Why Physics needs Ontology

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3. physics needs no philosophy
4. philosophy needs physics
5. there are exceptions to the above propositions
6. I am a physicist and not an exception

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- *What I dislike in this kind of argumentation is the basic positivistic attitude, which from my point of view is untenable, and which seems to me to come to the same thing as Berkeley's principle, esse est percipi. "Being" is always something which is mentally constructed by us, that is, something which we freely posit (in the logical sense). The justification of such constructs does not lie in their derivation from what is given by the senses. Such a type of derivation (in the sense of logical deducibility) is nowhere to be had, not even in the domain of pre-scientific thinking...*
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  A. Einstein: Albert Einstein: Philosopher-Scientist (1949)
- *..What this all boils down to is the eternally problematical connection between the world of ideas and that which can be experienced (immediate experiences of the senses)*
  A. Einstein, Letters to Solovine. 1906-1955,

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The debate between sense-experiences and “stuff“ coming from pure thought has been around since millenniums

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- Parmenides ~ 550 BC in his Poem on Nature[1]:
  It needs must be that what can be spoken and thought is; for it is possible for it to be, and it is not possible for what is nothing to be.This is what I bid thee ponder.
  One path only is left for us to speak of, namely, that It is. In this path are very many tokens that what is is uncreated and indestructible; for it is complete, immovable, and without end. Nor was it ever, nor will it be; for now it is, all at once, a continuous one.

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Herakleitos (after Parmenides)[2]: the external “IT IS“ moves according to a law

[2] Burnet translation, Bywater's Fragment ordering

Herakleitos (after Parmenides)[2]: the external "IT IS" moves according to a law

- *(4) Eyes and ears are bad witnesses to men if they have souls that understand not their language.*
  (91a) Thought is common to all.
  (91b) Those who speak with understanding must hold fast to what is common to all as a city holds fast to its law, and even more strongly. For all human laws are fed by the one divine law. It prevails as much as it will, and suffices for all things with something to spare.
  (95) The waking have one common world, but the sleeping turn aside each into a world of his own.

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- Platon in TIMAIOS constructs in a "theory about the cosmos" the geometric mean between the primitive ontology Fire and Earth, requiring thus further ontological elements: Air and Water

$$F : A = A : W = W : E$$

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Anaxagoras: Atomism ~ 460 BC

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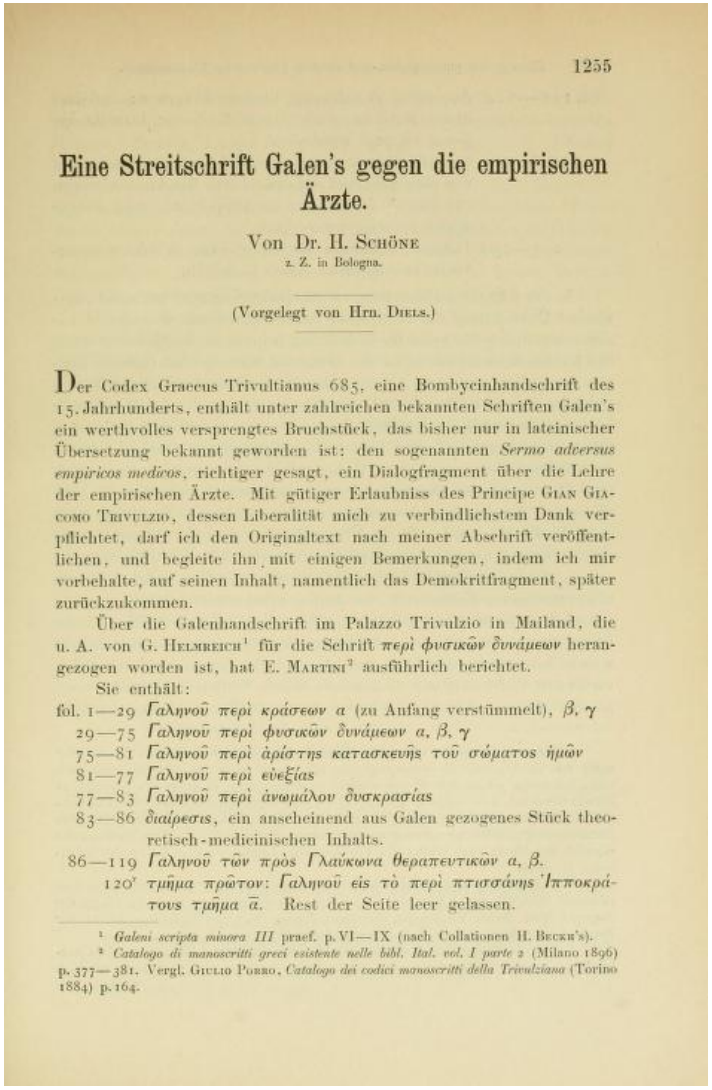
- Anaxagoras’ Methodology:
  From the weakness of our senses we are not able to judge the truth. What appears is a vision of the unseen.

Sitzung der philosophisch - historischen Classe vom 12. Dezember 1901



1255

Eine Streitschrift Galen's gegen die empirischen Ärzte.

Von Dr. H. Schöne
z. Z. in Bologna.

(Vorgelegt von Hrn. Diels.)

Der Codex Graecus Trivultianus 685, eine Bombycinhandschrift des 15. Jahrhunderts, enthält unter zahlreichen bekannten Schriften Galen's ein werthvolles versprengtes Bruchstück, das bisher nur in lateinischer Übersetzung bekannt geworden ist: den sogenannten *Sermo adversus empiricos medicos*, richtiger gesagt, ein Dialogfragment über die Lehre der empirischen Ärzte. Mit gütiger Erlaubniss des Principe Gian Giacomo Trivulzio, dessen Liberalität mich zu verbindlichstem Dank verpflichtet, darf ich den Originaltext nach meiner Abschrift veröffentlichen, und begleite ihn mit einigen Bemerkungen, indem ich mir vorbehalte, auf seinen Inhalt, namentlich das Demokritfragment, später zurückzukommen.

Über die Galenhandschrift im Palazzo Trivulzio in Mailand, die u. A. von G. Helmreich[1] für die Schrift *περὶ φυσικῶν δυνάμεων* herangezogen worden ist, hat E. Martini[2] ausführlich berichtet.

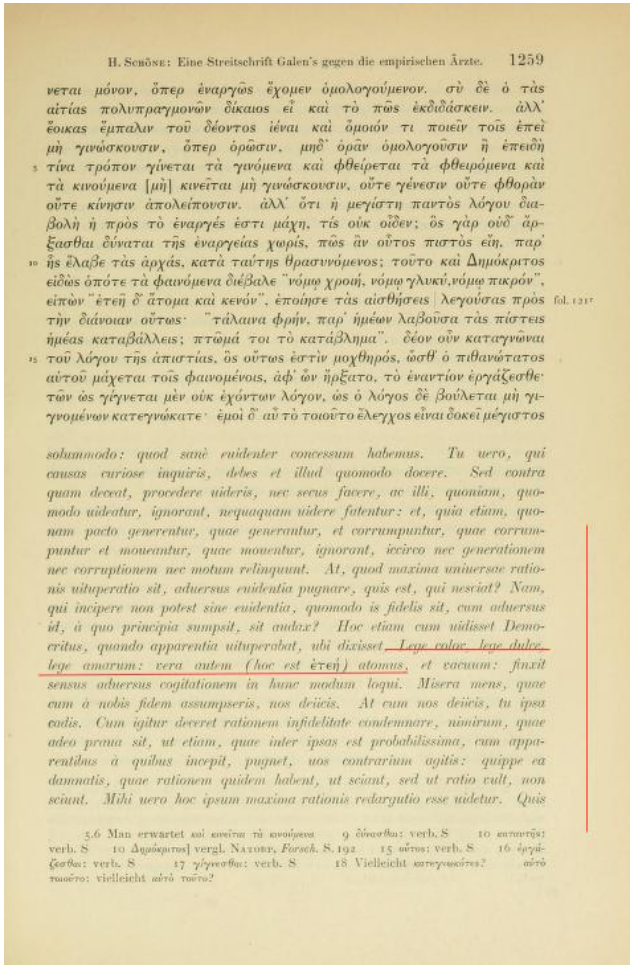
Sie enthält:

fol. 1—29 *Γαληνοῦ περὶ κράσεων α* (zu Anfang verstümmelt), *β, γ*
29—75 *Γαληνοῦ περὶ φυσικῶν δυνάμεων α, β, γ*
75—81 *Γαληνοῦ περὶ ἀρίστης κατασκευῆς τοῦ σώματος ἡμῶν*
81—77 *Γαληνοῦ περὶ εὐεξίας*
77—83 *Γαληνοῦ περὶ ἀνωμάλου δυσκρασίας*
83—86 *διαίρεσις*, ein anscheinend aus Galen gezogenes Stück theoretisch-medicinischen Inhalts.
86—119 *Γαληνοῦ τῶν πρὸς Γλαύκωνα θεραπευτικῶν α, β.*
120' *τμῆμα πρῶτον: Γαληνοῦ εἰς τὸ περὶ πτισσάνης Ἱπποκράτους τμῆμα ᾱ.* Rest der Seite leer gelassen.

[1] *Galeni scripta minora III* praef. p. VI—IX (nach Collationen H. Beckh's).
[2] *Catalogo di manoscritti greci esistente nelle bibl. Ital. vol. I parte 2* (Milano 1896) p. 377—381. Vergl. Giulio Porro, *Catalogo dei codici manoscritti della Trivulziana* (Torino 1884) p. 164.

A polemic by Galen (*Galenus ~ 200 AD*) against empirical medical doctors
by Dr. H. Schoene
The codex Graecus Trivultianus 685...of 15th century contains among many known writings of Galen a valuable lost piece... the sermo adversus empiricos medicos, a fragment of a dialogue....and I shall turn later to its content, namely the dialogue of Democritus...

The Dialogue: Democritus ~ 420 BC



H. Schöne: Eine Streitschrift Galen's gegen die empirischen Ärzte. 1259

νεται μόνον, ὅπερ ἐναργῶς ἔχομεν ὁμολογούμενον. σὺ δὲ ὁ τὰς αἰτίας πολυπραγμονῶν δίκαιος εἶ καὶ τὸ πῶς ἐκδιδάσκειν. ἀλλ' ἔοικας ἔμπαλιν τοῦ δέοντος ἰέναι καὶ ὁμοίόν τι ποιεῖν τοῖς ἐπεὶ μὴ γινώσκουσιν, ὅπερ ὁρῶσιν, μηδ' ὁρᾶν ὁμολογοῦσιν ἢ ἐπειδὴ τίνα τρόπον γίνεται τὰ γινόμενα καὶ φθείρεται τὰ φθειρόμενα καὶ τὰ κινούμενα [μὴ] κινεῖται μὴ γινώσκουσιν, οὔτε γένεσιν οὔτε φθορὰν οὔτε κίνησιν ἀπολείπουσιν. ἀλλ' ὅτι ἡ μεγίστη παντὸς λόγου διαβολὴ ἡ πρὸς τὸ ἐναργές ἐστι μάχη, τίς οὐκ οἶδεν; ὃς γὰρ οὐδ' ἄρξασθαι δύναται τῆς ἐναργείας χωρίς, πῶς ἂν οὗτος πιστὸς εἴη, παρ' ἧς ἔλαβε τὰς ἀρχάς, κατὰ ταύτης θρασυνόμενος; τοῦτο καὶ Δημόκριτος εἰδὼς ὁπότε τὰ φαινόμενα διέβαλε "νόμῳ χροιή, νόμῳ γλυκύ, νόμῳ πικρόν", εἰπὼν "ἐτεῇ δ' ἄτομα καὶ κενόν", ἐποίησε τὰς αἰσθήσεις | λεγούσας πρὸς fol. 1217 τὴν διάνοιαν οὕτως· "τάλαινα φρήν, παρ' ἡμέων λαβοῦσα τὰς πίστεις ἡμέας καταβάλλεις; πτῶμά τοι τὸ κατάβλημα". δέον οὖν καταγῶναι τοῦ λόγου τῆς ἀπιστίας, ὃς οὕτως ἐστὶν μοχθηρός, ὥσθ' ὁ πιθανώτατος αὐτοῦ μάχεται τοῖς φαινομένοις, ἀφ' ὧν ἤρξατο. τὸ ἐναντίον ἐργάζεσθε· τῶν μὲν γὰρ γέγνεται μὲν οὐκ ἐχόντων λόγον, ὡς ὁ λόγος δὲ βούλεται μὴ γιγνομένων κατεγνώκατε· ἐμοὶ δ' αὖ τὸ τοιοῦτο ἔλεγχος εἶναι δοκεῖ μέγιστος

solummodo: quod sanè euidenter concessum habemus. Tu uero, qui causas curiose inquiris, debes et illud quomodo docere. Sed contra quam deceat, procedere uideris, nec secus facere, ac illi, quoniam, quomodo uideatur, ignorant, nequaquam uidere fatentur: et, quia etiam, quonam pacto generentur, quae generantur, et corrumpuntur, quae corrumpuntur et moueantur, quae mouentur, ignorant, iccirco nec generationem nec corruptionem nec motum relinquunt. At, quod maxima uniuersae rationis uituperatio sit, aduersus euidentia pugnare, quis est, qui nesciat? Nam, qui incipere non potest sine euidentia, quomodo is fidelis sit, cum aduersus id, à quo principia sumpsit, sit audax? Hoc etiam cum uidisset Democritus, quando apparentia uituperabat, ubi dixisset "Lege color, lege dulce, lege amarum: vera autem (hoc est ἐτεῇ) atomus, et vacuum: finxit sensus aduersus cogitationem in hunc modum loqui. Misera mens, quae cum à nobis fidem assumpseris, nos deiicis. At cum nos deiicis, tu ipsa cadis. Cum igitur deceret rationem infidelitate condemnare, nimirum, quae adeo prava sit, ut etiam, quae inter ipsas est probabilissima, cum apparentibus à quibus incepit, pugnet, uos contrarium agitis: quippe ea damnatis, quae rationem quidem habent, ut sciant, sed ut ratio cult, non sciunt. Mihi uero hoc ipsum maxima rationis redargutio esse uidetur. Quis

5.6 Man erwartet καὶ κινεῖται τὰ κινούμενα 9 δύναται: verb. S 10 καταντῶς: verb. S 10 Δημόκριτος] vergl. Natorp, *Forsch.* S. 192 15 οὕτως: verb. S 16 ἐργάζεσθε: verb. S 17 γίγνεσθαι: verb. S 18 Vielleicht κατεγνωκότες? αὐτὸ τοιοῦτο: vielleicht αὐτὸ τοῦτο?

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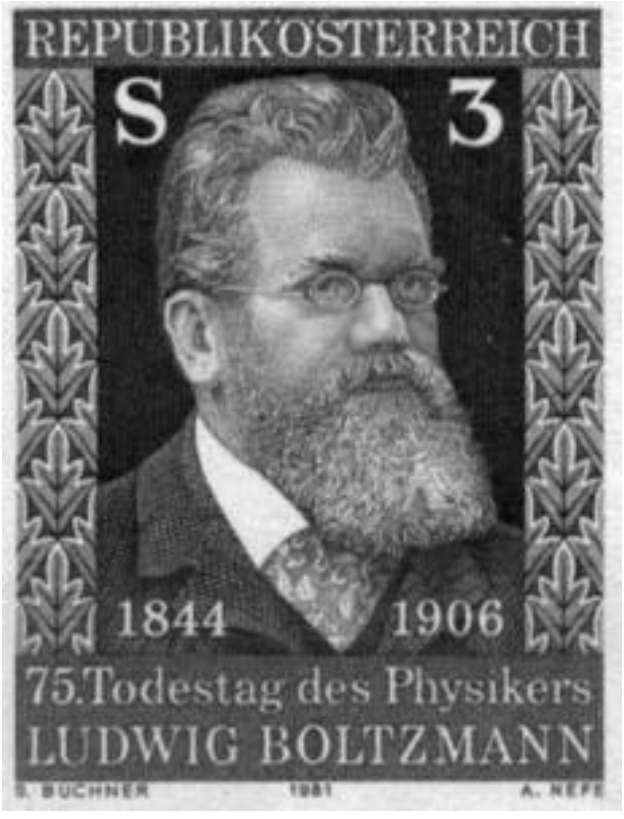
The dialog:
nous: apparently color, apparently sweetness, apparently bitterness, truthfully only atoms and empty space

senses: poor nous, from us do you take your pieces of evidence and want to be victorious over us. Your victory will be your defeat

in Einstein's words

I see on the one side the totality of sense-experiences, and, on the other, the totality of the concepts and propositions which are laid down in books. The relations between the concepts and propositions among themselves and each other are of a logical nature, and the business of logical thinking is strictly limited to the achievement of the connection between concepts and propositions among each other according to firmly laid down rules, which are the concern of logic. The concepts and propositions get "meaning", viz., "content", only through their connection with sense-experiences. The connection of the latter with the former is purely intuitive, not itself of a logical nature.

Example: Boltzmann's Atomism



Ludwig Boltzmann's atomistic theory of gases : atoms perform heat motion, at temperature T

$$\langle \frac{1}{2} m v^2 \rangle \sim T$$

That is pure thought.

Example: Ernst Mach ($\sim$ 1900) versus Atomism, thereby laying the foundations for physics without ontology

...The only real point of difference which has so far come to light concerns the belief in the reality of atoms. Here again, Planck can hardly find words degrading enough for such wrong headedness. After exhorting the reader, with Christian charity, to respect his opponent, P. brands me, in the well-known biblical words, as a "false prophet". It appears that the physicists are on the way to founding a church; they are already using a church's traditional weapons. To this I answer simply: "If belief in the reality of atoms is so important to you, I cut myself off from the physicist's mode of thinking, I do not wish to be a true physicist, I renounce all scientific respect – in short: I decline with thanks the communion of the faithful".

E. Mach: The Guiding Principles of My Scientific Theory of Knowledge and Its Reception by My Contemporaries

Can one see atoms? Anaxagoras' Methodology: Brownian Motion

Marian von Smoluchowski 

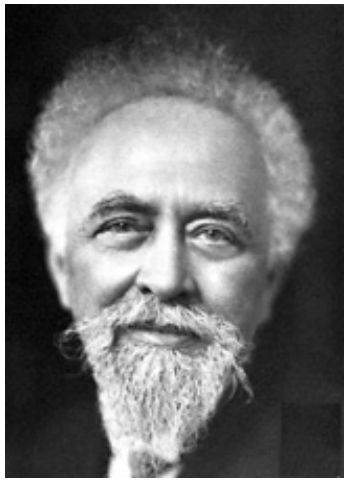
Can one see atoms? Anaxagoras' Methodology: Brownian Motion

Einstein 1905, and Smoluchowski (around the same time) suggested that the known phenomenon (described in detail by Robert Brown (~ 1850)) of the erratic motion of a microscopically small particle on a fluid is due to collisions with the atoms in the liquid performing heat motion

Marian von Smoluchowski

Nobel Prize for ATOMISM

Jean Baptiste Perrin 1870-1942, verified Einstein's and Smoluchowski's predictions in 1907, Nobel Prize 1926



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- in 1958 in Physics and Philosophy:
  . . . the idea of an objective real world whose smallest parts exist objectively in the same sense as stones or trees exist, independently of whether or not we observe them . . . is impossible . . .

Einstein answering Heisenberg

But you can't seriously entertain the idea, that one can base a physical theory only on observable quantities!....Because in reality it is the other way around: It is the theory that decides what one can observe

Schrödinger on missing ontology

Schrödinger on missing ontology

One can even set up quite ridiculous cases. A cat is penned up in a steel chamber, along with the following device (which must be secured against direct interference by the cat): in a Geiger counter there is a tiny bit of radioactive substance, so small, that perhaps in the course of the hour one of the atoms decays, but also, with equal probability, perhaps none; if it happens, the counter tube discharges and through a relay releases a hammer which shatters a small flask of hydrocyanic acid. If one has left this entire system to itself for an hour, one would say that the cat still lives if meanwhile no atom has decayed. The psi-function of the entire system would express this by having in it the living and dead cat (pardon the expression) mixed or smeared out in equal parts.

Feynman on missing ontology

Feynman on missing ontology

There was a time when the newspapers said that only twelve men understood the theory of relativity. I do not believe there ever was such a time. There might have been a time when only one man did, because he was the only guy who caught on, before he wrote his paper. But after people read the paper, a lot of people understood the theory of relativity in some way or other, certainly more than twelve. On the other hand, I think I can safely say that nobody understands quantum mechanics.
Richard P. Feynman (1965) The Character of Physical Law

Melville on omission of ontology

Melville on omission of ontology

While you take in hand to school others, and to teach them by what name a whale-fish is to be called in our tongue leaving out, through ignorance, the letter H, which almost alone maketh the signification of the word, you deliver that which is not true.
Hermann Melville (1851), Moby Dick; or, The Whale, Etymology [8].

Physics must be about ontology

If someone says .....you answer

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- physics is about observation:

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- physics is about observation: observation of what?
- physics is about information: information about what?
- physics is about measurement:

Physics must be about ontology

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6. the primitive ontology must move and the law for the motion is more or less uniquely determined by the what the ontology is
7. if one can convincingly argue ("common to all") how that physical theory explains the sense experiences that is a good physical theory

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Ontology of interaction: Fields (Aether)

It is inconceivable that inanimate brute matter should, without mediation of something else which is not matter, operate on and affect other matter without mutual contact. ... That gravity should be innate, inherent and essential to matter, so that one body may act upon another at-a-distance, through a vacuum, without the mediation of anything else by and through which their action may be conveyed from one to another, is to me so great an absurdity that I believe no man, who has in philosophical matters a competent faculty of thinking, can ever fall into it. Gravity must be caused by an agent acting constantly according to certain laws; but whether this agent be material or immaterial I have left to the consideration of my readers. ....So far I have explained the phenomena by the force of gravity, but I have not yet ascertained the cause of gravity itself. ... and I do not arbitrarily invent hypotheses. (Newton. Letter to Richard Bentley 25 Feb. 1693)

Maxwell on field ontology

This velocity (<A,N>: of the electromagnetic radiation) is so nearly that of light, that it seems we have strong reason to conclude that light itself (including radiant heat, and other radiations if any) is an electromagnetic disturbance in the form of waves propagated through the electromagnetic field according to electromagnetic laws.

Heinrich Hertz: Measurement of electromagnetic “fields“

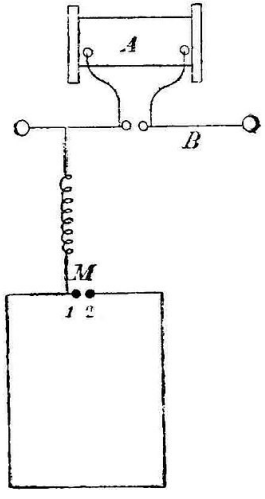
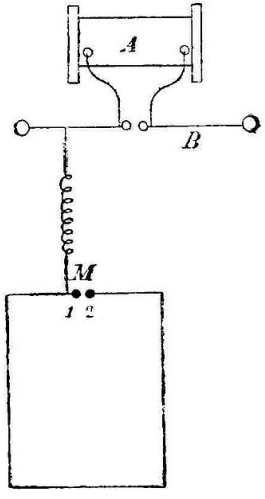


Fig. 6.

Ueber sehr schnelle electrische Schwingungen. In: Annalen der Physik und Chemie. Band 267, 1887

Heinrich Hertz: Measurement of electromagnetic “fields“

How? By and *only* by action on matter, the way matter and fields are coupled in the Maxwell-Lorentz equations



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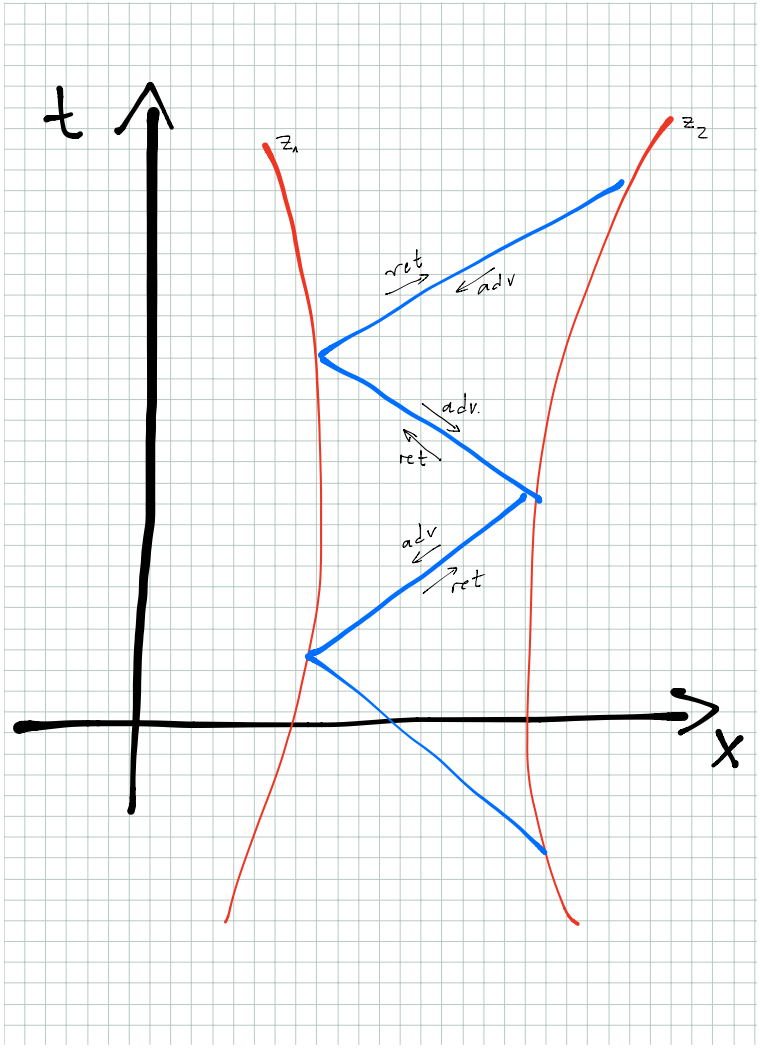
are fields an ontological necessity?

The supreme task of physics is to arrive at those universal elementary laws from which the Weltbild can be built up by pure deduction. There is no logical path to these laws; only intuition, resting on sympathetic understanding of experience, can reach them. [...] No one who has deeply thought about this subject will deny that the world of sense perceptions practically determines the theoretical system uniquely, even though there is no logical path leading from the perceptions to the fundamental laws of the theory; this is what Leibniz so beautifully called "pre-established harmony"

A. Einstein: Mein Weltbild (The World as I see it)

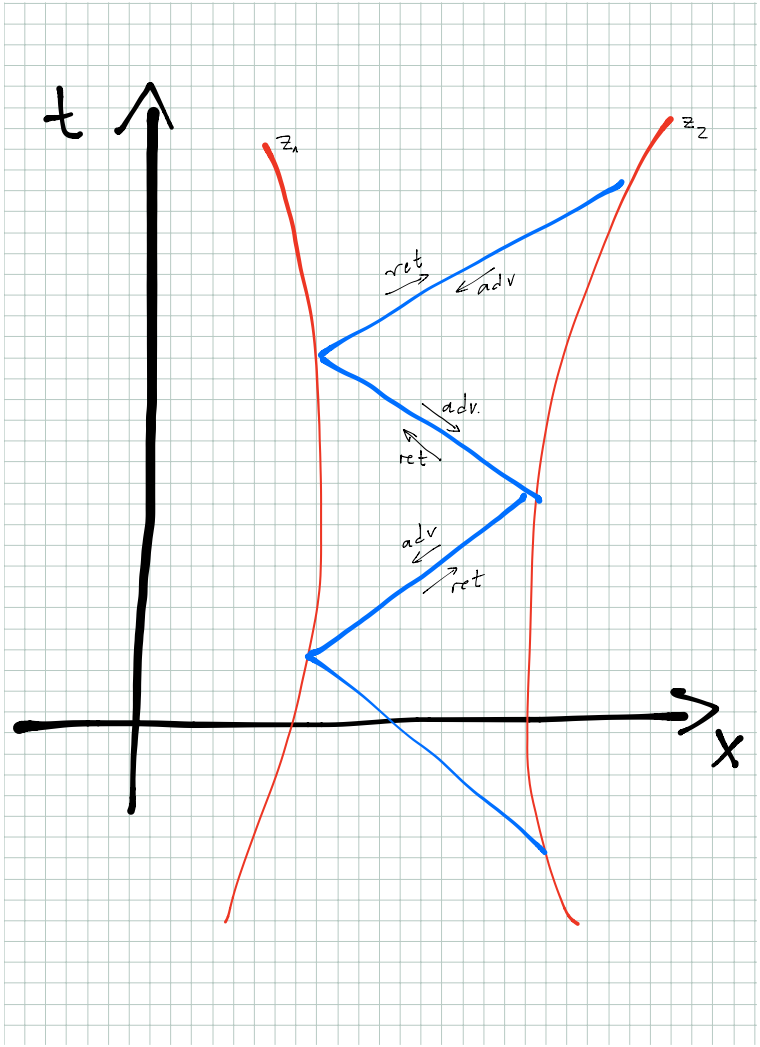
Pragmatism about ontology



Ampère-Gauss-Weber-Fokker-Schwarzschild-Tetrode-Wheeler-Feynman-Electromagnetism
direct interaction: no fields filling senselessly space, no singularities, but keeping up appearances

Pragmatism about ontology

Interaction without fields



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- Manipulation of the mathematical terms and symbols (combining them etc.) might lead to a more compact form...maybe better looking form of the law.
- Don't get excited: don't change the ontology because it observes the mathematically nicer looking law. That is betraying your thoughts about the physics.

Melville on honest and fruitful research

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Oh, Time, Strength, Cash, and Patience!