

UNITED WISDOM

Emptiness in Physics and Philosophy

World and Consciousness

Andrey Zarinsh & Maria Evilkut

W-15-N03 · EN

@andrey.zarinsh @ilkutki

Emptiness in Physics and Philosophy

Epigraph

> *Whatever is dependently co-arisen That is explained to be emptiness.*

Nāgārjuna, Fundamental Verses of the Middle Way, XXIV.18, first two lines. Jay L. Garfield's English translation, 1995, based on a Tibetan translation of the Sanskrit text. The Russian version is this article author's translation of Garfield's English.

What this article is about

The word “emptiness” travels easily between subjects. An empty cup, a vacuum in an accelerator, a quantum system's ground state and Buddhist emptiness can begin to sound like different names for one discovery. Each description, however, answers its own question: what is absent, relative to what is a state minimal, and does something exist independently of conditions? We will separate these questions, work through two small calculations and read a philosophical argument in its own setting. We can then compare ways of reasoning while preserving the differences between measurement, model and interpretation. This gives each concept a clear role: an engineering vacuum helps manage particle collisions, an oscillator model specifies energy levels, and Nāgārjuna's emptiness concerns dependence and existence. A similar word in translation does not by itself turn any one of these meanings into a universal key to the others.

I. Empty of what?

Imagine a cup left on the table after breakfast. Someone says, “It is empty.” Another person understands that the drink is gone. The cup nevertheless retains its walls, mass, shape and place on the table. Removing the air would change the question, without making the object disappear. Calling the cup empty in a philosophical sense would require yet another explanation: are we discussing the drink, particles inside it, or the object's independent existence? One object allows several descriptions of absence. They do not compete when their subjects are clear. Confusion begins when an answer to one question quietly becomes an answer to every other question, although each assertion still needs its own stated means of assessment.

Consider another invented example: a reading room after closing time. There are no visitors, but books, furniture, a timetable and conditions for future access remain. “The room is empty” describes people's absence now. “The room is available” concerns a possibility under specified conditions. “The room is useless” would require a separate argument about its

@andrey.zarinsh @ilkutki

purpose. The absence of visitors provides no such argument on its own. These sentences distinguish a physical situation, an organisational possibility and an evaluation. They suggest a useful starting discipline: name what is absent, then identify what the assertion leaves intact. The example proves neither physics nor Buddhist philosophy; it reveals the structure of an ordinary sentence from which confusion can grow.

Three questions sharpen the description: where is the absence being considered, what is absent, and under what conditions has that been established? “There is no water inside this vessel on inspection” differs from “There are no field excitations in this model.” The vessel, the model and the inspection are substantive parts of these statements. They limit the inference without weakening the claim. A statement with clear conditions is easier to assess and apply to a particular task. “There is nothing,” by contrast, sounds exceptionally strong but can leave even the subject of disagreement unclear. A discussion of emptiness therefore begins by identifying the question to be answered, before reaching for the most impressive picture of reality.

II. A vacuum that must be maintained

CERN's official engineering account connects vacuum with different tasks in an installation. Along the beam path, reducing gas reduces collisions with its molecules. In insulating systems, vacuum helps reduce heat entering the system. The shared term preserves these different purposes: the quality of the state is assessed against the relevant system's requirements. The technically useful question is therefore more specific than “Is it empty inside?” It asks what residual pressure has been achieved and whether it suits the function. The state has characteristics, maintenance conditions and a purpose. This differs from the empty breakfast cup, for which someone usually needs to know whether a drink remains, without numerically measuring the residual gas.

The same account gives beam vacuum pressures on the order of ten to the minus ten to minus eleven millibar. These are figures reported by a particular source about an engineering system, rather than new measurements made for this article. A very small number is not mathematical zero. For a simple invented example, take two pressures: p and p divided by a million. The second is a million times smaller, but that relationship does not establish the complete absence of matter. A ratio answers a question about quantities; absolute absence would need a different basis. In a demanding technical task, the difference between “very little” and “none at all” can become especially significant.

Engineering emptiness is thus achieved by working with conditions. The account we read discusses residual gas, pumps, coatings and cooling. The important relationship is that the desired state is produced and maintained by an arrangement, rather than by renaming space “nothing.” Walls, materials, temperature and the task remain part of the description even when

there is very little gas. We are not reproducing a construction procedure, but can notice that an account of absence also says much about the arrangement that is present. Turning engineering vacuum into an image of complete independence from its surroundings removes the very conditions that give the concept an assessable meaning and enable it to serve its purpose.

III. A minimum state still belongs to a system

Turning to quantum physics requires a new question. In R. L. Jaffe's theoretical discussion, excitations are considered relative to a vacuum state. This concerns a quantum system's description, rather than simply pumping gas out of a vessel. The absence of specified excitations does not abolish the model, its fields or its calculation rules. We cannot therefore imagine an engineering chamber, remove a few more molecules and conclude that we have disclosed everything about the quantum vacuum. Engineering pressure and a state within a theoretical description address different questions. Holding the statement together with the system that defines it is enough to begin understanding this distinction, without immediately constructing one comprehensive metaphysical picture.

The word “minimum” requires us to say what is being ordered and under which constraints. The lowest shelf in a cupboard is still above the floor; the lowest price among offers does not make an item free. These are ordinary analogies about relations, rather than models of quantum motion. They expose a logical step: a minimum within a specified set is not the absence of every quantity. A physical calculation also requires the allowed states, an expression for energy and the chosen reference. Without those details, “the lowest state” supplies no numerical answer. The oscillator will provide a concrete example that we can examine step by step instead of appealing to the mysterious associations of “quantum.”

It is particularly easy to confuse the absence of excitations with the absence of every possible characteristic. Once a state is defined within a theory, its properties are established through that theory and compared with suitable observations. The everyday meaning of an empty place cannot settle those questions. The reverse mistake is also possible: interesting properties of a minimum state are taken to support any story about emptiness. Additional steps still lie between the specified system and that story, and need to be stated and justified. A useful explanation can retain a precise question about a particular state, its properties and the limits of the inference actually warranted by a calculation, without first choosing an all-encompassing slogan.

IV. Half a unit and the energy reference

Allan Adams's lecture on the quantum harmonic oscillator gives the energy levels as $E_n = \hbar\omega(n + 1/2)$, where n takes the values zero, one, two and so on. Here ħ is Planck's constant divided by two pi, and ω is the model's angular frequency. It is convenient to express energy in units of ħω. Substituting n = 0 gives 0.5. For n = 1 we obtain 1.5, and for n = 2, 2.5. The gap between adjacent levels is one chosen unit. These numbers follow directly from the formula. We do not need to turn the oscillator into a symbol of the universe or add an assumption about a human observer.

The ground-state energy here is measured above the bottom of the specified potential well. In our teaching example, let us change the energy reference by adding seven units to every value. The first two numbers become 7.5 and 8.5, but the gap remains one. We have changed the reference, rather than the calculated transition between levels. This does not make every physical question about absolute energy meaningless. The result is narrower: a constant shift of all the levels preserves their differences in this example. Other problems, including energy's relationship with gravity, require their appropriate models and arguments. They cannot be settled by renaming zero in this short teaching sequence of numbers.

Nonzero ground-state energy also does not license a drawing of a particle necessarily moving back and forth along a classical trajectory. The lecture distinguishes stationary states from the classical picture of oscillation. The level formula describes the model's energy structure; it is not a frame from a little ball's motion. Nor does it establish a practical way to extract free energy: we have calculated levels and a gap, rather than built a mechanism for obtaining work. Precision means retaining that scale of explanation. One calculation can show why a minimum need not be numerical zero relative to the specified bottom. It cannot replace every question about fields, materials, observations and physical processes.

V. Force, separation and ideal plates

The Casimir effect supplies another concrete example. Jaffe's paper gives an expression for force per unit area between ideal parallel conducting plates. Its magnitude is proportional to the inverse fourth power of their separation d. The sign specifies the interaction's direction in this model; for our calculation, we need only the magnitude. Replacing d with d/2 puts (d/2) to the fourth power in the denominator, which is d to the fourth power divided by sixteen. The magnitude of force per unit area therefore increases sixteenfold. This is a deduction from the chosen dependence, rather than an experiment we have performed with actual plates or a promise about any material whatsoever.

The ideal model's conditions do substantive work. Jaffe discusses the limit of perfect conductivity and the role of material properties. The geometry is specified too: parallel plates

cannot simply be replaced by arbitrary objects with a small distance between them. The calculated factor of sixteen must therefore remain attached to those conditions. Changing them requires establishing an appropriate expression again, rather than mechanically inserting a new size into the old formula. The paper also discusses a different model problem, which would be misleading to mix with the electromagnetic plate result. The physical object and the assumptions determine the mathematical dependence we can use and the particular situation it can explain.

This example separates three steps: a system is specified, an expression is obtained, and a numerical deduction is made under its conditions. A phrase such as “the force of emptiness” skips those details and offers a ready-made image. The image may interest a reader, but does little to explain the fourth power of separation or the formula's domain of use. Restoring the plates, conductivity, geometry and quantity per unit area makes the subject less mysterious and more precise. Wonder can remain, now attached to a particular result. It need not act as evidence that every other conception of emptiness has already received physical confirmation simply because the result is surprising.

VI. An observation and its explanation

Jaffe asks a limited theoretical question: must a calculation of Casimir force refer to zero point energies? In the portions read for this article, he considers another formulation of the calculation and the conditions of the usual ideal result. This distinguishes the existence of a phenomenon from the necessity of one account of its origin. If another route reaches a calculated result, that result alone does not select a unique interpretation. This neither makes every explanation equal nor makes an observation uninformative. It calls for a separate examination of the additional arguments that favour a description, and of the particular question the formulations can resolve within the theory under discussion.

Imagine a discussion of two calculations yielding the same number for a specified quantity. One participant says, “Because the number agrees with the measurement, every sentence in the accompanying story is true.” Another asks which sentences were needed to obtain the number and which were added afterwards. That question sharpens the assessment of the result rather than destroying it. Agreement can support a calculation under the conditions examined, without testing every broader claim associated with it. Other tasks, observations or analyses of assumptions may help choose between accounts. This example concerns an inference's structure. It does not establish that any two physical descriptions are equivalent or replace a separate examination of their mathematical validity.

Jaffe's conclusion leaves deeper questions open. We do not read his limited argument as declaring quantum theory false or removing every meaning of vacuum fluctuations. Nor do we adopt cosmological estimates in a 2005 paper as measurements of the present day. This

source contributes something more specific: it demonstrates how a theoretical claim can be separated from an expanded metaphysical conclusion. Even within physics, a formula, material conditions and a general account of nature remain distinct. There is still more reason to avoid carrying a conclusion about possible calculation directly into a philosophical tradition that forms its questions and arguments through different means. The boundary is part of understanding the claim, rather than a reason to abandon it.

VII. What philosophical emptiness denies

Nāgārjuna's twenty-fourth chapter begins with an objection. An opponent attributes consequences to emptiness that would undermine the Buddhist path itself. The opening verses therefore cannot be read as a simple statement of the author's position. Nāgārjuna's reply connects the error with misunderstanding emptiness, its purpose and meaning. This matters to a reader: the chapter contains different voices, and the argument's sequence helps identify the speaker. Taking an opening objection out of the exchange can reverse its meaning. Our reading relies on Garfield's translation and commentary. It claims neither an independent comparison with Sanskrit nor a presentation of all Buddhist schools, and keeps the selected chapter's argumentative setting visible.

Verses sixteen to nineteen address the relationship between dependence and emptiness. The absence at issue is that of an independent inherent existence, rather than molecules removed from space. Something does not become nonexistent simply because its arising, designation and description depend on conditions. We can trace several relationships in our cup: material, manufacture, use and name. This example does not prove a philosophical proposition about everything, but helps us understand the question: what would it mean to regard the object as entirely independent of the relationships in which it appears and is determined? That question differs from the amount of gas inside the same cup, and calls for a different kind of argument.

Verse eighteen relates dependent arising to emptiness. In the surrounding commentary, Garfield warns against making emptiness a separate, inherently existing realm. Otherwise, denying an independent essence produces a new essence named “Emptiness,” reinstating the pattern being examined critically. There is no reservoir of a special substance from which we might obtain objects or personal powers. The subject is a philosophical examination of existence and designation. A helpful question is thus more specific than “Where is emptiness?”, as though it were another hidden substance. It asks which independent existence was asserted and why the object's conditions prevent us from accepting that assertion without further argument. This keeps the inquiry attached to its actual subject.

VIII. Convention that makes discussion possible

Verses eight to ten distinguish two levels of truth and stress the role of ordinary language. In the selected translation and commentary, this belongs to a Buddhist philosophical and religious setting. It does not establish that any sentence can arbitrarily be declared true. Ordinary descriptions are needed for discussion, action and explanation; critically examining independent existence does not abolish them with a gesture. The reading-room example helps preserve a distinction: a timetable may depend on people's decisions, but a visitor can still be mistaken about opening time under the established arrangement. The rule's dependence does not make every arbitrary entry equally usable for gaining access to the room.

A timetable's conventional character is nevertheless not identical to the philosophical distinction between two truths. The example only shows why dependence need not imply meaninglessness. An arrangement can function when its conditions of use are known, while changing those conditions may require changing its description. The philosophical text pursues a deeper question about existence and the Buddhist path's purpose. Preserving that depth means giving the teaching more content than the slogan “Everything is relative.” Such a slogan erases distinctions between a supported report, a mistake and a convenient invention. A substantive reading retains the particular dependence: what the subject depends upon, how its designation is grounded, and what the criticism of independent essence actually warrants.

Garfield's preface also establishes the translation's route: the English version draws on a Tibetan translation of the Sanskrit work. This does not automatically make it unusable, but identifies the reading offered. The translator states his philosophical approach and distinguishes translation from commentary. We therefore name the edition, identify the Russian fragment as a translation of his English, and keep Nāgārjuna's verse distinct from Garfield's explanation. These details make the interpretive steps traceable. They also remind us that the comparison concerns a particular philosophical reading and specified scientific texts, rather than two homogeneous collections labelled “the East” and “modern science.” The route to each claim remains available for a reader to examine.

IX. A similar question with different answers

The first useful comparison concerns conditions. An engineer specifies residual gas and the purpose of the vacuum. A theorist specifies plate materials and geometry. A philosopher examines the dependence of existence and designation. In all three cases, restoring conditions can reveal what a short sentence omitted. Similarity in that operation, however, does not establish the same object or result. A formula's dependence on idealisation is assessed mathematically and physically; an assertion about things' inherent nature is discussed through philosophical argument. The comparison offers a more precise question without merging the standards of support. It can therefore remain substantive even when a reader does not accept one of the interpretations being compared.

The second comparison concerns an unwarranted extension. For Jaffe, an alternative calculation does not erase every quantum phenomenon. For Nāgārjuna, the absence of independent essence is not a simple denial of everything that exists. We can compare these limits as ways of examining the move from an initial assertion to an attributed consequence. The source, argument and disputed subject still differ. A scientific paper does not validate a religious purpose; a philosophical verse does not derive the force between plates. Keeping this distinction gives comparison a clear function: detecting an excessive inference in a particular sentence. It requires no declaration that an ancient author had already formulated quantum theory in contemporary language.

The third comparison concerns zero. In the oscillator example, we changed the energy reference while preserving level differences. In the philosophical reading, questioning an inherently existing object preserved the possibility of ordinary description. Both prompt a question about what remains significant after an account's basis is clarified. Their answers differ: an energy gap is a specific calculable quantity, while ordinary designation is examined through a different argument. Treating them as identical would turn a useful example into confusion. A good comparison ends by naming a distinction that cannot be removed. This leaves its subjects sufficiently definite for us to discuss a resemblance, rather than simply admire an attractive image with no clear implications.

X. What precise distinctions contribute

We can now return to the phrase “Emptiness is full of possibilities” and ask what it means. If it concerns free time in a timetable, the possibility depends on time and access. If it concerns engineering vacuum, the physical task must be specified. If it concerns a ground-state model, the system and property of interest must be named. If it concerns Nāgārjuna, dependence, designation and philosophical context require discussion. One slogan can conceal four different conversations. Clarification preserves the image's expressive role while revealing where a separate argument, calculation or reading of a particular text becomes necessary. The word alone cannot do all of that work on its own.

“Science has proved emptiness” can be assessed in the same way. Which experiment is meant? What proposition did it test? What step carried its result to a claim about the absence of inherent existence? If those links are missing, the strong word “proved” cannot supply them. “Philosophy has explained the vacuum” requires the corresponding work: what physical result has been obtained, and how were the model's conditions accounted for? This article offers numerical examples and a historical argument, without turning them into one experimental proof. That is an honest boundary for comparison. It leaves room to think about concepts while keeping an open question from being replaced by a ceremonial conclusion.

The conversation can reach a modest but substantive result: absence should be described together with its subject, conditions and warranted inference. Vacuum can be an engineering achievement, a ground state part of a mathematical structure, and emptiness a philosophical response to questions about independence. Each meaning has strength when its task is preserved. Comparing them can make an omitted condition, unnamed reference or excessive consequence easier to identify. Further disagreement then becomes more concrete. People can discuss a particular formula or assertion instead of granting one familiar word authority to settle physics, philosophy and questions about human life for which this article has supplied neither a study nor a promised solution.

What this means in practice

Choose one sentence about emptiness, zero or nothing that you would like to understand more precisely. It can come from a text, without involving personal experiences. Beside it, write the subject, the absent property, the conditions and the basis for the conclusion. Then formulate another statement that does not follow from it. For example, “There are no visitors in the room now” does not mean “Nobody needs the room anymore.” If you want to calculate, substitute n = 0 and n = 1 into the oscillator formula, add the same number to both results and compare the gaps. For the plates, state the ideal model's conditions before calculating the factor of sixteen. Finally, read the first pair of comparisons below and try to name the distinction it preserves. This is an optional exercise with concepts and inferences, rather than a way to obtain energy, change the body or confirm a philosophical teaching experimentally. You can stop after one sentence. The aim is a more definite question for which an appropriate answer can then be sought.

Key quotation

> *Casimir forces can be computed without reference to zero point energies.*

R. L. Jaffe, The Casimir Effect and the Quantum Vacuum, abstract, 2005. Exact clause from a longer sentence. The Russian rendering is this article author's translation of the original English. The subject is a formulation of calculation, rather than a denial of quantum physics as a whole.

Connections between traditions

1. Specify what is absent. CERN describes residual gas and pressure in a maintained vacuum; Nāgārjuna's XXIV.16–18 examines the absence of independent inherent nature. In both cases, specifying the absent property prevents the inference that everything has disappeared. Comparison restores the statement's subject. Gas quantity is a physical characteristic, however, while independent existence is examined philosophically; measuring the first does not establish the second.

2. Name a description's basis. Adams's oscillator levels are measured above a specified bottom, and their gaps survive a constant shift. In XXIV.8–10, Nāgārjuna preserves ordinary language's significance while distinguishing levels of truth. Both moves expose conditions for a meaningful assertion. An energy reference is nevertheless not Buddhist conventional truth, and a mathematical operation does not confirm the religious argument.

3. Restore hidden conditions. Jaffe examines materials and the perfect-conductor limit; in XXIV.16–18, dependence challenges the picture of an inherently existing object. Comparison

asks which conditions disappeared from an excessively short description. A physical calculation's dependence on material does not, however, experimentally prove a universal philosophical proposition or derive it automatically.

4. Absence does not erase every property. Adams's ground state has specified energy above the well bottom; Jaffe considers excitations relative to the vacuum. XXIV.18–19 connects emptiness with dependent arising rather than simple destruction of what is described. This pairing clarifies a negation's meaning. A ground state does not become a physical container for Buddhist emptiness: the conceptual systems retain different subjects.

5. Check an added consequence. Jaffe shows that the Casimir effect alone does not establish a unique interpretation of calculation; in XXIV.7, Nāgārjuna addresses an opponent's misunderstanding. Comparison separates the initial proposition from a stronger consequence attributed to it. Theoretical physics and philosophical rebuttal employ different standards of support; similar scrutiny of inference does not make their results proofs of each other.

6. Preserve a question's purpose. CERN distinguishes beam and insulating vacuums; XXIV.10 and the selected commentary place the philosophical distinction within the Buddhist path. Stating a purpose shows why one word can do different work. Engineering purpose is not religious purpose, and comparison establishes no effects of meditation, treatment or personal transformation.

Primary sources

1. Nāgārjuna; Jay L. Garfield, translation and commentary. The Fundamental Wisdom of the Middle Way, chapter XXIV, Oxford University Press, 1995. Verses 1–19 and surrounding commentary, printed pages 293–306, were read; the edition's preface establishes the translation route and philosophical approach. The epigraph contains the first two lines of XXIV.18, page 304. English is translated through Tibetan; the Russian rendering is the article author's. The rest of the chapter and the Sanskrit and Tibetan originals were not compared; commentary remains distinct from the verses.

2. CERN. A vacuum as empty as interstellar space. The complete engineering explanation of vacuum systems, their purposes and residual pressure was read. No individual author or displayed date was established. Pressure orders belong to this account, rather than a new measurement. The source is not a theory of the quantum vacuum.

3. R. L. Jaffe. The Casimir Effect and the Quantum Vacuum, version 1, 21 March 2005, MIT-CTP-3614. The abstract, opening argument, ideal-model conditions, selected later discussion and complete conclusion were read. The middle portion and underlying experimental papers were not read. Equation 3, the question's limits and the abstract clause

are used. This is a theoretical discussion of formulations, without adopting dated cosmological estimates as present data.

4. Allan Adams. Lecture 8: Quantum Harmonic Oscillator: Brute Force Methods, MIT 8.04, 5 March 2013. The entire lecture was read. The distinction between a stationary state and a classical trajectory, and equations 0.30–0.31 on page 9, are used. This is a teaching derivation for an oscillator. The whole course, books and videos were not read; these equations are not presented as a universal theory of all fields.

Tags

emptiness, Buddhist emptiness, vacuum, quantum vacuum, physics, philosophy, Nagarjuna, Madhyamaka, Garfield, dependent arising, inherent nature, conventional truth, language, interpretation, model, measurement, CERN, residual pressure, oscillator, ground state, energy, reference point, Casimir effect, conductivity, idealisation, conditions, scientific explanation, limits of inference, comparison, primary sources

About the authors

Andrey Zarinsh is the author and founder of United Wisdom. He explores inner transformation, the unity of traditions, intercultural dialogue, and contemporary spiritual discipline. Instagram: @andrey.zarinsh.

Maria Evilkut is a co-author of United Wisdom. Alongside her research, she seeks to test these ideas in practice and observe how principles of unity and mutual understanding work in real life between people and cultures. Instagram: @ilkutki.