Main objective of the book

Considerations in the book concern the objects among which long-range (electromagnetic and gravitational) interactions operate, *as seen by relativity theory*.

This theory (special and general) is one of the most esteemed physical theories. Therefore, it was my great surprise when, on a close examination of appropriate Einstein's papers, I identified severe—if not fatal—drawbacks in *special* relativity, which is itself the basis for general relativity. First, its results (Lorentz transformation, lengths contraction, time dilation, relativistic mass, energy-mass equivalence) do not follow its premises, which means that the mentioned results do not belong to the theory (although they—or some of them—still may be true as such). To get them derived, another premise—to the effect that the velocity of light is constant and the same for all inertial observers—is necessary. And what makes the story worse, there is evidence that the additional premise is false. Second, the theory is internally inconsistent, because one can easily derive the following, plainly contradictory clause: If the velocity of light is constant (premise of the theory), then light moves with acceleration (immediate consequence of the famous $m=E/c^2$ with regard to electromagnetic radiation, since inertial mass has its origin in accelerated motion).

I was perplexed. How could it be that such potentially devastating traits of the theory have passed unnoticed for so long?

Or, putting it the other way: Am I wrong, or is it the theory which is wrong? And—because on cautious scrutiny I haven't found mistakes in my own reasonings—should we dispose of special relativity altogether? What, then, about the validity of general relativity, superposed on the special?

The other day I happened to read two Einstein's letters which gave me clue how to resolve the dilemma. The first was the famous letter to *The Times*, in which Einstein distinguished two types of physical theories, labelling them *constructive* and *principle*-theories. In his words, "[the first] attempt to build up a picture of the more complex phenomena out of the materials of a relatively simple formal scheme from which they start out." The second "employ the analytic, not the synthetic, method. The elements which form their basis and starting-point are not hypothetically constructed but empirically discovered principles that give rise to mathematically formulated criteria which the separate processes or the theoretical representations of them have to satisfy." Then he added: "The theory of relativity belongs to the latter class." But when it came to evaluating cognitive merits of both theories, Einstein unhesitatingly acknowledged the supremacy of the constructive ones: "When we say that we have succeeded in understanding a group of natural processes, we invariably mean that a constructive theory has been found which covers the processes in question."

In the second letter (addressed to Arnold Sommerfeld), Einstein—still treating constructive theories as superior—strengthened his characteristics of them, claiming that "a physical theory can be satisfactory only when it builds up its structures from *elementary foundations*. The theory of relativity is not more conclusively and absolutely satisfactory than, for example, classical thermodynamics was before Boltzmann had interpreted entropy as probability … . I believe that we are still far from having satisfactory elementary foundations for electrical and mechanical processes."

Faced with Einstein's esteem for constructive theories, I asked myself: Why didn't he elaborate the relativity theory as a constructive

one, i.e. starting from "elementary foundations for electrical and mechanical processes"? Because there was no such known foundations to start? I don't think so, for building from elementary foundations does not require having ones ready to use—they are just the basis of logical structure of a final theory and not the starting point of appropriate investigations. The foundations may be established by appropriate abductive reasoning.

Yet, Einstein didn't go that way. Why? Here is the possible answer, given by late Einstein in a letter to Louis de Broglie: "I am also convinced that one should look for a substructure... I have however long been convinced that one shall not be able to find this substructure *in a constructive way* from the known empirical relations between physical things, because the required mental leap would exceed human powers."

I think Einstein was too pessimistic, for in my opinion he was himself basically in a position to accomplish such task. It would consist in two essential steps: (i) Starting with his own fundamental insights concerning physical processes (such as $E=mc^2$ and $E=h\nu$), he could look for more and more fundamental ones, eventually reaching elementary foundations which would justify the insights. (ii) Instead of looking for consequences of special relativity postulates, he should look for assumptions (consistent with the foundations) from which the very postulates—as well as some of their consequences—could be deduced or derived.

It's a pity that he didn't follow that way…

In the book I myself venture into the task of elaborating the relativity theory as a constructive one along the above-mentioned logical procedure. As I am philosopher and not physicist, it won't be a "fully fledged" physical theory, but its outline only.

Results

I recalled above two particular great Einstein's insights, both concerning energy. Why just them? Because he often claimed that energy is the fundamental physical entity (e.g.: "According to

the special theory of relativity, both matter and radiation are but special forms of distributed energy"—Leiden lecture, 1920) and as such it is a proper candidate for elementary foundations - with just one important proviso: energy is to be understood in substantival, and not in attributive sense. In other words: one should assume that energy is substance, and the primal one among others. Then, in accord with Einstein's hypothesis concerning light quanta, one might assume that this fundamental substance is quantized. Let us call the appropriate elementary, three-dimensional quanta *ergons*.

The next step is to ascribe attributes to ergons that would secure the known electric and mechanical properties of physical processes, such as electric charge, magnetic momentum, inertia, etc. I propose the following:

- Each ergon vibrates and rotates; the frequency of vibrations is proportional to the energy of ergon, whereas the rotational frequency is the same for all of them.
- The vibrations are internal and longitudinal, consisting in the oscillations of energy density; during the vibrations energy and momentum is thus transferred within ergons.
- The velocity of vibrations is permanently changing (as is the case with each vibration), which means that they accelerate/decelerate all the time.
- The average velocity of vibrations within each cycle equals to c, which is known as the speed of light.
- Individual ergons can unite, giving birth to their *convolutions*.
- Elementary particles (e.g. electrons and quarks) are such convolutions of ergons.

I show that the above attributes suffice to generically derive Einstein's formula $E=mc^2$ (which he never succeeded to accomplish). They also suffice to explain why the principle of relativity (claiming that the laws of physics are the same in all inertial frames) holds good for electromagnetic processes, since acceleration does not depend on velocity. (Thus, the condition that Maxwell equations should be invariant under Lorentz transformation is obsolete.) In my book I also demonstrate that

another great Einstein's relativity claim—to the effect that *c* is the limiting velocity of all physical processes—may be derived from the attributes.

All that means that the above-mentioned project succeeded in attaining constructive special relativity.

But the merits of constructive approach to relativity are much more numerous. Here is their exemplary list:

- It allows to explain the origin and nature of elementary electric charge, ascribing it both to electrons and quarks (contrary to the Standard Model, which assumes that quarks charge equals to 1/3 or 2/3 of electron charge). The reason is that electric charge is due to rotational motion of particles and because its frequency is the same for all convolutions, their charges are equal. And the positive-negative distinction of charges depends on spatial orientation of rotations relative to the direction of energy transfer.
- It allows to explain the nature of electromagnetic forces and the laws governing them—e.g. why identical charges repel and the opposite ones attract each other. The main idea here is that the inertia of electrons' inner oscillations causes some tiny parts of electrons to be thrown away ("emitted") helically, making thus electromagnetic field. (I call such inertially torn off entities *derivates*.)
- It basically allows to explain energy levels of atoms in classical terms, that is solely by interplay of Coulomb and Lorentz forces, without invoking Bohr's quantum conditions. (By the way: the higher levels are not spatially placed above but below the ground level, i.e. they are closer to nucleus.)
- Particle spin is not its intrinsic *angular* momentum, but inner *transfer* of momentum within particle.
- There is no wave-particle dualism. Both apparently undulatory interference and polarization phenomena can be accounted for solely in terms of particles. Photons

as well as electrons are just internally vibrating particles whose motion consists in *stepwise forward* oscillations ("drgania kroczące"). (Such motion occurs when the forward amplitude of each inner oscillation is greater than the backward one).

- In the realm of subatomic objects there is no smooth and steady motion, but the above-mentioned stepwise forwarding vibrations only.

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Let's turn to general relativity, or—to be more precise—to Einstein's account of gravitation, which entered the theory as an offspring of his urge to extend the principle of relativity to accelerated motions. The problem is that he tried to achieve that goal not via some dynamical model of appropriate physical processes, but purely on the superficial ground of kinematics, by just manipulating with coordinate frames ("In pursuing the general theory of relativity we shall be led to a theory of gravitation, since we are able to 'produce' a gravitational field merely by changing the system of co-ordinates").

In the light of my foregoing criticism of Einstein's special relativity, his approach to gravitation (i.e the way of his reasoning, not its results) should be substantially modified. First, his treating the invariants of Lorentz transformation geometrically as an apt formula for squared line element and then connecting it with metric tensor is dubious, if not erroneous. (Recall that on the ground of constructive relativity Lorentz transformation is obsolete, being just an artificial tool devoid of physical meaning). Second, Einstein did not substantiate his crucial claim concerning double identity of metric tensor (as describing both gravitational field potential and geometric properties of space), since he reasoned along the scheme $(p \rightarrow q) \rightarrow (q \rightarrow p)$, which is not valid. Yet, his thesis was right, because gravitational force and potential depend crucially on *distance* among bodies, and distance is itself a paradigmatic

geometric entity. Therefore, Einstein's use of metric tensor was legitimate, but not because of distortion of Euclidean space by massive objects, but because of anisotropy of spatial distribution of sources of gravitation, spread out in space in a chaotic way. (Recall that Einstein's approach was all-inclusive, i.e. it took into account all massive objects in space, not just two as was the case with Newtonian approach.)

Let us now see what can be achieved when starting not with Einstein's special relativity, but with its constructive variety (as sketched above).

The force of gravity obviously depends on ponderable (gravitational) mass. Einstein in addition claimed that it also depends on inertia („[The theory of gravity] derives from the conviction that the proportionality between the inertial and the gravitational mass of bodies is an exactly valid law of nature that must already find expression in the very foundation of theoretical physics"), so we should take it into account. As masses are scalar entities, the mass of a body is just a sum total of its elementary constituents. Therefore, the inertia of those elementary particles must somehow be involved as well. How? Notice first that all elementary particles, experiencing permanent internal acceleration/deceleration, possess *inertial* mass. But it's not enough for gravitation, since interaction needs some mediating *milieu*. On the assumption that the interaction is quantized, there should exist quanta of appropriate field. Let's call them *gravitons*. How might they appear? My proposal is similar to that concerning electromagnetic field—they are derivates of particles torn off by way of their inertia. Recall that all particles participate in two internal motions—vibrational (progressive) and rotational, due to which they move helically. So do their quantal offspring (derivates). I conjecture that what differentiates the two kinds of quanta is that the quanta of electromagnetic field are those being torn eccentrically and thus possessing orbital angular momentum, while gravitons are emitted "centrally" and possess inner angular momentum, thus whirling around their own axis of rotation. Why

is this important? Because then, in their crossing material bodies, gravitons act in a way similar to a ship's propeller, which sends sea-water *backward*. On analogy, gravitons emitted centrally by some object and then crossing another object send minute parts of substantive energy of which the object is made backward, which is equivalent to the latter being "attracted" by the first. (Notice that causal effect of gravitons does not depend on the orientation of their whirl, which is why they do not possess electromagnetic properties.)

This is why inertial and gravitational masses are proportional. And this is how gravitation works on elementary level.

But not all interactions of masses are attractive. There is also something like "anti-gravitation," due to presence of *non-rotating* particles (convolutions). Such non-rotating objects appear when two oppositely charged particles of the same vibrational frequency—and thus of the same mass—unite, making greater convolution, because their rotations cancel (neutralize) each other. This is, for example, the case of electrons and positrons, abundantly produced in early phase of the evolving Universe. Derivates of such convolutions transmit then their linear momentum to another objects, contributing to their recoil. (I suppose this is just famous *dark energy* in action. Nothing extraordinary then.)

Aided with attractive and repellent interactions outlined above, a *cyclic* model of Universe is then argued for.