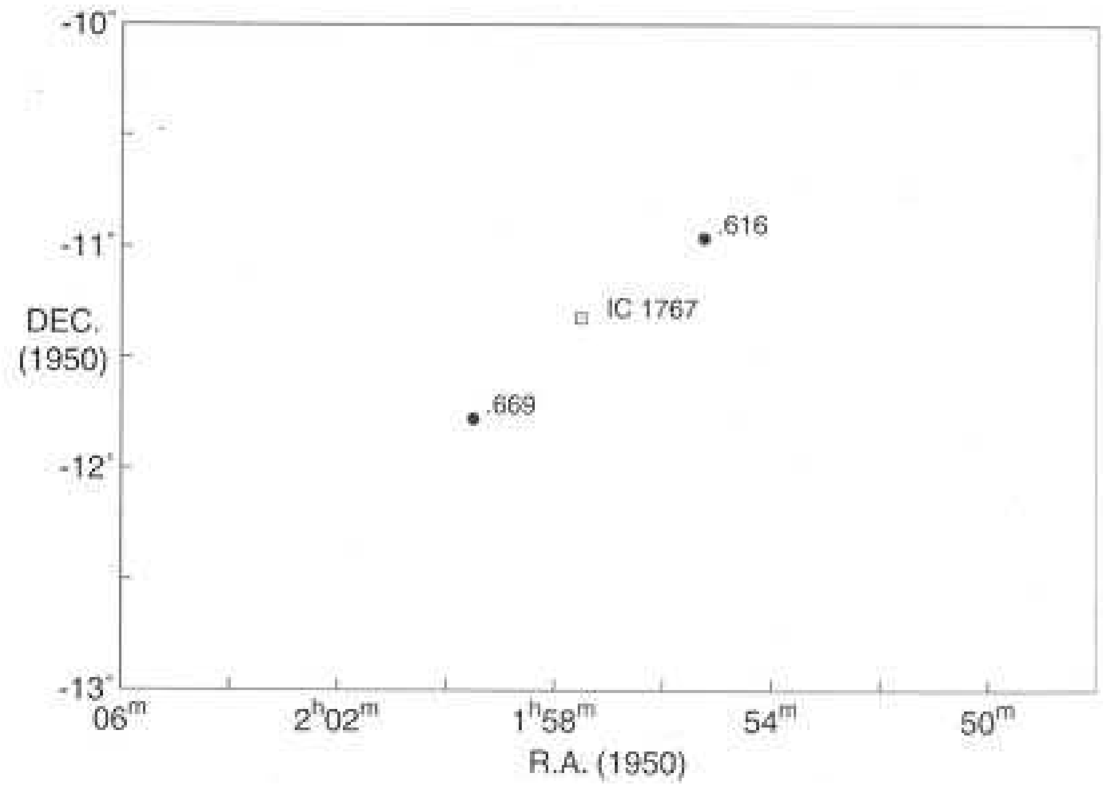

Fig. 17.— Radio Quasar z = .616 distance r_1 = 39.850 from IC 1767. Radio Quasar z = .669 distance r_2 = 40.079 from IC 1767. (Figure 1 of Arp (2003).)

(5) At this stage the quasar redshifts are somewhat similar to each other, but not enough to suggest membership in a cluster. It is interesting to ask, however, considering the possible range in quasar redshifts, why the intrinsic redshifts are so close to Karlsson values (as in the previous examples of +/- ejected quasars in this paper.

(6) When the quasar redshifts are transformed to the central galaxy they become (.6403 and .5882)/2 = .61! The Karlsson peak for IC 1767 z_0 = .61 is the same as the BL Lac climbing out the minor axis of the Seyferts NGC 4151 and UM 341 in the preceding summaries of the present paper. With all the possibilities from z_0 = .06 to 2.6 why does the association choose, for example, the Karlsson values near $z_0 = .59, .61, .61$ etc.?

(7) Now we come to the most decisive constraint that could be observed. It has to do with the two parts of the quasar as they separate. (Perhaps buoyancy, explosions, slingshots or jets.) It means the two pieces of the quasar have been ejected in opposite directions, finding similar momentum conserving pathways in both directions. The quasars are now separated by $79.93'$ and the midpoint between them is $39.96'$. Therefore the parent galaxy, IC 1767, finds itself only $.11'$ ($< 7''$) from the midpoint between the two quasars. The least one might say is that this quantitative precision could hardly be expected of a random background quasar.

15. Empirical Attempts to Understand Matter Creation/Evolution

The starting point for trying to infer the origin of a quasar is clearly the nature of conditions in the nucleus of the parent galaxy. When this nucleus fissions and sends out two parts, one in each direction, we are actually seeing the spectrum of the material which has generated the new quasar. This material must have the crucial ability to explain the intrinsic redshift of the new quasar. The plasma can be ordered as before or tangled with magnetic lines of force.

The direct approach to the nature of mass, as in the mass of an elementary particle, has been outlined by Hoyle & Narlikar (1972) and later applied to intrinsic redshifts by Narlikar & Arp (1993). The core of the assumption is that elementary particle masses are born near zero mass and gain mass as t (time) squared. The charged particle gas will generate a plasma which is high or low density, tangled or ordered, and synchrotron or thermal. It is important to utilize the viscosity of the plasmoid to cool temperatures and condense new galaxies from aging quasars. The intrinsic redshifts would then be a function of the age of the system observed. The observational evidence for the age-intrinsic redshift relation is further supported by the cases investigated in past and present papers.

The most puzzling remaining mystery is the periodicity of the Karlsson redshift peaks. Why do the redshifts collect around certain values, mathematically, in the galaxy nuclei where the intrinsic quasars incubate? Is the term plasma oscillation meaningful?

The conclusion of the authors is that we do not live in a mono-aged cosmological Universe but that we have a continual birth and evolution of structures.

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A. The Karlsson Periodicity in Redshifts

Burbidge & Burbidge (1967) noted the frequent occurrence of quasars with redshift $z = 1.95$. Later this became $z = 1.96$. Karlsson (1971) announced his famous equation which identified the seven major peaks in the distribution of quasar redshifts:

$$.06, \quad .30, \quad .60, \quad .96, \quad 1.41, \quad 1.96, \quad 2.64 \quad \ldots$$

or

$$(1 + n)(1.228) = (1 + n_{+1})$$

The lowest term has the value $z_K = .06$. At this redshift objects look mostly like galaxies with a few sufficiently bright apparent magnitudes classified as quasars. Burbidge (1968) reported seeing this peak at $= .061$. Arp et al. (1990) reported it at $z = .062$, consisting in a mix of objects which included both of what was called quasars and galaxies.

The main point of the Arp et al. (1990) paper, however, was to examine the claim that the periodicity was the result of a selection effect caused by the passage of emission lines through the photometric filters. Therefore radio selected quasars only were used. The test showed that the periodicity emerged more strongly than in any tests up to that date. But this paper also demonstrated the important principle that when the redshift of the parent galaxy was appreciable in terms of the quasar redshift that the redshift of the quasar had to be transformed into the reference frame of the parent galaxy by (Narlikar & Arp 1993)

$$(1 + z_0) = (1 + z_Q)/(1 + z_G)$$

B. Reference Frame Corrections to Obtain Velocity-like Residuals

Galaxy redshifts from the 2dF survey now enable samples of smaller, fainter companion galaxies around large, low redshift galaxies to be studied (Fulton & Arp 2009). Many of these cases show large numbers of surrounding galaxies. Most importantly, however, it turns out now that these companions have redshifts which are very closely the lowest discrete value of the Karlsson series, viz., $z_K = .06$.

In an extensive analysis of families in the 2dF deep field, Fulton & Arp (2009) compute z_0 for each quasar, select the closest Karlsson peak z_K, and compute a redshift, z_v, the velocity of ejection away from the putative parent galaxy, using the formulae of Narlikar & Arp (1993). It is important that all computations be in the $(1+z)$ mode. Narlikar (1994) has shown that the time intervals in the companions can be adjusted to that of the parent in the relativistic, gravitational, Doppler and intrinsic redshift modes. The intrinsic format also can be used and, if it is necessary, to make transformations of rest frames with it.

$$(1 + z_v) = (1 + z_0)/(1 + z_K)$$