

## Interactions and laws

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**Abstract:** *The finite speed of interactions is a sufficient requirement for description of relativistic effects without the interpretation of metric deformations. An interpretation using the aether is also possible. However, deduced laws will be always conventional.*

**Keywords:** *gravity, retarded potential, speed of light, refractive index, anisotropy, laws*

The speeds of electromagnetic and weak interactions (neutrino) are probably linked, as it was shown in [1]. However, it does not mean that this speed is a constant that does not depend on parameters. These interactions can be explained by retarded potentials with a speed of interaction that “depends” on near masses. I.e. it is modified by the gravitational potential (permittivity modification) using a factor like  $GM/rc^2$ . The space (the unit metre) is defined as  $x=ct$  from the proper time (the unit second). The SI definition fixes value of the speed of light in vacuum (void). The relativistic (observer-based) interpretation of effects is that the space is (more precisely: “the space looks like”) deformed in the presence of mass (and fixing the gravity as a fundamental interaction). However, alternative explanation is that the space is flat (i.e. with infinite radius of curvature) and the medium for interaction is modified. I.e. it is weaker through a decrease of the fine-structure “constant” (that is also effectively modified in the high energy physics and it was previously interpreted as permittivity that also plays role as an interaction strength in the Coulomb's law), then it causes slower motion in atoms and thus slower clock (“time”) ticking that is real and independent on an observer. This interpretation is more suitable. An object immersed in water also looks bent (differently for various observers) due to the effect of refraction (i.e. different speeds of light). However, it is not interpreted as a (fundamental) space deformation. The lensing is a similar effect (analogy). The gravitational wave observations of mergers suggest that the speed of gravity is same as the speed of light (electromagnetism). However, it is not clear whether it is a gravitational or an optical effect in detectors. The aether (“superfluid vacuum”) still was not experimentally ruled out (and can be a useful concept). Electromagnetic effects can be described as the retarded propagation of (the Liénard–Wiechert) potentials. The “variable speed of light” theories describe gravitation effects (that correspond to the Schwarzschild static solution  $ds^2=-\mu_r c^2 dt^2 + \epsilon_r dr^2 + r^2(d\theta^2 + \sin^2\theta d\phi^2)$  with  $\epsilon_r \mu_r = 1$ , i.e. the speed of light is not necessary changed) as a position dependent “refractive index”  $n = \sqrt{\epsilon_r}$  that decreases “speed of light” proportionally to the gravitational potential. (Note that the SI definition locally fixes value of  $c$  for the definition of metre. However, non-local two-way propagation is needed to observe relative length effects using a time standard.) It can be imagined as a gravitational effect on the aether (that is gravitationally densified by a source mass). This (non-fundamental “solid-state physics”) effect also propagates with the speed of light (taken as a specific property of the aether) and allows a generation of “gravitational” (i.e. “refractive-index”/permittivity anisotropy) waves and their detection by a laser interferometry. Note that index ellipsoid (e.g. indicatrix) exists, and thus, quadrupole (radiation) effects are expected. If other moments will be present, they can be attributed to the aether (and not to some fundamental laws) without any effect on the interpretation. Thus, we can see that the speed of permittivity propagation

(i.e. electromagnetic “fabric of spacetime”) is not necessary same as the speed of gravity. If we apply the reciprocity theorem to the gravity, we will see that gravitational detectors are very inefficient. However, the reciprocity theorem for electromagnetism with a time-varying permittivity allows such detection. Nevertheless, constituents of atomic nuclei (moving with speeds close to the speed of light) can radiate and receive “gravitational” (permittivity) waves (energy) effectively (as they are matched as electromagnetic transmitters with receivers). The characteristic time for “gravitational” radiation of amount of the rest energy of nuclei is comparable with the “age” of the (observable) Universe. The field of view of receivers (particles) covers full solid angle for an effective distance that is comparable with the “size” of the observable Universe. The symmetry of received energy allows atoms (mass) to keep them in a distance (to recycle gravitational energy) and the Universe to avoid a gravitational collapse (i.e. to be “stationary”). This is a connection with the large number hypothesis (ratio of sizes of the Universe and atoms). The “baryon acoustic oscillations” are retarded image of atomic orbitals (without a need of large density due to the Big Bang). This can be viewed as a (“dark”) energy transfer. The transmission and reception is a “random” process and its average over a part of the Universe (e.g. our observable Universe) behaves like a random walk with a large time constant. The current (“local”) state is that these “dark” (energy) waves dominate against “visible” matter. Atoms (“time”) are slower (lighter) than (a larger) spatial average. They increase their frequency (“rest” energy) with time (observed as the cosmological redshift), and thus, “local” Universe departs from the negative (antimatter) state. And this increase (it is also just a coincidence/parameter without any fundamental reason) accelerates (“accelerating Universe”). The Universe thermalizes (to the cosmic microwave background with an energy density that corresponds to the nuclear binding energy) with fluctuations that can come (perpetually) from its infinite spatial extent. The Universe can be also without singularities (the creation/death or “black holes”) with a closed cycle of elements (powered by reabsorptions of radiation).

The relation  $2=1+1$  is not a human-independent “law” (“true”) of mathematics. It is a definition (convention) of “2” as it was shown in the set theory. Similar misunderstandings are present in physics. E.g. the Ohm's law is not a (natural) law, but it is a (conventional and subjective) definition of the unit ohm. And “fundamental” physical constants have (in the SI) human-fixed numerical values. Note that the result of any measurement (experiment) is only a number (ratio). Thus, there is no place for human-language-based quantities or other mysticism (irrationalities, interpretations) in axiomatic (convention) based science.

All laws are conventions. And more, all decisions (thinking) have no (objective, natural, supernatural) reason. They are solutions (corresponding to sets of equations for inputs and outputs). However, a problem solving (named as intelligence, superintelligence or artificial intelligence) is only a simple interaction (“life”) of simple (physical problem, reflex, subconsciousness) or complex systems (consciousness, society, Earth) with complex (“unpredictable”, “live”) outputs.

[1] P. Křen: Superluminal motions, 2016, <https://gsjournal.net/Science-Journals/Research%20Papers-Cosmology/Download/6701>