Possible Perspective for Quantum Mechanics Interpretation: An Essay-Suggestion

Spiridon Dumitru

Abstract — **The idea of new-type articles, named *"Perspectives"*, announced recently by some leading journals, is suggested to be approached for the controversial question of quantum mechanics interpretation. Firstly, it is revealed briefly the unsatisfactory situation of the nowadays predominant doctrine about that question. Then some basic elements of the proposed approach are presented. Those elements refer to (*i*) uncertainty relations, (*ii*) distinction between own tasks of quantum mechanics and description of quantum measurements, (*iii*) defects of collapse scenarios for measurements, and (*iv*) depiction of quantum measurements as data transmission stochastic processes. The essay closes with some concluding remarks.**

Keywords — Quantum Mechanics Interpretation, Shortcomings of the Existing Predominant Doctrine, Revaluation of Uncertainty Relations, Abandonment of Collapse Scenarios for Measurements, Quantum Measurements as Information Transmission Processes.

I. INTRODUCTION

Recently, some of the journals from the Physical Reviews family announced [1]: *"a new article type, "Perspectives", to provide forward-looking views of cutting-edge science that has recently emerged or is enjoying renewed activity".* Those articles are supposed to*" identify critical open questions"* and to *"provide a comprehensive outlook on avenues for progress".*

That announcement shows signs of a good opportunity for promising approaches to the subject regarding the interpretation of Quantum Mechanics (QM). The respective subject and is present in a large number of debates and controversies for almost a century (see [2], [3] and references). But, in spite of such a number, until today, in regard to the whole class of mentioned matters, no consensus has been reached among the scientists.

Today there are known an appreciable number of doctrines announced as QM interpretations. Among the respective doctrines, one appears as being predominant - namely the *'Copenhagen interpretation',* which *"still reigns supreme, receiving the most votes - 42%"* [2]. Remarkably, in its main part, the Copenhagen interpretation focuses on questions regarding the crucial significance/importance of Uncertainty Relations (UR) and Quantum Measurements (QMS). We will denote here the respective part as Predominant Conventional Doctrine (PCD).

The preconized perspective articles are expected [1] to be focused on texts *"longer than typical research papers"*, e.g. on writings aiming to discuss as wide as a possible number of known comments (debates and controversies). But, in regard to the subject of QM interpretation, such a large task study is beyond my efforts realizable now. That is why, for the moment, I attempt to expose my vision about a perspective of QM interpretation in form of a modest essay. My present attempt germinated from a few ideas announced by me within the articles [4]-[6] and here, supplementary, it contains some new considerations. I hope that, potentially, my ideas and considerations can stimulate other scientists toward more exhaustive approaches of the previously mentioned subject.

This essay starts, in Section II, with a brief presentation of the current inadequate situation (deficiencies and misconceptions) of aforesaid PCD. After that, in Section III, it will be given out the basic constructive elements of an approach in perspective regarding QM interpretation. Some ending comments are given finally in Section IV.

II. NOWADAYS UNSATISFACTORY SITUATION OF PCD

Surprisingly, within the existing mainstream literature, the above-mentioned PCD is presented rather through many disparate assertions, but not through a complete and systematized set of clearly defined Basic

Percepts (BP). Nevertheless, such a set can be collected by means of a careful examination of today's most known publications. The respective set is detailed in our freely accessible paper [5].

Note that, in its integrity, the aforesaid PCD emerges completely from the assertions inserted in the mentioned set of BP. As a glorification of PCD doctrine, in modern mainstream literature, the UR is raised to a rank of a fundamental concept named Uncertainty Principle (UP). Associated, it is promoted the idea that the description of QMS should be regarded as a constitutive part of QM. The strangest element proposed within such descriptions is the so-called *'wave function collapse'*, regarded as being the essence of a QMS.

Incredibly, all the leading publications omit the fact that each of the BP, as a constitutive part of PCD, is discredited (and denied) by insurmountable deficiencies. The most significant of the mentioned deficiencies we have detailed and evaluated recently [5] and [6].

Now, summarizing, we can note that the whole aforesaid set of PCD deficiencies is dominated by the following Misconceptions (***M***):

- ***M₁***: For quantum theory UR is a capital piece which must be ranked to the status of fundamental principle.
- ***M₂***: QMS have a basic essentiality/inseparability with QM, their description being the most important part of the QM.
- ***M₃***: A QMS have to be regarded as a scenario consisting in a single extraction from a set of random data, scenario named Wave Function Collapse (WFC).

The above-reminded deficiencies of PCD philosophy, and directly the misconceptions $M_1 – M_3$, mark the profound shortcomings of the true base and content of that philosophy regarded as leading doctrine. In essence, the respective shortcomings are unavoidable and insurmountable within own framework of the alluded doctrine.

III. Some Constructive Elements for the Here Suggested Outlook

The aforesaid shortcomings discredit completely the status (reputation) of PCD as a leading view on the question of QM interpretation. Consequently, for a good perspective, it becomes interesting to look for a new approach to the mentioned question, an approach able to *"provide a comprehensive outlook on avenues for progress"*. Such a new approach, in form of a modest sketch, we aim to present in the current section of this essay.

Here is the place to mention the fact that our present approach, as well as its precursor texts, were stimulated by the appreciations/remarks which I received in a letter from the late scientist J. S Bell (see [7] and the APPENDIX in end of this essay). Through that letter he made known to me:

- *"I agree with what you say about the uncertainty principle: it has to do with the uncertainty in predictions rather than the accuracy of 'measurement'. I think in fact that the word 'measurement' has been so abused in quantum mechanics that it would be good to avoid it altogether".*

As regards the new approach aimed by us in this section, we appreciate as reasonable to construct it by a substantial reconsideration of the misconceptions $M_1 –M_3$. Therefore, we propose that a perspective approach to the QM interpretation be built around the next subsections.

A. Revaluation of the True Significance for UR

In [4]-[6], through multiple arguments, we have shown that the views about UR promoted by PCD do have not any capital/essential meaning for physics. Namely, we proved that the true significances of UR are:

- ***a)*** either of historic reminiscent pieces, without any lucrative value for physics, in a thought-experimental justification of Heisenberg's type,
- ***b)*** or simple and limited mathematical formulas in the theoretical vision promoted by PCD.

In the above ***b)*** significance UR are nothing but truncated and lower order correlation relations specific to intrinsic fluctuations of quantum systems. Note that a non-truncated version of such relations proves to be a completely correct QM formula. Remarkably is the fact that the respective formulas allow solving in a genuine manner the cases of observables pairs $L_z – \varphi$ (angular momentum - azimuthal angle) and $N – \phi$ (number-phase), pairs which, in PCD literature, are regarded as being completely rebellious couples of observables.

Note now, the important matter is that any approach of a QM interpretation depends on the implication (presence/significance) of the UR within the routes followed by the respective interpretation. In regard to the respective matter, we have notified [8] of the next opinions:

- A direct/explicit such implication leads to ambiguous, deficient, and unnatural visions regarding QM (visions that are encountered on routes promoted by many mainstream publications).

- An omission/removal of the aforesaid implication allows a potentially simple, improved, and natural conception of QM (i.e., a possible new perspective route).

We suggest that the above-noted UR true significances to be subsumed into a new approach in the perspective of QM interpretation. Surprisingly, the here suggested subsuming come to consolidate Dirac's guess (based on other considerations) that: *"uncertainty relations in their present form will not survive in the physics of future"* [9].

B. Separation of QMS Description from QM's Own Framework

From a veritable perspective, the descriptions of quantum systems' intrinsic qualities, respectively of QMS aspects should be considered as completely distinct scientific tasks. This is because of the reason that quantum systems, endowed with intrinsic properties, exist as objective elements of reality, independently if they are subjected or not to some QMS. The aforesaid reason appears as a generic synthesis of some illustrative remarks such are the following ones:

1) *"Was the wavefunction of the world waiting to jump for thousands of millions of years until a single-celled living creature appeared? Or did it have to wait a little longer, for some better-qualified system (...) with a PhD?"* [10].

2) As an example of a quantum system, one can consider an atom from a galaxy from the edge of the known universe. The properties of such an atom are completely independent of the measuring information that can possibly be captured by an observer from the Earth. Moreover, that capture can take place after a such long time, when in fact the atom in question turned itself into completely something else system, e.g. by radioactive decay.

Therefore, for a constructive approach to QM interpretation, able to *"provide a comprehensive outlook on avenues for progress"*, it must admit a 'de jure' separation of QMS description from the own framework of QM.

C. The Own Framework of QM as A Depiction of Quantum Systems' Intrinsic Properties

For a first matter, we note now the fact that the revaluations of PCD, as they were detailed in the paper [4] and reminded above in Section II, do not disturb in any way the own framework of usual QM. This means that, in spite of the PCD assertions, the common QM keeps all its known specific elements which refer exclusively to the intrinsic properties of the considered physical systems.

The mentioned keeping can be pointed out also by an attentive examination of an old book [11] due to E. Madelung. The respective book, avoiding any reference to the interpretation/significance of UR or QMS, presents all usual QM technicalities (principles, concepts, equations, models, computational practical rules and so on) that regard only the intrinsic features of considered systems. Note that the entire content of Madelung's approach was developed exclusively based on data known at that time about the intrinsic properties of quantum systems (those data were concerned with the particle-wave duality and conservation of probabilities associated with non-relativistic quantum particles). It seems that the mentioned Madelung's avoidance anticipated (at least partially and from another outlook) the next Bell's later annotation: *"The word 'measurement' has had such a damaging effect on the discussions that (...) it should be banned altogether in quantum mechanics"* [10].

Being stimulated by the above remarks we recommend accepting the following perspective-view: In their essence, at the present stage of science, the intrinsic properties of nonrelativistic quantum systems can be described completely by the known procedures of usual QM. Such an acceptance is warranted and encouraged by some of the leading scientists through statements such is the next one: *"ordinary quantum mechanics (as far as I know) is just fine for all practical purposes"* [10]. Today's readers can find QM texts, sufficiently *'fine for all practical purposes',* in books such are [12] or [13], if one omits the considerations about the importance (high ranking) of UR and QMS.

<u>Observation</u>: In the writing of specific formulas in QM it must be used with caution the bra-ket notation (initiated by Dirac). This is because in certain particular situations (e.g. in discussions about UR) that notation leads to ambiguities (see Appendix B of [4]).

D. Demotivation of The Idea about Collapse Scenarios for QMS

Many of the nowadays active scientists embrace opinions similar to the next one:

- *"To our best current knowledge, the measurement process in quantum mechanics is non-deterministic"* [14].

According to such opinions, the result (received information) given by a QMS process, should be represented in terms of some stochastic (probabilistic) output data.

But, surprisingly, in numerous publications of mainstream literature, a QMS is regarded as a scenario that provides as a measuring result a single (deterministic) value. In that value, one presumes that collapses the whole physical content of the measured observable. Generically, the mentioned scenario is named Wave

Function Collapse (WFC). Its' very popular exemplification is known through Schrodinger's Cat Thought Experiment (SCTE) (for notable references about WFC and SCTE themes see [4]-[6]).

The above-mentioned scenarios about QMS can be contradicted through a number of consistent arguments (see [5]). Mainly, it must be noted the fact that quantum observables are stochastic variables. Consequently, a true measurement of such an observable should consist not in a single deterministic outcome/value but in an adequate probabilistic set of such outcomes/values. The data given by such a set are expected to provide relevantly (and as complete as possible) information about the considered observable.

So, the idea to regard QMS as collapsing scenarios is contradicted by a number of arguments such as: (*a*) the probabilistic incorrectness, (*b*) the possibility of imagining non-quantum but completely similar scenarios (e.g., for SCTE), or (*c*) lack of ratified practical tests. Therefore, the idea of appealing to the alluded scenarios proves itself to be not a real scientific subject but rather a set of superfluous exercises (fictive schemas), without any theoretical or practical value.

Accordingly, to the above-noted observations, the idea of collapse scenarios as conceptual representations of QMS should be demotivated and omitted in any new approach in perspective for the QM interpretation.

E. Separate Theoretical Descriptions of QMS in terms of Information Theory

Inside the debates about QM interpretation, within the diversity of viewpoints regarding QMS, are known even glorification assertions like the following one:

- the description of QMS is "*probably the most important part of the theory* (QM)" [15].

But, in the same diversity, were reported also observations such as the next one

- *"Despite long efforts, no progress has been made (...) for (...) the understanding of quantum mechanics, in particular its measurement process and interpretation"* [14].

In spite of the assertions and observations as are the ones mentioned above, the subject of QMS involves also questions of real/practical interest for physics. Between such questions, naturally, the most important ones appear as being the matters:

    a) the true interrelationship of QMS with the today-known and agreed QM pattern,

    b) the search for genuine theoretical QMS descriptions

As regards the aforesaid interrelationship, based on the arguments from the above subsection B, we reiterate again the fact that usual QM describes exclusively and completely only the intrinsic properties of nonrelativistic quantum systems. Thus, the description of QMS has to be considered as a distinct (and additional) subject that must be investigated separately but somewhat in association with QM in itself.

For searching of some genuine theoretical descriptions of QMS, it seems auspicious to start the approaches by agreeing on the following observation:

- *"It seems essential to the notion of measurement that it answers a question about the given situation existing before the measurement. Whether the measurement leaves the measured system unchanged or brings about a new and different state of that system is a second and independent question"* [16].

Accordingly, for a measured physical system, the "*situation existing before the measurement*" regards the intrinsic properties of that system. The quantitative details of respective properties play the role of *'input data'* (entrance information) within the measurement. Additionally, for the same system, the measurement results are accumulated in *'output data'* (received information) which are provided by measuring process. So, the whole measurement looks as a transmission process for information, while the measuring device appears as a communication channel (regarded as in [17]). Thus, an overview of a measurement can be depicted through (1).

$$\begin{bmatrix} input \\ data \end{bmatrix} \Rightarrow \begin{bmatrix} communication \\ channel \end{bmatrix} \Rightarrow \begin{bmatrix} output \\ data \end{bmatrix} \tag{1}$$

We recall that this scheme was applied (see [18] and Appendices E and H from [4]) in describing non-quantum measurements for the fluctuations of thermodynamic-macroscopic quantities considered as classical random variables.

Implementation of scheme (1) for the QMS description requires the consideration of the following remark:

- *"To our best current knowledge, the measurement process in quantum mechanics is non-deterministic"* [14].

Accordingly, the QMS descriptions have to be presented by means of some non-deterministic (stochastic/random) entities. In a minimal model, such entities can be the wave functions (in their qualities

of implicit probability carriers) respectively the quantum operators (regarded as generalized random variables).

Thus, in the case of a theoretical QMS description, the input data can be considered as being comprised in *in-wave-function* Ψ_{in} associated directly with the intrinsic properties of the measured system. Note that Ψ_{in} must be estimated theoretically within the known framework of usual QM. As regards the same QMS the output data should be represented through some quantities having stochastic features. Formally, such features can be considered as comprised in an *out-wave-function* Ψ_{out}.

Therefore, a QMS appears as an information transmission process (or stochastic transformation), which, through the measuring device (acting as a communication channel), transposes the wave function from the *input*-reading Ψ_{in} into the *output*-image Ψ_{out}. The aforesaid processes can be depicted through the next symbolic relation, which is shown in (2).

$$\Psi_{in} \Rightarrow \begin{bmatrix} measurement \\ process \end{bmatrix} \Rightarrow \Psi_{out} \tag{2}$$

Additionally, to the transformations (2), regarding wave functions, a complete theoretical representation of a QMS must refer to the descriptors of observables A_j (j=1, 2, ..., n) specific to the measuring system. The respective observables are described through the corresponding Hermitian operators $\hat{A}_j$, considered as generalized random variables, and defined in terms of usual QM. Note that, in our opinion, the mentioned operators should have the same mathematical expressions $\hat{A}_j$ in both *'in'* and *'out'* versions.

According to the above-noted specifications, the numeric parameters (of first and second order) of an observable A can be defined through (3).

$$\langle A \rangle_{\eta} = \left(\Psi_{\eta}, \hat{A}\, \Psi_{\eta} \right), \qquad \sigma_{\eta}(A) = \sqrt{\left\langle \left(\hat{A} - \langle A \rangle_{\eta} \right)^2 \right\rangle_{\eta}} \tag{3}$$

Within these formulas the various symbols have the following significances: $\eta = \{in, out\}$, (f, g) denotes the scalar product of functions f and g, $<A>_\eta$ represents the mean (expected) value of observable A in η - readings while $\sigma_\eta(A)$ depict the corresponding standard deviations of fluctuations specific to A regarded as a quantum stochastic variable.

Of principle, the theoretical description of a physical measurement must include also estimations of some markers that characterize the errors of that measurement. Therefore, we specify that for a QMS described theoretically through the above briefly mentioned terms, the specific errors of an observable A can be evaluated through the following theoretical (*th*) parameters shown in (4).

$$\varepsilon^{(th)}\left(\langle A \rangle \right) = \langle A \rangle_{out} - \langle A \rangle_{in}, \qquad \varepsilon^{(th)}\left(\sigma(A) \right) = \sigma_{out}(A) - \sigma_{in}(A) \tag{4}$$

For useful scientific purposes, the QMS descriptions, considered generically as above, must be detailed by certain analytical concrete illustrations. Some modest kinds of such illustrations were suggested in our recent paper [5]. Our approach, for the concretization of QMS description, was centered around the idea to do not use straightly the wave functions Ψ_η, which, being QM probability amplitudes, have not meanings as direct probability carriers. For such carriers we appealed to entities such are situational probability, probability density and probability current. So, for suggesting an image about QMS, instead of (2) we have to resort to (5).

$$\begin{bmatrix} probabilistic \\ content\ of\ \Psi_{in} \end{bmatrix} \Rightarrow [QMS] \Rightarrow \begin{bmatrix} probabilistic \\ content\ of\ \Psi_{out} \end{bmatrix} \tag{5}$$

The core elements of our alluded approach are reminded below through the next brief examples (*E*):

1) E_a: A case with situational probabilities

Let us consider the case of a QMS for a single quantum observable A which have a non-degenerate discrete spectrum of eigenvalues a_j (j=1,2,...,n). Such an observable can be described by the operator $\hat{A}$ which satisfies the equations $\hat{A} \cdot \varphi_j = a_j \cdot \varphi_j$ where φ_j (j= 1,2,...,n) denote the corresponding eigenfunctions. When the set of eigenfunctions φ_j (j= 1,2,...,n) constitutes an orthonormal basis the wave functions Ψ_η ($\eta =$ *in, out*) can be represented as (6).

$$\Psi_\eta = \sum_{j=1}^{n} \alpha_j^{(\eta)} \cdot \varphi_j \,, \qquad\qquad \sum_{j=1}^{n} \left| \alpha_j^{(\eta)} \right|^2 = 1 \qquad\qquad (6)$$

Here $\left| \alpha^{(\eta)}_j \right|^2$ denotes the situational probability that wave function Ψ_η to have as component the eigenfunction φ_j Then, by considering the QMS as linear conversion, (5) can be itemized through (7).

$$\left| \alpha_k^{(out)} \right|^2 = \sum_{j=1}^{n} M_{kj} \cdot \left| \alpha_j^{(in)} \right|^2 \qquad\qquad (7)$$

where M_{kj} (k, j = 1, 2, . . . , n) represent the elements of a doubly stochastic matrix.

More concrete additional details induced by (6), regarding the characteristics of the quantum observable A, are given in Section B and Appendix F of our paper [4].

2) E_b: A case involving density and current of probabilities

Now let us consider a spin-less quantum particle, supposed to be in a unidirectional motion along the x-axis. Then the corresponding wave functions Ψ_η ($\eta = in, out$) will be taken of the form $\Psi_\eta = \Psi_\eta$ (x) (note that here we omit to specify the time t as a visible variable because the considered state of a system refers to a given ante-measurement instant). Because in the now considered case the alluded wave functions are only probability amplitudes (deprived of direct probabilistic meanings), we will appeal to entities with direct probabilistic significances. Such appealed entities are the probability densities $\rho_\eta = \rho_\eta$ (x) respectively the probability currents $j_\eta = j_\eta$ (x), defined as in usual QM [13].

Note that, as they are defined, ρ_η and j_η refer to the positional and the motional kinds of probabilities respectively. In experimental terms, the two kinds can be regarded as measurable by distinct devices and procedures. A similar situation one finds in electric studies where the aspects regarding the position and mobility of electrical charges are evaluated through completely different quantities (whose measurements are due by means of distinct devices and procedures). Due to the aforesaid specifications, it results that, if the considered QMS is regarded as a linear transformation of probabilities, the generic diagram depicted in (5) can be represented through (8).

$$\rho_{out}(x) = \int_{-\infty}^{+\infty} \Gamma(x,x') \cdot \rho_{in}(x') \cdot dx'$$

$$j_{out}(x) = \int_{-\infty}^{+\infty} \Lambda(x,x') \cdot j_{in}(x') \cdot dx' \qquad\qquad (8)$$

Here Γ (x, x') and Λ (x, x') denote two corresponding doubly stochastic integral nuclei (kernels). They incorporate extra-QM elements regarding the characteristics of measuring devices/procedures specific to the probability density and current. The respective elements do not belong to the usual QM framework which refers to the intrinsic features of the measuring system (particle).

Now note that, for any observable A, the expressions for $\rho_{out}(x)$ and $j_{out}(x)$, estimated through (8), allow to calculate the corresponding mean value $<A>_{out}$ associated with the output wave function Ψ_{out} (x) (see the details around the relation (42) in [5]). On the other hand, the calculations regarding the measurement input data will be done by taking the function Ψ_{in} (x) from the QM evaluations of the intrinsic characteristics of the measured system. Thus, one obtains all the values (3) and (4), associated with the measurement of the orbital observable A for a particle in unidimensional spatial motion.

Some concrete illustrative details and formulas induced by the transformations (8), about the aforesaid measurement, are presented in Section 5.4 and Appendix G of our article [5].

Now, related to the above discussed examples E_a and E_b, it should be noted that their essence is contained in transformations (7) and (8). Moreover, the alluded essence is condensed into the kernels M_{kj}, respectively Γ (x, x') and Λ (x, x'). The distinctive characteristic of the mentioned kernels is double stochasticity. It specifies the fact that a QMS, seen as a stochastic transformation, must have the following main feature: a particular input certainly induces one of the attainable outputs and, complementary, a distinct output is surely generated by one of the possible inputs.

A further matter regarding the aforesaid kernels. Their concrete expressions need to be established by appealing to considerations which are completely separate from the elements belonging to usual QM. The respective elements refer exclusively to the intrinsic properties of physical systems (see above the subsection B). Consequently, the expressions into discussion must be shaped by putting in theoretical patterns the features of measurements devices/procedures taken into account. Such shapings for the mentioned kernels M_{kj}, Γ (x, x') and Λ (x, x') were discussed briefly in [5].

Through the examples E_a and E_b, reminded above, we suggested that a distinct QMS description to be done in the spirit of (5), i.e., by means of some quantum entities having direct probabilistic significance. Of course, in principle, a separate description of QMS is possible to be realized also in the spirit of (2), that is through a straight appeal to wave functions Ψ_η. Also, from a general viewpoint, an autonomous description of a QMS can be done with the aid of a mix between (2) and (5). But, as a general rule, all the mentioned descriptions have to conform to (1).

Note: The above-sketched description of QMS is nothing but a theoretical model. It aims to point out mainly the conceptual distinction between QMS and QM. The respective model does not contain any consideration of the practical evaluations of the real physical properties of quantum systems. Such evaluations are in the task of a well-delimited field of experimental physics.

IV. Conclusion

For the controverted question of QM interpretation, through this essay, we attempted to propose a perspective approach in sense announced recently by some leading journals.
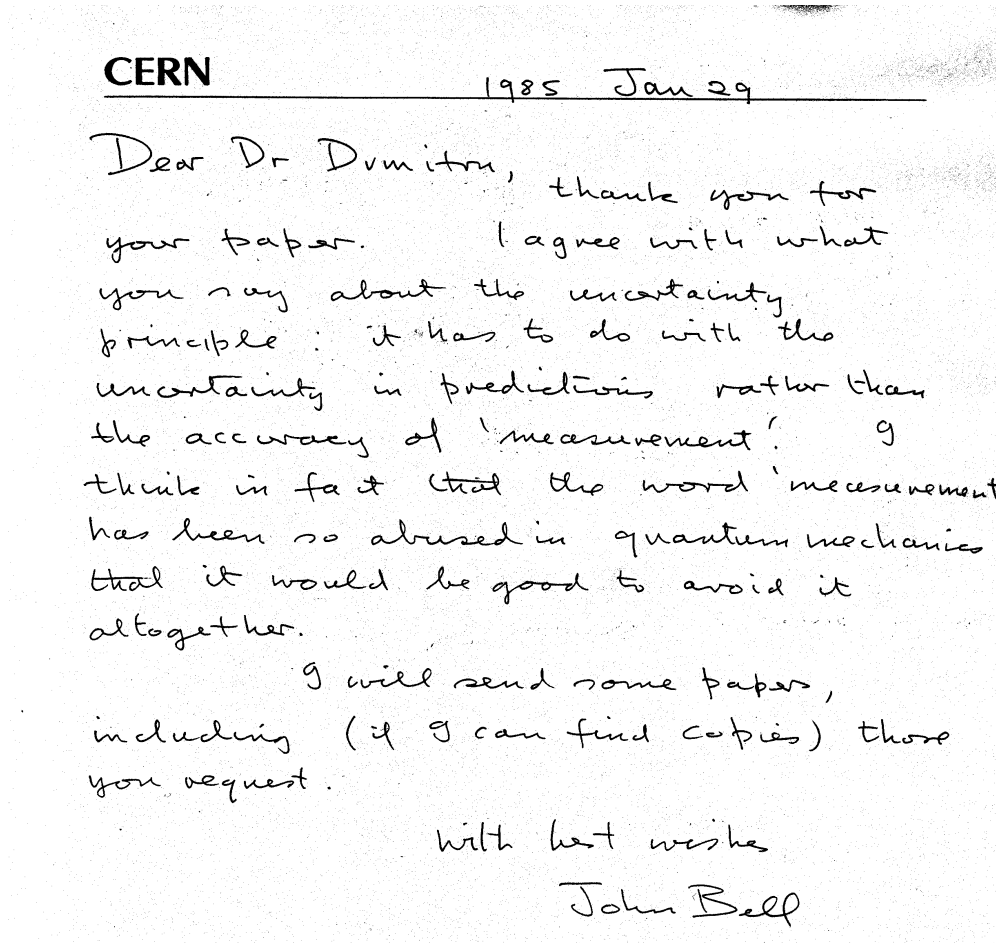
Our proposal is motivated firstly, in Section II, by pointing out the faulty situation (deficiencies and misconceptions) of the nowadays predominant doctrine regarding the alluded question.

Then, based partially on the findings from recent our articles [4]-[6], along Section III, subsections *A-E*, we suggested some primary elements for the intended construction in perspective. The respective elements consist of profound reconsiderations of views about (i) uncertainty relations, (ii) distinction between QMS and QM's own framework, (iii) depiction in QM of intrinsic properties regarding quantum systems, (iv) collapse scenarios in QMS description, and (v) separate descriptions of QMS as data transmission processes.

We hope that, as above detailed, our present essay will be able to offer a realistic base for constructing a possible perspective approach for QM interpretation.

Appendix

A private letter from the late scientist J. S. Bell to the present author

CERN   1985 Jan 29

Dear Dr Dumitru,
                    thank you for your paper. I agree with what you say about the uncertainty principle: it has to do with the uncertainty in predictions rather than the accuracy of 'measurement'. I think in fact that the word 'measurement' has been so abused in quantum mechanics that it would be good to avoid it altogether.

I will send some papers, including (if I can find copies) those you request.

With best wishes
John Bell

REFERENCES

[1] Editorial: Introducing Perspective Articles, *Phys. Rev. A 105*, 2022.
[2] Wikipedia. *Interpretations of quantum mechanics*. [Internet] Retrieved from https://en.wikipedia.org/wiki/Interpretations_of_quantum_mechanics.
[3] Wikipedia. *Minority interpretations of quantum mechanics*, [Internet] Retrieved from https://en.wikipedia.org/wiki/Minority_interpretations_of_quantum_mechanics.
[4] Dumitru S. Caducity of idea about wave function collapse as well new views on Schrodinger's cat and quantum measurements. *Progress in Physics,* 2013; 9(1): 63–68; arXiv: 1210.4121v3.
[5] Dumitru S. A Survey on Uncertainty Relations and Quantum Measurements: Arguments for Lucrative Parsimony in Approaches of Matters. *Progress in Physics*, 2021; 17(1): 38-70. ISSN 1555-5534.
[6] Dumitru S. Can Schrodinger's Cat Be Really a Quantum Touchstone? *European Journal of Applied Physics*. 2021; 3(3): 29–32. https://doi.org/10.24018/ejphysics.2021.3.3.81.
[7] Bell JS. A private letter from the late scientist J. S. Bell to the present author, January 29, 1985. PostScript for quant-ph/0004013v1. [Internet] Retrieved from: arxiv:quant-ph/0004013v1 Fig.1.gif.
[8] Dumitru S. Routes of Quantum Mechanics Theories, *Progress in Physics*, July 2012:3. Letters to Progress in Physics L1.
[9] Dirac PAM. The evolution of the physicist's picture of Nature. *Scientific American*, 1963; 208: 45–53.
[10] Bell JS. Against "measurement". *Physics World*, 1990; 3: 33–40. Article reprinted also in some books containing Bell's writings.
[11] Madelung E. *Die Mathematischen Hilfsmittel der Physikers, Abs. 4, Quantentheorie.* Springer-Verlag Berlin 1953.
[12] Bransden B.H., Joachain CJ. *Quantum Mechanics,* 2nd Edition, Harlow, Pearson Educational Ltd.; 2000.
[13] Schwabl F. *Quantum Mechanics Fourth Edition*. Berlin, Springer; 2007.
[14] Hossenfelder S. At the frontier of knowledge, arXiv: 1001.3538v1.
[15] Auletta G. *Foundations and interpretation of quantum mechanics*. Singapore, World Scientific; 2000.
[16] Albertson J. Quantum-mechanical measurement operator. *Phys. Rev.,* 1963; 129: 940–943.
[17] Wikipedia. *Communication channel*, [Internet] Retrieved from: https://en.wikipedia.org/wiki/Communication_channel.
[18] Dumitru S. Phenomenological theory of recorded fluctuations. *Phys. Lett. A.*, 1974; 48, 109–110.

A POSTSCRIPTS ANNOTATION

In its wholeness, the above suggested perspective-construct for QM interpretation is imagined to be a source of many utile topics (for educational, scientific, and practical purposes) but not as a basis to extravagant and abstract disputes/debates. We appreciate that such an imagining requires avoiding unnecessary mathematical excesses (terms or considerations). Our appreciation is inspired from the *'parsimony principle'* (known also as Ockham's razor), a principle which can be summarized through the next desiderata: (a*) "Of two competing theories, the simpler explanation of an entity is to be preferred"* and *(b)"Entities are not to be multiplied beyond necessity"* (see: Encyclopedia Britannica. *Occam's razor* and Wikipedia. *Occam's razor.*