

## **Intuitive Physics from Natures Elements; Inertial Fields**

Wind, Water, Racing Yachts, and the Discrete Field Model.

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peter.jackson53@ymail.com

It may seem that we have no more natural intuition about Relativity than we have about quantum mechanics (QM) yet nature has revealed far more than we yet understand, including in the elements on Earth. Einstein said; “*we don't yet understand 1,000<sup>th</sup> of 1% of what nature has revealed to us.*” But with mathematics being considered the only language of physics we suggest we are missing and failing to translate important parts of the language of nature. Intuition can only come with good knowledge and experience, and assumption is the enemy of knowledge and destroyer of logic. We give an example of a better approach to empiricism, one of conceptual logic informed by both experience of nature and knowledge of physics theory. The results support the discrete field model (DFM) of mutually exclusive reference frames, which unifies Relativity and QM on a united field basis, explaining the constant speed of light for all emitters and observer frames, removing all the paradox from physics and many of the anomalies from astrophysics..

Few will consider it in the 'translated' terms below, but experienced racing yachtsman will be familiar with the uncertainty of wind and dynamic superposed waves, but also with five or more interacting inertial frames at once. First is the Earth Centred Reference Frame (ECRF) of his GPS, the sea bed and anchored race marks, then secondly the flow of a river or tidal stream of the sea, with faster flow in deeper water, and with respect to which his boat moves. The third is the surface wave motion, which will include multiple frames as wind induced waves overtake waves, and may include standing waves in the ECRF induced by tidal flow over sea bed features. Superposed waves at all scales from tiny ripples to Tsunami's interact with apparent uncertainty and on different vectors, making 'flat' patches and steep waves appear as if from nowhere, but which an experienced helmsman can read and anticipate. He sits at rest in the fourth inertial frame of the boat itself, with drive, drag and momentum, apparent wave frequencies depending wholly on it's vector. The fifth, again a dynamic variable, is the wind, the frame in which the air is at rest, yet this is local and varies dynamically with time and both vertical and horizontal position. Setting the best shape of a sail for the wind and wave conditions is critical to speed. A boat may sail at three times the 'true' wind speed at some relative angles. Nearby boats have other frames or states of motion to account for to avoid collisions and the effects on wind vector. The sails and keel change local pressure of wind and water to create a vectors for the boat with respect to those of the elements, creating the 'apparent wind' speed and angle all sailors know and use. The air may be at rest in the frame of the land, but the water flow alone will create an apparent wind for the boat to sail in, the tide-wind. Frames are essentially inertial but with constant accelerations, as when the boat hits a wave, changing speed and wind angle. The 'bizarre' prediction of SR that the inertial mass of an object is dictated by the state of motion of each observer is intuitively explained; On 'impact' (equivalent to measurement) each wave will find the inertial mass of the boat different according to the boat's speed, and indeed vice versa.

All inertial frames interact to change the vectors experienced by the boat. A racing yachtsman will intuitively estimate, before he tacks, what the new wind vector and 'course over the ground' on the opposite tack, will become. Sophisticated computer programmes using GPS and apparent wind and water vectors can now estimate the compound vectors to guide less experienced sailors (B&G Hercules etc.) but computers can't account for the effects of waves, anticipate change, or find any certainty of wave height at any given position. Waves move water, but the water is just the medium they move within. A waves energy is cyclic and kinetic, and as it interacts with the boat it is expended and the energy is absorbed or reflected. 'Non elastic' rigid interaction is best for preserving boat speed, but in either case new waves are emitted or scattered by the boat, moving at a new speed dictated by the boat's reference frame. When sailing into oncoming waves their frequency is high, but, turning to run with them, frequency falls while wavelengths remain the same in boat's frame, and speed increases as wave energy becomes positive. A skilled helmsman will utilise gravity, wave face inclination and vector to maximise speed. Wavelength (in the waters frame) is critical for interaction. Each boat length has critical wave frequencies (in the boats frame) where interaction is maximised, affecting resonant motion, relative speed, and the new emitted wave pattern. Amplitude, and the differences between phase and group velocities have a real intuitive meaning, and the quanta of action of expended energy each wave of the continuous surface is painfully clear, and it's minimisation the focus of the helmsman's task.

Light is not a 6<sup>th</sup> frame but moves in the ECRF system with the GPS signals that must do so to constantly provide the boats speed and course, not it's heading, 'boat speed' or course through the water but it's vector 'over the ground.' That frame is modified by the moving air, at  $n = \sim 1.0003$ , but the effect is too small to measure, but light scatters, slows and refracts in water ( $n = 1.33$ ) distorting apparent depth and position of obstructions viewed from above. Most sailors won't consider things in the terms described but the most successful have an intuitive understanding of the dynamic= relationships. This shows that some intuition about both uncertainty and relativity in nature *is* possible with the right way of thinking and experience. Motion must always be defined 'with respect to' something local, and the correct observer frame must always be used for the specific task, not assume one idealised observer 'lab frame' or Earth centred frame for everywhere in the universe. Perhaps the most interesting aspect on analysis is that each frame of matter is best considered as a mutually exclusive 'field', with everything relative, and acceleration as the interactive boundary between fields. The energy of motion and change can fit logically into such a formalism. It is the acceleration of air behind the sail which drives the boat, and it is the air accelerating the waters surface which forms the waves via rotation. There may be no wind in the ECRF but the tidal current will cause waves by interaction with both air and the sea bed. In a flat calm in the straights of Dover the sea will still be rough, from the fast tidal flow and the scattering of waves from passing ships and ferries, crossing like em waves with minimal interference unless resonant. When a yacht measures the energy of a wave by interacting with it, in discrete quanta from the continuous surface, that part of the wave is spent, and spray landing on the boat must be accelerated on contact into the boats inertial frame.

So an experienced helmsman can anticipate far more interacting change than the sophisticated computers used, which can't anticipate wave uncertainty or likely current and wind changes. Most helmsmen will not consider this consciously but they can gain a sense of when a large compound wave will appear from the background pattern. Race crews look out for wave patterns and inform the helmsman, but, particularly for those who sail at night, and beating to windward, the impending onset of a large wave will be 'felt', if only by surface topography, and he will know to add power from ('lean on') the sails to increase momentum and inertia in preparation for the impact. EM energy illuminates this complex dynamic system, light being part polarised entering the ionosphere, then changing speed dramatically, by  $n=1.33$  plus any water velocity, at the water surface, so moving with respect to the water, whatever it's state of motion. A string of photons or Q-bits will Doppler shift in length on such transitions, both contracting and dilating. At a medium of  $n=1$  the shift will be purely due to the co-motion.

In logical analysis we find that each inertial frame may indeed be considered as a mutually exclusive but dynamic field or system, defined by co-motion, each bounded by scattering, acceleration, and the Doppler effect. Each element or wave changes speed (accelerates) on interaction, by part or all of the velocity  $v$  of the relative motion. This is consistent with Fizeau's result (1849) for moving media, and we find, with Raman's result that light always changes speed to propagate with respect to; "*the common velocity of its ultimate particles*". This is not only equivalent to the SR postulates but allows 'non-absolute' unified fields as *local* background frames. The DFM construction tests and finds consistent results from mutually exclusive inertial frames, systems or fields, rather than applying Lorentz group formulae to Cartesian co-ordinate systems. The solar system is considered in the model as a discrete system for the purpose of transmitting and measuring EM wave speed. In accordance with the principle of least action such a system and its boundary shock, only exists if co-motion through the background exists. Its mutual exclusivity is only for measuring  $c$ , and smaller identical systems, such as the ECRF, may move within it. It is scale invariant. Valid vector measurement can only be made within each system, but can be derived by analysis of relative system velocity is know.

The basic formalism does not require ether, as the particle boundary zones define the fields as 'spaces', yet because no background field is 'absolute' it now *allows* these as local CMBR rest frames or 'preferred' 3<sup>rd</sup> frame quantum fields, then allowing a simpler explanation for simultaneity (see 'thought gedankens' below.) Raman suggested (1922) that even in the voids between dielectric media particles light moved at  $c$  with respect to the collective medium not any electron orbital motion within it;. This is consistent with the DFM mechanism, equivalent to light emitted from Earth changing speed<sup>i</sup> to move at  $c$  in the Heliosphere's barycentric frame. In this case a field energy condensate is required, consistent with the Lamb shift of vacuum interaction and the recent confirmation by Wilson et al (2011) of the dynamic Casimir effect (DCE)<sup>ii</sup> creating light by motion of a mirror in the vacuum, where "*the ideal mirror represents a boundary condition for the EM field*" considered as a scattering surface, with emissions, at the mirror oscillation frequency used,

considered as microwave photons. We predict that this, as Raman's assumption, is in the frame of the local vacuum,<sup>iii</sup> giving the logical basis for  $c = dt$  and that this represents pair production, resulting in ions, with the energy for the phase change into matter derived from increased pressure, or compression, of the estimated 73% mass energy not locally in 'matter' phase. This supports a suggestion of the DFM that the possible addition of the word '**locally**' may be made to the SR Postulates, including the Principle of Relativity; *The laws of physics are the same in all inertial frames, and the propagation speed of light is always measured at c.* While; "*locally measured at c,*" may seem obvious it does change and clarify current understanding.

The accelerative boundaries between frames are ion plasma clouds, shocks<sup>iv v</sup> and 'dark matter' halo's, and the mechanism diffraction by scattering, also providing curved light paths with magnitude subject to mass and motion. The refractive index  $n$  of plasma at some 0.99998 does not reduce from it's high wave/particle interaction coupling strength, modulation motion due to relative velocity of media, resolving the failure of the Law of Refraction at co-motion.

We must consider the implications of the fact that we can only ever 'see' light via scattering, and seeing a sequence of scatterings from another frame does not allow valid measurement, or an assumption that *apparent*  $c = v$  is not visible. The new Architecture of the DFM derives a 2<sup>nd</sup> class of observer frame, arbitrary states of motion which are invalid for measurement, all non local frames are within it, and all measurement of reality is Local, without hidden variables. Lorentz, similar to all eminent physicist, said; "*..we can make no progress without some hypothesis that looks somewhat startling at first sight, we must be careful not to rashly reject a new idea..*" He was also concerned about limiting velocity addition, saying of the 'daring' "*..restriction of what is accessible to us, **a restriction which cannot be accepted without some reservation.***"

Recent research has shown that we need to find a less 'self centric' view of nature to gain a clearer vision of how it works,<sup>vi</sup> to step back in detachment for a more holistic view, to not confuse *personal* view and subjective experience with a concrete reality that only maths can describe, but also to not ask maths to *replace* those dynamic conceptual thinking and visualisation skills. The DFM shown intuitively that many disconnected concept in physics can be united into the same thing, which is consistent with Bronkowski's; "*All science is the search for unity in hidden likenesses.*"

## Conclusions

We conclude that in analysis simply of the behaviour of natural elements, in terms of both Relativity and Quantum Physics, an intuitive understanding which supplements the more normal, purely mathematical, language, can suggest a new logical mechanism to unify and simplify our understanding of nature. This does vary in some ways from current physics, but we suggest when we find nature conflict with physics it may be wise to re-assess both rather than just interpretation of nature.

In the DFM inertial fields are simply different systems, like buses. Light moves at  $c$  locally within each bus. For a bus moving at  $v_1$  with respect to the road; if an observer in a car passing in the other direction at  $v_2$  video's a passenger walking down the bus at  $v_3$  with respect to the bus, the analysis of the videotape can give an apparent speed of  $v_1 + v_2 + v_3$ , as it is not a valid measurement of the passenger's local speed, which may be limited in the frame of the bus. His speed, (and thus also vector) can only be validly measured from the frame of the bus. His 'time averaged Poynting vector' may be 'apparently' reversed, and the law of refraction fail, without paradox. All moving cars may get different results as none is valid. All light from the bus reaches the camera at  $c/n$  via the quantum mechanism of scattering. Similarly. Einstein's 'train gedanken' allows a simple intuitive 'simultaneity', as light moves within the train's frame at the local  $c$ , (as the SR postulates) and his 'light box' would not have to shrink as we are allowed to see the bouncing light pulse on the diagonal as we expect when the box moves, but, if we remove the sides, the pulse will fly off into space as the mirrors move away, as our intuition tells us. We find this equivalent to Einstein's conceptual local space as matter '*spatially extended*', and his final conception of space as "*infinitely many 'spaces in relative motion'*" (1952).

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