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## COHERENCE OF EPISTEMIC JUSTIFICATION *VERSUS* THE PRINCIPLE OF CORRESPONDENCE IN MODERN COSMOLOGY

*It is argued that an effective methodology of contemporary mathematical cosmology related to the modelling of the very early stages of the evolutionary universes consists not in the principle of correspondence of its theoretical constructs with empirical reality, but in the coherence of epistemic justification which relates to the belief-like commitments of the community of cosmologists.*

**Keywords:** cosmology, epistemology, coherence, correspondence principle, beliefs, extrapolation.

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## ЭПИСТЕМОЛОГИЧЕСКАЯ КОГЕРЕНТНОСТЬ ОБОСНОВАНИЯ *VERSUS* ПРИНЦИП СООТВЕТСТВИЯ В СОВРЕМЕННОЙ КОСМОЛОГИИ

*В статье автором развивается аргумент о том, что эффективно действующей методологией современной математической космологии, моделирующей ранние стадии эволюции Вселенной, является не традиционный принцип соответствия между теоре-*

*тическими конструктами и эмпирическими реальностями, а известный из теории познания принцип эпистемологической когерентности, который не требует апелляции к эмпирическому опыту и который строится на предпосылках правоты и истины, устанавливаемыми сообществом космологов-исследователей.*

**Ключевые слова:** космология, эпистемология, когерентность, принцип соответствия, верования, экстраполяция.

Contemporary cosmology, as the study of the universe at large, is characterised by epistemic situations when the principle of correspondence between the constructs of its theories and empirical realities does not work. This happens when cosmology attempts to predicate (on the basis of extrapolation) something about the long distant past of the universe with no hope of verifying theoretical constructs by means of any direct observations. In this case, even if mathematics is applied to model some aspects of the universe, there is always a possibility that this mathematics is incomplete and historically contingent so that the theoretical vision of reality (its construct) will change. Indeed, if one speculates about the past of the universe on the grounds of a simple physical causation, one can assert that the display of the cosmos (through the light which reaches us on the surface of the null past cone) is the remote consequence of that which took place in the past (which cosmology attempts to predicate in theoretical terms) and which is beyond the conditions of observability. This frozen image of the past of the universe is given to us through its display here and now, but the sense of this past can only be conceived in certain limits. Cosmology attempts to phenomenalize this past through its theories, which are incomplete and constantly corrigible. In other words, any attempt to reduce our knowledge of the past of the universe to the limits of the constituting ego of a cosmologist, as its “now”, is a reasonable but never ending, inexhaustible enterprise. The universe in its historical past is predicated from within a very short historical period when cosmology emerged as a social and cultural fact. Then the question arises: if we have no direct access to the past of the universe, what is the sense of its theoretical mod-

elling in terms of constructs with respect to which the correspondence principle with empirical reality does not work? The answer comes from an observation that theoretical cosmology (not observational astronomy and astrophysics), *de facto*, bases its methodology not on the correspondence principle, but on the *coherence of epistemic justification*. E. McMullin argues that cosmology, as well as other disciplines which attempt to reconstruct the past (such as geology, paleontology or biology) rely on *retradiction* as that foundational principle which can bring into focus the past of the universe. The acceptance of this principle “is due to the cumulative success of the historical sciences, of geology, of paleontology, and of evolutionary biology. Success is not measured here as it might be in physics and chemistry. It is a matter of *coherence* rather than of novel prediction. The coherence lies not just in the particular historical reconstruction of a long-past geological or biological episode but in the ways in which one reconstruction supports another, and the scope of the concepts and explanatory concepts on which the reconstruction is based gradually widens” [8, p. 120]. Here, however we have to face an ontological question as to what extent coherence of justification entails truth. For McMullin, who associates retradiction with a kind of realistic methodology this entailment is paramount because “when reconstructions of quite different sorts of evidence drawn from geology and evolutionary biology, say, begin to “jump together”, as it were, begin to blend fairly harmoniously into a single story, then our conviction grows that the story is not just coherent but is also close to truth” [8, p. 120]. It is not obvious, however, that experience of dealing with geology and biology is so easily

transferable towards cosmology, in particular, towards what is concerned with the origin of the universe as a whole, but not only of that its part where we find ourselves.

The basic reason for invocation of the coherence theory of justification in cosmology is that cosmology starts its discourse with a specific set of propositions, which can be qualified as beliefs, rather than apodictic assertions. As it is widely known, cosmology as a physical science is only possible under the assumption that there is a fundamental uniformity in the universe in space, as well as in time, in what concerns physical laws. This so called “cosmological principle” cannot be empirically verified because humanity occupies a particular position in space and in time from which the predication of the wholeness of the universe is attempted. Let us analyse carefully how this basic belief enters all cosmological constructs and makes the whole theory coherent.

The cosmological principle makes it possible to proceed beyond the contingencies of observations from a particular location in space (which indicates the isotropic distribution of matter on scales of what is treated as clusters of galaxies) to space as a whole, which itself represents a construct because space as a whole, is not available on the level of sensibility, and thus is a mental construction [16]. However to give this intuition of space a physical content one has to postulate that one can shift our home place and potentially experience a similar structure of space everywhere. The most natural attribute of this shift is a simple spatial translation which presupposes the uniformity of the overall structure. This presupposition forms a basic belief which allows one to apprehend the totality of space physically. This belief is deeply rooted in the natural attitude which positions all shifted home-places as physically real [7]. A similar belief asserts that the distribution of the material content of the universe which is observed astronomically from our home-place is not isotropic only for us, but for all possible shifted home-places. This entails the overall uniform-

ity of matter across the visible and invisible universe. As result the natural attitude of cosmology creates a rough construct of the universe as a whole as a complex of uniform space-time and matter. The link between these two basics ingredients in description of the universe is achieved formally by implementing the theory of General Relativity. What is important that since the isotropic and uniform metric space is constructed on the basis of the belief, the construct of space as a whole inheres in belief, as well as the construct of cosmological matter consisting of clusters of galaxies. The fundamental role of the cosmological principle is that being implemented it allows one to use the formal connection between space-time structure of the universe and its material content across the global structure thus satisfying the desire for the universe as a whole to be explicable in terms of the physics established locally. The choice of the physically motivated equation of state (for example the equation for dust in present era-cosmology) for cosmological matter allows one to develop a formal connection between the constructs of the energy density of the cosmological fluid and the universal scale factor  $a(t)$  (geometrical size of the universe) which in turn introduces new constructs. These formal connections follow from the Einstein equations and lead to the conclusion that since the scale factor grows in terms of the metric time, the universe expands. It is this connection which leads to introducing the notion of the hot (radiation-dominated) universe if the expansion is reversed backward in time. Through a limiting procedure when the cosmic time is going to zero another construct of the beginning of the visible universe (the Big Bang) is introduced. This construct as such represents a limiting reference point with respect to all other possible constructs. Physically it is supposed to be treated as that initial point in the state of the universe which is responsible for all other physical effects. However one must remember that in order to make a conclusion on the Big Bang as all-encompassing “beginning” of the visible uni-

verse as well as all space one needs to have a basic belief that the universe is uniform. If we generalize this observation one can state that the notion of the universe as a whole in the standard cosmological model can itself be considered as a generalizing construct which is deeply dependent upon the basic belief in the possibility of shifting of home places, that is the uniformity of the universe.

The epistemic connection between the construct of the universe as a whole and the life world takes place only along the past line cone (that is the visible universe) whereas all other parts of the allegedly existing spatial structure of the universe are in formal connection with the construct of the visible universe. These formal connections are possible only through the basic belief that the structure of the universe outside the visible realm can be potentiality comprehended by some hypothetical observers similar to those ones who observe the visible universe. However this potentiality as an eidetic variation of home places does not actualize its physicality because the similar necessary conditions for the observers to exist outside the visible universe do not guarantee their actual existence, that is that the sufficient conditions are fulfilled. In other words, the necessary conditions for embodiment in other places of the universe do not entail automatically its sufficient conditions and thus remain no more than an eidetic intuition, or a belief.

The construct of the visible universe possesses a heuristic quality of predicting some new properties of the universe which are subject to the empirical testing. Thus on the one hand we have an epistemic coherence among different cosmological constructs which follow from their mutually dependent nature under the assumption of the cosmic uniformity. On the other hand there is a certain percolation of this epistemic coherence towards coherence of truth by predicting new epistemic links with the life world. As a bright example of this in the history of cosmology is the prediction of the cosmic microwave background radiation (MBR) as remaining matter ingredient from

the early hot stage in the universe evolution which was detected in 1965. According to theory, the MBR represents a newly predicted construct which, as it turned out has (through the advance of technology) epistemic connection with the world of experience. However even in this case one must be cautious in order to avoid the implementation of the principle of correspondence with the theory of the early universe because what is observed is interpreted (through constructs) as the remote consequence of that which is asserted as physically existent in the past. We are unable to verify all details of the cosmological scenario by making experiments which reproduce in any feasible physical sense that long-ago past. In this sense the predication of the past still remains through coherence of constructs-beliefs which is supported by the communal convention in established cosmology. One can argue that the very sense of the past is established from the present, so that one cannot affirm this past as physically existent on the grounds of correspondence with the present (in spite of an obvious temptation to use analogy with other historical sciences like geology or paleontology). The correspondence between the observed phenomena and their preexistent past takes place on the level of intentionality, when the past is assumed to exist in a sense different from what the universe displays being *de facto* the image of the past, but not physical causality. In this sense the discovery of the MBR becomes a signifier of that which allegedly took place in the past of the universe but as such does not exhaust the whole content of what is signified; the discovery of MBR does not change the status of cosmological theory of the past as being true in the sense of epistemic coherence, it just strengthens this coherence by referring one of its signifiers to the reality of the life world.

#### **Coherence of Epistemic Justification in Cosmology**

Let us discuss in more detail what is meant by epistemic coherence in general and why it seems plausible to conjecture that cosmology

follows this route in justification of its theories. If one proceeds in cosmological study beyond the observable towards the universe before decoupling or even earlier, one has to hypothesize of entities and corresponding physical mechanisms which are not directly observable and sometimes not related to any known forms of matter [4, p. 1208–11]. These hypotheses being abstractions from experience in many ways function as intentional objects which by its function in theory can have no direct relation to that which is observed (they can also be described as metaphysical assumptions). There is an element of irreducible belief is present in their invocation which reflects the fact that cosmology is driven not only by strong logical connections following from the established physical causality but from intentionality of cosmologists who are driven by intuitions about the unity of the universe encoded in its common past. Since it is clear before the beginning of any theoretical quest that the initial conditions of the universe cannot be tested, not only because they are separated from us by an unbridgeable gulf of temporal immensity, but also because one cannot transcend this universe in order to “have a look” at its beginning from “the outside” any predication of the beginning of the universe must entail a certain epistemic justification which cannot by definition be based in correspondence with the empirical physical reality. Still this prediction takes place and implies beliefs in realities of what is predicated. The presence of such irreducible beliefs makes sense of the success of modern cosmology, its popularity and priest-like ability to preach about the universe as if its truth would be the truth of really existing things. Indeed it is because the principle of correspondence with the empirically observed things and facts cannot be employed in cosmology, it implicitly bases the assurance in its hypotheses and models in the *coherence* and mathematical rigor of its theories [1, p. 187–204]. In other words, the justification of cosmological theories comes not from their direct reference to the observable facts or em-

pirical reality, but through coherence of explanation which is achieved by applying a set of mutually consistent and connected beliefs which aim ultimately to codify in terms of mathematics that fundamentally contingent display of the large-scale universe which is given to humanity’s gaze. The coherence theory of justification holds that a belief is justified to the extent to which the belief-set of which it is a member is coherent [2, p. 116]. “According to the coherence theory, to say that a statement is true or false is to say that it coheres or fails to cohere with a system of other statements; that it is a member of a system whose elements are related to each other by ties of logical implication” [17, p. 130]. In different words, what is at issue in a coherence theory is a matter of a proposition’s relation to other propositions and not its coherence with *reality* or with the *facts of matter*. This is similar to Margenau’s requirement for constructs to possess *logical fertility* and to obey logical laws: “It asserts little more than that they have relational meaning. But in no sense does the present requirement make it necessary for the proposition involving constructs to be materially true, to have an existential counterpart” [12, p. 82], that is that they cohere with the facts of matter. Coherence theories of justification operate with propositions-beliefs, or constructs-beliefs. As we have mentioned above, all major cosmological constructs contain the presence of a basic belief in the uniformity of the universe.

However, the major problem here is that the epistemic coherence does not guarantee that knowledge progresses towards truth. Justification can grow, but there is no criteria that it delivers truth: cosmological models can become more sophisticated and expanded, but there will still be a problem whether their advance guarantee any convergence towards that alleged reality which they aim to describe. In technical philosophical terms this situation sounds as there is no conduction from the coherence of epistemic justification to coherence of truth. It is in this sense that a coherentist

epistemology can be characterised as knowledge without a foundation of certainty. Since the coherence of epistemic justification in cosmology has to abandon the principle of correspondence with empirical reality and a foundation of certainty, it has to appeal to different criteria of assertions of truth of these theories. Cosmology, in what relates to radical mathematization, in similarity with the coherence approach, maintains that truth is accessible in the extralogical realm where all criteria of reasonability as its foundation do not work. For example, by insisting that there are many disjoint universes which comprise a sort of totality, “cosmology of the multiverse” enters a certain contradiction with the main stance of existential phenomenology: it predicates the universes where no condition of embodiment is possible. In spite of the existential futility of such predications, which can have sense as no more than an eidetic variation of the *possible* in order to affirm the *actual*, cosmology finds a sort of “extralogical” justification for the existence of such universes. This extra-logicality follows exactly from the fact that *discursive entailment* is replaced by *beliefs*. But for beliefs to sustain the challenge of scepticism one needs a *communal*, that is conventional argument. This implies that epistemic justification in theoretical cosmology where no correspondence principle works relies on the acceptance of certain ideas about the universe by community [15, p. 331–33]. The community of cosmologists then establishes the sense of truth of that which is inferred from a theory. The coherent system of beliefs in cosmology determines as justified all sorts of statements about the remote past of the universe, including the statement that there was the universe before there were people. And being determined as justified, they are justified, for such is the nature of justification. It is typical for the coherence theorist not to be constrained in its justification to only that which one will someday be able to verify. The validity of cosmology’s propositions about the past of the universe is thus not under obligation to be tested in any

direct observations because the very reality of this past is established on the grounds of coherence of a certain set of *beliefs* about this past.

If cosmology relies on the coherence of its own statements it is fundamentally enclosed in itself and cannot be assessed from an outside system of thought. Since there is no direct link between coherence of justification and coherence of truth, which naturally requires breaking out of the system of coherent suppositions, cosmology can afford to create as many theories allegedly explaining the origin of the universe as it wants, without even a slight idea whether these theories correspond to truth. In fact, the question of truth is inappropriate in this context because everybody, philosophically honest, understands in advance that the fullness of truth of what concerns with the foundations of the universe cannot be grasped through some fragmented theories. All references to correspondence with the available empirical material do not reach their aim, because the process of adjusting theories of the early universe in order to fit observable data is in a state of permanent advance, so that all theories, seen philosophically, seem to be metaphors of the human desire to know the universe. They also manifest a fundamental human incapacity to achieve this goal. In this case the whole pattern of coherent epistemic inference in cosmology has a sense of belief which *attempts* to express communion with the universe, which is to remove “presence in absence” of its totality by sheer presence.

Now it is not difficult to conjecture along the lines of phenomenological reasoning that the communal nature of knowledge established on the grounds of epistemic coherence leads to the view that physical reality (and the universe) is a mental accomplishment (“hypostasis of mental creations” [3, p. 291; 5, p. 44]). As the coherence theorist would say, the nature of objective reality is determined by the coherent set of beliefs about it. M. Munitz, discussing whether the universe as whole can be discovered, suggests that it would be “to say that

the concept of the universe as a whole is a creative, constructive achievement, and invention, not a discovery” [13, p. 141]. Here a distinction is implied between nature as it appears in primary perceptual experience and nature-for-physicists, as an *ideal* limit of the allegedly convergent sequences of “images of nature” which are constructed in the course of history. Any particular articulation of what is called nature can be assigned a character of an historical event. The articulation of the past is thus an event within the life-world of a particular community, loaded with a sense of the community’s lived past and of decisions to be made in the future. As P. Heelan points out, “it is not the case that every historical event is also an event of a scientific kind..., but when the local community is one of expert witnesses, then the scientific data produced by that community are also historical events in relation to that community” [6, p. 66]. In his classical paper on phenomenology and physics H. Margenau argued along the same lines that “physical reality” is best defined as the totality of all valid constructs and rules of correspondence. In this approach the universe is defined not as a static, but as a dynamic formation: “...the universe grows as valid constructs are being discovered. Physical entities do not exist in a stagnant and immutable sense but are constantly coming into being” [9, p. 278]. The reality changes with the flux of experience [12, p. 295]. However, for Margenau the belief of many scientists in the convergence of the system of the entire set of physical explanations which would deliver them an ideal of their aspirations, that is a unique and ultimate set of constructs for which would reserve the name ‘nature’ or ‘reality’, is problematic because it is not capable of scientific proof [12, p. 76]. Since this convergence assumes a sort of historical process, it implies the postulate of history which is not physics [11, p. 343]. Historicity, according to Margenau, involves knowing which “arises through a union of a knower and his object of knowledge” [10]. Thus the very ideal of “reality” independent of the process of

knowledge, seems to be dependent of the factors linked to human existence which develops the sense of history and defines its goals. In this case the abovementioned convergence of “images of reality” can have its source rather in a philosophical argument asserting the existence of a certain *telos* of the human spirit which drives this convergence to its fulfilment, but this argument exceeds the scope of scientific justification and is grounded in beliefs about humanity as transcending the certainty of nature itself. The situation in modern cosmology, where the ever increasing set of theoretical constructs reveals the components of the matter content of the universe which escapes any physical description (dark matter and dark energy, for example) points exactly to the danger of idealisation of the scientific description of the universe as ultimate and accomplished in an a-historical sense: the more details we know the less we understand the whole. In this sense the ideal of convergence of constructs in cosmology remains no more than wishful thinking.

The point of view on the historical contingency of scientific research and thus fundamental conditionality of its results and views of reality, which we exemplified above, raises the conviction that the statements of cosmology (with respect to realities inaccessible to any empirical verification) established on the grounds of coherence and logical fertility of its constructs cannot have truth-values independently of our verification and, because it is our verification, it can never be conclusive. In spite of an explicit belief of the physical cosmologists in the possible convergence of the sense of these statements to a sort of truth which lies beyond our reach, at every particular stage of research the truth of what these statements deliver turns out to be contingent and incomplete, open to further exhaustion through research. To say that the verification of this or that statement in cosmology is never conclusive is to say that although our assertion of this statement may well be warranted in the circumstances, our warrant for it is always defeasible:

new elements of theory or insertion of new indirect data could always make the assertion in question unjustifiable at all. In the case of the lack of empirical verification the cosmological statement has no truth-condition independent of the capacity of scientific community to recognise it as true. Thus the claim of cosmology for objectivity and neutrality does not hold.

There are two philosophical qualifications which can be made with respect to this conclusion. For philosophers working in the natural attitude such a position would raise some suspicion of anti-realism. If one denies the verification-transcendent truth (even in a weak form as an ideal of a convergent set of self-correcting explanations based upon the ultimate rules of correspondence) one effectively adopts an anti-realistic view that truth is not independent of our capacity to find out about it, or, in other words, to have beliefs about it in a particular context. The meaning of this “context” can be very different according to the field of research, starting from a simple sensual perception in an experimental science and finishing by a more sophisticated scheme, let us say in theology. Anti-realism emerges naturally in that particular modification of a coherence theory which does not think of the set of truth as a determinate totality; it is the case which we discuss in the present paper: what we can recognise as true in cosmology is indeterminate and open-ended. Scientific truth in this approach is not that hypothetic unique which transcends the conditions of knowledge, but is determined by the fundamental plurality of that which we are able to discover and recognise in that sort of truth.

If, however, one adopts a phenomenological stance in which any knowledge is possible only within the noetico-noematic correlation, the suspicion of anti-realism falls away, simply because the certainty of knowledge is immanent to the constituting consciousness, so that, by definition, knowledge of the universe cannot escape the conditions of its origin in a particular realisation of consciousness (be it personal or collectively historical). The issue of

the verification-transcendent in this case become a question which we have posed before on the possibility of retaining a sort of transcendence in knowledge which is immanent. The stance of the coherence theories of explanation and truth, in particular in their anti-realistic versions, points towards the possibility of such a transcendence simply because it claims that the process of knowledge is intrinsically incomplete and open-ended, leaving the immanent discursive consciousness with a sort of image of reality and some statements of its truth without any exhaustion of that subject matter which it aims at. In this sense the knowledge of the universe as a specific contingently historical process, based in many ways on the conventional agreements of the community of scientists, never exhausts the sense of the universe, or, the excess of intuition over knowledge. Indeed one can attempt to express the experience of admiration by the forces of the universe through very complicated mathematical theories (a kind of incantation), but all of them will remain no more than symbolic and metaphoric images of that anticipated unity and infinity of the universe which is present in the incarnate human subjectivity. For example, since there is no empirical access to the Big Bang, all that we express about it by using cosmological theories can be characterised as metaphors and an esoteric symbolism based in the mathematical formalism. The beauty of this symbolism, its coherence, give us some assurance to believe in the possibility of the Big Bang as a principle of explanation and justification. However the “truth” of the Big Bang in an ontological sense remains unclear and, what is more important, fundamentally inaccessible. In other words, all cosmological theories give us some symbolic representation of that towards which they aspire, but that which will never be known and reached in a sense of truth. The apophaticism in cosmological research is thus present as the limitation of thought: it wanders around the idea of the Big Bang, but it will never reach it as the ultimate origin of the universe [14]. In this case all



competing theories are epistemologically and axiologically equal, but no one can pretend to claim the fullness of truth and the knowability of the Big Bang as that which is intended in a hidden teleology of cosmological knowledge. Thus all cosmological knowledge is apophatic in the sense of its limited validity determined by the boundaries of the physical, and because of the open-endedness of the intended horizon and a fundamental inexhaustibility of the truth about the universe by means of discursive thinking. However, in order to realise this fact, one should place one's consciousness in a phenomenological attitude, which is capable of bracketing all theoretical statements about reality and to conceive them as varieties of expression of the human intuition about the entirety

and identity of the universe. But this attitude is simply not available to cosmologists themselves. They will never agree with the verdict of philosophy that all eidetic imagination in cosmology, incarnate in complicated formulas, is only a wandering around truth, but not truth itself. At the same time it is exactly the limited nature of our knowledge of the universe, its apophatic character, which makes it possible to render the *belief* in the transcendent other of all we see in the universe, not as an ideal of convergent rules of correspondence with something which is out there waiting for our grasp, but, on the contrary, as that unobjectifiable givenness whose gaze upon the *ego* constitutes this *ego* through the never-ending enquiry about the universe.

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