# The cosmos in the light of systems theory

Mathias Hüfner 2017

*J. Needham has emphasized that Western thought has always shifted between the idea of a world that is an automaton and a theology according to which God rules over the universe. He called this the peculiar European schizophrenia .* C.A. Ronan 1978

In 1949, Karl Küpfmüller [1] first drew up the concept of systems theory in the context of communications technology. The idea is to describe completely a concrete fact as a system as a black box through its external behavior by few system characteristics without knowing anything about the internal processes. The method introduced by Küpfmüller had a high potential for generalization to other scientific and technical aspects.

The inadequacy of a "zero past" in control engineering and other technical applications, introduced as a Big Bang in the cosmology, aroused the need for a theory of system behavior in any past and finally led to a new theoretical conception of the system description, the state description. The concept of the state, which has always been fundamental to classical physics, has also become a general concept of a general system conception and modern systems theory. [2]

In the following, the ideas of systems theory are briefly sketched out and their advantages compared with the standard model of cosmology. Starting from Hamilton's system of motion equations, one can conceive p and q as states of the mechanical system of the movement of mass points or stars. Thus, instead of the differential equations for the coordinates and impulses, the simple form is obtained as

$$\dot{z}_i = dz_i/dt = \partial H / \partial z_{l+i} = H_i(z_1, z_2 \ldots z_{2l})$$

The $q_i$ are replaced by the $z_i$ from 1 to l, and the $p_i$ by the $z_i$ of l + 1 to 2l. The 2l-tuple $z(z_1, z_2 \ldots z_{2l})$ then denotes the state of the Hamiltonian system at time t, and the set **Z** is called the state space. The state z (t) = z is a 2l-tuple of variables from which not only the spatial position of the mechanical system at time t can be taken, but also all its future positions in space. This requires no knowledge of the past of the system. As far as the future is concerned, it is sufficiently taken into account by the present state. Thus, the past of the system has become completely uninteresting since it can be reconstructed anyway only in time-invariant systems. The standard model of cosmology is based on time reversal. It projects the image of the actual state into the past by means of a redshift, which is inadvertently interpreted as an escape speed. It does not take into account the natural evolution of the stars from their origin to their death. I. Prigogine in 1972 [3] was the first to deal with evolutionary systems by extending thermodynamics to open systems beyond the thermodynamic equilibrium.

Evolutionary systems as well as the cosmos, however, are not time-invariant as everyone may comprehend very easily at the Game of Life of J.H. Conway. The description requires more variables than p and q. For their movement, but also their developmental state, for example by means of the spectral class from the Herzsprung-Russel diagram, which depicts the star development.

As time and place depend in a dynamic system over the speed interdependent, leading to failure of the theory of relativity in a space-time continuum, another thought was added by the automaton theory. This theory describes discrete-time systems, (How time should be quantitatively expressed in cosmic dimensions?) in which inputs from a set **X** are answered with outputs of a set **Y**, which need not be real numbers like the p and q. Here, unlike in the Hamilton system, a distinction is made between forced variables (the inputs x from a set **X**,) the free variables (the states z from a set **Z**) and the observable variables (outputs y from a set **Y**). At the same time, two functions (figures) are defined.

$f: \mathbf{Z} \times \mathbf{X} \rightarrow \mathbf{Z}$, $f(z,x) = z'$ as a transfer function from one state to another and

$g: \mathbf{Z} \times \mathbf{X} \rightarrow \mathbf{Y}$ $g(z,x) = y$ as result function of the dynamic system

The difference to a Hamilton system is that it is closed and that there is no result function in the Hamilton system. The states are assumed to be observable. The preset location functions q can be regarded as inputs x.

The advantage of such a system definition with respect to the Hamilton system is that no source-free nature of the vector field is required, which allows the emergence and disappearance of mass points. The game of life can therefore take place. Stars may arise and pass away. The question of how the system passes from one state to another can be determined individually. No translatory or rotational movements are mandatory. As a successful example for this approach, the simulation of a galaxy carried out by A. Peratt [4] can be viewed. If one is outputting a system for inputting another system, systems can be coupled. The consideration of subsystems facilitates the modeling of natural processes very substantially.

In the generalization of this approach, interactions between two and more systems can be defined. Networks of systems can also be described in principle. Systems theory is still a young science, although it has already been successful in all disciplines. By means of relational databases, we can now handle practically multi-dimensional states. One example is the Sloan Digital Sky Survey Project, where the observable state of the sky is documented. It returns the set **Y** of the current system state of cosmos.

**References:**

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