Physics and Religion: what kind of relation?

NIDHAL GUESSOUM
American University of Sharjah, UAE

In just a few centuries, physics has established itself as the most fundamental and, arguably, the most powerful of all sciences, able to explore and reveal facts at the smallest to largest scales of nature, from quarks to galaxies, and at the shortest to longest times (billions of years and beyond). It has also come up with and established bewildering theories, from quantum mechanics to inflationary cosmology. And with all this, it has largely changed people's view of nature and the universe, perhaps even their 'worldviews', their understanding of their place in the universe. On the other hand, it is difficult to describe religion's trajectory over the last few centuries, even if one can delineate general features of religion, partly due to its huge spectrum of forms as well as the wide variety of beliefs, acts, and codes of behaviour that members and practitioners of various religions adopt. In this paper, I attempt to outline the main characteristics of both physics and religion in order to highlight the similarities or close concepts that can help each learn from the other, but also the ideas or positions that we may find in each and which can sometimes lead to conflict, opposition, and rejection of the other side. In particular, I focus on the concepts of 'truth(s)', 'explanation', 'interpretation', 'reality', 'complementarity', 'humility', and others, dissecting them in an attempt to draw lines of convergence or divergence between physics and religion.

Introduction: Delineating physics and religion first; can they be related at all?

Physics can be defined as the study of material (almost always non-living) objects and their phenomena (including, and especially, changes) and laws (relations between physical factors that describe how the phenomena occur, under what conditions, to what extent, etc.). Laws can be formulated in various ways, empirically (directly from observations and experiments), analytically, semi-analytically, etc.;

they can also be derived (top-down) from higher first principles, or constructed bottom-up (from lower-level laws).

In just a few centuries, physics has established itself as the most fundamental and, arguably, the most powerful of all sciences, able to explore and reveal facts at the smallest to the largest scales of nature, from quarks to galaxies, and at the shortest to the longest times (billions of years and beyond). It has also come up with and established bewildering theories, from quantum mechanics to inflationary cosmology. And with all this, it has largely changed people's view of nature and the universe, perhaps even their 'worldviews', their understanding of their place in the universe.

However, it is important to explore the characteristics of physics: How 'objective' is it (independent of the actor/author's views and ideas)? Is it universal (independent of local culture)? Can the results that it presents be considered 'facts'? Do its theories keep changing, or are any to be considered as 'established'?

Physics, like the rest of (natural) science, is a collective human endeavour to understand the physical world; it *aims* to be (and most scientists insist that it does succeed in being) objective and universal, despite personal and social effects. The two main features that support its striving to be objective and universal are: a) the fact that its claims are based on evidence; b) in establishing results, it relies on independent checks (the peer-review process, despite its shortcomings, and the insistence on falsifiability and repeatability). Still, scientific knowledge (including in physics) is tentative (awaits independent confirmation) and cumulative.

Religion, on the other hand, can be defined as a system of beliefs, rituals or practices (required or recommended), and codes of behavior.

It is (generally) characterised by the following: a) it is usually based on faith in supernatural entities or agents, belief in sacred texts and/or prophets; it gives importance to tradition (ideas and practices that have come down through the ages), and the personal experience of the believer/follower of the religion; b) the sacred texts are sometimes taken literally, but often interpreted metaphorically, and are believed (by the religion's followers and often by others) to contain some wisdom or truths; c) perhaps most importantly, religion aims to give meaning, purpose, value, and a sense of identity to the believer/follower.

Contrary to physics/science, however, it is difficult to describe religion's trajectory over the last few centuries, even if one can delineate general features of religion. Doing that is difficult partly due to the huge spectrum of forms that religions take as well as the wide variety of beliefs, practices, and codes of behavior that members and practitioners of various religions adopt.

Now, physics and religion are sometimes said to be two 'explanatory' approaches to the world. That is because they claim to describe "reality", the 'world', or 'existence', although these terms are (clearly) rather fuzzy and most likely mean different things in the two domains (in physics and in religion). In fact, physics uses different terms for these concepts: physical conditions instead of 'reality'; universe (or the galaxy or the solar system or whatever system) instead of 'world'; and 'state' instead of 'existence'. One does find those fuzzier terms used in philosophical discussions of physics topics (quantum 'world', cosmology, etc.) but then the discourse has shifted from scientific to philosophical and sometimes even theological or at least metaphysical.

Physics and religion also have some essential differences in the methods they adopt and the types of knowledge they present. Religion tends to be traditional (adopting ideas passed on through history), while physics is more 'modern' (i.e., scientific, method- and evidence-based). Religion is more personal, experiential, and subjective, while physics is more collective and objective (removing the individual actor from at least the result). Religion is rather informal (beliefs do not have to be rigorously justified), whereas physics is more formal (methodical). Religion is more intuitive and more readily accepts 'common sense', whereas physics and science insist on testing and establishing any claim methodically and rigorously.

Philosophical issues from physics through history

Physics was for many centuries a branch of philosophy. Until modern times, physics was referred to as 'natural philosophy', at least the part of philosophy that dealt with knowledge (epistemology) and started with logic, the methods of rigorous reasoning.

In antiquity, 'physics', due to the lack of probing instruments, was largely limited to the study of the motions and changes of objects and

their causes. Indeed, the nexus between causes and effects was long a rich source of discourse and debate among philosophers. Aristotle famously divided causes into four types: material causes (what various objects and elements of the phenomenon under consideration are made of), efficient causes (the sources of the changes being observed), formal causes (from 'form' or 'essence', what determines the types of objects taking part in the phenomenon), and final (what the objects are to become, what 'final' state their evolution is to reach, etc.). The last type of 'cause', often described as 'teleological', is the most objected to, modern physics/science rejecting the idea that phenomena have any 'destination' that they are taking objects to, and insisting that initial states and the laws governing those phenomena determine the next/final state (although here one gets into the debates over 'determinism', which I will come back and address briefly later).

In mediaeval times, religion had become a central player in all debates, including those about nature and physics. Natural phenomena were now, at least in the Euro-Asian region (the Judeo-Christian-Islamic world), seen and regarded as God's works. Their regularity and order were highlighted by scriptures (the Bible and the Qur'an) explicitly and repeatedly, and they were considered a prime argument for God's existence and his creation of, and action in, the world.

Perhaps a short detour into physics/science in the Islamic Era can be useful in highlighting this interconnection between theology and natural science in medieval times.[1]

Al-Kindi (801–873 AD), one of the earliest Arab Muslim philosophers, a polymath (physician, mathematician, and music theorist) and early adopter of and subscriber to peripatetic (Aristotelian) philosophy, is perhaps most famous for the Kalam cosmological argument: that there must be a God/Creator, as cause-effect chains cannot go back indefinitely; there must be a 'prime mover' or 'prime initiator' of things.

Ibn Sina/Avicenna (980-1037 AD), one of the greatest philosophers, physicians, and polymaths in Islamic civilisation and even in all of history, introduced subtle but important distinctions between existence and essence. Avicenna insisted that we must look beyond the object's

[1] For a more detailed review of Islam's past and present engagement with science, see Nidhal Guessoum, 'Science, religion, and the quest for knowledge and truth: An Islamic perspective,' *Cultural Studies of Science Education*, 5 no. 1 (2010): 55-69.

movement, to the source of its existence and the 'principle' behind it, i.e. the creator of the world.

Avicenna also insisted that while the world can be eternal (alongside God), it is contingent and not necessary. He also divided creation into 4 different types: *Ihdath*, i.e. creation of nature's entities, both temporary and eternal; *Ibda`*, i.e. creation – without intermediary – of eternal non-decaying creatures; *Khalq*, i.e. creation through other agents; and *Takween* (formation), i.e. creation through worldly, decaying, temporary agents.

Al-Ghazali (1058-1111 AD), one of the greatest theologians in the history of Islam, is perhaps most famous for introducing 'occasionalism', that God re-creates the world at every instant with every particle and every event/phenomena; he thus constantly acts in the world, and regularity in the phenomena, what people describe as (or ascribe to) 'laws' are simply 'God's habits', which he is free to break at any time, what one would then regard as miracles.

To further show the strong connection between physics/science/astronomy in the classical Islamic worldview, we may recall Al-Battani (850-929 AD), a very illustrious astronomer, who wrote: 'By focusing attention, observation, and extensive thought on astronomical phenomena, one is able to prove the unicity of God and to recognize the extent of the Creator's might as well as His wide wisdom and delicate design.'[2]

Likewise, Al-Biruni (973-1050 AD), one of the greatest natural scientists in the Islamic and medieval era, explicitly stated that the motive behind his research in physics and astronomy is the Qur'anic verses: '*Those who reflect on the creation of the heavens and the earth (and say): Our Lord! Thou hast not created this in vain! Glory be to Thee…*' (3:191).

From 1543 onwards, a scientific revolution occurred over two centuries or so, starting with Copernicus's heliocentric hypothesis, which soon was strengthened and supported by Kepler's laws of planetary motion and Galileo's revolutionary observations of the heavens using a telescope, the whole enterprise culminating in Newton's

[2] Muntasir M. Mujahed, *Usus al-Manhaj al-Qur'aniy fi Bahth al-'Ulum al-Tabi'iyyah*" [The bases of the Qur'anic methodology in the study of the natural sciences] 2nd edition (Jeddah: ad-Dar as-Su'udiyya li n-Nashr wa t-Tawzi', 2004), 100.

Principia, which combined laws of motion and of gravity, all described mathematically using calculus.

This new physics later came to be labeled 'Classical' (to Mechanics was added the Electromagnetism of Faraday, Maxwell, and others). Most importantly, as far as our discussion here goes, is the fact that this 'classical physics' was wholly deterministic and naturalistic: the entire world could, in principle, be traced, past to future, cause to effect, using just initial conditions and the laws of physics.

Newton's physics provided, in principle, mathematical descriptions of all earthly and cosmic phenomena, with God needed only for the initial creation and for miracles, if they ever occurred, being seen as violations of the laws and order of the universe.

And with his physical explanations of how the world works, both in the heavens and on earth, Newton allowed others to introduce a 'mechanical universe' that had, in Laplace's famous retort to Napoleon's question, 'no need for the God hypothesis'. In Laplace's physics/mechanics, the precise knowledge of initial conditions and of the laws of the universe allows one (theoretically) to determine its entire future history.

The only thing for which God was still needed was the original act of creation. Naturalism and Deism (God as an initial creator of the universe but not as an actor in it after that) became essential ideas.

This would change with 'Modern Physics': Quantum Mechanics brought in a fundamental randomness and a probabilistic (thus indeterministic) description of (at least) the subatomic world; and Relativity destroyed any absolute, objective characteristics of space, time, energy, and other physical quantities, which then depended on the observer.

Quantum Mechanics has various 'interpretations', i.e. what the results (of calculations and observations) actually represent or mean, but the most famous one is the Copenhagen interpretation (named for the school of physicists, led by the great Niels Bohr, who came up with that interpretation and publicised it). It stipulates that each property of the quantum object is some kind of probability cloud, which has no specific value and evolves through time; however, the act of measurement 'collapses' the cloud into specific states with 'real' physical quantity values.

This random/probabilistic vs. deterministic view of the world led to a famous discussion between Bohr and Einstein, the latter strongly opposing that 'indeterministic' description of the world. As the anecdote goes, over a heated dinner discussion, Einstein told Bohr: 'God does not play dice', to which Bohr replied: 'Albert, don't tell God what He can or cannot do…' As Witham comments on the encounter: 'Einstein operated out of ancient Middle Eastern monotheism, which clashed with Bohr's ancient Asian precepts that defined reality as a godless flux… Thus, no argument by Bohr could persuade Einstein, who could not abandon Spinoza's God.'[3]

Various great physicists later took one side or the other of this debate and adopted various philosophical positions on the thorny question. Heisenberg, in particular, stressed that his uncertainty principle (that some pairs of physical characteristics, e.g. the position and speed of a particle) had allowed for a new acceptance of the 'natural language' of religion. As he put it: 'After the experience of modern physics, our attitude toward concepts like mind or the human soul or life or God will be different from that of the nineteenth century.' [4] Most importantly, Heisenberg realised – and told Bohr – that many people would move to use the new indeterminacy as 'an argument in favor of free will and divine intervention.' [5]Still, others were very cautious; Eddington had remarked to the 'religious reader' of his *New Pathways* in Science book that 'I have not offered him a God revealed by the quantum theory, and therefore liable to be swept away in the next scientific revolution…'[6].

By the late twentieth/early twenty-first century, randomness (both quantum, which is fundamental, and chaotic, which is not fundamental and is only due to our limitedness in knowing things precisely) became an important fixture in physics and other scientific fields as well as in technology. Indeed, randomness was found to be quite ubiquitous and essential in the universe, from galaxy formation to weather and climate. Moreover, Laplace's claim of total determinism was shown to be wrong

[3] Larry Witham, *The Measure of God: Our century-long struggle to reconcile Science and Religion* (San Francisco: Harper San Francisco, 2005), 138.

[4] Werner Heisenberg, *Physics and Beyond. Encounters and Conversation*, trans. A.J. Pomerans (London: G. Allen & Unwin, 1971), 140.

[5] Ibid., 91

[6] Arthur Eddington, *New Pathways in Science - Messenger Lectures, 1934* (Cambridge: Cambridge University Press, 1947), 307.

even for planets in the solar system, which dynamics were found to have some degree of chaos.[7]

This probabilistic vs. deterministic debate and the Bohr-Einstein exchange above best highlight the connections between modern physics (or at least some important topics of it) and theology (most generally, not related to any specific religion).

Lines of divergence and convergence between Physics and Religion

One major and fundamental source of friction (sometimes considered a point of irredeemable divergence) between religion (at least with traditional views) and science (including but not limited to physics) is its methodological naturalism, which excludes any reference to God or any supernatural agents (spirits, angels, etc.) when describing or explaining natural phenomena. I do not believe that this is necessarily a point of rupture and conflict between the two, as philosophers and rational theologians in past centuries (the Mu`tazila rational theology school, Ibn Rushd and other Muslim or non-Muslim philosophers) not only accepted the concepts of 'secondary causes' and laws which rule natural phenomena but saw no conflict between that and their firm belief in God and religion.

When Carl Sagan, the late astronomer and science advocate and populariser, gave the Gifford Lectures, he, a nonbeliever, spoke of the relation between religion and science and described the latter as 'informed worship.'[8] His wife, the author Ann Druyan, who wrote the introduction to the book, noted: 'he never understood why anyone would want to separate science, which is just a way of searching for what is true, from what we hold sacred, which are those truths that inspire love and awe.'[9] She added: 'His argument was not with God but

[7] Jacques Laskar, 'A numerical experiment on the chaotic behaviour of the Solar System', *Nature* 338 (1989): 237–238; 'The chaotic motion of the Solar System. A numerical estimate of the size of the chaotic zones', Icarus 88 (1990): 266–291; 'Is the Solar System stable?' in Chaos, edited by Bertrand Duplantier, Stéphane Nonnenmacher, Vincent Rivasseau (Basel: Birkhäuser, 2013), 239-270.

[8] Carl Sagan, *The varieties of scientific experience: A personal view of the search for God*, edited by Ann Druyan (New York: Penguin, 2007), xiii.

[9] Ibid., xi.

with those who believed that our understanding of the sacred had been completed.'[10]

So we must then ask: is there divergence or convergence, between science (here most valiantly represented by physics) and religion? Indeed, not all scientists and philosophers agree about any great harmony between religion and science. Various possible typologies of relations between the two have been proposed:

i. Ian Barbour, the late physicist and philosopher famously proposed four categories of interaction between science and religion: conflict, independence, dialog, and integration.[11]

ii. John Haught, the contemporary Christian theologian who specialised in issues at the interface of science and religion, has also suggested four different ways: conflict, contrast, contact, and confirmation.[12]

iii. Freeman Dyson, the late famous physicist and wide-ranging thinker, suggested complementarity (with separation) between science and religion, and Stephen J. Gould, the late paleontologist, proposed the NOMA (Non-Overlapping MAgesteria) principle.[13]

iv. John R. Staver, a science education professor, generally summarised the different possible relationships as: cousinly, mutually respectful, non-overlapping, competitive, proximate-ultimate, dominant-subordinate, and opposing-conflicting.[14]

Dyson's complementarity idea is an interesting viewpoint. Borrowing an idea from Niels Bohr, he makes an analogy between the mutual relation of science and religion and the complementarity between the wave and particle natures of light and quantum objects, or between justice and mercy in ethics, form and substance in literature, or thought and feeling in psychology.[15] He insists that complementarity implies total separation, since in physics it is impossible to observe the two aspects simultaneously. However, I must note that a total disconnection between the two is neither necessary nor fruitful. Those who uphold

[10] Sagan, T*he varieties of scientific experience: A personal view of the search for God*, xi.

[11] Ian G. Barbour, *When Science Meets Religion* (San Francisco, CA: Harper, 2000).

[12] John F. Haught, *Science and religion: From conflict to conversation* (Mahwah, N.J.: Paulist Press, 1995).

[13] Freeman J. Dyson, *A many-colored glass: Reflections on the place of life in the universe* (Charlottesville: University of Virginia Press, 2007).

[14] John R. Staver, 'Skepticism, truth as coherence, and constructivist epistemology: grounds for resolving the discord between science and religion?', *Cultural Studies of Science Education* 5, no.1 (2010): 19-39.

[15] Dyson, *A many-colored glass: Reflections on the place of life in the universe*, 2007.

this kind of "independence" (as in Barbour's typology) justify it on grounds of the risk of getting the two fields muddled, such that one will not be able to do either rigorous science or serious religion. This risk is definite and must be watched for, but the solution is not necessarily total disjunction. Still, I think 'complementarity' can perhaps constitute a commonly useful concept for physics/science and religion.

Hard-line scientists, however, refuse any such 'fruitful' interaction but often argue that there is absolutely no need for religion at all, that science is—at least in principle—capable of inducting and ultimately fully explaining any realm of natural or human activity, a position often referred to as 'scientism', with a bad connotation. Conversely, religion sometimes trespasses its bounds into science's territory by presenting (usually through its scriptures, which are held sacred) descriptions and explanations of natural or human phenomena, topics which we now recognise to be the (sole) purview of science, and the latter often providing different explanations than the scriptures. If we are to have a healthy relationship between science and religion, neither should allow itself to invade the other's territory, and where there may be areas where both can say something (e.g. what is 'human'?), the dialog must be proper, with each side presenting what it alone can provide: facts and data from science, meaning and purpose from religion.

Whatever relation or interaction they may or may not have, physics and religion, it must be stressed, have different agendas and methods and speak to different parts of our minds. They use different concepts: 'truth(s)' vs. 'facts', theories vs. beliefs, models vs. organisations or hierarchies, etc. They do share some common vocabulary (e.g. laws and principles) and concepts (e.g. unicity, truth, etc.). Truth (small or capital T), although sometimes used by both, is a rather subjective concept in religion and a contentious one in science.[16] Indeed, when do we consider theories as 'true' and results as 'facts' in science?

Furthermore, science and religion have largely different methods. In physics, 'validation' (of results or theories) is done by using repeatable experiments and peer reviewing of any claim; in mathematics, and sometimes in philosophy, 'proofs' are demonstrated using verifiable rules of logic and previously established theorems and results. In

[16] Guessoum, 'Science, religion, and the quest for knowledge and truth: An Islamic perspective,' 2010.

religion, however, 'arguments' are adopted if they are accepted by the scholars (if they are 'convinced' by them), and they are often regarded as sufficient.

One way that religion and science find some commonality is in the usage of 'explanations' and 'interpretations' of texts (sacred or other, for religion), concepts (unicity, probabilities, randomness, etc.), and data (for science), models and theories (e.g. inflation, many-world quantum mechanics, etc.).

And finally, we should recognise some commonality between religion and science in that both adopt (at least in principle) an attitude of 'humility': we don't know for sure; only God knows; we must be ready to admit error; our results are tentative; etc.

A Proposed Conciliation or Harmonisation

From the above, we can conclude that there are a number of points of 'contact' and potential 'friction' between physics and religion/theology, from methodological naturalism to fundamental randomness (is quantum random fundamental/ontological in nature? did God deliberately build the universe on randomness?). However, we have also seen that physics/science and religion/theology are not necessarily in conflict: one may delineate the areas that each rules (proper, correct description of natural phenomena with laws and parameters vs. proposing existential explanations, meanings, etc.) and the different methods that each employs. The laws of the universe (or secondary causes in the language of medieval philosophers and theologians) could then be seen as 'proxies' for God, operating with regularity through his 'support'. This could indeed be God's subtle way of ruling over the universe.

Most religious people would declare that God did indeed set the world on a rational and ordered basis, making the world behave according to rules/laws and making these reachable and knowable to humans, otherwise he would be a malicious, vicious god. Does he then act in this world; does he then abide by those laws, or is he free to violate them? Two theological views then present themselves (and are adopted by various religious thinkers): either God acts within those rules/laws, perhaps taking advantage of quantum and other bewildering features of

the natural world, or he acts overtly and suspends/violates the laws that he himself had set for the world. The contemporary Muslim theologian Aref Ali Nayed has remarked that although it is true that God is totally free to decide as he wills, this does not mean that He grants Himself unreasonable freedom. After all, he has stated in the Qur'an that 'He has ordained mercy on Himself" (Qur'an 6:12), the key word being 'ordained'. I may add that in a famous *hadith qudsi* (a non-Qur'anic divine pronouncement) He tells humans: 'I have prohibited injustice on Myself.' By analogy, Nayed concludes: 'Reason need not be above God and externally normative to Him. It can be a grace of God that is normative because of God's own free commitment to acting consistently with it.'[17]

My view is that physics and science must be considered neutral and independent of theology and religion; they have their own (naturalistic) methodology, which allows them to establish results with objective and universal standards as much as feasible. However, religious believers may add a theistic 'envelope' both without loss of rigor and with gains in meaning, ethic, and general worldview. To paraphrase Dyson, science and religion can avoid conflict and be positive engines in humanity's growth if science can accept to give up its imperialistic dreams and if religion can accept to be less 'dogmatic' and more open to contributions from other fields of knowledge (science, arts, etc.).

To close this section, I may recall how Carl Sagan insisted that science's rigorous methodology forces us to remain honest against our tendencies to deceive ourselves; this he referred to as 'the height of spiritual discipline'[18]. In the same mutually respectful and enriching vein, Dyson quotes the novelist Madeleine L'Engle: "When I try to find twenty-first century mystics, to help me in my own search for meditation and contemplation, I turn to the cellular biologists and astrophysicists, for they are dealing with the nature of being itself, and their questions are theological ones: What is the nature of time? of creation? of life?'[19]

[17] Aref Ali Nayed, 'A Muslim's commentary on Benedict XVI's Regensburg lecture', *Islamica Magazine*, 18(2006): 46–54; 51.
[18] Sagan, *The varieties of scientific experience: A personal view of the search for God*, xi.
[19] Dyson, *A many-colored glass: Reflections on the place of life in the universe*, 144.

Summary and Conclusion

To sum up and conclude, I must stress that it is first important to clearly understand the different natures and domains of action of physics/science and religion.

Physics/science and religion have two largely different purviews. The first aims to describe/explain natural phenomena, how they happen, under which conditions and laws, what those imply; etc. The second proposes existential explanations: why are we here, why is there a universe, where did it come from, do phenomena and events have any meaning or is the whole thing 'pointless', etc. In his 'reflections' book, Freeman Dyson describes religion as 'an essential part of the human condition, more deeply rooted and more widely shared than science.[20]

However, confusions and trespasses sometimes occur when science and religion attempt to address questions that are not part of their domains; for example, scientists insisting that there is no God, or theologians insisting that humans did not evolve from lower-level species, and such. The first principle that one must insist on is the importance of respecting each other's purviews.

The second idea that I tried to bring out and highlight is the possibility and benefit of dialogue and complementarity between the two spheres, while still insisting on the proper conditions that must be upheld, namely that the fundamental mechanisms of science must not be corrupted or even negotiated and that the dialogue must be positive, constructive, and intending to be mutually enriching.

One such area of dialogue and complementarity is 'randomness', which is widespread and diverse in the universe and takes two different forms: fundamental (the quantum type) and epistemic (due to our limited capabilities in measuring and specifying parameters). Interestingly, randomness is found to be not without some underlying order or probabilistic-statistical pattern. Indeed, randomness not only follows simple, elegant laws and produces beautiful order, but in fact was necessary for differentials to occur in nature and varieties to emerge. Without quantum fluctuations, the universe would have been utterly homogeneous, and complex structures (galaxies, stars, planets, etc.)

[20] Dyson, *A many-colored glass: Reflections on the place of life in the universe*, 131.

would not have formed. This brings up a very interesting discussion about this relates to God, the creator of the universe.

In earlier times, randomness used to be thought of as God's way of hiding his plans, and many cultures practiced cleromancy, casting lots by throwing dice or bones with symbols to try to 'uncover' divine plans or get divine hints. More recently, and with the realisation that randomness plays important roles in various areas, from cosmology to biology, a number of authors have insisted that randomness strongly conflicts with divine providence. For instance, Robert Charles Sproul wrote: 'The mere existence of chance is enough to rip God from his cosmic throne. … If chance exists in its frailest possible form, God is finished.'[21] Similarly, Benedikt Paul Göcke, reviewing randomness in cosmology and biology formulated an 'Argument [against the existence of God] from Chance and Randomness': 'If there is a random state of affairs in the universe, then God does not know that his providential plans are fulfilled.'[22]

But this antagonism and conflict are not a necessary, logical outcome of the existence of randomness in the universe. First, as I have noted, complexity and richness of the natural world would not have been possible without randomness, or at least the latter made the former possible. Furthermore, we have found some mathematical order underlying randomness; could God's plan be built on probabilities and statistics? Furthermore, some have argued that true randomness, as we have learned from computer science, is beyond humans' capabilities (our random number generators are actually based on deterministic formulas or algorithms), and if true randomness really exists in the world, then it actually points to an 'infinite mind'. In an essay titled 'God is Random: A Novel Argument for the Existence of God', Serkan Zorba writes: 'I will propound the idea that the epistemic cost of unpredictable randomness is infinite intelligence, and thereby present a new a posteriori argument for the existence of God from the irreducible randomness of the quantum world.'[23]

[21] R. C. Sproul, *Not a Chance: The Myth of Chance in Modern Science and Cosmology* (Grand Rapids: Baker Books, 1994).

[22] B. P. Göcke, 'Did god know it? God's relation to a world of chance and randomness', *International Journal for Philosophy of Religion* 78 (2015): 233–254.

[23] Serkan Zorba, 'God is Random: A Novel Argument for the Existence of God' *European Journal of Science and Theology* 12, no.1 (2016): 51-67; 51.

To conclude, a harmonious, complementary relationship is possible between physics/science and religion, provided that physicists/scientists resist reductionism and scientism and the claim that science—and only science—can answer all questions pertaining to the world, the cosmos, and existence, and provided that religious thinkers tone down dogmatic and imperialistic tendencies (claims that religion applies to all areas of life and knowledge).