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SCIENCE AND AESTHETICS: HOW BEAUTY CAN EMERGE FROM MATTER

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ABSTRACT

The emergence of beauty and emotions from matter is discussed in the framework of modern Quantum Physics. The artistic experience is connected with a resonant interaction between subjects and objects, which is made possible by the quantum property of all bodies to fluctuate.
Keywords: aesthetics, fluctuations, quantum physics, resonance.

1 INTRODUCTION

Conventional science has frequently been the target of the criticism for being unable to include in its own framework the beauty of Nature, a very fundamental aspect that cannot emerge from the array of equations underlying usual physics. True, people speak about the beauty of mathematics but this statement is an external judgement on the equations; equations cannot contain any intrinsic consideration of beauty. This shortcoming has been the object of a number of papers by Ilya Prigogine [1] and Enzo Tiezzi [2–4]. Tiezzi pointed out that since beauty is an essential part of Nature and living natural organisms, any scientific approach unable to express beauty could not be a candidate to describe Nature in a complete and satisfactory way. This inability underlies the split between the two cultures, the humanistic and the scientific one, preventing the emergence of a unique human culture.

How can we understand beauty? This topic has been a fundamental object of discussion among philosophers and an account of them exceeds the scope of the present paper. We wish to suggest in the present very short discussion, a possible approach to the problem. Let us start from the definition of Beauty and Art we find quite appealing. At the beginning of 19th century, Schelling [5] defined the aesthetic experience as a resonance between a subject and an object. Within this line of thinking the requirement of the definition of an art masterpiece becomes pointless, whereas the meaningful question is to ask when an object is a masterpiece and for whom. Beauty is therefore simultaneously a highly subjective property (an object could be beautiful for me and ugly or trivial for someone else) and a universal property able to put the subject in a close resonance with the Universe. This statement parallels the endeavours started in the first years of the 20th century about new forms of artistic expression (Modern and Contemporary Art).

The existence of a resonant interplay between a subject and a part of the Universe, which is an objective property, is subjectively perceived by the subject as an emotional involvement implying pleasure and beauty. Science can therefore have a dialogue with Art by clarifying the nature of the resonant interplay we have spoken about.

Modern Quantum Physics could give a contribution to this endeavour. Quantum Physics describes the physical reality as an ensemble of objects in close relationship with an all-encompassing Quantum Vacuum, which establishes therefore a connection among all objects. As a consequence of this long-range entanglement among objects, they cannot but fluctuate, acquiring therefore the phase as a characteristic variable. In suitable conditions, different objects can tune together their phases and acquire consequently a correlated behaviour. Quantum Physics ,which is usually regarded as a theory relevant for the microscopic objects only, appears at a deeper level the way to connect macroscopic

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and microscopic levels of reality, namely to assemble the microscopic components into macroscopic objects behaving and performing in an unitary way. In the present paper we will discuss the above topics in more detail.

2 FLUCTUATION AND RESONANCE IN QUANTUM PHYSICS

A quantum object has the intrinsic property of fluctuating. While in the ancient vision Nature was endowed with the property of the *horror vacui* (fear of emptiness), in the quantum vision Nature is endowed with the property of the *horror quietis* (fear of rest) [6]. This property could be understood as a consequence of the Heisenberg uncertainty principle:

$$\Delta p_i \, \Delta q_j \geq \delta_{ij} \, h/4\pi, \tag{1}$$

where p_i and q_j are the components of the position vector **q** and the momentum vector **p** of a particle, h is the Planck constant, $h = 6.64 \times 10^{-27}$ erg-sec and δ_{ij} is a symbol which is 1 for $i = j$ and 0 for $i \neq j$. Inequality (1) implies that **p** cannot be zero in any finite region, namely the particle cannot be never at rest in any finite region.

Walter Nernst [7] has been the first to realise that different bodies could tune together their intrinsic fluctuations, producing a collective regime of all the particles present in a specific region of the space and therefore giving rise to an extended object, which in turn still fluctuates. This early realisation has been corroborated by the modern theory of Quantum Coherence [8–10], which describes the conditions allowing previously uncorrelated physical objects to enter a regime of phase correlation and hence, of entanglement.

In this context, a living organism, and consequently a human being, can be understood as a coherent system open to the external world and consequently be able to tune his own oscillations with the fluctuations of some part of the Universe [11–14]. Moreover, a living organism has an intrinsic tendency to co-resonate with the largest possible part of the Universe; this tendency is the consequence of the fact that the living dynamics requires that the phase of the organism be defined as much precisely as possible [11–13]. The phase Φ is connected with the number N of co-resonating oscillators by the uncertainty principle

$$\Delta N \, \Delta \, \Phi \geq ½ \tag{2}$$

Inequality (2) implies that a sharp definition of Φ compels N to become as large as possible; since the number of the component oscillators of the organism is finite, it is forced to co-resonate with the largest possible ensemble of external oscillators. The tendency of every organism to open itself to the external world finds therefore a rationale. Moreover, by opening itself to the external world, the organism becomes healthier and healthier and the consequence is the feeling of being fully alive. The emergence of pleasure is the internal consequence of this process and the organism consequently recognises as *beautiful* everything it finds responsible for this feeling of pleasure.

The above consequence of the theory of Quantum Coherence converges to the conclusions drawn in the framework of Psychodynamics. For instance, Wilhelm Reich was able in the 1930s to trace back the healthy state of an organism to its own regular oscillation (he named it *pulsation*), which reaches its optimum when it occurs in unison with other organisms (*orgasm*) [15, 16]. Consequently life includes a tendency of all organisms to reach a resonant state with the others and pleasure and happiness are the subjective feelings connected with this state, whereas beauty is the objective property that the organism attributes to its partners in the resonance. In this vision, Love and Beauty are absolutely objective but each organism perceives them in a subjective way which could be objectively described.

It is useful to refer to the theoretical approach to the human brain dynamics proposed by G. Vitiello [17–19] that has found experimental corroboration [20]. In this theory, the dynamics of the brain cannot be traced back to a sum of the dynamics of single neurons but is intrinsically a collective coherent dynamics of all neurons which resonate with a large number of external oscillators (Vitiello terms them *the Double* of the brain). Each individual brain has its own Double, different from the Double of everyone else; it is just the difference among the Doubles that makes individuals different among them. An individual can become a component of the Double of another individual, becoming consequently an object of his love.

The longings for love and beauty imply that the organisms are described as eigenstates of the phase, which means that the information on the number of their oscillators is cancelled according to equation (2). As a consequence, a theory where the organisms are described in terms of their individual molecular structure, making therefore the phase uncertain, cannot find in itself any key to the problem of beauty, as Tiezzi has correctly complained.

We have learned from one of the co-workers still alive (H.P. Duerr, personal communication) of Werner Heisenberg about an interesting conversation that Heisenberg had with Einstein, just after formulating his celebrated uncertainty principle. Einstein told Heisenberg that he had no technical objection to his work, but nevertheless felt uneasy about the fact that it was impossible, in principle, in Quantum Physics to calculate everything. This property collided with his deep faith that everything should be computable, at least in principle, in the physical world. Heisenberg, who was not only a scientist but also a professional music player in the Munich Philharmonic Orchestra, replied that there are for sure in the Universe, properties which cannot be calculated, like the artistic experience and the emotional involvement; consequently a physical theory where everything might be computed would be unable for sure to account for such properties and would give rise to a split Universe where matter and soul would be mutually irreducible. He did not like this last consequence. We completely share this point of view.

3 CONCLUSIONS

In the present short paper, we have suggested the possibility that the Quantum Physics could provide the conceptual framework to account for the emergence of beauty, love and emotions in Nature. This framework looks similar to the proposals produced within other humanistic approaches, like, among others, the philosophy of Epicurus, the magic thinking in the Renaissance, the Romantic thinking, the Reichian approach and the humanistic psychology and, moreover, resonates with the Prigoginian vision of Nature.

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