On Reviving Tired Light

Toivo Jaakkola
University of Helsinki Observatory
Tahtitorninmaki
SF-00130 Helsinki

Halton Arp has recently (1989) presented empirical criticisms of the validity of tired-light mechanisms as an explanation of anomalous redshifts. This is extremely welcome and represents the beginning of a true discussion among those who are not content with standard big bang cosmology. The unorthodox theories are legion: there almost as many theories as there are unorthodox thinkers in this domain. This situation is not conducive to advances in our understanding of a difficult problem. Therefore discussion, and even dispute, are necessary, unavoidable and useful. And who has greater right to initiate the discussion than Chip Arp, the pioneer of the field?

Of course Arp's comments, presented in his usual cogent manner, are open to further discussion. Here I shall follow his numbering, basing my arguments only on studies in which I have been personally involved, since I am directly aware of their connection to the issue under discussion.

1. *Perturbation of photon path*: QSOs (with compact or no radio structure) and some other compact objects are, regardless of redshift values, close to us, as Arp has argued and successfully proved. Hence, they are of small absolute size. Under these circumstances, a tired light mechanism need not blur the image of the object in the short

light path from the object through a redshifting medium, or, as I think, through a cylindrically symmetrical gravitational redshifting agent. The additional cosmological redshift is in most of these cases insignificant, causing hardly any extra diffusion of the image. On the other hand, there definitely are cases where the image is extended, either due to the true structure, or, just perhaps, due to the blurring effect.

2. *Additional redshift caused by interposed objects*: Evidence that diffuse matter (or a redshifting medium/agent connected to it) redshifts the light from more distant objects does indeed exist. This is clearly seen in the Milky Way, appearing as an anomalous kinematical feature (North-South rotational asymmetry, etc.) (Jaakkola *et al.* 1978, Moles & Jaakkola 1977) and as several heliocentric anomalies in the kinematically constructed structural maps of the spiral structure (Jaakkola *et al.* 1984, Jaakkola et. al. 1985). As for the star clusters, unfortunately no systematic studies have been done of this question, but until one is done nothing can be said one way or the other. For galaxy clusters and groups, such studies do exist (Jaakkola 1976, Jaakkola 1983a), and these point to an increase of redshift proporational to the depth of the galaxy within the cluster as seen from the observer's position.

3. *Different redshifting medium*: There is no reason why there could not be different kinds of material "vacuum" or other redshifting agents for different objects, even in association with each other. This may depend on the ages, histories or other properties of the individual galaxies.

4. *Excess redshifts in objects with large apparent diameters*: The same applies to excess redshifts in objects with large diameters (Moles & Jaakkola 1976). As for redshifts of galactic centres and gradients outward, just this has been observed within our own galaxy

(Jaakkola 1978a, 1978b, Jaakkola *et al.* 1978). Based on preliminary observations, similar effects are found in some other galaxies as well.

5. *Redshift perturbations along the edges of redshifting shells*: Large excess redshifts appear in very compact objects, but projection of more distant objects through the narrow redshifting halo has a low probability. Perhaps, on closer inspection, candidates for this effect might be found. For smaller effects, I refer to the (*m,z*) relations within systems of galaxies (Jaakkola 1976, 1983a) as well as the effect of the local supergalaxy on the redshifts of more distant galaxies (Jaakkola 1978, Jaakkola *et al.* 1989, Jaakkola *et al.* 1975a, Jaakkola *et al.* 1975b, Jaakkola *et al.* 1976), which seems to play an important role in the so-called Rubin-Ford effect. Also, the *z*-gradients across the disks of galaxies (with a higher "velocity" for the far side than for the near side, independent of distance from the minor axis), can be included with this group of arguments (Jaakkola *et al.* 1975c).

Arp suggests that the intrinsic nature of the object causes the excess redshift, and relates this to the youth of the object. I completely agree with this, and have advocated the idea in some contexts (e.g. Jaakkola 1973, 1977). But this does not exclude tired light mechanisms. The NGC3067/3C232 system can easily be understood as a young QSO expelled from the nucleus of the galaxy, with its own redshifting atmosphere.

I would like to point out here again that there is no dualism of "anomalous" and "systematic" (cosmological) redshifts. There is only one systematic redshift effect with a single physical mechanism. (Jaakkola 1978). The strength of the effect depends on other physical conditions, including age and density (which are related parameters). Excess redshifts of QSOs are an extreme form of this single effect, *z*-gradients across systems of galaxies and across the disks of single galaxies are intermediate forms, while the cosmological redshift lies

at the other end of the strength scale. This should be taken into account when discussing the validity of tired light mechanisms. By contrast to Arp's metaphor about systems becoming tired more easily in their infancy, I would say that climbing one hundred meters up a steep hillside may tire one more than wandering blithely for miles across flat grasslands.

As on other occasions, Arp adopts the Hoyle/Narlikar theory according to which all particles increase in mass over time. Locally, e.g. in newborn QSOs, this and other unknown particle processes are quite conceivable, but applied on the cosmological scale, as an interpretation of cosmological redshift, it is, in the author's personal opinion, unacceptable. It implies cosmic time, and hence abandons the perfect cosmological principle, which was the enduring element of the classical steady-state theory of Hoyle and others. A violation of that principle contradicts observations which show that the distant regions of the Universe do not differ from nearby regions (Jaakkola 1982, Laurikainen & Jaakkola 1985a, 1985b, Jaakkola *et al.* 1979, Jaakkola 1983b). The strongest argument, both theoretically and empirically, in favour of tired light mechanisms and against the standard model and other theories involving cosmic time is that only the former keep the cosmological principle intact, in its proper form (Jaakkola 1989).

This discussion would be on a much firmer footing if the relevant empirical data were examined in adequate detail by independent groups. All the publications referred to here were studies in which the author participated personally, mainly during the 1970s. Unfortunately, I know of no other such empirical studies. Of course, this is a very unsatisfactory state of affairs. Since these studies were done the data in all relevant areas has expanded by an order of magnitude, and should provide enough material for a serious investigation of the present problem, which, as Arp points out, can

surely be solved by observational means. In the meantime, the arguments I have given here are, I hope, sufficient to infer that the various tired light mechanisms are not yet completely out of the running.

References

Arp, H., 1990. in *IEEE Trans. Plasma Sci*., **18**, 77

Jaakkola, T., 1973. *Astron. Astrophys*., **27**, 449.

Jaakkola, T., 1976. in *Proc. Third European Astron. Meeting*, 218.

Jaakkola, T., 1977. *Astrophys. Space Sci*. **88**, 283.

Jaakkola, T., 1978a. *Scient. Inf. Astron. Council, USSR Acad. Sci*., No. **45**, 190.

Jaakkola, T., 1978b. *Acta Cosmologica*, **7**, 17.

Jaakkola, T., 1983. In A. van der Merwe, ed., *Old and New Questions in Physics, Cosmology and Theoretical Biology, Essays in Honour of Wolfgang Yourgrau*, Plenum Press, p. 223.

Jaakkola, T., 1983a. *Astron. Nachr*., **304**, 103.

Jaakkola, T., 1989. *Apeiron*, **4**, 9.

Jaakkola, T., Holsti, N., and Laurikainen, E., 1984. *Astrophys. Space Sci*., **107**, 84.

Jaakkola, T., Holsti, N., and Teerikorpi, P., 1985. in H. van Woerden, ed., *The Milky Way Galaxy*, Proc. IAU Symp. No. **106**, 305.

Jaakkola, T., Karoji, H., le Denmat, G., Moles, M., Nottale, L., and Vigier, J.P., 1976. *MNRAS*, **177**, 191.

Jaakkola, T., Karoji, H., Moles, M., and Vigier, J.P., 1975a. *Nature*, **256**, 24.

Jaakkola, T., Moles, M., and Vigier, J.P., 1978, *Astrophys. Space Sci*., **58**, 99.

Jaakkola, T., Moles, M., and Vigier, J.P., 1979. *Astron. Nachr*., **300**, 229.

Jaakkola, T., Moles, M., Vigier, J.P., Pecker, J.C., and Yourgau, W., 1975b. *Found. Phys*., **5**, 257.

Jaakkola, T., Pecker, J.C, and Vigier, J.P., 1989. *Apeiron*, **6**, 12.

Jaakkola, T., Teerikorpi, P. and Donner, K.J., 1975c. *Astron. Astrophys*., **40**, 257.

Laurikainen, E. and Jaakkola, T., 1985a. *Astrophys. Space Sci*., **109**, 111.

Laurikainen, E. and Jaakkola, T., 1985b. in J.L. Nieto, ed., *New Aspects of Galaxy Photometry*, p. 309.

Moles, M. and Jaakkola, T., 1976. *Astron. Astrophys.*, **53**, 389.
Moles, M., and Jaakkola, T., 1977. *Astrophys. Space Sci.* **48**, L1.