COMMENTARY

# Limitations of the Method of Integration in Astro- and Fundamental Physics

Yang Cao[1]

1 Communication University of China, China

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## Abstract

I take a reflection of the mathematical method of integration applied in physics and astrophysics in the research. I examine the theoretical premise of integration entailed in its applications in the fields, and with qualitative comparative analysis, regard the inconsistency of the mathematical method in physical and astrophysical theories. I seek to uncover the formal science's affinity to the natural sciences in the research, and assert that number theory and set theory are better substitutes in modern physics and astrophysics. With a relativistic (astro-) physics perspective, I discuss and compare the representations of causality, capacities for deviations, and error tolerance with the methodological approach. I discuss the implications with the example of the Cosmic Microwave Background, and conclude with the teleology of the (astro-) physical sciences.

**Yang I. Cao**[1,*]

[1] *Founder, Scientifique Global Limited*

[*] Correspondence: Room 1508, 15/F., Office Tower Two, Grand Plaza, 625 Nathan Road, Kowloon, Hong Kong. Email: ypach@yangpachankis.us

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## 1. Introduction

The presumption of continuity is implied in the mathematical method of integration. The latter has been an important mathematical tool in astronomy and astrophysics, and there is even a recent novel interferometric and spectrometric development by utilizing the Fourier transform[1]. Indeed, without the theoretical premise of continuity, there can hardly be any pragmatic applications in technology, but there is the risk for scientific integrity if and when continuity is taken for granted.

Continuity does not exist on an atomic and subatomic level, and is only an approximation. In electron-positron annihilation, the energy transferred to gamma rays is maximum when emitted in the direction of the incident positron[2]. The mathematical rules of Calculus exactly fail to provide a satisfactory formalism in accurate expressions, for example, the Fourier transform exactly avoided $tan\theta$, while the quantum jump method employed a second integral along the continuous time presumptions for mathematical expressions of the wave function[3].

Troubled by the inadequacies in precision and availability of the mathematical methods in fundamental physics and astrophysics, the research seeks to discuss the alternatives with qualitative comparative analysis (QCA) to the method of integration. From a researcher's perspective, I adopted number and set theories in place of the anticipations for integration, especially that when infinities are concerned[4]. Consequentially, the research is a discussion on the formal science's implications to the natural science in general, and to fundamental physics and astrophysics in particular.

## 2. Methods

The principle underlying the QCA share the theoretical premise that the formal science construct applied in the natural sciences ought to conform to the structure and changes of the latter. For instance, equations are widely used in physics, but rarely equivalences. Even though Newton's Third Law of motion may be expressed in equation in terms of vectors, equivalence is more precise in terms of the conservation of momentum.

### 2.1. The Non-Probable Causality

The theory of relativity is fundamentally the causal inference to Newton's Third Law. It is absurd to presume that the action of A caused the reaction of B if the forces of the action and the reaction are equivalent to one another. Equally absurd is that A's kinetic energy caused A's change of movement the moment it hit B.

In the simple example, both scenarios can be easily expressed with integrals with the element of movement according to the change in time

$$\int_{V_{A2}}^{V_{A1}} f(V_A)dV_A \equiv \int_{V_{B1}}^{V_{B2}} f(V_B)dV_B \qquad (1)$$

and

$$\int_{t_1}^{t_2} \frac{1}{2}(m_A V_{A1}^2 + M_B V_{B1}^2)dt = \int_{t_2}^{t_3} \frac{1}{2}(m_A V_{A2}^2 + M_B V_{B2}^2)dt \qquad (2)$$

if time were indeed continuous. But when examined closer, equations (1) and (2) don't state time in a continuous fashion. While equation (2) adhered to the continuity of time with the dissect from $t_2$, the instance of change in equation (1) with the basic variations of $f(V)$ was only stated in terms of the zero net change in general relativity. In other words, the causal inference provided by the combination of the two only stated the probabilities of cause in terms of effects at the instance of $t_2$.

Saving the phenomenon is still a significant part of science, and what I am proposing is the mathematical perspective of inquiry into the nature of physics or astrophysics. What I see about mass is a collection of atoms composed of different chemical bonds. The macroscopic phenomenon of mass ought to be able to be expressed by the microscopic behaviors. The photoelectric effects and dispersion in non-solids can both be explained by pair production, and why can't Newton's Third Law be expressed in terms of this?

For one, the expressions can take some long pages, and for two, there will be some significant discussions of consensus to satisfy the intersubjective domain in relation to different specialized disciplines. The adoption of set theory to the quantum realm was discussed by Hossenfelder and Palmer[5] with regard to superdeterminism, and both the continuous and non-continuous domains can be encompassed by set theory, that is, the rigid and non-rigid body versions of the example set[6].

### 2.2. Choice for Transitions

Number theory is a concrete complement for set theory. The theoretical premise for the method of integration is not only the presumption of continuity, but also the specific patterns in the continuum that can be summarized. The premise of integration's applicability in quantum physics followed the threshold of quantum jump in the electrons' behaviors so that the intervals can be summarized quantitatively before the next qualitative change[3]. An important detail, however, is neglected when applying integration to quantum physics, and that is the possible dimensional differences in the collection of signals received.

When it comes to relativistic physics, an important element of astrophysics nowadays, the elementary causal inference starts with the quantum systems, not ending with them. There is rarely any software that can provide the basis for numerical analysis in astrophysics, and the most that have been done are modeling off the original data and new commands of how to conduct the next observations. SAOImageDS9 is one of a kind I have seen with comprehensive documentation in the software with the numerical and algorithmic basis of operations on the data, apart from the numerical values in each pixel. Direct analysis for inductive functions off the original data is made possible in such an example, even though revisits on general relativity are necessary when it comes to coordinates and spacetime in a continuous or non-continuous fashion[4].

### 2.3. Robustness and Discreteness

With the development of machine learning (ML) and artificial intelligence in the astronomical and physical sciences, the robustness of these models does not take into account the degrees of randomness. The implementations of randomness in ML were discussed by Vovk, Gammerman and Saunders[7] for confidence levels, however, discrete algorithms only take into account the numerical likelihood and not the whole physical and astrophysical contexts like humans do. Besides, the approximation of confidence levels only originates from the Shannon entropy analyses for computability, that is, the reconfigurations of the continuity presumptions[7][8].

So, for the robustness (or say rigor) in the physical and astrophysical bases, the degrees of randomness from numerical analyses are essential with the relativistic prerequisites. The detection of a 1-KeV atom can either be from some near sources' photoelectric effect or the remainders from the sources after billions of light years' decay, and we can't even rule out the possibility of it being proportionally both. Therefore, the discreetness on a cosmological sense cannot be rightly achieved without assigning the degrees of randomness in observational results.

## 3. Result

Error tolerance is the unique strength in substituting the method of integration with number theory and set theory. Quantum indeterminacy is a concrete example on the strengths for quantitative research. The mathematical method's capacities for error tolerance are the phenomenological approach to causal inference. While integration deals with a limited numbers of sampled variables, set and number theories are capable of dealing with multiple variables. In this regard, error tolerance also means interpolatability.

Integration is a deductive mathematical method to (astro-) physics, and the mathematical languages of set and number theories lead to induction. The interlaced shifts may be different to fundamental research experiments and the other utilitarian approach to technologies. In a pragmatic perspective, the apparatus rationale in human science only detects the samples on a continuum of consciousness and then the samples are analyzed *post hoc*. So, measurement bias cannot be corrected by the analytic phase, but a deductive approach in such a phase can only widen the measurement bias, if at all measurable.

Functional analyses are still operable with the set theoretic and number theoretic approaches. The convenient tool of functional analyses, unless with strong evidence and argument for a causal inference, does not set a strong case for plausibility without analyzing into the degrees of randomness. Subjective bias in professionalism often occurs in the specific scenario and the method of integration is one of the causes from habit.

The study of randomness is the study of cosmology itself. The concept of entropy implies the classic physics expectations for order, and randomness itself is rarely acknowledged in the (astro-) physical sciences. It is worth noting that the sequence of prime numbers in mathematics is still random beyond current human summarization, and the differentiation between organic and inorganic chemistry that compose life from the lifeless is still a mystic domain.

## 4. Discussions

The randomness of the cosmic microwave background (CMB) is site-specific in the disciplinary corridor of discussion in the research, and may be an under-studied field of research. The Big Bang model takes the CMB's site specificity for mathematical summary, but neglects the causal inference construct for physical cosmology. Revisiting the CMB by the theoretical premise of randomness may further correct the measurement and subjective bias in the current organizational construct of the sociology of knowledge with the pragmatically organized scientific evidence.

Is it only a matter of associative thinking or the spirit of scientific integrity in the relationship between the linguistic matters of the formal sciences and the signified in the natural sciences? The unique characteristics of the formal sciences are stated to "transmute opinion about the base and contingent beings of this world into the necessary knowledge of pure reason", and simplicity is the elegant choice[9]. It is also stated, however, numerical experiments only "confirm to their affinity with pure mathematics", and their affinity with the natural world does not replace the laws of nature[9].

## 5. Conclusions

If physics and astrophysics is about achieving certainty, then rationalities on the uncertain are the prerequisites for discovery. The certainties of Newton's Third Law were uncertain, and it was by the collision experiments the certainties were revealed in the Standard Model (SM) of particle physics. There are, however, still large gaps to truly express Newton's Third Law with the mathematical construct from the SM and non-SM particle physics, yet it does not imply they would not provide better approximations.

The contemporary purpose of (astro-) physics is concentrating on dark energy. The pattern of energy transfer during positron and electron annihilation, apart from the orbital paths of electrons that do not render a symmetric assumption, may be a microscopic clue to the cosmological phenomena[2]. Representing mass with the Bloch Sphere is the current apparatus rationale to bridge the certainties between the quantum realm and Newton's Third Law, and the probability density function to the method of integration is still a valid method not to be taken for granted.

Reexaminations of the causal chain presumptions are the assertions of the research. The exercise of consciousness may be the formal sciences' purpose for natural scientists. What the research has introduced to the natural sciences' scope is the validities of the social sciences' research methods to the former. The objectivity of knowledge is always a sociological construct instead of the subjective epistemology that is absolute in individual scientists.

## Statements and Declarations

### Funding

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### Conflict of Interest

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### Data Availability

No data was used in the research.

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