The space - a stationary complex "Cosmic Tension Field" (CTF). Constancy of $c = (\varepsilon_0^{-1} / \mu_0)^{1/2}$ demands it

CTF as the universal inertial reference frame holding 100% of the energy, manifest & un-manifest

Also available on YouTube

TALK:
https://quicycle.com/video/qc0104-prof-chandrasekhar-roychoudhuri-cosmic-tension-field/
QA&D:
https://quicycle.com/video/qc0105-prof-chandrasekhar-roychoudhuri-cosmic-tension-field-qad/

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The space - a stationary complex "Cosmic Tension Field (CTF)". Constancy of $c = (\varepsilon_0^{-1} / \mu_0)^{1/2}$ demands it.

ABSTRACT

I will use Huygens' process driven thinking introduced in the context of his postulate of "Secondary Wavelets" along with his "Non-Interaction of Waves" of 1690, and his ether as modern CTF. I also accept the built-in causality in our math. I will try to show that CTF, so far, is the best unifying platform for all branches of physics. **Will propose some new experiments also.**

Objective of this article is to demonstrate that by keeping our focus on understanding and visualizing the physical interaction ***processes***, which are going on in natural evolution, will keep on helping us integrating newer knowledge towards a united whole-istic model. The foundation of my thinking is Huygens' postulate on the root of EM wave propagation ***process,*** which requires a stationary Cosmic Tension Field (CTF), historically known as "ether". CTF holds 100% of the energy of the universe. I will use the CTF-model to (i) critically review Special Relativity related optical interferometry, (ii) Cosmological Redshift & (iii) a model for the emergence of particle superposition effects.

All manifest and observable phenomena are different kinds of excited states of the same CTF (EM waves & particles), all of which are mutually interacting and undergoing rule-driven transformations obeying the law of conservation of energy. Asymmetry drives perpetual evolution (transformations). Intrinsic dialectical interaction properties and complexities create diversity, which assures continuous evolution, slow enough for biological lives to enjoy the processes and even learn and visualize the processes!

PREAMBLE

- 1. Optical science and engineering have been playing the key enabling roles behind the continuous advancement of physics since ancient times. It has been the strongest guiding and enabling scientific discipline since ancient times. While the mainstream physics has become stagnant for decades, optical science and engineering has been steadily adding many new fields, like Nanophotonics, Plasmonic Photonics, Opto-Genomics, etc.

- 2**. Recent publications by physicists Smolin, "Trouble with Physics", 2007 & Hossenfelder, "Lost in Math", 2018, are deeply troubling for the future of Physics** & our credibility as the gatekeeper of the enabling knowledge of Optical Physics. **These are very valuable critical books, but do not define the path for our corrective journey. This is in contrast to my book: "Causal Physics: Photon by Non-Interaction of Waves", Taylor & Francis, 2014.**

- **3. Quicycle talks, that I have listened to, are definitely breaking new grounds. I have a lot to understand and learn.**

- 3. Huygens' secondary wave postulate, since 1690, has been the key tool that has been driving continuous & un-interrupted growth in optical sciences. Huygens' core contribution is the process driven thinking about waves before Maxwell's wave equation came along. This PROCESS driven thinking is the key tool that modern physicists have been benignly neglecting.

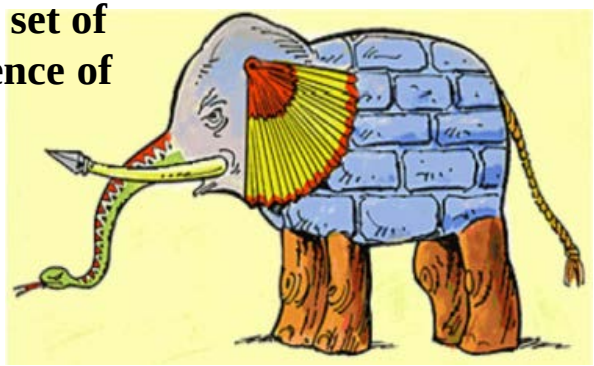
We are all "blind"

The classic allegorical story of 5 blind men and an elephant!

Key bottlenecks can be overcome only by continuous iterations, not by revolutions of "paradigm shifts".

- No sensor can gather all the relevant information ever !
- No theory can be complete (Godel's "Incompleteness")!!
- All "working theories are necessarily incomplete"!!!
- Evidence based science is never the final science!!!!

We must iterate, iterate, iterate, …., towards creating a single unified set of postulates that allows the emergence of different working theories



- Gather diverse input.
- Visualize conceptual continuity among the diverse interaction processes..
- Refine the concept by imposing logical congruence between many observations.

The purpose of Physics is to model, validate & understand physical interaction processes behind natural phenomena

- All species have been evolving as creative engineers emulating nature-allowed/guided processes. The molecular engineering skills of viruses exceed those of human PhD's! Many species of ants are far superior architects than the humans! They live in perfect harmony with nature without de-stabilizing it.
- Collectively, we have been taking arrogant pride in our progress while de-stabilizing the biosphere in the name of our current technology driven economic system. The dominant current tendency is to hang on our current mode of living! This is certainly not a sign of collective intelligence..
- **The primary responsibility of physicists should be to adopt the *system engineering thinking* & add value to the sustainable evolution of the biosphere.**
- We cannot afford to keep waiting for "Paradigm Shifts" for a century or more for new breakthroughs. We must adopt the philosophy of continuous and iterative modification of all "working theories", while continue to integrate the separate sets of fundamental postulates behind the individual working theories into a single set of grand unified postulates.
- **There is a need for an urgency of Evolution Process Congruent Thinking in physics.** This is an advocacy to elevate the prevailing abstract physics-thinking towards functionally useful system engineering thinking. If nature is a system engineer; we are better off by becoming conceptual and hands-on reverse engineers!

Impact of Non-Interference (non-interaction) of Waves (NIW)

Impacts in Classical Physics

1. **Spectrometry:** The resolution limit $\delta\nu\delta t \geq 1$ is not a principle of nature.
2. **Coherence:** Waves are never incoherent. Visibility (correlation) is determined by the time constant of the detecting system.
3. **Polarization:** NIL implies superposition of orthogonally polarized beams cannot generate elliptically rotating E-vector.
4. **Mode locking:** A laser pulse is generated by "time gating" of saturable absorber, not locking of modes
5. **Pulse broadening:** Is due to time diffraction, not due to dispersion of Fourier frequencies.
6. **Fourier transform & light beating spectroscopy** determine real carrier frequencies, not Fourier frequencies.

Impact in mathematical framing of physics problems

Mathematical operating symbols should be carefully tied with transformational interactions

The time-frequency Fourier theorem is not a principle of nature!
No natural interactions create Fourier frequencies out of a pulse nor create a pulse out of Fourier frequencies.

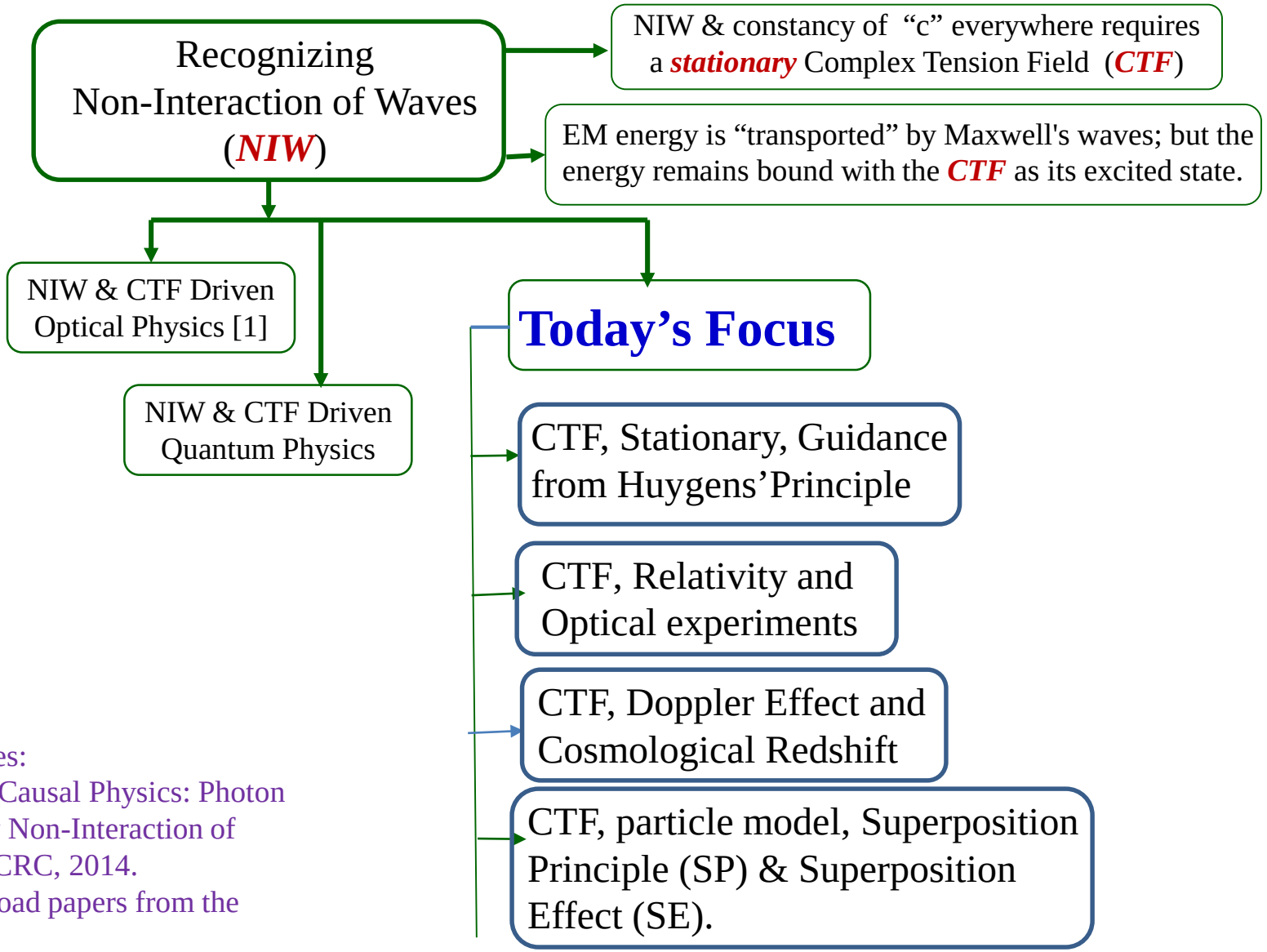
Wiener-Khintchine theorem – Fourier spectral density and autocorrelation functions form a "Fourier transform pair" – is based on non-interference of Fourier sinusoids!

More to come!

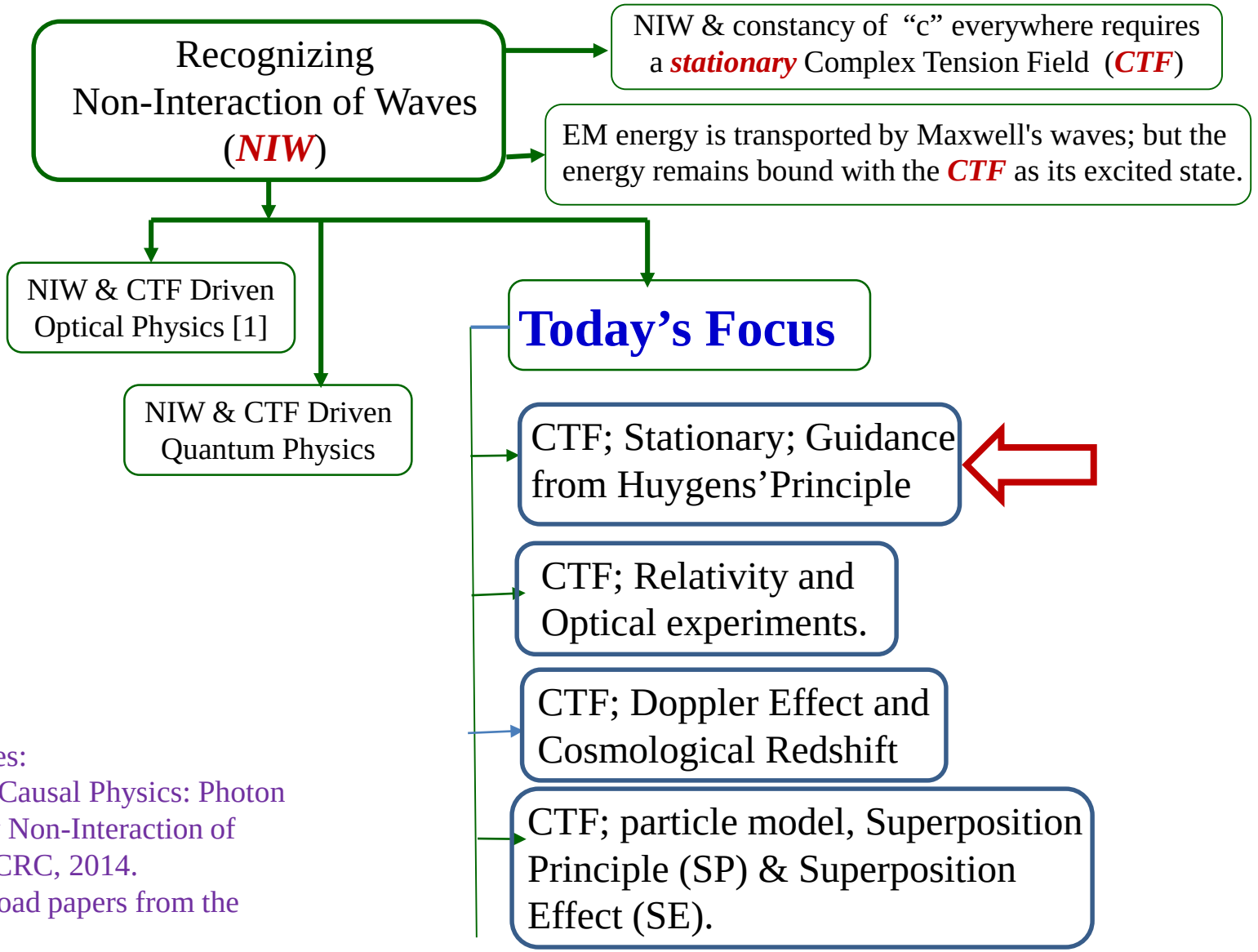
Impact in Quantum Physics

1. Photons are divisible & summable in light-matter interactions.
2. Dirac's "photons" do not conform to causality & energy conservation
3. Classical photon as an exponential wave packet conforms to quantum predictions: $\Delta E_{mn} = h\nu_{mn}$
4. A photon cannot interfere with itself. "Which way?" photon travels, is a meaningless question.
5. Bell's Inequality theorem is inapplicable to superposition effects due to photons.
6. Indivisible entangled single photon interference does not exist

C. Roychoudhuri, "Consilient Epistemology", in Proceedings of the first interdisciplinary CHESS interactions conference", World Scientific, 2009,



References:
1. C.R., "Causal Physics: Photon Model by Non-Interaction of Waves", CRC, 2014.
2. Download papers from the website:
http://www.natureoflight.org/CP/



References:
1. C.R., "Causal Physics: Photon Model by Non-Interaction of Waves", CRC, 2014.
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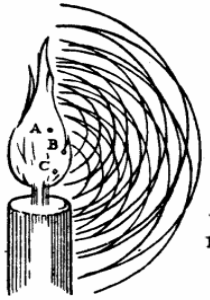
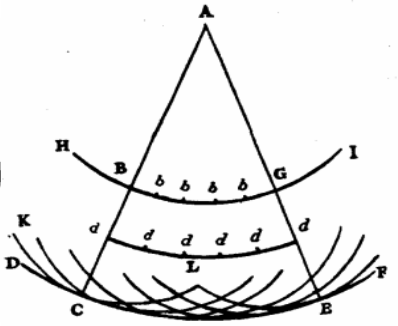
Huygens' 1690 book explicitly underscored the wave propagation process:

(1) Each point is a secondary source, hence holds tension energy. (2) Diffractively evolves through each other unperturbed. (3) Hence the assertion, Non-Interaction of Waves (NIW).

1629–1695





$$\Psi(P_0) = \frac{-i}{\lambda}\iint_{\Sigma} U(P_1)\frac{\exp(ikr_{01})}{r_{01}}\cos\theta\, ds$$

Huygens-**Fresnel** Diffraction integral explicitly accommodates NIW (1817).

Only interacting materials, **undergoing square modulus energy transfer,** can display the presence of light beams as different kinds of physical transformations. The **energy transfer process** must incorporate the detector's interaction parameter, the dipolar polarizability,

$$D(x,y,z) = \Psi * \Psi = \left|\frac{-i}{\lambda}\iint_{\Sigma} \chi(\lambda) U(P_1)\frac{\exp(ikr_{01})}{r_{01}}\cos\theta\, ds\right|^2$$

The NIW-property is true for all linear waves: Case for water surface tension waves.

Before crossing

Just crossing

Well into crossing

Propensity of water waves to perpetually expand as circular wave packet remains unperturbed even when two wave groups cross through each other.

Appreciation: (i) Michael Ambroselli, my past PhD student, for video recording and processing. High School student, David Park, for helping me carry out these experiments, including the next slides on material based waves..

The NIW-property is true for all linear waves: Case for water surface tension waves (video).

Appreciation: (i) Michael Ambroselli, my past PhD student, for video recording and processing. High School student, David Park, for helping me carry out these experiments, including the next slides on material based waves..

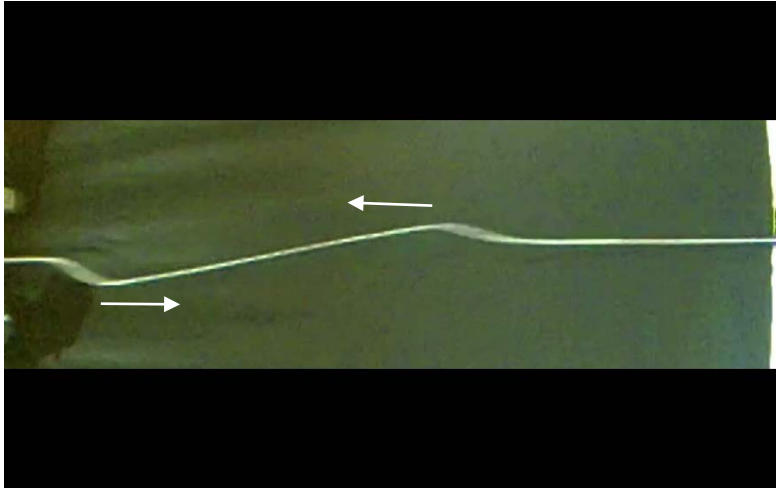
The NIW-property is true for all linear waves:

Case for the mechanical tension wave in a spring.

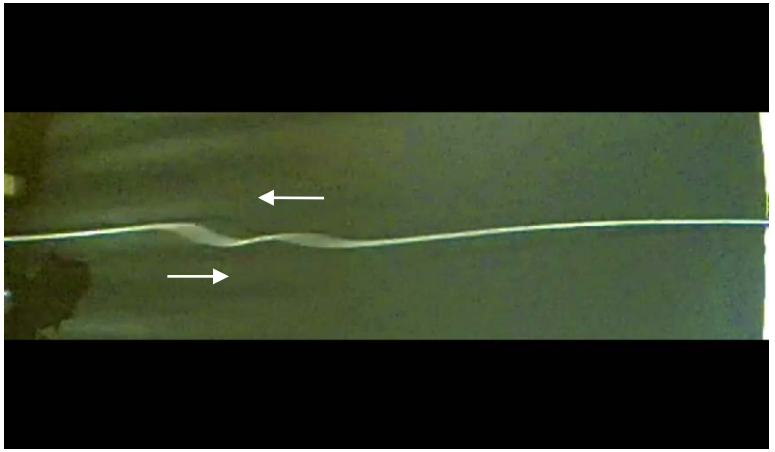
Propensity of string waves to perpetually propagate along the string-tension, remains unperturbed even when two wave-pulses cross through each other.

Appreciation: (i) David Park, a high school student for diverting me to use spring instead of rope. (ii) Michael Ambroselli for video recording and processing.

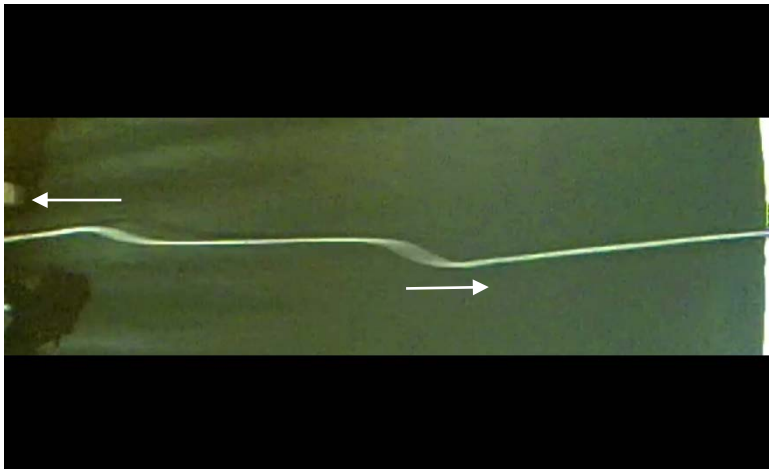
Wave pulses approaching.



Wave pulses about to cross.

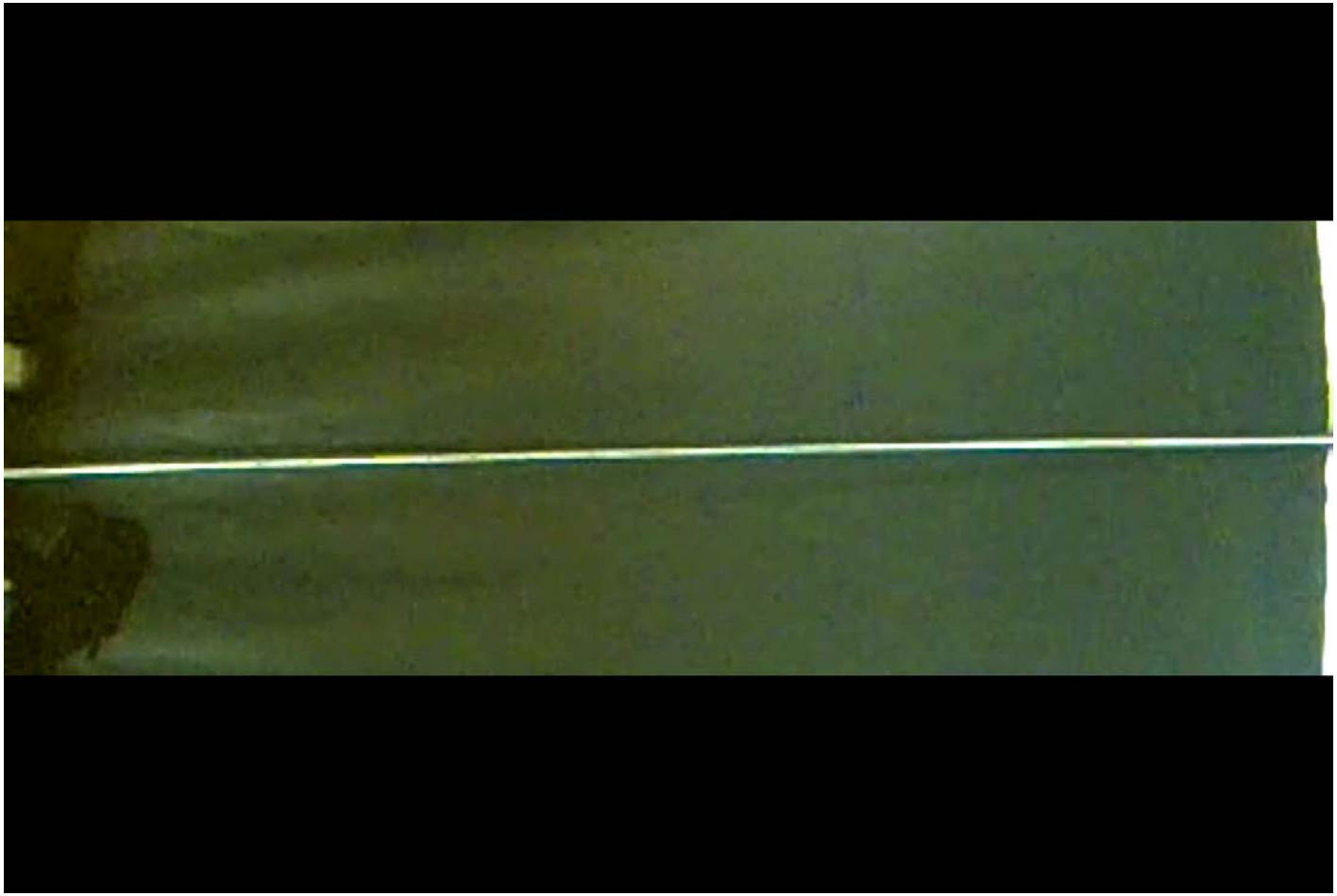


Wave pulses have crossed through.



The NIW-property is true for all linear waves: Case for the mechanical tension wave in a spring (video).

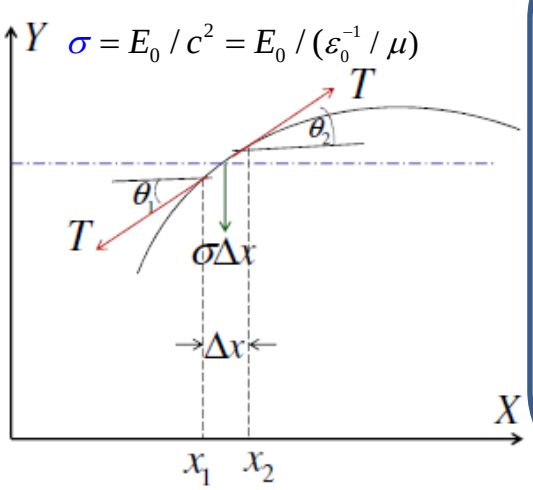
The wave-energy resides in the stressed medium that holds the tension field.



Appreciation: (i) David Park, a high school student for diverting me to use spring instead of rope. (ii) Michael Ambroselli for video recording and processing.

Deriving EM wave equation as per classical string wave model assuming CTF possesses electric & magnetic tensions.

Inertial resistance,



String wave derivation:

$\sigma a = F$; or, $E_0 / (\varepsilon_0^{-1} / \mu_0) a = F$, where $\sigma = E_0 / c^2$.

The wave equation for a string under tension is derived by equating two balancing forces. Inertia times acceleration of an elemental string length equals the restoring tension force. Displacement of string position is "y".

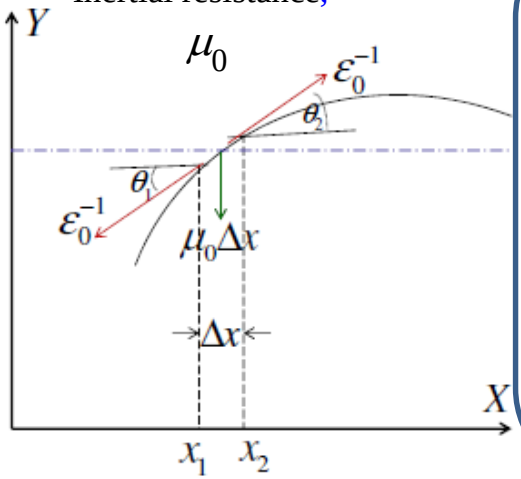
$$\sigma\Delta x \frac{\partial^2 y}{\partial t^2}(x,t) = \Delta_x (T \sin\theta) \approx T\Delta_x (\frac{\partial y}{\partial x})$$

Inertial resistance to material movement.

$$\sigma\Delta x \frac{\partial^2 y}{\partial t^2}(x,t) = T\Delta_x \frac{\partial y}{\partial x} \Rightarrow \frac{\partial^2 y}{\partial t^2}(x,t) = \frac{T}{\sigma}\frac{\partial}{\partial x}\frac{\partial y}{\partial x}(x,t) = \mathrm{v}^2 \frac{\partial^2 y}{\partial x^2}(x,t)$$

$$\frac{\partial^2 y}{\partial t^2} = \mathrm{v}^2 \frac{\partial^2 y}{\partial x^2}; \quad \mathrm{v}^2 \equiv T / \sigma$$

Inertial resistance,



EM wave derivation as per string model:

The wave equation for "vacuum" under tension is derived by equating two balancing forces. Mass times acceleration of an elemental string length equals the restoring tension force. Displacement of string position is "y".

$ma = F$

$$\mu_0\Delta x \frac{\partial^2 y}{\partial t^2}(x,t) = \Delta_x (\varepsilon_0^{-1} \sin\theta) \approx \varepsilon_0^{-1}\Delta_x (\frac{\partial y}{\partial x})$$

Inertial resistance given by generated magnetic field.

$$\mu_0\Delta x \frac{\partial^2 y}{\partial t^2}(x,t) = \varepsilon_0^{-1}\Delta_x \frac{\partial y}{\partial x} \Rightarrow \frac{\partial^2 y}{\partial t^2}(x,t) = \frac{\varepsilon_0^{-1}}{\mu_0}\frac{\partial}{\partial x}\frac{\partial y}{\partial x}(x,t) = c^2 \frac{\partial^2 y}{\partial x^2}(x,t)$$

$$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}; \quad c^2 \equiv \varepsilon_0^{-1} / \mu_0$$

What can we learn from the comparison between mechanical string & EM wave equation?

Distinguishing the origin of inertial properties of EM waves vs. particles:

Inertial resistance for particles

$$m = E_0 / c^2 = E_0 / (\varepsilon_0^{-1} / \mu_0)$$

Inertial resistance for EM waves, μ_0

Elementary particles are localized self-looped, in-phase (and hence resonant & stable), EM-wave-like oscillations of the stationary CTF. Thus, CTF provides the platform for the desired unified field theory. Forces are diverse gradients induced on the CTF. 100% energy always resides in the CTF, **hence the law of conservation of energy and the 1st and the 2nd laws of Newton.**

Schrödinger's equation is incomplete as it does not incorporate the dynamics behind the emergence of particles out of the stationary CTF. It provides the external dynamics:

$$\frac{\partial \psi(x,t)}{\partial t} = -\frac{\hbar}{i2m}\frac{\partial^2 \psi(x,t)}{\partial x^2}$$

[+V(x,t) needs to be added to move a particle!]

It does not directly represent propagation of any waves manifest in any tension field. There is no acceleration term or second derivative of a physical parameter w.r.t. time! **Particles need potential gradients to move**.

Primary school experiments tell us:

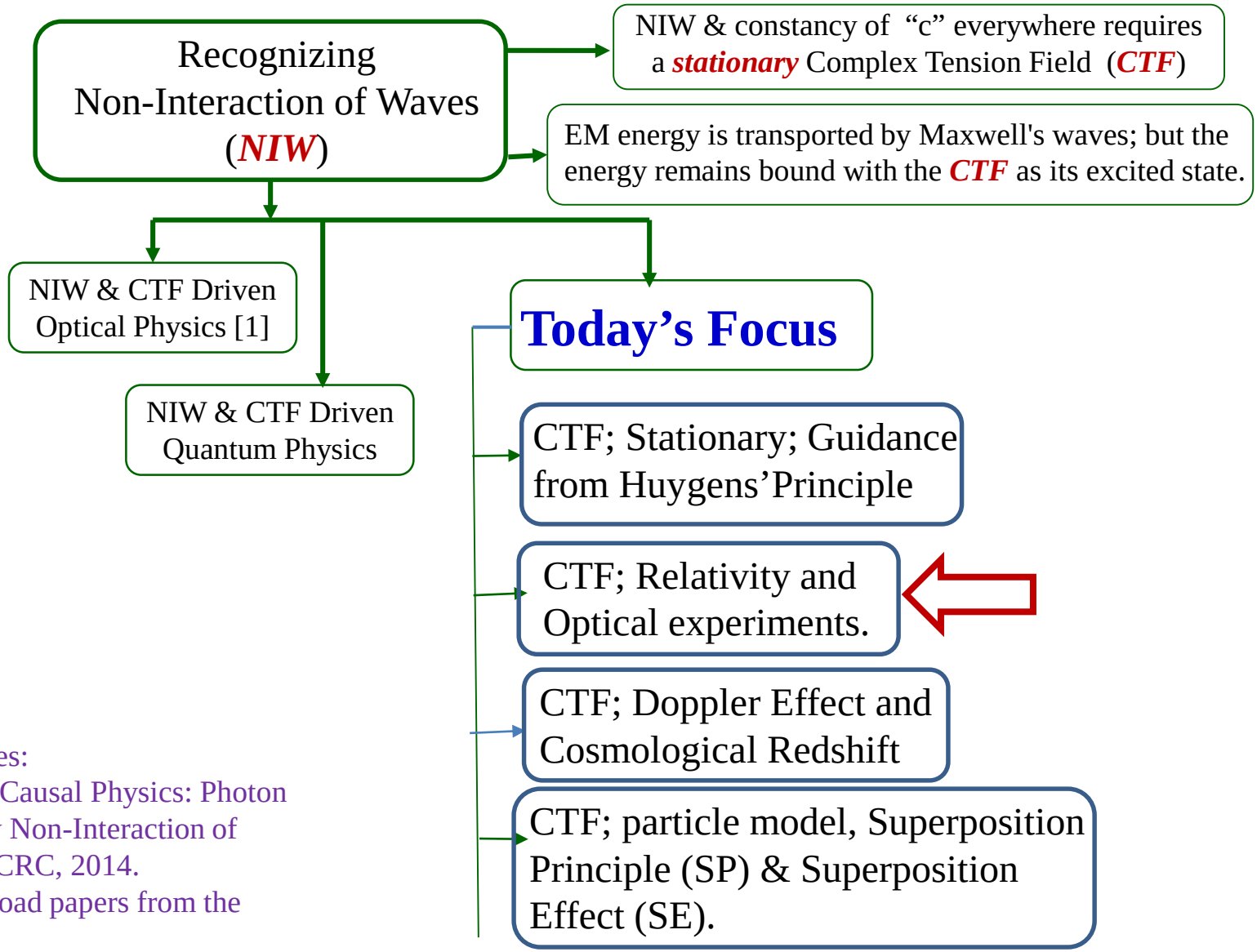
Space is a modifiable “medium”!

Annular magnets with opposite polarity attracts each other.

Annular magnets with same polarity repels each other. Space between them has “magnetic tension” that helps the upper magnet floating against gravitational tension.

A still blade changes the “magnetic tension” from repulsive to attractive by creating opposite polarities on its two sides.

An wooden blade, being “non-magnetic” does not alter the “magnetic tension” of the space.



References:
1. C.R., "Causal Physics: Photon Model by Non-Interaction of Waves", CRC, 2014.
2. Download papers from the website:
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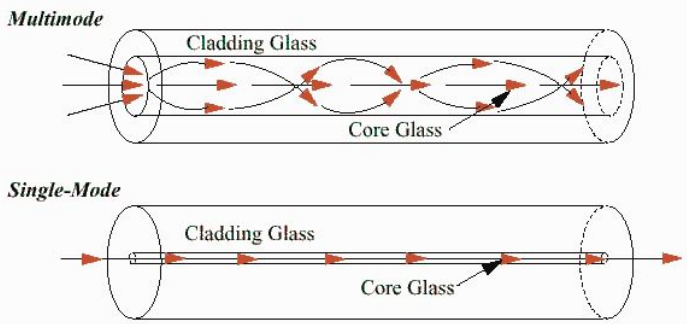
EM wave vector remains trapped by the medium it travels through

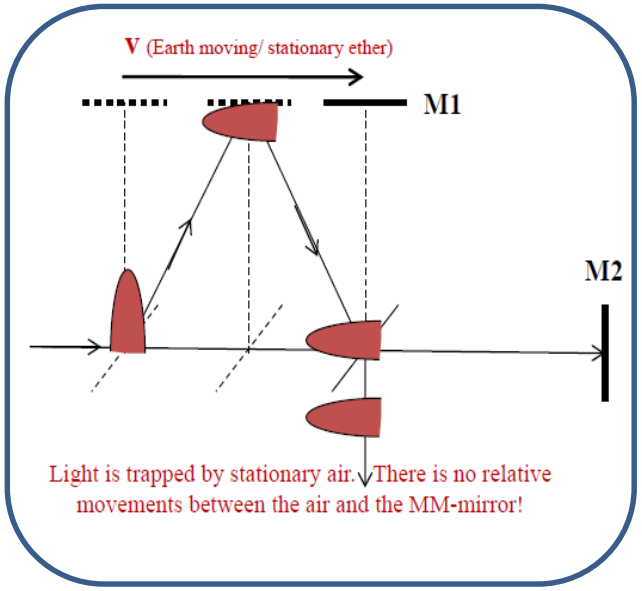
1. M-M Experiment could not have detected even if there were “ether drag” through the stationary air in the lab.
2. Fresnel Drag in a moving medium, measured by Fizeau is a classical phenomenon due to moving bulk dipole assembly (Panofsky & Philips)
3. Fresnel drag is zero when materials of different index is used as relatively STATIONARY media in the interferometer.
4. Interferometry, measuring relative phase difference, would not be able to discern CTF (or ether) drag.
5. **We need to develop an alternate experimental technique, while appreciating the basic physical process of wave propagation.**

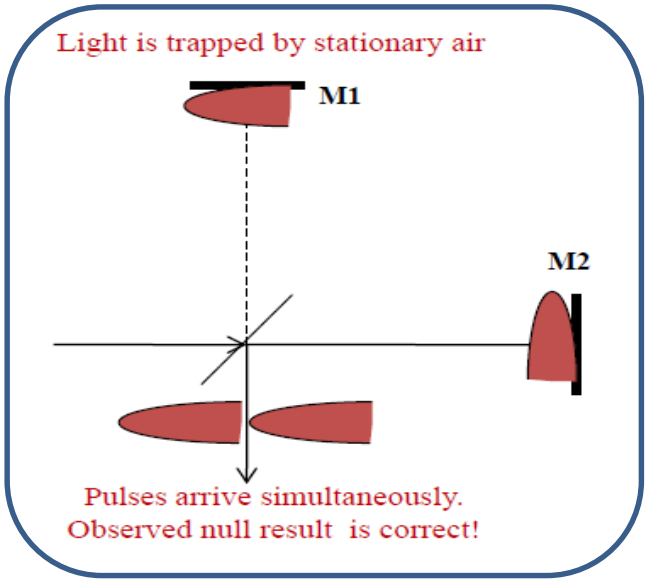


Fresnel drag cannot be induced by earth’s motion. Otherwise, transpacific fiber communications would have had problems!

Wave propagation is due to “perpetual push forward by the tension field of the excitation imposed on it. In a glass fiber, glass IS the EM tension field with reduced tension than the material-free CTF. Imagine the differential delays between E-W vs W-E we would have been experiencing in intercontinental fiber-optic communication due to Earth’s 30,000km orbital velocity! That is why fiber-gyroscopes work.

With stationary air on the lab table, only null results can be obtained by Michelson-Morley type of experiments.
The vertical beam does not travel a longer triangular path!





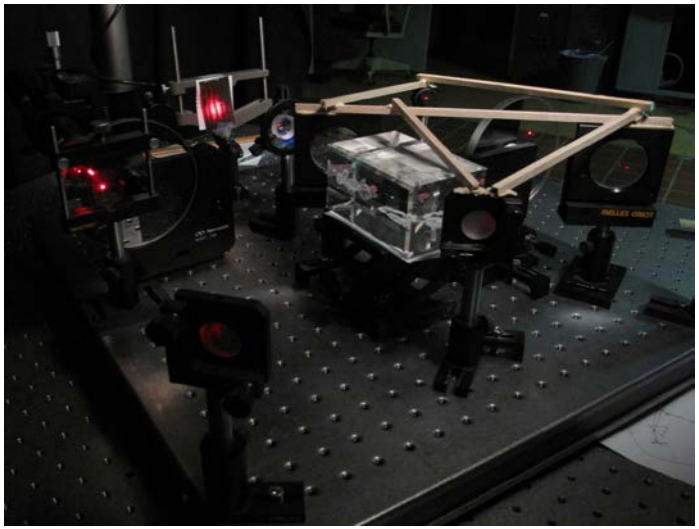
Light beams, trapped by stationary lab air, cannot travel in a triangular path!

Light beams travel straight back and forth taking equal time. **Hence the null result!**

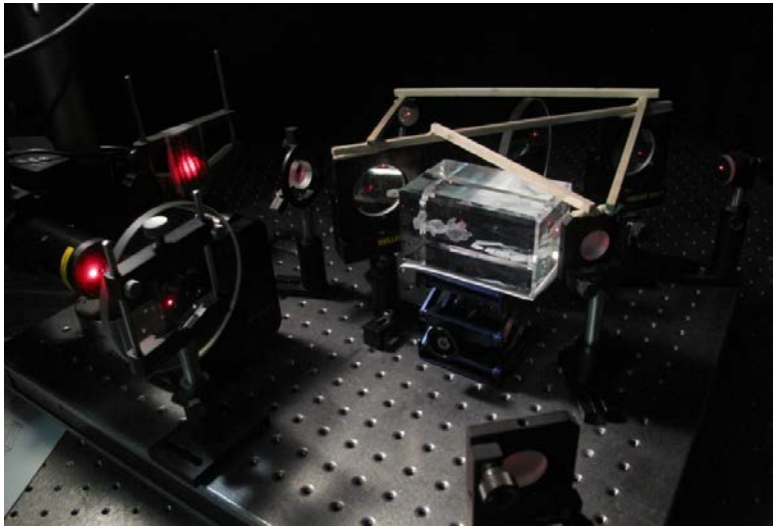
No need to introduce the ad hoc length contraction and time dilation.

Can the differential Fresnel drag due to relatively stationary glass (n=1.5) and air (1.0003) due to the earth's orbital velocity around the Sun?

Mach-Zehnder interferometer, *does not produce differential fringe shift* due to a 10cm glass block moving with a velocity of 30km/s with the earth as its orbital motion around the Sun.



Light traveling from West to East

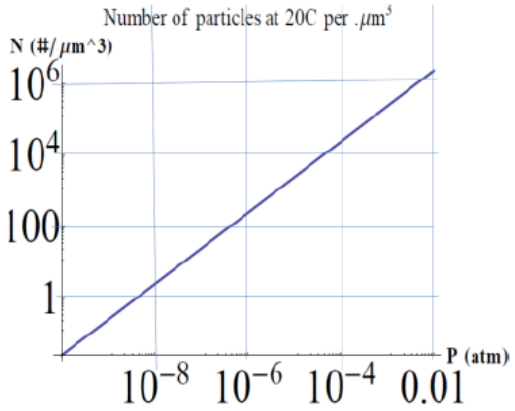


Light traveling from East to West

Null Fresnel drag implies that an assembly of material dipoles (a material medium) completely controls the propagation of EM excitation. This was the original interpretation of Fresnel (Panofsky & Phillips). This also indirectly validates my postulate that material particles are localized self-looped excited states of CTF.

Nothing to do with Relativity!

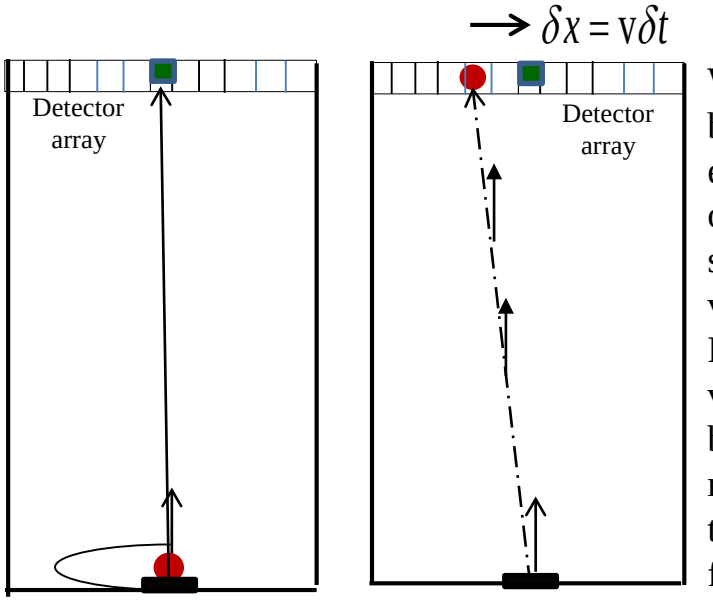
Proposed space-based, or super-vacuum chamber-based experiments to test CTF drag



Even a few molecules per lambda-cubed volume can trap the Poynting vector.

Light pulse propagation is dictated by the CTF in free space

If there is no CTF drag inside the super vacuum chamber on earth due to earth's orbital velocity.



When the box is in the empty space on a moving satellite, the vertical Poynting vector falls behind with respect to the box frame.

Measuring stationary CTF in deep space on a satellite and measuring CTF-drag or CTF-non-drag inside super vacuum chamber on earth.

- Exploit earth's orbital velocity 30km/s
- Use "centering" detector array of pitch 100 micron.
- The necessary distance between the pico second pulsed diode and the detector array should be a minimum of 1meter. For 1 pixel shift in the arrival of light.

Consequences of CTF in Special Relativity

- **1. How does CTF model influence the two key postulates of the SR?**

CTF accommodates them automatically.

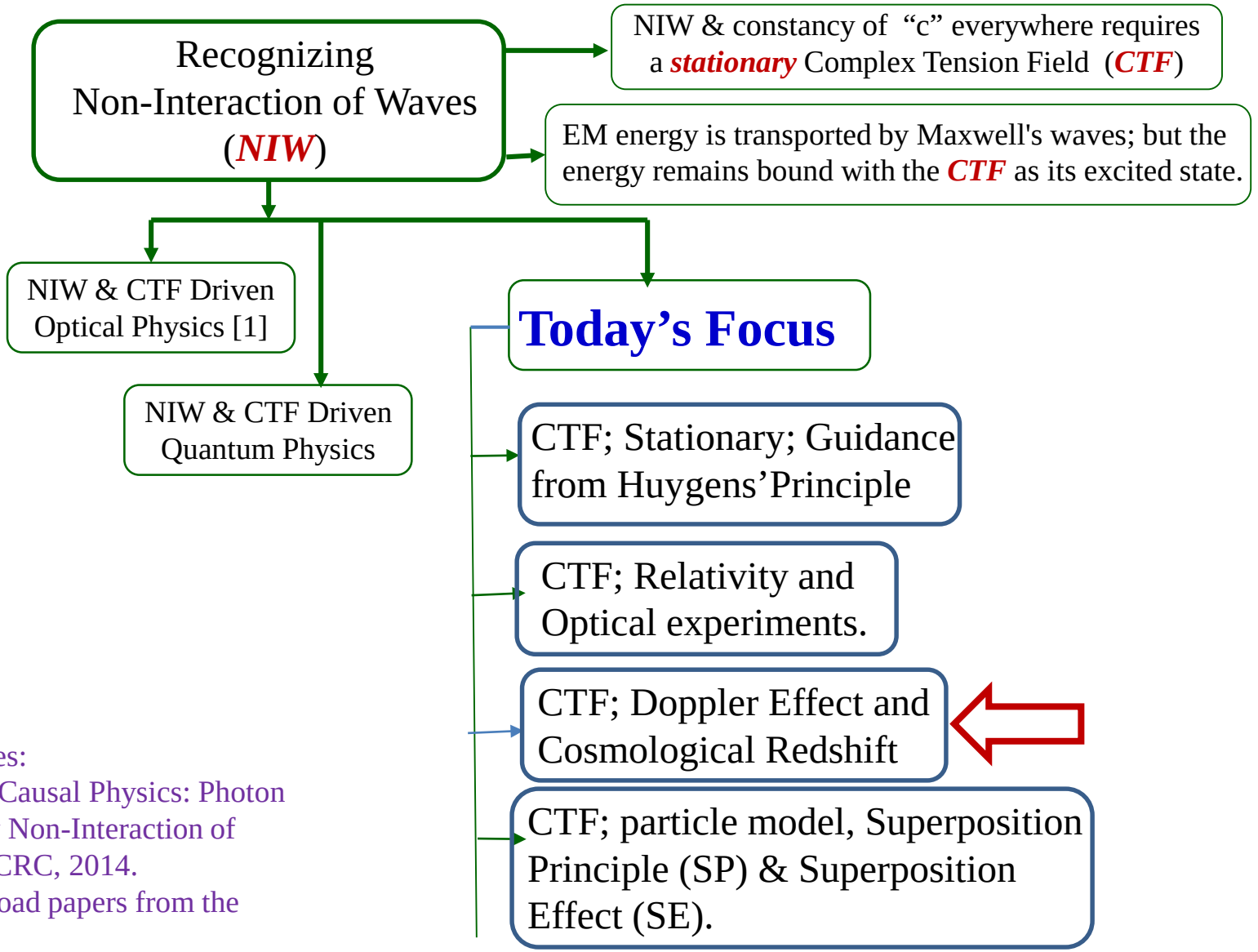
(i) c-constant everywhere – Romer derived the velocity of light with this assumption using the relative delays in seeing the moons of Jupiter..

(ii) Laws of Physics are same everywhere – Fraunhofer's interpretation of the Steller dark lines already validated that.

- **2. Is space-time 4D real?**

The universe is a 3D system as we perceive it with our daily experience.

The running time "t" is not a primary characteristic parameter of any physical object in this universe. It is indirectly derived from frequency, which is a physical parameter of most of the fundamental entities in this universe.



References:
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Impacts in Cosmology

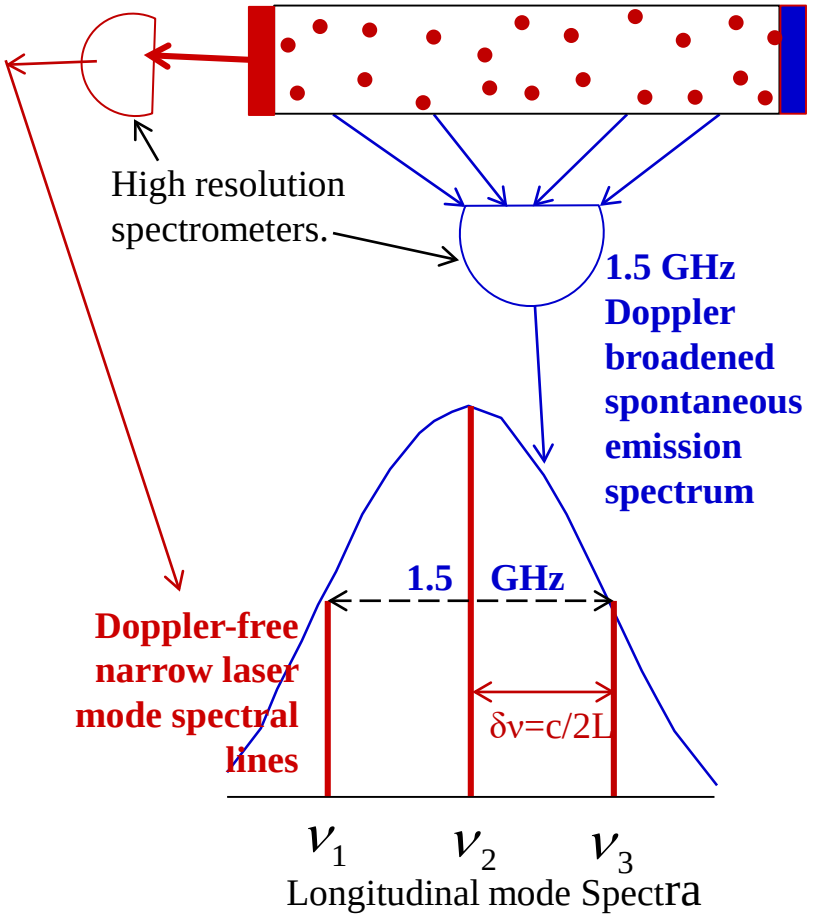
- 1. Understanding the physical process steps behind the Doppler shift induced line broadening implies: (i) Absolute velocity of a star is determinable, and (ii) the Cosmological (Hubble) Redshift cannot be due to Doppler Effect.

- 2. Expansion of the universe to generate CMBR threatens the constancy of the velocity of light, since the tension properties of the medium must also change with the expansion of CTF:

$$c = (\varepsilon_0^{-1} / \mu_0)^{1/2}$$

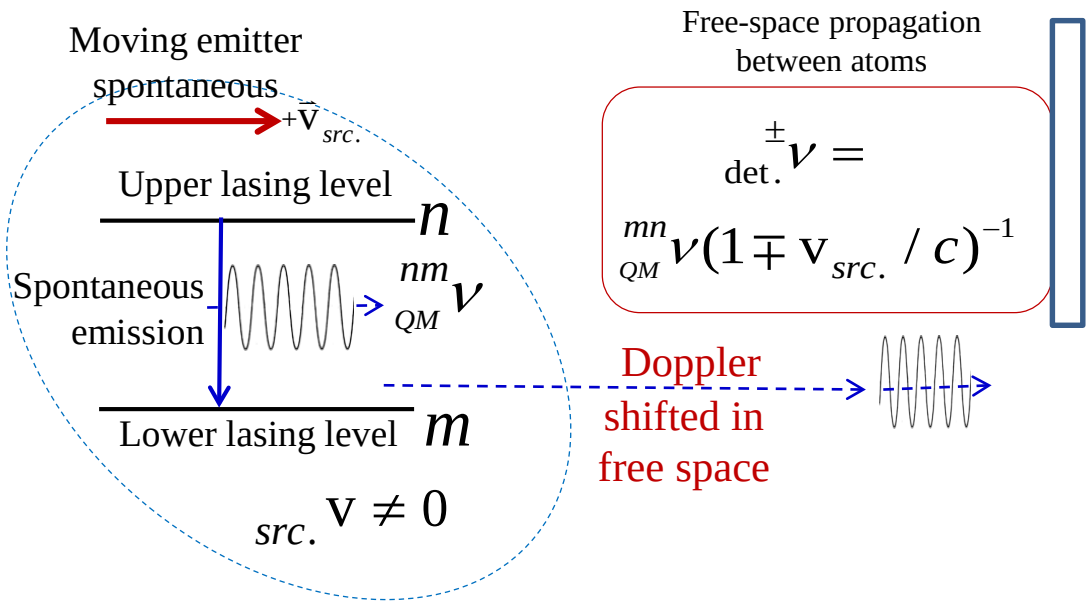
The stationary CTF-model reveals that the emergence of the Doppler Shifts due to source velocity and the detector velocity are due to distinctly different physical processes. Unfortunately, it challenges the postulate, Cosmological Redshift, as a Doppler Effect.

Simultaneous spectral analysis of spontaneous and stimulated emissions from Ne-atoms from a He-Ne laser



- Einstein's "process driven thinking" on light emissions yielded the concept and theory (A & B coefficients) behind the stimulated emission, different from spontaneous emission.
- The atom sending out the spontaneous wave packet can stimulate an excited atom to emit a stimulated wave packet only if their velocity vectors are identical.
- Atoms are surrounded by the same stationary CTF whether they are emitting light from a distant star or an earth-based laboratory discharge tube.
- EM waves & particles being the excited states of the same stationary CTF, the laws of natural phenomena are the same in this universe.

Spontaneous & stimulated emissions tell us that the source & detector velocities are discernible for actual & apparent Doppler Shifts!

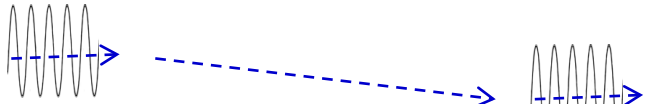


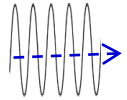
C.R., “Hijacking of the 'holographic principle' by cosmologists”; Proc. SPIE Paper #8833-15

Spontaneous & stimulated emissions tell source & detector velocities are discernible for actual & apparent Doppler Shifts!

The vectorial velocities must be same.

Doppler shifted stimulating photon





Moving emitter stimulated $v_{det.}$

Upper lasing level n

Perceived frequency $\overset{nm}{}_{QM}\nu$

Lower lasing level m

$v_{src.} \neq 0$

$$\overset{}{}_{det.\pm}\nu = \overset{}{}_{med.}\nu(1 \pm v_{det.}/c)$$

$$= \overset{nm}{}_{QM}\nu \frac{(1 \pm v_{det.}/c)}{(1 \mp v_{src.}/c)}$$

$$= \overset{nm}{}_{QM}\nu; \quad \text{for } \vec{v}_{det.} = \vec{v}_{src.}$$

Relative axial vectorial velocity must be zero for effective QM resonance.

Internal quantum transition frequency always remain same. Or, Does it change with high velocity?

Stimulated photons in free-space with the same Doppler shifted frequency to match the cavity-allowed $c/2L$ modes.

C.R., "Hijacking of the 'holographic principle' by cosmologists"; Proc. SPIE Paper #8833-15

Stimulated emission tells source & detector velocities are discernible!

Moving emitter spontaneous

Upper lasing level n

Spontaneous emission ν_{QM}^{nm}

Lower lasing level m

$\nu_{src.} \neq 0$

Free-space propagation between atoms

$$\nu_{det.}^{\pm} = \nu_{QM}^{mn}(1 \mp \nu_{src.}/c)^{-1}$$

Doppler shifted in free space

Stimulated photons in free-space with the same Doppler shifted frequency to match the cavity-allowed $c/2L$ modes.

Moving emitter stimulated

Upper lasing level n

Perceived frequency ν_{QM}^{nm}

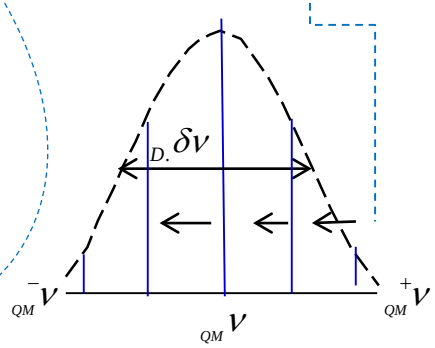
Lower lasing level m

$\nu_{src.} \neq 0$

$$\nu_{det.\pm} = \nu_{med.}(1 \pm \nu_{det.}/c) = \nu_{QM}^{nm}\frac{(1 \pm \nu_{det.}/c)}{(1 \mp \nu_{src.}/c)} = \nu_{QM}^{nm}; \quad \text{for } \vec{\nu}_{det.} = \vec{\nu}_{src.}$$

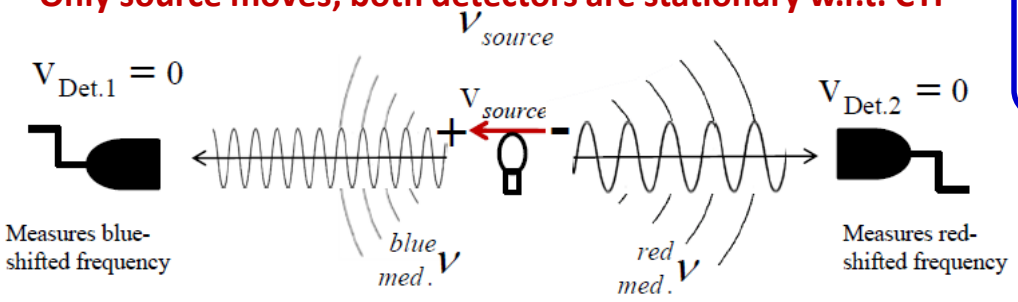
Internal quantum transition frequency always remains same.

Relative axial vectorial velocity must be zero for effective QM resonance.



Measurable physical Spectrum

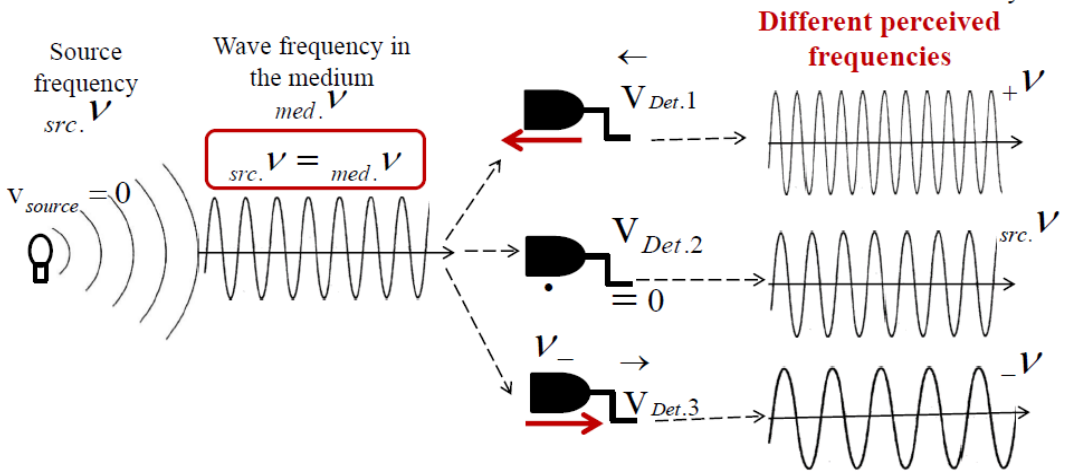
Only source moves; both detectors are stationary w.r.t. CTF



Stationary CTF allows the determination of absolute velocities

$$ {}_{med.}\nu = {}_{sorc.}\nu(1 \mp v_{sorc.}/c)^{-1} $$

Detectors move with different velocities in the medium. The source is stationary.

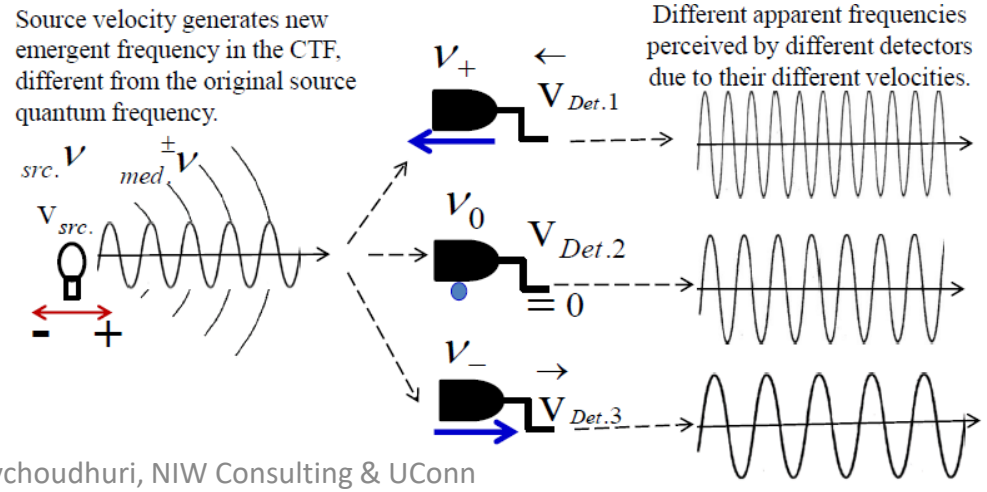


$$ {}^{\pm}_{det.}\nu = \frac{c \pm v_{det.}}{\lambda_{med.}} = {}_{src.}\nu(1 \pm v_{det.}/c) $$

Both the source & the detectors move w.r.t. the CTF

Source velocity generates new emergent frequency in the CTF, different from the original source quantum frequency.

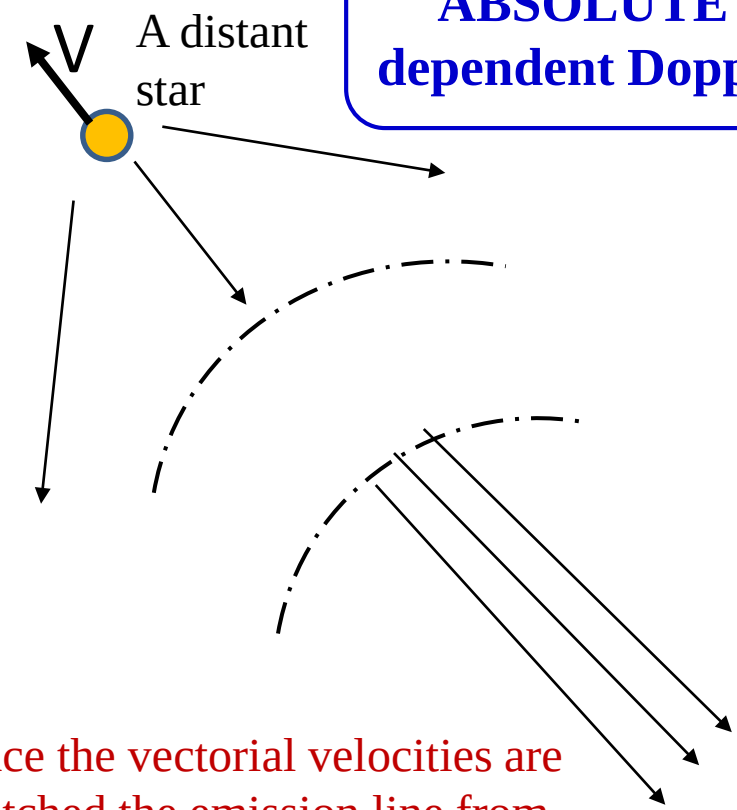
Different apparent frequencies perceived by different detectors due to their different velocities.



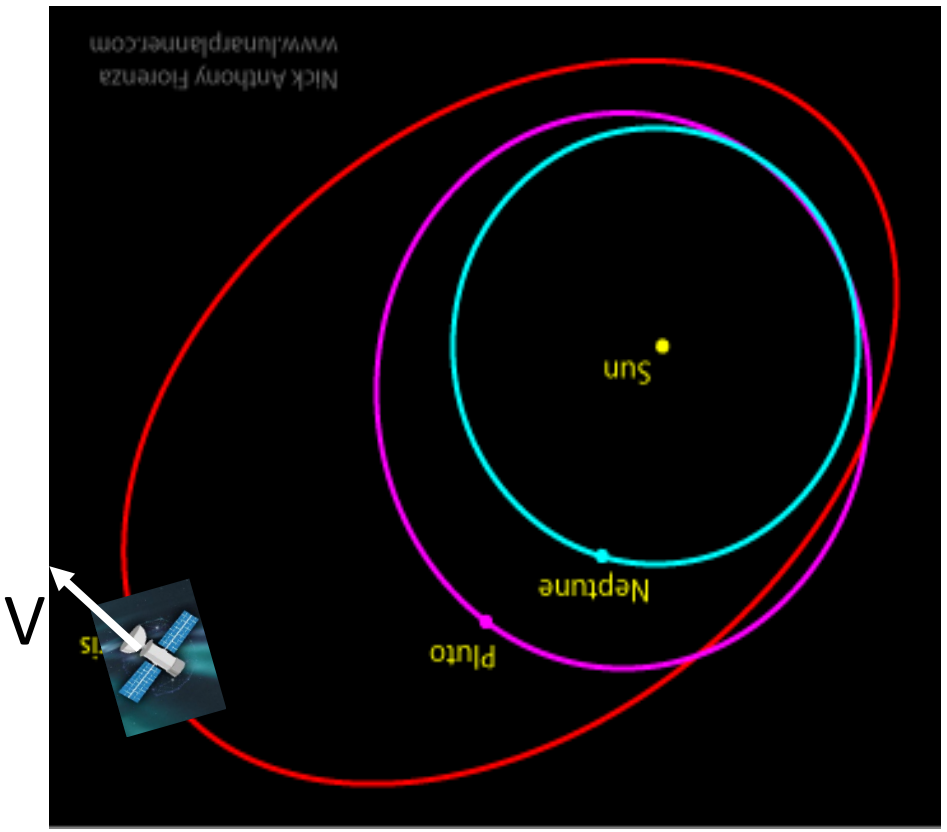
$$ \nu_{det.\pm} = {}_{med.}\nu(1 \pm v_{det.}/c) = {}_{sorc.}\nu \frac{(1 \pm v_{det.}/c)}{(1 \mp v_{src.}/c)} $$

"Can one distinguish between Doppler shifts……"; SPIE Vol. 8832-49 (2013).

A cartoon for a satellite based measurement of the ABSOLUTE velocity of a star by nulling the velocity dependent Doppler shift of a specific atomic emission line.



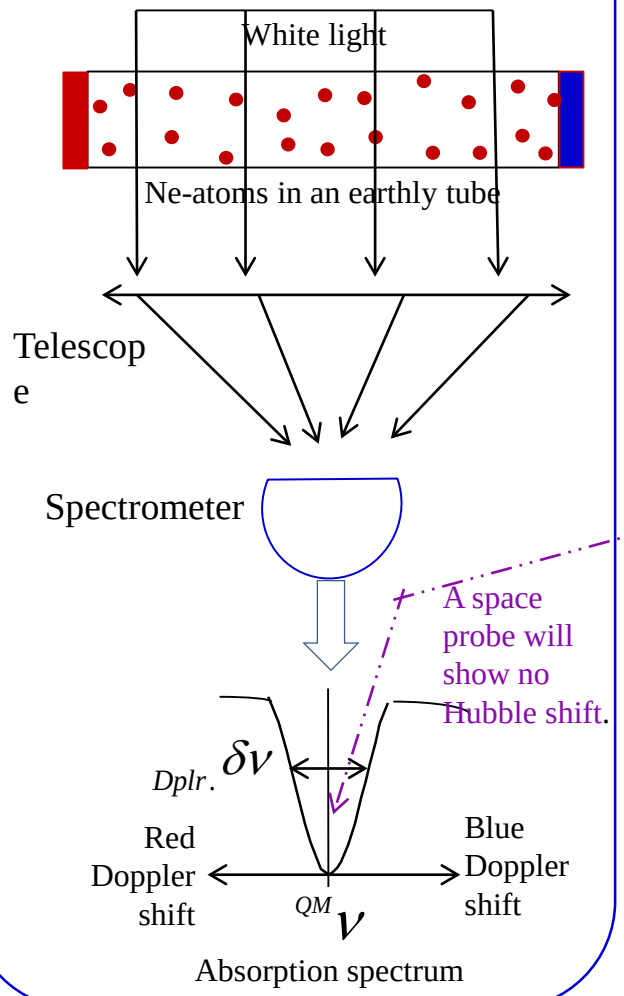
Once the vectorial velocities are matched the emission line from the star will be displayed at the location in the spectrometer that corresponds to the QM predicted emission frequency.



Understanding the physical process steps behind the Doppler-shift-induced line broadening implies Cosmological (Hubble) Redshift cannot be due to Doppler Effect.

Understanding absorption spectroscopy

Lab absorption spectrometry



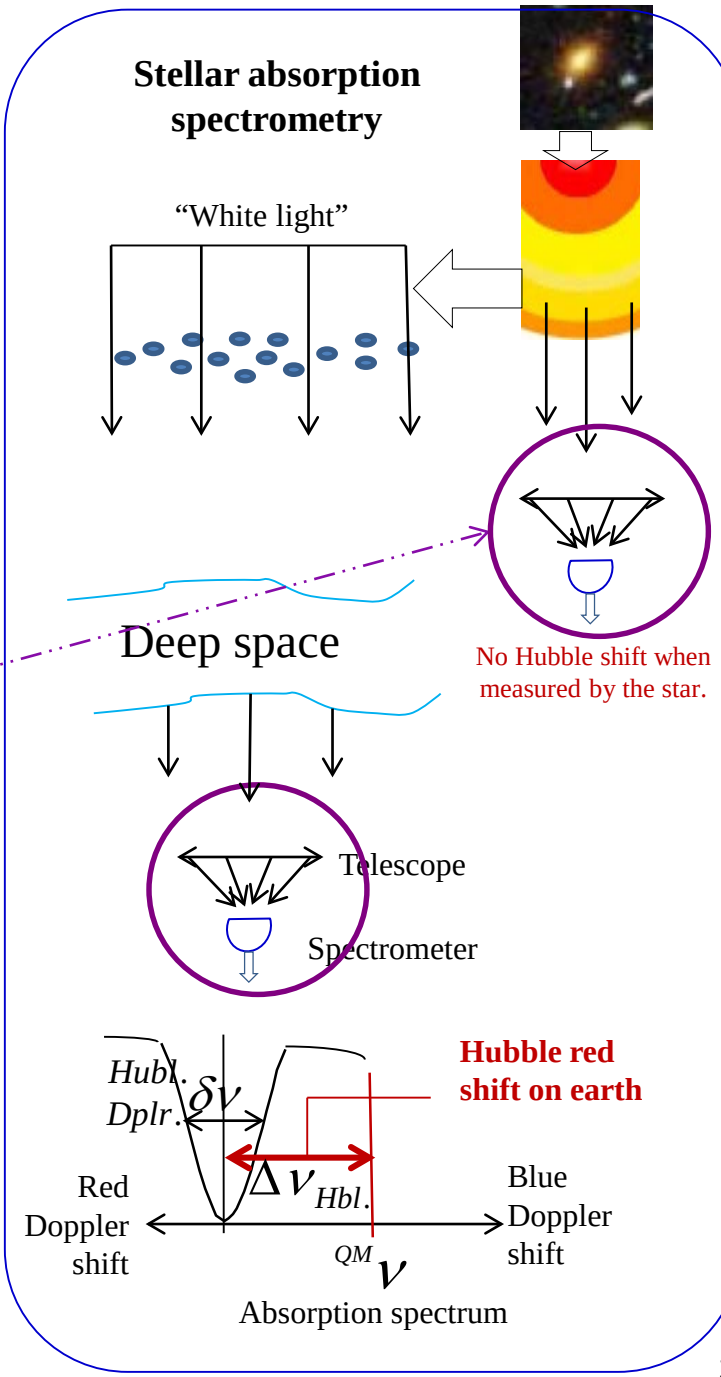
C.R., "Hijacking of the 'holographic principle' by cosmologists"; Proc. SPIE Paper #8833-15

Do the atoms move with respect to the "star-frame", or the "earth-frame", or the "lab-frame" or the "vacuum-frame" (CTF)?

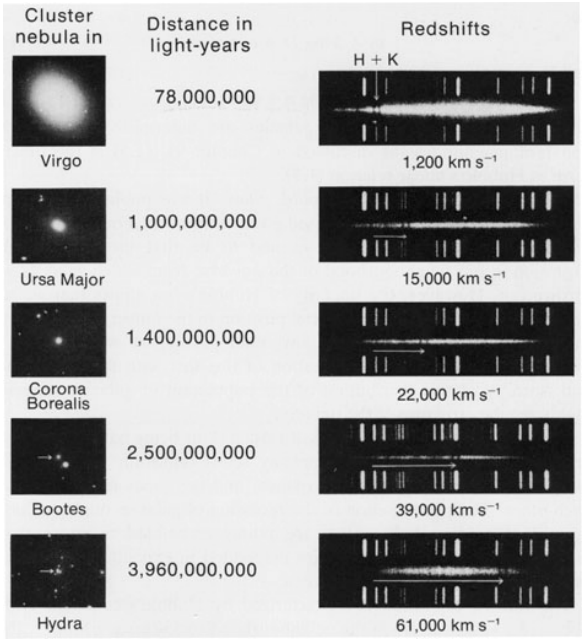
We posit that it is the "Vacuum-frame" (CTF), which is stationary everywhere!

Like the stimulated emission frequency, the absorption freq. is determined by the velocity of the "detector" only!

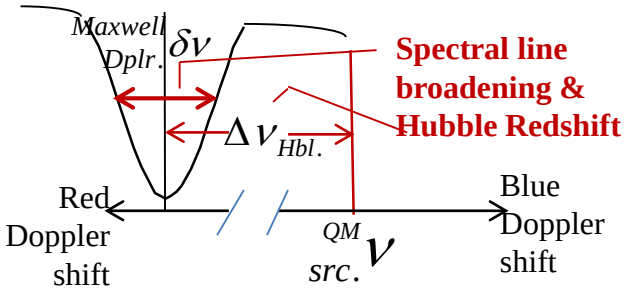
Stellar absorption spectrometry



Absorption lines, a non-signal, cannot undergo physical changes!
Real physical signal is the white light emitted by inner corona of stars!

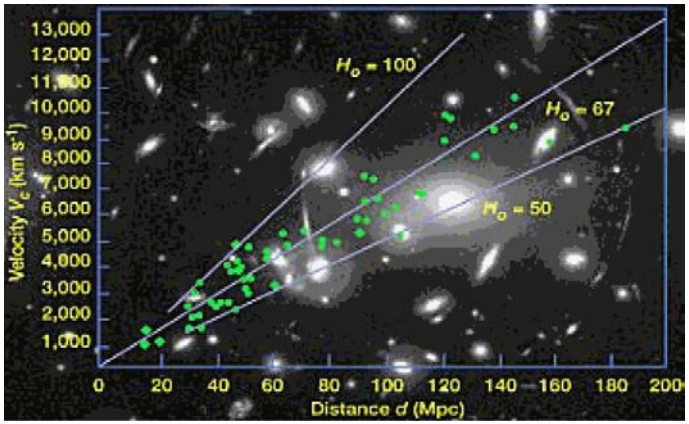


Emission and absorption physical processes are identical in all stars.



Absorption spectrum

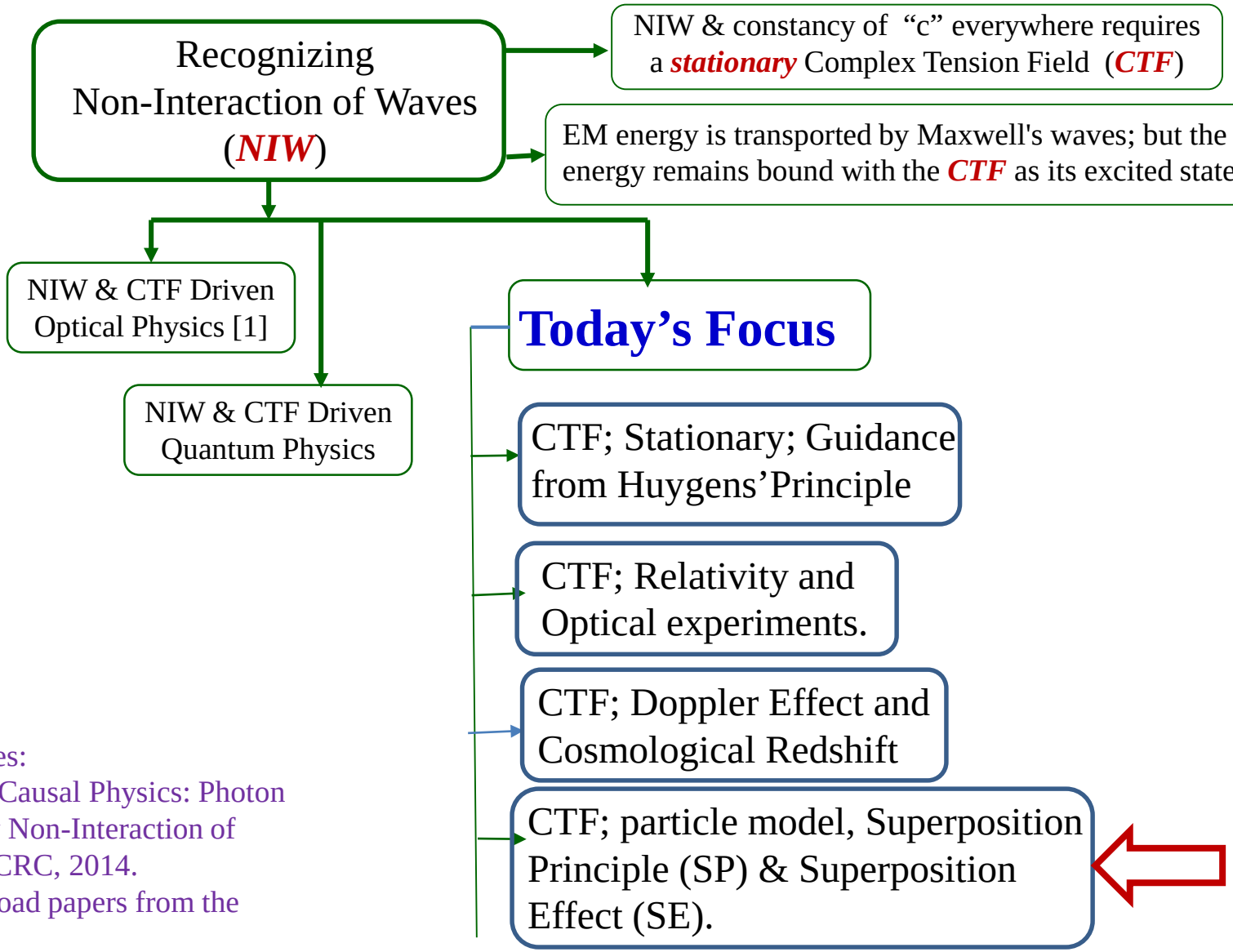
[Hubl. Redshift $\Delta\nu$] Due to travel to earth. $\gg\gg$ [Maxwell Dopler $\delta\nu$] Due to atoms' vel. in star.



http://astro.wku.edu/astr106/H_K_redshift.jpg

We posit that Cosmological (Hubble) Red Shift during cosmic travel of star light is different from source/emitter velocity dependent Doppler shift.
Do we really have an expanding universe?

C.R., "Hijacking of the 'holographic principle' by cosmologists"; Proc. SPIE Paper #8833-15

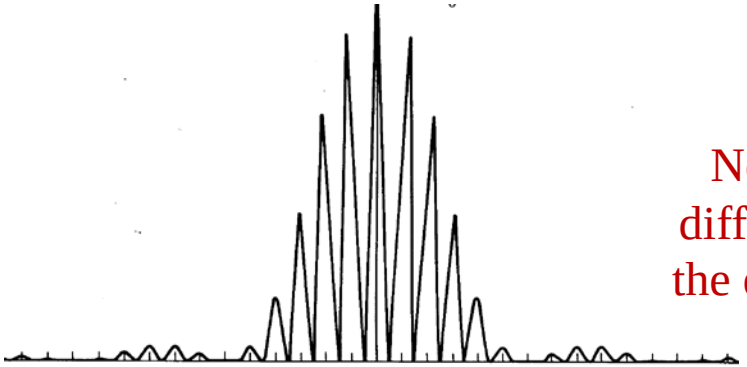


References:
1. C.R., "Causal Physics: Photon Model by Non-Interaction of Waves", CRC, 2014.
2. Download papers from the website:
http://www.natureoflight.org/CP/

CTF & mathematical causality can help overcome wave-particle duality

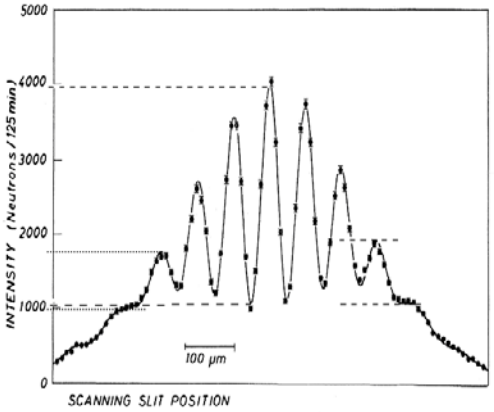
- We propose that particles are ***localized,*** self-looped (in-phase, and hence resonant and stable) perpetually propagating electromagnetic oscillations. Like that for EM waves, the energy of the particles are held by the CTF itself.
- CTF facilitates ***EM waves to spread out naturally*** as per Huygens' Principle.

However, to maintain integrity, individual particles cannot spread out. Further, a beam beam of particles do not spread out unless one imposes a limiting aperture, **For particles, the spreading due to limiting aperture would be Gaussian.** This spreading is functionally (quantitatively) different from light beam spreading.



2-slit diffraction pattern for light beam. The fringes are of high contrast; the envelope function is clearly sinc-squared.

Notice the differences in the envelopes.



2-slit neutron beam diffraction pattern. The fringes are of low contrast; the envelope function appears to be more likely a Gaussian..

Superposition Effect (SE) is an observable phenomenon.
Superposition Principle (SP) is mathematically correct; but not observable!

Schrodinger's free particle: $\exp[iE_k t/\hbar] = \exp[i2\pi ft]$, with $E_k = hf_k = 1/2mv^2$

$\lambda = h/p = h/mv$. For $v = 0$, $\lambda = \infty$. This is unphysical.

We are replacing de Broglie wave by de Broglie FREQUENCY.

Unobservable Linear **SP** : $\psi_{1,2} = a_1 e^{-i2\pi f_k t} + a_2 e^{-i2\pi f_k (t+\tau)}$: A single particle cannot **four physical parameters**

We need a detector's interaction.

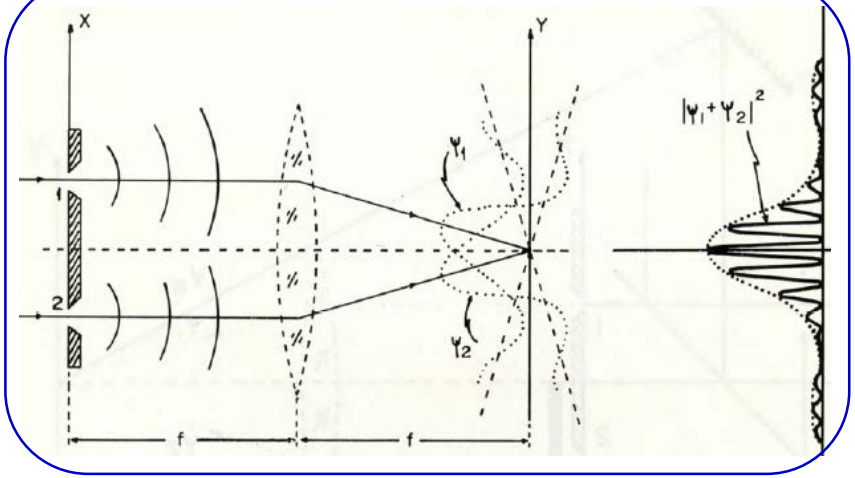
Observable Non-linear quadratic **SE** : $\left|\psi_{1,2}\right|^2 = \left|\chi a_1 e^{-i2\pi f_k t} + \chi a_2 e^{-i2\pi f_k (t+\tau)}\right|^2$

The real physical signals simultaneously stimulate a detector. If the signals are resonant to the detector, it responds to both the signals simultaneously and absorbs the quantum cupful of energy out of the both the signals.

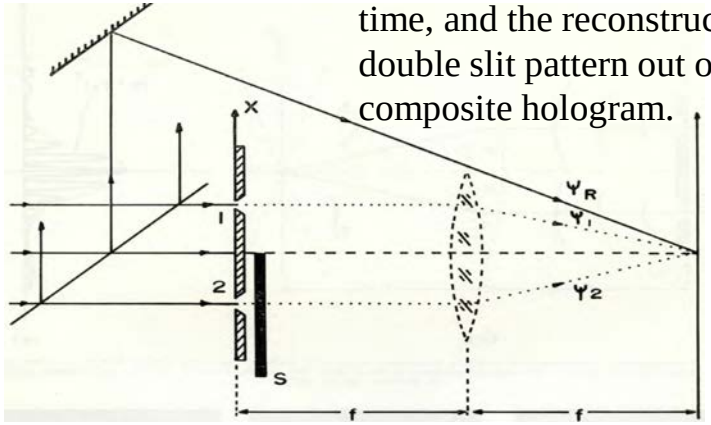
Single particle or photon interference is a non-causal folk story. Wave-particle duality is not our new knowledge. It is our continuing ignorance, hindering progress in physics.

Two beam Superposition Effect. Physical reality of each slit-signal

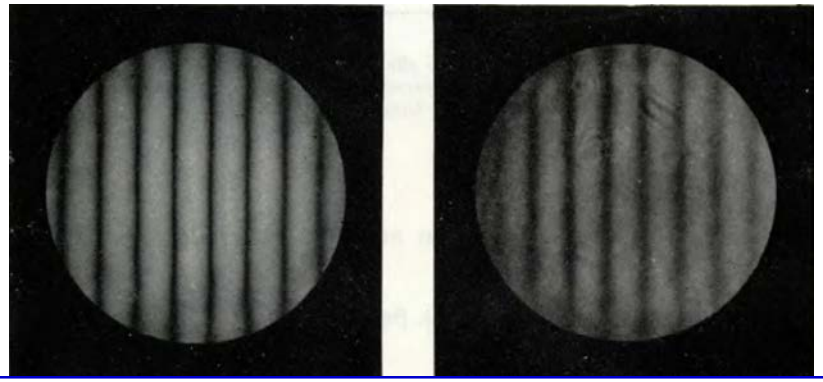
Double-slit: Classical wave signals from each of the two slits can be holographically registered separately, and then the double-slit pattern can be reconstructed



Optical set up to holographically record single-slit patterns, one at a time, and the reconstruct the double slit pattern out of the composite hologram.



Direct record of the far-field double slit pattern.

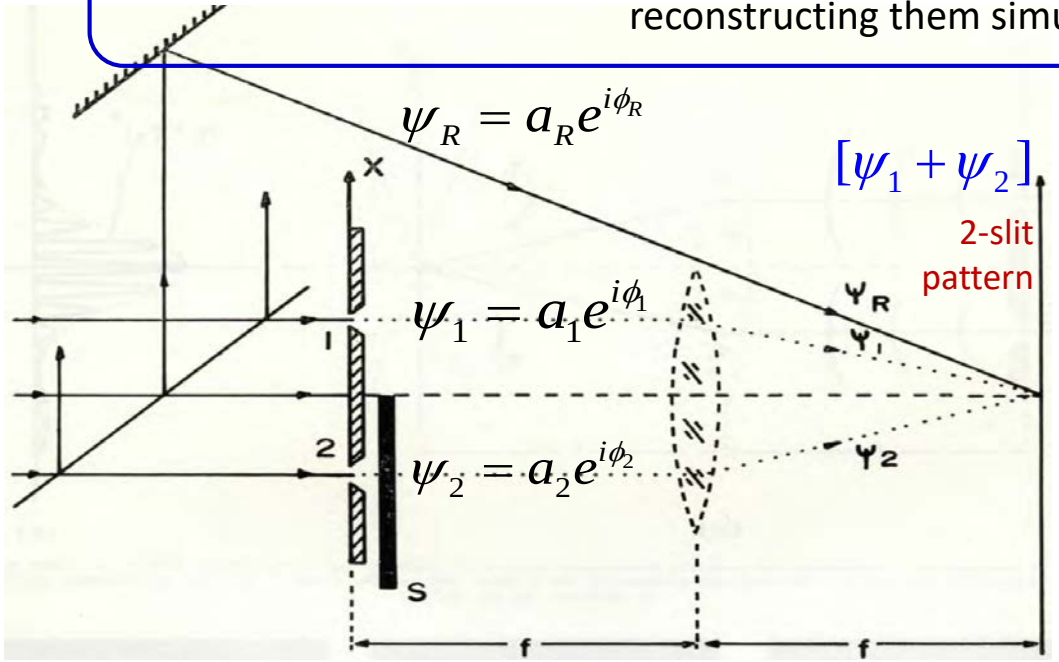


Holographic reconstruction of the double slit pattern after registering one-slit at a time on the hologram.

1. C. Roychoudhuri, R. Machorro & M. Cervantes, “Some interference experiments and quantum concepts – II”, Boletin Inst. Tonatzintla, Vol.2 (1), June 1976.
2. C. Roychoudhuri, Causal Physics: Photon Model by Non-Interaction of Waves; Taylor & Francis, 2014.

Demonstration of the separate physical reality of each of the two slit-signals

Math for recording and re-constructing each of the two slit-signals separately and then reconstructing them simultaneously



Two separate holographic records of signals from the slit-1 and slit-2

$$\left|\psi_1 + \psi_R\right|^2 = \left|\psi_1\right|^2 + \left|\psi_R\right|^2 + \psi_1^* \psi_R + \psi_1 \psi_R^*$$

$$\left|\psi_2 + \psi_R\right|^2 = \left|\psi_2\right|^2 + \left|\psi_R\right|^2 + \psi_2^* \psi_R + \psi_2 \psi_R^*$$

Holographically recorded fringes re-generate the signals from slit-1 and slit-2:

$$T_{\text{Hologram}} = \left[\left|\psi_1 + \psi_R\right|^2 + \left|\psi_2 + \psi_R\right|^2\right]$$

Amplitude transmittance of the developed hologram:

$$A_{\text{Reconstruct}} = \psi_R [T_{\text{Hologram}}] = \gamma \psi_R \left[\begin{array}{l} \left\{\left|\psi_1\right|^2 + \left|\psi_R\right|^2 + \psi_1^* \psi_R + \psi_1 \psi_R^*\right\} + \\ \left\{\left|\psi_2\right|^2 + \left|\psi_R\right|^2 + \psi_2^* \psi_R + \psi_2 \psi_R^*\right\} \end{array}\right]$$

Rest of the terms constitute modified reference beam and conjugate image.

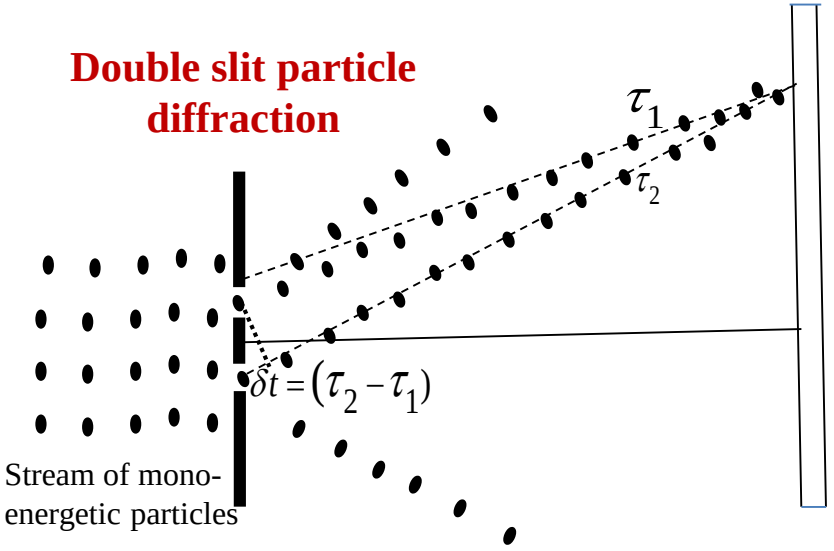
$$A_{\text{Double Slit}} \propto \gamma \psi_R [\psi_1 \psi_R^* + \psi_2 \psi_R^*] = \gamma \psi_R \psi_R^* [\psi_1 + \psi_2]$$

γ Hologram amplitude transmission factor

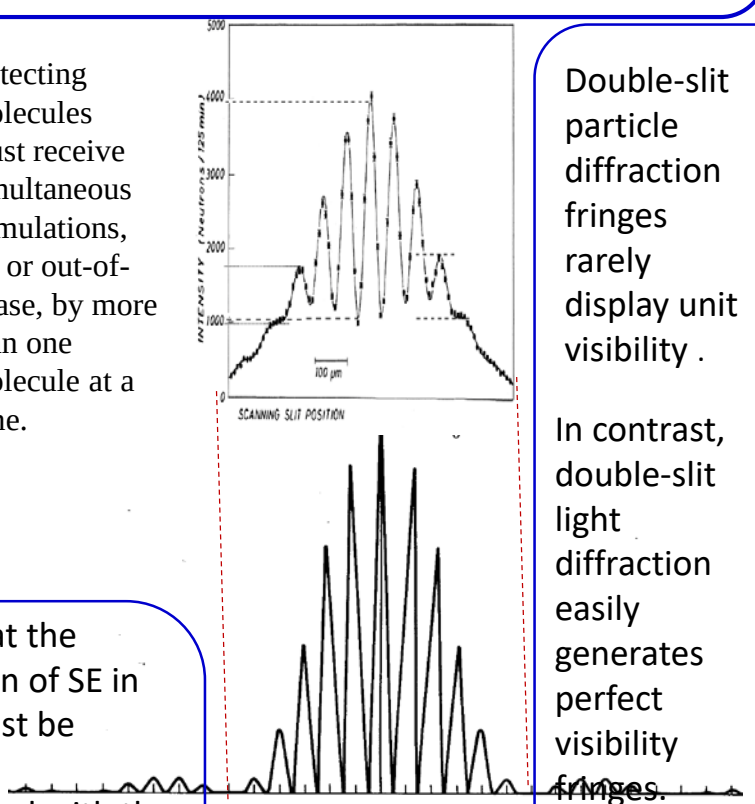
Re-constructed 2-slit pattern

As per our causal math, two or more signals must arrive at a specific site on the detector carrying different phases due to differential propagation delays. EM waves propagate as Huygens secondary wavelets.

Double slit particle diffraction



Detecting molecules must receive simultaneous stimulations, in- or out-of-phase, by more than one molecule at a time.



Double-slit particle diffraction fringes rarely display unit visibility .

In contrast, double-slit light diffraction easily generates perfect visibility fringes.

What are the physical causes behind this difference?

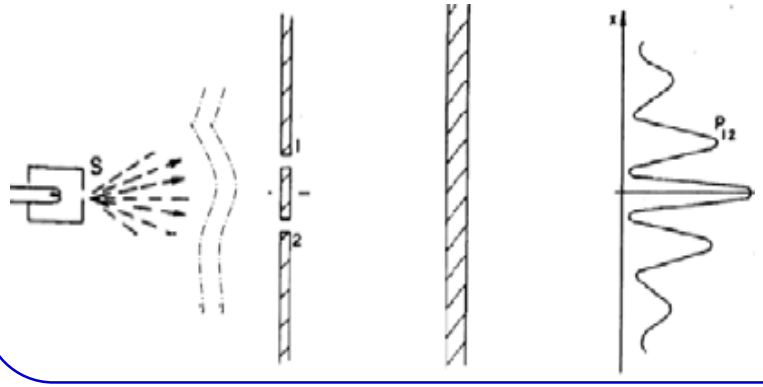
1. The theory tells us that the harmonic oscillation of phase at the detector site is the key causal reason behind the generation of SE in detectors. So, detector's stimulations (quantum effect) must be sensitive to the relative phases.
2. So, the "Pilot wave", or something similar must be generated with the particle velocity.
3. How do the independent mono-energetic particles become mutually phase-steady with each other. For, optics, it is Huygens' secondary wavelet. What is it for particles?
4. Further, the harmonic wave generated only in a tension field!

C. Roychoudhuri, "*Causal Physics*", Taylor & Francis, 2014.

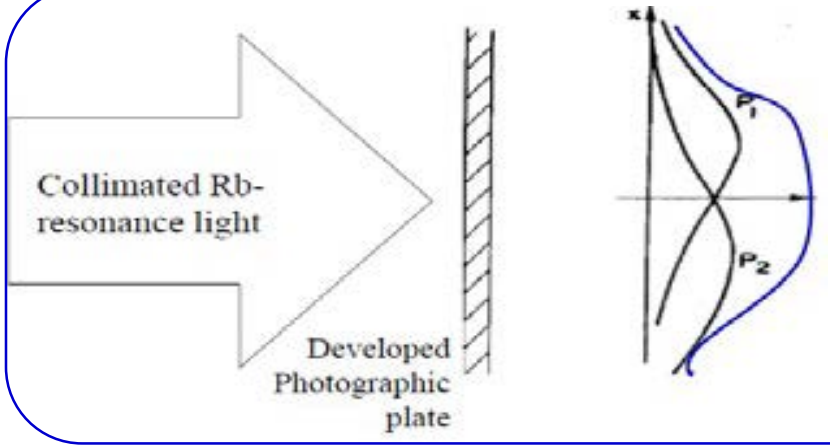
Proposed double slit experiment with Rb-atomic beam.

The objective is to validate the proposed origin of dark fringes as due to the resultant "out-of-phase" stimulation of the local detecting molecule collectively by all the particles arriving on the detecting molecule. A thick Ag-halide emulsion could be used as the detector. The dark fringes are not due to non-arrival of Rb-atoms. They arrive out-of-phase & fail to stimulate.

If the two slits are sufficiently apart, the Rb atoms will be spatially and independently scattered into two Gaussian beams. The development should be such that the embedded Rb-atoms are not washed away during the development.



Then, the white light illumination will show the standard black-n-white double-slit fringes.

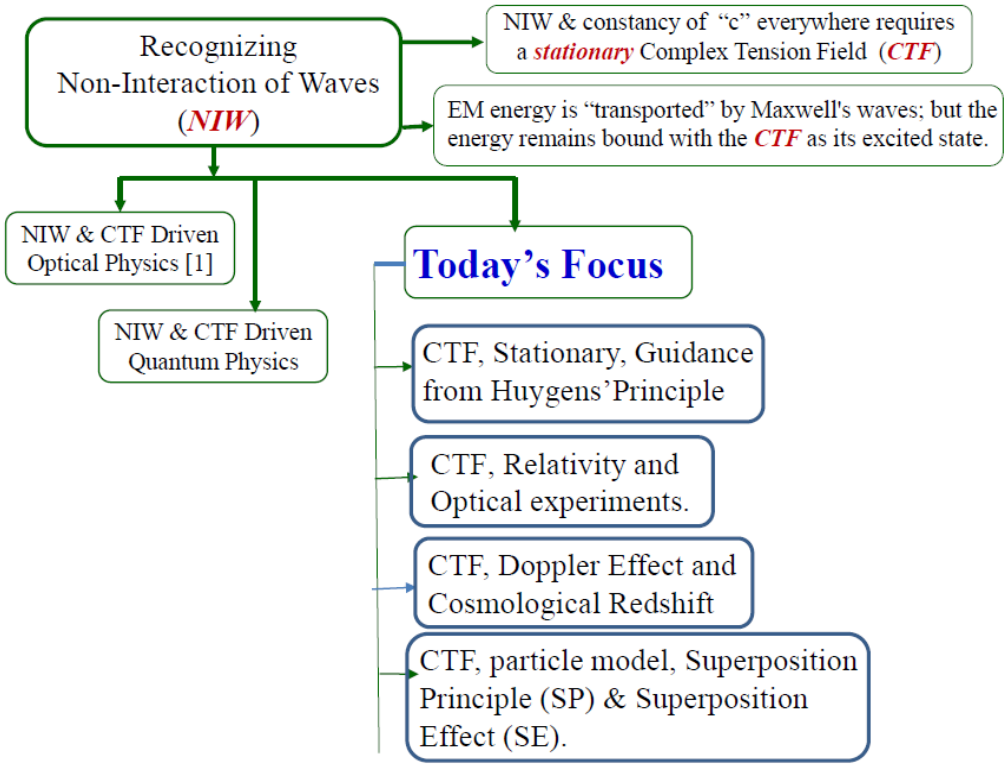


Illumination by a 780nm laser light beam will induce resonance fluorescence by all the Rb-atoms, scattered as Gaussian beams.

Yet to be carried out.

100% of the cosmic energy is held by the CTF

If the proposed particle model holds, then the ~5% of the MANIFEST energy is due to EM radiations and the particles as the excited states of the CTF, as is accepted now. However, the rest of the UN-MANIFEST energy is still contained in CTF in un-excited state. We do not need Dark Eenergy and Dark Matter are needed.



1. C.R., "Causal Physics: Photon Model by Non-Interaction of Waves", CRC, 2014.
2. Download papers from the website:
http://www.natureoflight.org/CP/

STRENGTHS OF CTF

- CTF is a very powerful option as a possible platform for a unified field theory.
- Stationary CTF is the inertial reference frame for the cosmic system.
- CTF naturally accommodates the two postulates of Special Relativity.
- CTF accommodates Newton's 1st and 2nd Laws.
- CTF brings out EM waves and particle as different excitations of the same tension field.
- CTF accommodates basic tenets of QM, while removes the need for wave-particle duality.
- Xxxxx
- Yyyyy
- Best of all, it brings back hard causality in physics.

The key “take-aways”

- Non-Interaction of Waves (NIW) is a generic property of all linear waves. They do not influence each other in the absence of interacting materials. We have been benignly neglecting NIW even though it is built into our mathematics.
- CTF is the 3D stationary inertial reference frame for our universe in which EM waves and particles are diverse kinds of excitations.
- That is why (i) the velocity of light is constant everywhere in the space and (ii) the laws of nature are same everywhere in this universe. These are the properties of the same CTF.
- Null M-M experiment is natural. It cannot determine the ether (CTF) drag since the Poynting vector of EM waves are always guided by the tension field of the material medium, which dominate CTF.
- CTF being the “medium” in space, the Doppler effect of EM waves due to source velocity and the detector velocity are experimentally discernible. Experiment is proposed.
- This last observation also implies that Cosmological Redshift cannot be a Doppler effect.
- “Expanding Universe” model counters the constancy of the velocity of light, as that will change the intrinsic tension values, ε and μ, of the CTF.
- Special Relativity essentially is an unnecessary burden on Physics. Running time is not a physical (operational or engineering) parameter of anything in nature. It is a conceptually derived parameter from the frequency of some oscillator. The frequency can be “dilated” or “contracted”, but not the running time.