COSMOLOGICAL MODEL WITH INHOMOGENEOUS SPACE AND NONUNIFORM TIME

B. ABRAMENKO

AEG Forschungs-Institut, Frankfurt am Main, Germany

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Abstract. A cosmological model with inhomogeneous space and nonuniform time is proposed and substantiated. Both space and time are assumed to be finite, i.e., curved of positive sign and characterized by a variable curvature.

The replacement of the absolute universal time by a relative proper time, intrinsic for individual gravitational objects, is in accord with the spirit of relativity.

Numerous consequences of this model leading to observable phenomena in galaxies, quasars and in the solar system are derived from the mathematical analysis of the line element, Equation (8), of the model in the papers mentioned in Section 4.2, where they are confronted with observational evidence. In addition several predictions following from the theory are listed (Section 4.3), whose verification by future observations may justify the postulate lying at the basis of this theory.

1. Introduction

The problem of adequacy of the contemporary physics to account for all phenomena observed by astrophysicists in recent years was occasionally discussed in scientific conferences without arriving at a common agreement. While Ambartsumian, Hoyle and a few others, in a discussion following Woltjer's report (1971), believed that an extension of physics was required to cover new facts discovered, the majority still held the known laws to be quite adequate to cope with the problem arising and even denied the necessity or expediency of looking for any new approaches.

It seems that those holding this viewpoint overlook the fact that discoveries of recent times confront astrophysics with the question of validity of the known laws of nature during the time spans of billions of years and cannot therefore be assumed a priori as granted. One has to recall the careful warning expressed already by Hubble (referred to by Whitrow, 1946): 'We cannot assume that our knowledge of physical principles is yet complete'.

It is appropriate here to mention also the opinion held by Unsöld (1947): 'it is probable that in considering time intervals exceeding 10^9 years we have to go over to cosmological physics'. He believed that the present physics should undergo an essential extension when approaching the world age of a few billion years, like changing to relativistic physics at velocities approaching the light velocity C. His analogy of the present situation in physics where he replaces the classical physics by a relativistic one is quite justified, and necessary conclusions thereof should be drawn.

The reason for the failure of classical physics at V -> C is that C represents the
upper limit of physically possible velocities, which replaces in the infinite one in the pre-relativistic physics. Velocities exceeding $C$ have no physical sense (hypothetical tachyons do not interact with common matter and do not belong to the physical picture of the real world). Likewise there must be an upper limit of time intervals beyond which longer time spans have no physical meaning.

2. Metrical Structure of Time

2.1. Infinite Uniform Time

The time of classical physics is the time of Newton, whose characteristic found place in his Principia: 'Tempus Absolutum, verum et mathematicum, in se et natura sua absque relatione ad externum quodvis aequabiliter fluit'. This time is infinite in the past and in the future, for it is supposed to flow, at the same rate, from minus infinity (or at least from the instant of the world origin) to plus infinity, and any time intervals of however long duration are physically meaningful. The relativistic physics took over the concept of infinite time and changed nothing in respect to validity of physical laws during time intervals of any length. This is evident from the equation of the line element in relativistic world models

$$ds^2 = -\frac{R^2(t)}{(1 + \frac{1}{2}Kr^2)^2} [dr^2 + r^2(d\theta^2 + \sin^2 \theta d\phi^2)] + c^2 dt^2,$$  

where $K$ describes the curvature of space and $t$ is universal time which flows uniformly forever, any time instant being indistinguishable from another. The succession of time instants can be represented by the infinite sequence of points in a straight line, which justifies the designation of this time as rectilinear uniform time. Milne (1940) wrote that 'In relativity the notion of uniform time is adopted without discussion', and he questioned the justification of such an assumption.

The concept of absolute character of time was justly criticized by Mach (1912), de Sitter (1918) and Eddington (1925); the latter showed that it contradicts the spirit of relativity. The validity of absolute time for the whole of the Universe reintroduces the concept of simultaneity for distant places in the Universe, which was denied by relativity. Indeed, hypothetical observers located in galaxies, even very distant from each other, can establish, by studying the $R = f(t)$ diagrams with highest precision, that certain events within their systems occurred simultaneously, for time flows uniformly everywhere. The theoretical possibility of establishing such a simultaneity was rejected by relativity even in principle, apart from the actual improbability of attaining the high precision required. Therein lies the contradiction between the notions of relativity and absolute time.

Aiming to abolish the absolute character of time de Sitter (1918) attempted to introduce an alternative structure of time. Time in his cosmological model is represented by a curve of negative curvature, hyperbola. Therefore it is curvilinear but