# Views about the "Oxford Questions". Wave Function Collapse and Schrödinger's Cat: Are They Real Scientific Topics or Plain Fictions?

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Motivated by the recently published "Oxford Questions" we review the foundational character of the wave function collapse theme. We show that the respective theme, as well as its twin analogue represented by the Schrödinger's cat problem, are not real scientific topics but plain and rather trivial fictions. Consequently, we suggest that the related items of the "Oxford Questions" have to be perceived with some epistemic caution.

## 1 Introduction

The newly diffused *The Oxford Questions on the Foundations of Quantum Physics* [1], known also as "*Oxford Questions*, aims to formulate "*a list of main open questions about the foundations of quantum physics*". Within the respective list, the issue "*whether or not the 'collapse of the wave packet' is a physical process*" is approached in "*several Oxford Questions: in particular, 1b, 2a, 2c, 3a, 3c and 5a*". The issue is mainly brought into attention in 3c: "*How can the progressive collapse of the wave function be experimentally monitored?*".

It is expected that, in the future, the Oxford Questions will stimulate more or less extensive studies in both advanced and pedagogic research. Previous to these studies, it is important to examine the correctness of the items gathered in the Oxford Questions, particularly the ones pertaining to the above-mentioned quantum collapse. Such an examination is intended in this short paper, by using some ideas noted in some of our recent works. Section 2 is focused on the theme of Wave Function Collapse. Additionally, in Section 3, we examine the case of Schrödinger's Cat Thought Experiment which in fact is a twin analogue of the Wave Function Collapse. We find that both the Wave Function Collapse and the Schrödinger's Cat Thought Experiment are not real scientific topics but only pure fictions.

The present paper ends in Section 4 with some closing thoughts, particularly with the suggestion that, for real science, the invalidated Oxford Questions items have to be regarded as needless.

## 2 On the wave function collapse

Historically speaking, the Wave Function Collapse concept was brought into scientific debate by the conflict between the following two suppositions:

$\mathbf{s}_1$ The old opinion that a Quantum Measurement of a (sub)atomic observable should be regarded as a single sampling (trial) which gives a unique deterministic value. ■

$\mathbf{s}_2$ The agreement, enforced by theoretical considerations, is such that to describe such an observable one should resort to probabilistic (non-deterministic) entities represented by an operator together with a wave function. ■

To avoid conflict between suppositions $\mathbf{s}_1$ and $\mathbf{s}_2$ it was in diffused the thesis that, during a Quantum Measurement, the corresponding wave function collapses into a particular eigenfunction associated with a unique (deterministic) eigenvalue of the implied operator. Such a thesis has led to the Wave Function Collapse concept regarded as a true dogma. The respective concept was assumed, in different ways and degrees, within a large number of mainstream publications (see [2–8] and references therein). But, as a rule, the previously mentioned assumptions were (and still are) not accompanied with adequate elucidations concerning the initial correctness of the alluded concept in relation to the natural themes of Quantum Mechanics.

Now, explicitly or implicitly, the Oxford Questions [1] put forward the problems:

$\mathbf{p}_1$ Whether or not the "collapse of the wave packet" is a physical process. ■

$\mathbf{p}_2$ How can the progressive collapse of the wave function be experimentally monitored? ■

$\mathbf{p}_3$ According to which theoretical scheme, justified by physical reality alone, can a Wave Function Collapse be described properly? (This is in the situation [6] where a whole "*zoo of collapse models*" have already been invented. ■

In order to generate significant remarks on the above-mentioned Oxford Questions problems $\mathbf{p}_1$–$\mathbf{p}_3$, now we wish to bring into attention some ideas prefigured and to a certain extent argued in our recent paper [9, 10]. We mainly pointed out the ephemeral character (i.e. caducity) of the Wave Function Collapse concept. Basically our argumentations are grounded on the following indubitable facts. Mathematically, a quantum observable (described by a corresponding opera-

tor) is a true random variable. Then, in a theoretical framework, such a variable must be regarded as endowed with a spectra of eigenvalues. For a given quantum state/system the mentioned eigenvalues are associated with particular probabilities incorporated within the wave function of the mentioned state/system. Consequently, from an experimental perspective, a measurement of a quantum observable requires an adequate number of samplings finished through a significant statistical group of data/outcomes. That is why one can conclude that the supposition $\mathbf{s}_1$ of the Wave Function Collapse concept appears as a false premise while the whole respective concept proves oneself to be a useless fiction.

The previously noted conclusion can be consolidated indirectly by mentioning the quantum-classical probabilistic similarity (see [11–14]) among quantum mechanical observables and macroscopic random variables, studied within the thermodynamic theory of fluctuations. On the whole, a macroscopic random variable is characterized by a continuous spectra of values associated with an intrinsic probability density. Then, for measuring a macroscopic random variable, a single experimental sampling delivering a unique value (result) is worthless. Such a sampling is not described as a collapse of the mentioned probability density. Similarly, a quantum measurement must not be represented as a wave function collapse. Moreover, a true experimental evaluation of a macroscopic random variable requires an adequate lot of samplings finished through a statistical set of individual results. A plausible model for a theoretical description of the alluded evaluation can be done [14–16] through an information transmission process. In the respective model, the measured system appears as an information source while the measuring device plays the role of an information transmission channel to the recorder of measurement data. As part of the mentioned measuring process, the quantum mechanical operators (describing quantum observables) preserve their mathematical expressions. Additionally, the transmission to the the recorder of quantum probabilistic attributes is described by means of linear transformations for probability density and current(associated with the corresponding wave function).

Taking into account the above mentioned indubitable arguments, we think that in natural perception the "collapse of the wave function" cannot be considered as a physical process. Consequently, the Wave Function Collapse concept does not have the qualities of a real scientific topic, it being only a purely trivial and worthless fiction. Moreover, the above noted problems $\mathbf{p}_2$ and $\mathbf{p}_3$ make no sense. That is why the further studies expected to be raised by the Oxford Questions would be more appropriate if ignoring all the elements regarding the Wave Function Collapse concept.

## 3 As regards the Schrödinger's cat

Subsidiarily to the above considerations about the Wave Function Collapse concept, some remarks can be brought into question [9] concerning the famous Schrödinger's Cat Thought Experiment. The essential element in the respective experiment is represented by a single decay of a radioactive atom (which, through some macroscopic machinery, kills the cat). But the individual lifetime of a single decaying atom is a random variable. That is why the mentioned killing decay is in fact a twin analogue of the above mentioned single sampling taken into account in supposition $\mathbf{s}_1$ of the Wave Functions Collapse concept. So, the previous considerations reveal the notifiable fact that is useless (even forbidden) to design experiments or actions that rely solely on a single deterministic sampling of a random variable (such is the decay lifetime). Accordingly, the Schrödinger's Cat Thought Experiment appears as a twin analogue of the Wave Functions Collapse i.e. as a fiction (figment) and a deontology without any real scientific value.

The previously mentioned fictional character of the Schrödinger's Cat Thought Experiment can be argued once more by observation [9] that it is possible to imagine a macroscopic thought-experiment completely analogous with Shrödinger's quantum one. Within the respective analogue, a cousin of Schrödinger's cat can be killed through launching a single macroscopic ballistic projectile. More specifically, the killing macroscopic machinery is activated by the reaching of the projectile in a probable hitting point. But the respective point has characteristics of a true macroscopic (non-quantum) random variable. Consequently, the launching of a single projectile is a false premise, similar to the supposition $\mathbf{s}_1$ of the Wave Function Collapse concept. Add here the known fact that within the practice of traditional artillery (operating only with macroscopic ballistic projectiles but not with propelled missiles) designed for an expected destruction of a military objective, one uses a considerable (statistical) number of projectiles but not a single one. So the whole situation with a macroscopic killing projectile is completely analogous with the Schrödinger's Cat Thought Experiment which uses a single quantum radioactive decay. Therefore, the acknowledged classical experiment makes clear once more the fictional character of the Schrödinger's Cat Thought Experiment.

According to the above-noted remarks, certain things must be regarded as being worthless, i.e. allegations such as: *"the Schrödinger's cat thought experiment remains a topical touchstone for all interpretations of quantum mechanics"*. Note that such or similar allegations can be found in many science popularization texts, e.g. in the ones disseminated via the Internet.

## 4 Closing thoughts

Through the contents of the previous sections, we have brought into attention a few significant remarks regarding the themes of the Wave Function Collapse and the Schrödinger's Cat Thought Experiment. Through the respective remarks, we argue that the mentioned themes are not real scientific

topics but pure and trivial fictions. So we find that the Oxford Questions have an important, prolonged drawback and, consequently, their invalidated items have to be regarded as needless things for science.

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