Reinstating the Existence of Single System Quantization as an Issue of a Pre-Statistical Quantum Reality

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Global quantization reinstates basic quanta counting. It covers increasing numbers of experimental results in the pre-statistic realm. The ensuing 2-tear quantum aspect opens up a topological venue for highly ordered quantum structures while calling for abandoning the nonclassical statistics of Copenhagen Doctrine.

1. Introduction

In the course of time physics' general inquisitiveness has rather consistently moved from the macro-to the microphysical realm. Taking a look in a perspective of time at this vast macro-to micro-physical field of description, some aspects emerge that are neither macro- nor typically microphysical in nature. Since the metric field gives us the sense of micro-macro distinction these description aspects may be taken to be metric-independent; they can be said to be innately ***scale*** invariant. In the scalar domain *flux, charge and action* have a *metric-independent* feature, because they are known as countable quantum items the invariance of which is metric independent. The integrals 1,2,3 testify to that:

Aharonov-Bohm $\oint_{C_1} A = nf$; $n=1,2,3\ldots$ (1)

Similarly linked by c_1 and $f = \tilde{h}/2\tilde{e}$

Gauss-Ampère $\oiint_{C_2} \tilde{G} = s\tilde{q}$; $s=1,2,3,\ldots$ (2)

Net charge 'enclosed' by c_2 and $\tilde{q} = \pm\tilde{e}$

Kiehn product $\oint\!\!\oint\!\!\oint_{C_3} A \wedge \tilde{G} = ns\tilde{\alpha}$ (3)

Action quanta inside c_3 and $\tilde{\alpha} = \pm\tilde{h}/2$

The one-form A is defined by the **four**-vector potential and $\tilde{G}$ the 2-form of Minkowski's joint expression for displacement D and magnetic field H. The tilde specifies *impair* features of the form 2. The use of Cartan form-language here imlies Eqs.1, 2, 3 obey ***general relativistic*** invariance yet as a consequence of a by Cartan [**2**] cited metric-independence(1924) they also meet an added feature of ***scale*** independence.

These three integrals have been around well before they became related to quanta. ***In fact, after Faraday's electrolytic experiments of 1835, Eq.2 established the existence of charge quanta and so became indeed a first explicit messenger of quantization.*** Although not officially recognized as such, theory accepts its validity and it is taught as Gauss' law of electrostatics. These integrals replace the prematurely discarded pre-1925 quantum recipes. They also yield approximations of Schrödinger's statistical reality, ***but now have their own pre-statistic reality in the more conclusive renditions Eqs.1,2,3.***

In 1959 Aharonov and Bohm [3] introduced Eq.1 as spacetime counter of flux units; using Schrödinger's single-valuedness of Y for its unit size *h/e*. An electron interference experiment designed to check this AB effect confirmed the size *h/e*. The seminal experiments of Doll *et al* [4] and Fairbank *et a*l [5] measuring ***static*** flux states confirmed in 1961 a smallest flux quantum *h/2e, the* ***static*** *counterpart of the* ***dynamic*** *unit h/e.*

Yet despite these explainable distinctions the AB integral is acknowledged as a tool in contemporary physics but has been denied the fundamental status of Gauss' integral. A ratio of the AB- and Gauss integrals surprisingly accounts for a unified description of the integer and fractional quantum Hall effect Z_H= $(n/s)(h/e^2)$ using two quantum numbers *n* and *s*. Yet over the past 30 years the vast majority has ignored this surprising result, not even asking questions whether this surprise result has a basis in true physics. Instead, Schrödinger's statistical process was preferred to account for a highly ordered non-statistical display of a near perfect quantum Hall order. *Only dogmatic adherence to Copenhagen Doctrine could have placed a statistics at the cradle of quantum Hall order.*

Granted the cited existence of a silent distrust against the AB law seemed due to a bold move of extracting a non-statistical result from the phase of Schrödinger's Y function. Physics accepted Gauss' integral-2 but remained strangely ambivalent about integral-1 such as testified *e.g., by* recent quantum Hall history. The fact is that ***closed forms*** are the centerpiece of discussion for both, because they define a field topography by having domains of vanishing exterior derivatives (the ocean) complemented by domains of nonzero exterior derivative (islands in the ocean). Consider as classical 3-dimensional example the displacement vector D, its divergence (equivalent of exterior derivative) creates a divD=0 versus divD≠o contrast marking a topography of a physical field and its electric sources. These signs of physical topology take shape in the image of de Rham's cohomology [1] theory. Along with an unquestioned validity of the Gauss integral, an independently proven existence of the AB integral and its smallest period *f=h/2e* confirmed by [4,5] **ought to** rule out further doubt about Eq.1; *i.e.,* no more lingering silent sabotage, because the truth is that ***Schrödinger's process exists by the grace of Eq.1!***

Recognizing a period integral similarity with Brouwer's degree of a map, Kiehn [6] in 1977 took all three period integrals1,2,3 as a complete set probing quantum order. The topology is perhaps more tangible by calling on de Rham's existence theorem [7,1] for ***closed*** differential forms. Kiehn's approach retains options for topology *change*, which from a de Rham angle is verifiable as charged pair creation or/and annihilation.

2. Consequences for the Quantum Hall Effect

The earlier mentioned ratio of integral 1 over integral 2 has yielded a de facto accuracy and precision that was good enough to lead to corrections in official determinations of *h* and *e*. Topologically the ratio of the two integrals 1 and 2 describes a cyclotron ring current linking a flux of the applied B field perpendicular to the interaction space of the Hall effect sample, yielding $Z_H=(n/s)(h/e^2)$. The integer n=1,2,3… counts the flux units *h/e* linked in a ***dynamic*** situation and the other integer taken to be even s=2,4,6 etc. covering an option of multiple Cooper pairing. Over and above, observed odd enumerators have been a tell-tale signs of *reduced* ratios *n/s hinting at super-conduction*.[8]. Yet those astute experimental observations were sadly abandoned in the wake of the vast majority favoring Schrödinger-based assessments of the quantum Hall effect

Schrödinger-based assessments of the integer effect start out with a single charge cyclotron missing out on Cooper pairing to cover induced superconductivity. The fractional effect now calls for a many body approach, leaving an integer-fractional dichotomy.

A matrix of identical cyclotrons slowly slides through the 2-dimensional interaction space. The Hall impedance Z_H defined as Hall voltage over Hall current equals linked flux over linking charge passing the Hall probe, equaling the ratio of linked flux over linking current passing the probe, drift matrix velocity size cancel thus yielding Z_H. Multiple Cooper pairing is how more than one electron pair can reside in the same cyclotron orbit; *i.e.*, boson behavior of Cooper pairs coming to the rescue. An BCS-type argument has electrons in the interaction space interact exclusively with nearest neighbors in adjacent layers of the interaction space, thus promoting Boson formation overcoming repulsive interactions between electrons in same orbits.

3. Consequences for the Copenhagen Doctrine

Having thus argued how Gauss' theorem can accumulate boson pairs Eq. (2), along with the experimentally proven flux count of Eq. (1) thus adds considerably to a pre-statistical applicability of both laws working in tandem. Eq. (3) is reducible to Eqs. (1) and (2) still opening up more potential of getting independent info about *n* and *s*. In other words, contrary to Copenhagen Doctrine not all quantum info is statistical. Copenhagen's statistical exclusivity has been a major hurdle preventing full acceptance of Aharonov-Bohm developments. The fact is we have to settle for a pre-statistic branch of quantum physics, *i.e.*, alongside the more familiar statistic branch. Compatibility requires mutual transitions exist but are excluded under nonclassical statistical rule. An outline of ensuing repercussions has been presented in a volume 181 of the Boston Studies in the Philosophy of Science [9]. It is in part Popper's [10] initiative replacing Copenhagen's single system by an ensemble of orientation- and phase-random systems, now governed by *classical*- not by a nonclassical statistics. In retrospect Schrödinger-type quantum mechanics so becomes more classical. Instead of deriving the AB integral from the Schrödinger Y phase; *the latter is now subject to the AB law indicating rather then postulating single-valued wavefunctions.*

Schrödinger equation mystique invited *non-classical paradigm* and then led to more of the same. The experimental resurrection of the single system quantum aspect is now a special reminder how finiteness of matter is at the source of all quantum phenomena transcending from the tangible to the abstract. Planck's initial step of introducing the quantum of action is, so far, physics' most abstract step ever!

Conclusion

Recognizing the Aharonov-Bohm and Gauss-Ampère integrals (plus Kiehn product version) as valid pre-statistical quantum laws calls for drastic change in Copenhagen Doctrine. In the process it removes an embarrassing conceptual schism affecting the current state of physics. In application these tools reveal a strikingly simple unification of the integer and fractional quantum Hall effects while rescuing abandoned observations hinting at Cooper pairing [8] hinting at an indeed clearly observed induced super-conduction. Extensive evidence supportive of these interconnected changes has been in the open for rebuttal over the last fifteen years in ref.[9]. *Let us request this vast Copenhagen majority to compare methodologies so as to let open forum guide the way! The cited conflict needs to be confronted, because it is too embarrassing to let it linger.*

References

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[10] K. Popper, Naturwissenschaften 22, 807(1934); In a correspondence with Popper, Einstein later expressed himself in favor of an ensemble view of Schrödinger's equation. In the Thirties D,J. Blokhinstev in Russia, Harvard's E.C. Kemble and others wrote texts favoring ensemble views. Nonclassical statistics though has remained the big hurdle preventing a complete interpretive switch from Copenhagen's past.