Participatory Observers as the Basis of Physical Reality

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Abstract

Wheeler's idea that physical reality is the outcome of the activity of participating observers is applied in the context of nonlinear dynamics, taking into account biological factors assumed to be relevant. The constraint that structures that develop should have biological value is shown to be able to account naturally for many features of the quantum domain, thus providing an alternative paradigm to the conventional 'theory of everything' one, which has over time become problematic. For the future, detailed investigation of nonlinear dynamics along the lines discussed here is likely to be more fruitful in regard to the problem of understanding nature than continuing current attempts to tweak 'theories of everything' to fit.

The thesis of this paper, amplifying previous work (Josephson 2019), is that current physics has been led astray by its presumption of the existence of a 'theory of everything' of a mathematical character. The alternative presented here can be viewed as a development of Wheeler's *participatory universe* idea (Wheeler 1983, Meijer 2014), where 'observer-participants' are the source of lawful behaviour as the consequence of processes relating physics and meaning, on the basis of a cyclic structure where physical laws lead to the coming into being of participants who, in consequence of the understanding that they have of their situation, are able in turn to influence the laws to which they are subject.

However, this picture has an implausibility in that it is far from clear how the posited situation could come about as it would seem to require observers to act backwards in time. The picture proposed here differs from Wheeler's in that this kind of observer-participancy is posited to occur at many levels, the simplest being non-linear dynamical systems with a small number of degrees of freedom only. In ways familiar in the biological context, such systems can coordinate with each other to form progressively more complicated entities, but the question then is how familiar physics could emerge from such a complicated structure. The proposed solution is that certain system features have biological value, and a combination of such features can give rise to systems similar to those studied in conventional physics, but biological factors are at work here and there is no conventional, mathematically based, 'theory of everything'.

Here, then, nonlinear dynamical systems are involved in a cyclic process with physical processes and observers giving rise to each other as in Wheeler's picture, the *persistence* of such systems over time being the key defining factor that they share with familiar biological systems, making them special. Persisting systems are familiar in physics as well, but what is different in the situations of interest here is the role played by highly specific information processing related to functionality, which emerges as a result of the role that functionality can play in ensuring persistence. Information in this context is *meaningful*. Behaviour of a biological character does not have to involve chemistry as commonly assumed, being equally possible on the basis of much simpler mechanisms.

If we assume that nature is fundamentally biological, where does this leave ordinary physics? The answer in essence is that biological and physical systems (and physicists) share in interest in laws and regularities. Functionality, needed for biological systems to survive, is dependent on certain regularities. And, as noted by Wheeler, extensive repetition of certain processes may lead to laws being obeyed precisely in the limit in some contexts, which is how conventional physics can emerge. In addition, control exerted by the observers may be a factor relevant to questions such as the origin and evolution of life, as will be explained in more detail later.

Biology being fundamental, in a way that physics is not, means that different principles are expected to apply, including for example those studied in coordination dynamics (the study of how different systems work together (Kelso 2013), and biosemiotics, the study of the way information conveys meaning in biological systems (Hoffmeyer 2008, Favareau 2015). This is in effect a new discipline, like biology but in a very different context, namely that of dynamical systems. While individual systems can be studied mathematically, systems as a whole have sufficient variability that there can be no 'theory of everything' of the kind sought by physicists although, as noted, general principles are relevant despite such variability.

In this posited new discipline, we are involved with a situation where some aspects can be examined in detail (for example, a toy model of development involving observer-participancy is that of Osborne (1995)). Key questions in biological situations, already studied in subdisciplines such as those referred to above are those of what is that enables systems to survive, and in what ways do they develop? The general picture underlying our assumptions is that of systems with a degree of persistence combining to form bigger systems, known as synergies in the field of coordination dynamics.

An important concept in analyses is that of the degrees of freedom of a specific system, which in mathematical models equate to the number of parameters of the system. This kind of picture is consistent with string theory models, as strings vibrate in multidimensional spaces. From this perspective, it is natural for entities like strings to emerge in the kind of model under consideration. Such multidimensional entities would be the outcome of simpler vibrating entities coming to coordinate together in ways relating to their biological value. We hypothesise that the system behaviour has a linear aspect, associated with degrees of freedom associated with low amplitude phenomena, but also a non-linear one associated with larger amplitude degrees of freedom that can interact synergetically with each other in ways associated with corresponding models, realised by strings related to specific types of particles.

In this picture, strings would have no value in themselves, their value consisting in what could be achieved with their use. This can be related to Wheeler's scheme noted earlier, whereby 'the universe created human beings to help creating the universe' which would appear to require backward causation. As noted, it is not clear how such a situation could come about in the first instance, so we hypothesise instead the existence of some primordial observer or observers whose existence is not tied to our particular universe, and who over time observe many universes coming into existence, learning how to control their progress so as to lead to the most desirable outcome. Such 'intelligent design' emerges naturally in the hypothesised picture, and need have no religious connotations.

In ordinary biology, many features of life are present because of the support they can give to life. In the same way, many features of quantum physics can be understood as the consequence of alternative potentially life-supporting features, as we now discuss. An example is that of invariance: if phenomena exist that are equivalent in a particular set of situations (in the sense of there being transformations connecting the various situations, then if a skill making use of the given phenomena is acquired in one such situation then the transformation process, once it has been acquired, will allow the same process to be applicable in other situations in the set. An example is rotational invariance: certain transformations exist that can replicate a given process when one performs the given operation. A given system can therefore benefit if it can create that invariant situation, by for example having mechanisms that detect the lack of invariance and discover how to eliminate it, and also learn to carry out the transformations as needed.

Thus there are specific reasons why symmetry could emerge. Furthermore, the transformations involved would form a group, and developmental processes could lead to such group developing into more elaborate ones over time until some optimal outcome was achieved.

Two groups of particular interest here are the Lorentz group and the spinor group. The former can be thought of as having biological relevance as it implies that the synergies involved with the symmetry would be transformed from stationary entities to moving ones under the transformations concerned, and the latter because of the connection with the fact that multiplication of the state vector by a phase factor does not alter the physics. More precisely, if an entity comes into existence that can be operated upon by elements of the spinor group, then this group (in the appropriate representation) has the effect of multiplying by a phase factor, providing a mechanism for phase to enter naturally in the physics.

In principle, then, the observed laws of physics can be explained as the outcome of many observer-participatory process in this way, with the details being the product of the activity of the primordial observer, as discussed.

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The two authors contributed equally to the ideas contained in this paper.

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