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A SUGGESTION ON THE PAIR OF QSO TRIPLETS 1130+106 {B,A,C}, {X,Y,Z}

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RESUMO. O alinhamento de um par de tripletos de quasares descoberto por Arp e Hazard é tentativamente explicado por uma combinação de (i) a idéia de ejeção de quasares por galáxias, (ii) uma construção de Narlikar sugerindo uma origem comum para as seis imagens, e (iii) uma topologia não trivial do espaço cósmico.

ABSTRACT. The alignment of a pair of QSO triplets discovered by Arp and Hazard are tentatively explained by a combination of (i) the idea of quasar ejection by galaxies; (ii) a construction by Narlikar suggesting a common origin for the six images; and (iii) a nontrivial topology of cosmic space.

Key words: GRAVITATION — QUASARS

I. INTRODUCTION

This paper makes use of an unorthodox idea combined with a straight but unfamiliar one. The first is Arp's hypothesis that QSOs are somehow ejected by galaxies. See Arp (1988) and references there. This idea will sound more acceptable if we take it to mean that quasars might be formed around lumps of matter associated with galactic jets. I shall here use 'ejected' or 'emitted' in this wider sense. This theory implies that quasars may also be 'ejected' by other quasars, taking for granted that the latter are active galactic nuclei. (See also Charlton and Salpeter [1989].)

The unfamiliar assumption is that the global topology of cosmic space may not be the trivial one assumed in the standard Friedmann-Robertson-Walker (FRW) cosmology. See, for example, Ellis (1971); Sokolov and Shvartsman (1974); Fagundes (1983); Demianski and Lapucha (1987); and references there. A nontrivial topology allows the universe to be closed for any value of the density parameter Ω (with a null cosmologial constant Λ). One of its consequences is the production of multiple images of a single source. Here I shall be using a closed Einstein-de Sitter model with 3-torus topology, as in Fagundes and Wichoski (1987), because of the simplicity of Euclidean geometry. But the dimensions of the 3-torus will be rather small (a few hundred megaparsecs) in order to fit the data. This is in agreement with the idea of "small universe" discussed in Ellis and Schreiber (1986). See also Gott (1980), Fang and Liu (1988). However, this model will be found usatisfactory, because it predicts too many unobserved images, so I will end the paper pointing to the possibility of using a closed hyperbolic space, which would not predict so many new images.

II. A STRIKING PAIR OF QSO TRIPLETS

The quasar triplets 1130+106 {B,A,C}, {X,Y,Z} discovered by Arp and Hazard (1980) - they are more accurately named as {1130+107, 1130+106, 1130+105), (1131+112, 1130+111, 1130+109), cf. Hewitt and Burbidge (1987) - are quite remarkable as to the combination of discordant redshifts and the alignment of each triplet, plus the similarity of the triplets to each other. See Fig. 1 below, reproduced from Arp and Hazard (1980), with Prof. Arp's permission.

If the middle quasars in these triplets had an intermediate redshift, say $z \approx 1.9$, we would be inclined to think that they had 'ejected' the flanking ones, the small differences in redshift being then attributed to Doppler effect. We might think of a powerful gravitational lens to account for the similar patterns of the triplets, whose middle objects are separated by about 20 arcminutes.

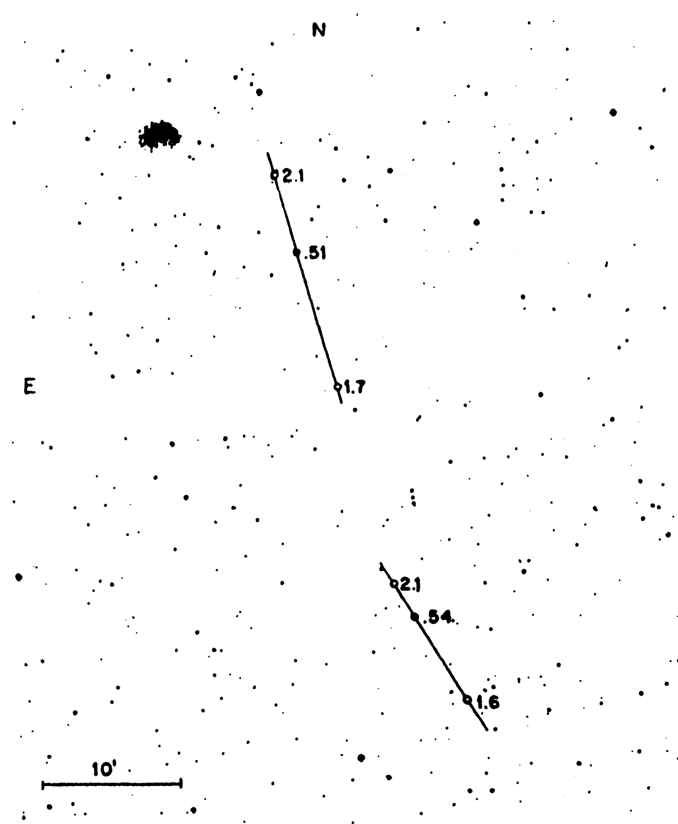

FIGURE 1. Reproduced, by permission, from Arp and Hazard (1980).

On the other hand, if we had just one, instead of two of these triplets, we could interpret the $z \approx 0.5$ quasar as the parent, that would have ejected the other two at about time $z = 1.9$, and by a topological production of conjunct images we would now have the central image at that time blocked by the source at $z \approx 0.5$. I have tried, but not succeeded, to couple this idea with the lens effect to produce an explanation of the second triplet. The problem is that the near and far images are displaced differently by a given lens, so as to distort the remarkable alignment in both triplets.

III. THE SIX QUASARS AS A SINGLE SYSTEM

As a workable alternative I take advantage of a construction by Narlikar

1981), published as Fig. 25 in Burbidge (1981) and here reproduced as Fig. 2, ith Prof. Burbidge's and The New York Academy of Sciences's permissions.

The idea is that the six quasars are actually a sextet, centered on bject Z (with redshift 1.7), that would have 'emitted' the other five. With he value $H = 75$ km s^{-1} Mpc^{-1} for the Hubble constant, the distances and look-ack times are as shown in Table 1 (assuming for the moment no local motions).

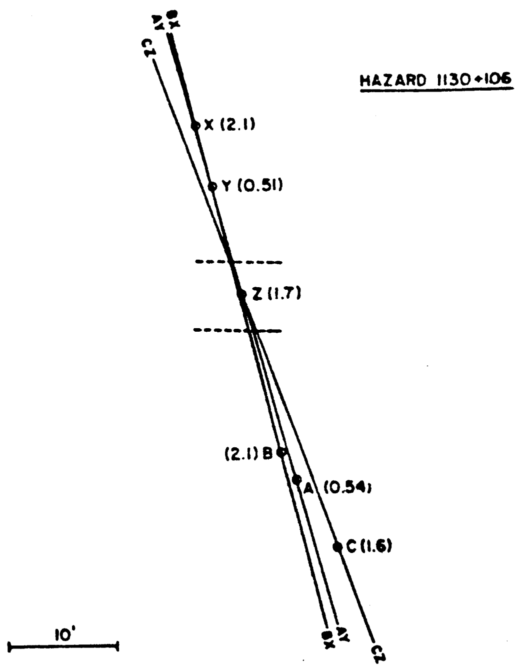

FIGURE 2. Reproduced, by permission, from Burbidge (1981).

But contrary to Arp's assumption of intrinsic redshifts, I use the idea f topologically produced multiple images to explain the discordant edshifts: see Fagundes (1989) and references there. In Fig. 3 cosmic space is epresented, in fixed, comovingcoordinates, by a shaded rectangle - actually e "fundamental polyhedron" (FP) is a parallelepiped. The similar but un-aded rectangles are replicas of the FP, the locus of the repeated images of ources in the FP.

The data were fitted assuming a cell length of 387 Mpc in the direction f the triplets. The parent source would be some unknown member of the Local roup (LG in Fig. 3). At time $z \approx 0.54$, or 4.1×10^{9} years ago, a symmetrical et would have produced quasars A and Y. The source itself was then not ufficiently luminous. Earlier the source had brightened, to be seen now as bject Z, at $z = 1.7$, together with the 'emitted' object C, Doppler-shifted by $_D \approx -0.037$. Finally, at $z = 2.1$ we again see only the 'emitted' quasars B and , the source being then nonluminous (note in Table 1 the 400 million years apse to its luminous state at $z = 1.7$).

Interesting as it is, this picture suffers from an excess of riches. It predicts a similar pattern in the opposite direction, and probably in many other directions on the sky See Fagundes and Wichoski (1987) Since there seem to be no quasars near RA 23^h30^{min} Dec $-10^\circ.40$, it is not worthwhile

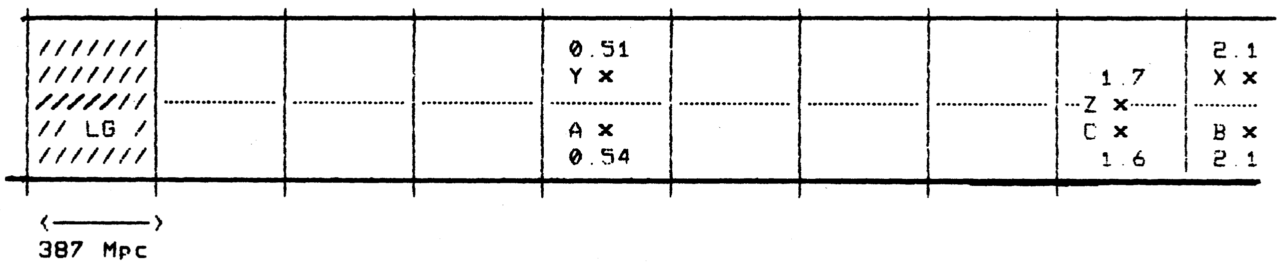

FIGURE 3

now to proceed discussing other aspects of the model. I rather want to try to get a similar picture from a closed hyperbolic model, like the one in Fagundes (1989) but with a smaller fundamental polyhedron. Such models do not predict so many new images, and the source need not be located nearby.

TABLE 1. PROPERTIES OF THE MEMBERS OF THE TRIPLETS

QSO	REDSHIFT	MAGNITUDE[a] (V)	DISTANCE[b] (Mpc)	LOOKBACK TIME[b] (10^9 years)
X	2.1	19.0	3456	7.1
Y	0.51	16.9	1490	4.0
Z	1.7	19.9	3131	6.7
B	2.1	19.4	3456	7.1
A	0.54	17.5	1553	4.1
C	1.6	19.0	3039	6.6

[a]From Hewitt and Burbidge (1987)
[b]With $H_o = 75$ km s^{-1} Mpc^{-1}, and ignoring local motion.

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