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THE GESTALT PROBLEM IN QUANTUM THEORY: GENERATION OF MOLECULAR SHAPE BY THE ENVIRONMENT

ABSTRACT. Quantum systems have a holistic structure, which implies that they cannot be divided into parts. In order to create (sub)objects like individual substances, molecules, nuclei, etc., in a universal whole, the Einstein–Podolsky–Rosen correlations between all the subentities, e.g. all the molecules in a substance, must be suppressed by perceptual and mental processes.

Here the particular problems of Gestalt (= shape) perception are compared with the attempts to attribute a shape to a quantum mechanical system like a molecule. Gestalt perception and quantum mechanics turn out (on an informal level) to show similar features and problems: holistic aspects, creation of objects, dressing procedures, influence of the ‘observer’, classical quantities and structures. The attribute ‘classical’ of a property or structure means that holistic correlations to any other quantity do not exist or that these correlations are considered as irrelevant and therefore eliminated (either deliberately and by declaration or in a mental process that is not under rational control). An example of an imposed classical structure is the nuclear frame of a molecule. Candidates for classical properties that are not imposed by the observer could be the charge of a particle or the handedness of a molecule. It is argued here that at least part of a molecule’s shape can be generated ‘automatically’ by the environment. A molecular shape of this sort arises in addition to Lamb shift-type energy corrections.

1. THE GESTALT CONCEPT

What we call reality consists of a few iron posts of observation between which we fill in by an elaborate papier-mâché construction of imagination and theory.

John Archibald Wheeler (1980, p. 149)

There has been much controversy between psychologists so far as the concept of an object’s shape is concerned. From a ‘structuralist’ (reductionist) point of view, perception of objects (patterns, textures, etc.) is explained in terms of perceptual ‘atoms’, that is to say, in terms of local entities and structures (Julesz, 1991). Gestalt psychologists on the other hand claim that the ‘Gestalt’ (= shape, configuration) of an object can only be perceived in a global, nonlocal manner (Köhler, 1971). From their point of view, the Gestalt of an object is a holistic concept.

and this view is summarized in the slogan “The whole is different from the sum of its parts”.

This slogan has constantly irritated and annoyed the critics of the Gestalt concept. Karl Popper (1980, p. 75), for example, remarks:

Köhler, and other Gestalt theoreticians, asserted that the opposite of a Gestalt is a heap – ‘ein Haufen’. To this I have replied that a heap is also a Gestalt, and that therefore it has not been shown that the Gestalt idea – of a whole as being more than the sum of its elements – is really very important, because everything which consists of elements is more than the sum of its elements. The thing which the Gestalt theoreticians in those days were opposed to was the idea of a structure built of atoms; of things that were regarded as if they were built out of bricks. But the point is, of course, that atomic structures are not built of bricks; and bricks are not like heaps. Rather, bricks are also Gestalten. Everything in that sense is ultimately a Gestalt. In other words, I do not say that the Gestalt concept is empty, but that it is almost all-embracing.

Surely, Popper is right to state that a brick also has a Gestalt. But that accepted, one observes that an object may emerge out of a heap of bricks and that the Gestalt of an object made out of bricks and the Gestalt of the underlying bricks composing this object are on different levels of perception. This point of view is nicely illustrated by random-dot stereograms (Julesz, 1971, 1991) as that given in Figure 1. There the bricks used are little squares. As long as the respective pattern is viewed monocularly, one sees nothing more than an aggregate