In Memoriam Toivo Jaakkola
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Dying so young, at 54 years of age, is in itself a sad and painful thing. But when one is, as Toivo Jaakkola was, in a period of full productivity, of continuous creative imagination, it is for all his friends and colleagues an almost intolerable loss.

Toivo Jaakkola was born on March 11, 1941, at Pelkosenniemi, in eastern Finland, then close to the battle lines in the war against Russia. He passed his "student's examination", entitling him to follow a university curriculum, at the famous University of Oulu, on the northern shores of the Gulf of Bothnia, in 1960. In 1967, he received his "Phil. Cand.", a Finnish degree more or less equivalent to Master of Science. It was in Paris, in 1977, that he defended a very daring thesis, on the subject "*Etudes sur la nature des décalages vers le rouge dans les galaxies*" (studies on the nature of extragalactic redshifts), at the Université Pierre et Marie Curie. He earned the highest grade (*mention très honorable*, equivalent to a *magna cum laude*). I am happy to have served as a member of the jury.

In the meantime, Jaakkola worked for a time in Finland, first as an assistant at the Observatory of the University of Oulu (1966-69), then at the Observatory of the University of Helsinki (1970-88), where he taught extragalactic astronomy and cosmology since 1971. He became a docent of astronomy in 1978, in Helsinki, and at Oulu in 1979. He was an acting Professor of Astronomy at Helsinki in 1979-80. But his works were so original and at odds with the conventional viewpoint that he was not very popular in his own country, with his own establishment; and he was more or less forced to go abroad for longer or shorter periods. He spent 9 months in Kiev (1969-70), again in Paris (at the Institut Henri Poincaré, at the Institut d'Astrophysique, at the Observatoire de Meudon), 9 months in 1974-75, and on many other occasions. He finally succeeded in being recognized in his own country as a competent candidate for the post of Professor of Astronomy at Helsinki (in 1979) and at Turku (in 1980), but he was never appointed to these chairs. Naturally, he was a member of IAU (since 1973), and took part in many meetings and symposia, of the IAU and other institutions. He passed away at Ryttyla, in Finland, on May 24, 1995.

The number of his publications is rather large., and covers not only his favourite topics (problems of extragalactic astronomy and cosmology), but also more classical questions, such as the study of Mercury. Altogether, he published, alone or in collaboration (with known astronomers such as Karachentsev, Markkanen, Teerikorpi, Moles, Vigier, the group around Vigier in Paris, and myself). Actually, the number of his publications exceeds 80, but the number of unpublished essays is certainly still much larger, since unfortunately, or perhaps fortunately, Toivo was so productive and imaginative that many of his papers were often rejected by the classical large journals, because of their lack of orthodoxy (or lack of "a respectable allowed non-orthodoxy"!!)

Jaakkola was undoubtedly inspired in his research by his philosophy of life. He was a non-believer, a skeptic. And he was very sensitive to the hidden hypotheses, of a metaphysical nature, underlying most of the classical papers concerning the general structure of the Universe. Hence his contributions tended to doubt, or even reject, the classical interpretations, proposing other novel interpretations.

There is little doubt that Toivo's philosophy led him to reject, *a priori*, the big bang standard model of the evolution of the Universe, for reasons that were very near those of Einstein or Ambartsumian (when he was still working in the framework of the "socialist" science). There is little doubt about this attitude *a priori*. It may be looked at with sympathy, but it may be heavily criticized of course, as being of a philosophical nature, more or less, not of a purely scientific nature, based primarily on the observed facts. But it precisely led Toivo into many discussions of the alleged facts, the classical arguments on which the first "standard" models of the Universe were based, and the classical observations which, later on, were used to comfort the classical standard modelists in their faith.

Jaakkola, like Einstein, was first convinced of the importance of Mach's arguments about inertia and gravitation. As he was convinced also by a careful examination of several types of observations that their is no proof whatsoever of the evolution of the Universe within its observable limits, he claimed that the Universe is at least statistically stable. But how is any stability possible in the presence of gravitation? We know that Einstein, like Seeliger before, and several others, assumed a repulsive force (Seeliger, and Neumann assumed an exponential term to be added to the Newton's force, Einstein expressed it in his equations by a term containing the cosmological constant Λ); others put it in the properties of the ether. The hypothesis Jaakkola adopted is that the solution lies in the redshift itself (whatever its origin may be, provided it is not an expansion): indeed radiation is diluted not only by the Newtonian $1/r^2$ law, but also by an additional $1/(1+z)$

Redshift appears as an absorption-like effect, which acts upon light, and upon gravitation as well, and which acts just as the exponential term of Seeliger . Of course, the difficulty is the same as the chicken and the egg: Is it the departure from Newtonian gravitation, which creates the redshift; or is it the redshift which leads to these departures? But Jaakkola insists that both problems can be solved together, the redshift being due to the decrease of the gravitational effect relative to Newtonian gravitation, the decrease being due to the redshift itself, by a coupling between gravitational and electromagnetic interaction.

In this coupling, the Machian interaction radius is essential (see *Apeiron* No. 1), and it leads to a coherent stability at scales larger than a certain value (the Machian interaction decreases with distance as $(\exp(-Hr/c) - 1) = 4az(1+z)$, a being $= 1.6 \times 10^{9}$ cm s^{-2}, which expresses the Machian inertial contribution to forces exerted from the Universe on any particle within it). From this (but using various observed data, and the assumption of an infinite Universe), Jaakkola describes a synthetic view in which the hierarchical structure is understood, the angular momentum in the Universe as well, and the global isotropy and homogeneity as well as the global stability of the Universe. Facts seems to agree with Jaakkola's description more than with the standard big bang models. But of course, many standard cosmologists would disagree with this view...

Jaakkola's model, in the framework of an infinite Universe, led him to adopt the so-called perfect cosmological principle, that of Hoyle, Gold, Bondi, which he sees as a completion of the Copernican system. Of course, Jaakkola bases this interpretation on the many observations leading to the non-velocity nature of the observed redshifts, observations which he reviewed on several occasions very carefully. Therefore, he did not accept the whole of the Hoyle theory; for him "continuous creation" is quite unnecessary.

Even heretic cosmologists have expressed different views: for example, for Jaakkola, the redshift is inherent in the equilibrium of the Universe; it is not linked, as it is for Vigier and myself, to an interaction of material (with a non-zero rest mass) photons with the intervening matter between source and observer; nor is it linked, as it is for Arp and others, to the "youth" of recently created atoms, ejected by some galaxies. Although Jaakkola disagreed with the tired-light mechanisms to explain the redshift (inherent indeed in much of his unified view of the gravito-electric nature of the universe), he defended this view against Arps' argument., showing there his open mind toward other "heresies".

One should say that, like other heretical "theories", Jaakkola's theory is perhaps only a stimulating and rather vivid sketch: one can say the same, unfortunately, of many non-orthodox theories, in the sense that they have rarely attracted the attention of pure mathematicians, easily inclined to adopt the more conventional views of the establishment cosmologists and astronomers.

Quite original in his approach to the Universe, described above, is the idea of an electromagnetic coupling with the gravitational force, a view close to that defended, for example, by Alfvén. The origin of this idea lies in the preceding considerations. Here I should perhaps quote Jaakkola:

> *The coupling of electricity and gravitation, which is the cause of the redshift and the exponential weakening of gravitation.... makes Newton's law inapplicable on the cosmological scale... The gravitational parameter G changes from a constant to a physical variable which is constant only over the homogeneous distribution oft the cosmological scale... The theory based on the Perfect Cosmological Principle also implies a thorough change in our concepts of space and time But this cannot be achieved without philosophical work in clarifying concepts, sharpening methods, and pointing out the basic ontological content of the cosmological problem. In particular the materialistic ontological statement which is the focus of the temporal aspect of the cosmological principle, namely that matter is indestructible not only in the quantitative sense, but also in the qualitative sense, cannot be avoided in cosmology... (Apeiron No. 4).*

One sees here that Jaakkola's strong attachment to philosophy (in particular that of Engels), led him to adopt points of views that may differ even from Einstein's. Jaakkola's mind was ever open! But let us come back to the "electrogravity" (*Apeiron* No. 18). This concept, very difficult indeed to define, emerges from the idea that, out from a large mass of matter (say: a quasar:; or say: the Universe...), emerges light, an electromagnetic vibration, as the only measurable quantity linked with this extreme condensation of gravitational forces. This is also the case of the cosmic background radiation. An example of the reasoning is the following. Consider radiation from some high redshift QSO (not necessarily a "cosmological" redshift); the redshift dims the energy of the photons emitted in the very condensed source of energy E_o; and they are observed at energy $E_o/(1+z)$. The absorption of the fraction $1/(1+z)$ of the original energy so produced takes place within the gravitational field of the quasar—by the electro-gravitational coupling. But absorbed energy must be re-emitted; this will be the "electro-gravitational radiation" process—precisely. In space, similarly, electro-gravitational radiation is observed as "cosmic background radiation". Here I shall not develop this profound and extremely productive idea, of which Jaakkola has shown not only its coherence, but its relevance and excellent agreement with many conventional or anomalous observations (generally not taken into consideration by conventional cosmologists).

He was still involved in numerous projects; his untiring mind was in a constant state of creation: gravitation, redshift, electro-gravitational coupling, origin and evolution of galaxies, cosmology. More precisely, he was working, at the moment of his untimely death, on the problem of the so-called missing mass, on the large scale structure of the Universe, and its formation, on the local Supergalaxy and the Great Attractor, on redshift periodicities, on the kinematics of galaxies and the Galaxy, but also on orbital anomalies in the solar system, on tests of cosmic evolution, on the Hubble-Tolman test, and on other cosmological tests... .Always Jaakkola had in mind that the conventional model (the "big bang") was fundamentally based on erroneous and implicit assumptions.

And always, he moved, as if on some converging spiral, toward a unified solution, the basis of which appeared to him more and more an elaboration of electro-gravity, his major leading idea during his last years. I have little doubt that, had time been given to him, and perhaps, some cooperation with a good mathematician (new mathematical tools may have proven quite useful), he would have succeeded in this unification....

Jaakkola had a strong personality, often difficult to understand. He could stay for hours in the mi dst of others without saying a word, apparently absent from the group (but pursuing, within himself, the difficult paths of his thoughts). One word, ironical and witty, would fall, from time to time from his closed lips, under his bent brow. His tendency to be very solitary, even, often, sad and depressed, a somewhat irregular way of living , undoubtedly all brought on his end sooner. He suffered because he was not accepted more widely in his own country, and always had to fight for his rights. He must certainly have been tired of the struggle.

We shall miss his deep and far-reaching views on the Universe, and his faithful friendship for those who did not reject him. In this special issue of *Apeiron*, we present the last essay from the pen of Toivo Jaakkola, followed by essays dedicated to his memory.

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