Can one distinguish between Doppler shifts due to source-only and detector-only velocities?

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SUMMARY

This paper revisits the optical Doppler shift as the classical Doppler shift based upon spectroscopic line broadening of spontaneous emission (moving source) and quantum mechanical conditions for stimulated absorption and emissions (moving detector). We find that excited emitting source-atoms and stimulated detecting-atoms clearly discern their individual absolute velocities with respect to the cosmic vacuum (Complex Tension Field, or CTF). In other words, the optical Doppler shift does not depend solely upon the relative velocity between a pair of source and detector; as the prevailing assumption is. The implication is that Doppler shifts of light in distant galaxies are determined by the LOCAL velocities of the atoms with respect to the CTF; and the emissions frequencies remain completely independent of the velocities of the various detectors in various other galaxies. But the independent local velocities of these detectors introduce further apparent but different Doppler shifts during measurements due to their own velocities with respect to the same stationary CTF. The key assertion of this paper is that, the classical Doppler shift for material based waves and the optical Doppler shift for CTF based EM waves, follow the same and two different physical processes during emission and absorption and hence the representative mathematical formulation should be same as classical Doppler shift formula. Light emitted by an atom in a star in a galaxy at a distance of 10 billion years from the Sun, could not have coordinated its Doppler shift "knowing" its relative velocity with an earth based detector's; because the earth did not exist! The Sun was born barely 4 billion years ago. Calculation of optical Doppler shift based upon current relative velocity between the two galaxies is a non-causal model and hence can lead to erroneous physical conclusions like *Expanding Universe*, which may not be true. It is more likely that the distance dependent Hubble redshift is due to a distant dependent frequency (energy) loss of photon wave packets engendered by very weak dissipative property of the CTF, like the postulate of *Tired Light*, or something else. We support our model by analyzing the origin of multi-longitudinal modes in He-Ne lasers. Light emitting and absorbing atoms in distant galaxies follow the same set of QM rules as those in our laboratory. We can safely assume that the physical properties of the free space between distant galaxies and that between the atoms trapped in a low pressure He-Ne laser tube are one and the same. Then we analyze the spontaneous and stimulated emission characteristics of Ne-atoms in a population inverted laser tube. The spectral line broadening measured in emission and absorption spectrometry is due to Doppler broadening introduced due to the statistical Maxwellian velocity distribution of the atoms; which is determined by the mean temperature of the surrounding. Again, our assumption is that this Maxwellian Doppler broadening process is the same in the earth-based discharge tube and in the corona of distant stars. Both classical physics (Doppler & Maxwell) and quantum physics (emission and absorption) are same here as in the distant galaxies. And these two branches of physics are complementary, not discordant with each other.

Keywords: Cosmological Red Shift; Classical Doppler Shift; Relativistic Doppler Shift; Hubble Red Shift; Space as a physical field, Complex Tension Field; Space as a frequency reducing dissipative field; Spontaneous and Stimulated Emissions; Non-causality of Relativistic Doppler Shift.

1. INTRODUCTION

The emergence of the century-old prevailing-belief behind optical Doppler shift as due only to the relative velocity between the source and the detector started with the firm acceptance of the absence of ether in the space (i) due to consistent null results of Michelson-Morley (MM) experiments and (ii) due to the broad acceptance of Einstein's proposition (through his special theory of relativity) that absolute velocity of any material body cannot be determined due to our inability to define any inertial reference frame. Our position is that while all physical theories to model physical processes going on in nature have to be based on our incomplete knowledge of the cosmic system; but we must not formalize our lack-of-knowledge as confirmed new-knowledge. In other words, while interim theories must be framed based upon the limited knowledge we have about the cosmic system, we must consciously and openly acknowledge that such theories must be constantly scrutinized as to their foundational hypotheses as our overall knowledge advances. In other words, our scientific culture should pro-actively nurture the emergence of alternate concepts and models; which could supersede our current theories and knowledge. If we promote the culture that the foundation of the edifice of physics has been firmly established by the theories of special and general relativities (SR, GR) and quantum mechanics (QM); then we are telling our younger generations that, in research, the only option they have is to discover the right shaped stones or construct the right shaped bricks which will fit into the current edifice of physics. Such a culture could have the effect of suppressing the further evolution of the deeper enquiring minds of our follow-on generations of young students. It is not very different from various religious dictums that the ultimate truth of the universe has already been given to us through the chosen messiahs. Such a discussion in our scientific community would be healthy, even if I do not succeed in presenting here a better Doppler theory for optics than the prevailing one. The prevailing theory tells us that optical Doppler shift depends solely upon the relative velocity between the source and the detector [Bernstein]:

Equation (1)

Let us first summarize the reasons behind this century-old prevailing-belief.

The velocity of light remains same for all observers irrespective of their different relative velocities.

We accept this postulate as correct; but we need a physical model to support this postulate. Except for gamma rays, design and modeling of all telescopes for radio waves, visible waves and X-ray waves, are very successfully carried out by using the wave-modeling diffraction integral of Huygens-Fresnel, which is a solution of Maxwell's wave equation. All these waves are also traveling across the entire galaxy. Maxwell's wave equation is identical in structure with that for waves in stationary strings with mechanical tensions. So, we posit that the space is comprised of a physical Complex Tension Field (CTF). EM waves are propagating undulations of this stationary tension field [, xx, xx, xx]. This effectively modified old ether, as a physical field, rather than as a novel substance different from EM waves and particles. This postulate accommodates Michelson-Morley type of experiments without time-dilatation and without the problems of old ether theories. EM waves are propagating undulations of this stationary tension field. Particles are localized, self-looped resonant undulations of the same CTF [xx]. The velocity of light $c = (1/\varepsilon_0\mu_0)^{-1}$ (in empty space) implies that ε_0 and μ_0 are two of the many intrinsic tension properties of CTF. Intrinsic characteristics of elementary particles have been captured by the "fine structure constant" $\alpha = (e^2/2h)(\varepsilon_0^{-1}\mu_0)^{-1/2}$. Thus, we only need two other tension-related characteristics, e and h for CTF to support localized resonant oscillations as particles. That particles are resonances, is corroborated by the findings [Greulich] that the internal energies [xx] of all particles can be expressed as integral multiples of the energy of an electron.

Optical Doppler shift is determined by the relative velocity between the emitter and detector. The absolute velocities of an object cannot be determined.

We present arguments that atoms, as quantum mechanical light emitters and detectors, behaves as though their absolute velocities remain independent of each other with respect to the quiescent CTF. Analysis of the prevailing spectrometric observations (data) and their Doppler shifts (broadening) validate this assertion.

2. A REVIEW OF CLASSICAL DOPPLER SHIFT

2.1 Source moving; detector stationary

The classical concept and derivation of Doppler shift started as a "physical process" based on the relative motions of both the source and the detectors with respect to the "stationary tension field" that supports the wave propagation!

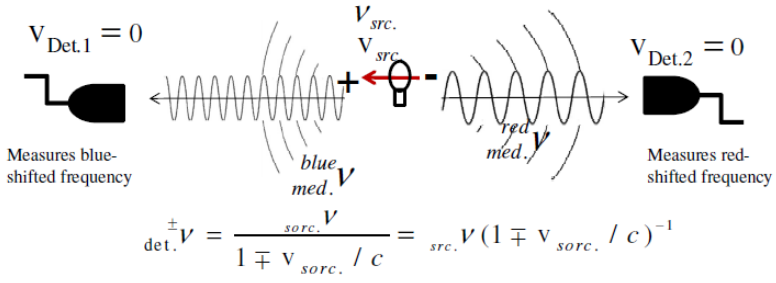


Figure 1. Classical Doppler frequency shifts due to a moving source and stationary detectors.

2.2 Source stationary; detectors moving

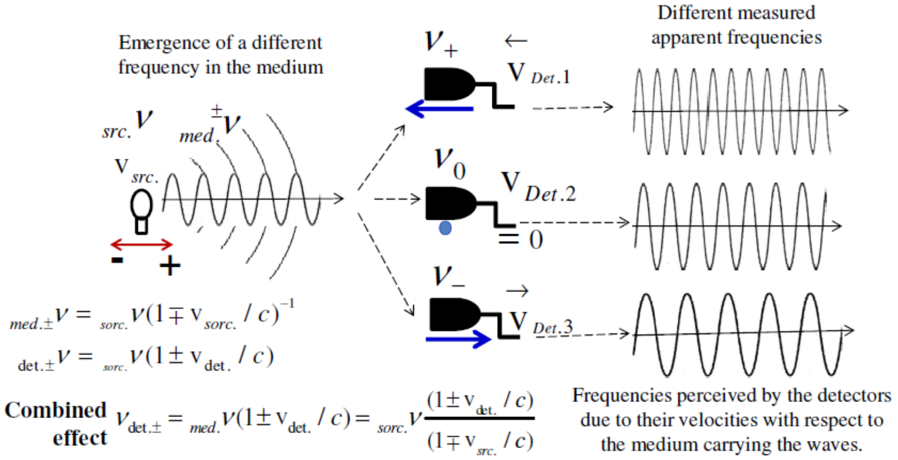


Figure 2. Classical Doppler frequency shifts due to a stationary source and many moving detectors. Note that the same real frequency in the stationary medium is experienced as different wave frequencies by different detectors due to their different velocities with respect to the stationary medium, and relative to each other.

2.3 Source and detectors both are moving with respect to the stationary medium

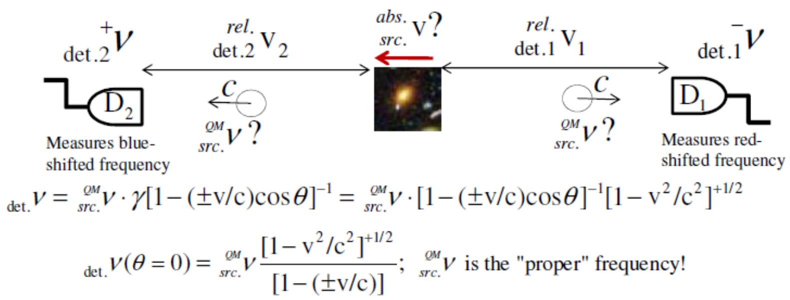


Figure 3. Both the source and the detectors are moving in different directions with respect to the stationary tension field that supports the perpetual propagation of a wave fixed by the tension properties of the tension field.

3. A REVIEW OF SPECTRAL LINE BROADENING EXPLAINED BY CLASSICAL AND QUANTUM PHYSICS

Let us now summarize the origin of spectral emission line-broadening due to spontaneous emission from gas atoms and spectral absorption line-broadening by gas atoms. Intrinsic quantum mechanical resonance frequency for downward and upward transitions remains fixed, at least for kinetic velocities that we measure as thermodynamic average temperature. The gas atoms suffer statistically broad distribution of velocities, which is given by the Maxwell-Boltzmann velocity distribution, $df\,(\mathrm{v})$ denotes the number atoms within the velocity band v and $\mathrm{v}+d\mathrm{v}$ [xx]:

$$df\,(\mathrm{v}) = (M\,/\,2\pi kT)\; e^{-M\mathrm{v}^2/2kT}\, d\mathrm{v} \qquad \text{(xx)}$$

So, a detector in a spectrometer, at rest with respect to the wave-sustaining tension medium, will perceive all the spontaneously emitted wave packets of frequency ${}_{QM}\nu$ as ${}_{med.}^{\pm}\nu = {}_{\det.}^{\pm}\nu$ due to the source (here atom) velocity $\mathrm{v}_{\mathrm{atm.}}$ with respect to the stationary tension field:

$$\begin{aligned} {}_{med.}^{\pm}\nu = {}_{\det.}^{\pm}\nu &= {}_{QM}\nu(1 \mp \mathrm{v}_{atm.}\,/\,c)^{-1} \\ &= {}_{QM}\nu(1 \pm \mathrm{v}_{\mathrm{atm.}}\,/\,c) + \text{2nd \& higher order terms} \end{aligned} \qquad \text{(xx)}$$

The corresponding Doppler broadened spectrum (Fig., due to statistical velocity distribution, is given by [xx]:

$$_{Dop.}S(\nu) = \frac{1}{_{D.}\delta\nu}\left(\frac{4\ln 2}{\pi}\right)^{1/2} e^{-4({}_{\det.}\nu - {}_{QM}\nu)(\ln 2/{}_{D.}\delta\nu^2)};\ \text{where}\ {}_{D.}\delta\nu = \left(\frac{2kT}{M}4\ln 2\right)^{1/2}({}_{QM}\nu\,/\,c) \qquad \text{(xx)}$$

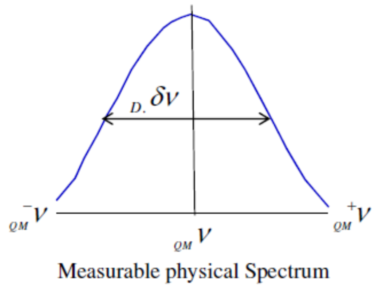


Figure 4. Broadening of the measured spectral line from a gas discharge tube due to statistical distribution of the velocity of the gas atoms, given by Maxwell-Boltzmann formula (Eq.xx).

Fig.5 presents a graphic depiction of the spectral line broadening, ${}_{D.}\delta\nu$,due to thermal velocity distribution of the atoms, even though all the spontaneous emission frequency during the quantum transition between the levels $n \to m$ remains fixed to ${}^{mn}_{QM}\nu$, but it evolves into ${}_{med.}^{\pm}\nu$ in the stationary medium due to the source velocity. Classical and QM formalisms do not help us visualize the detailed physical processes behind this evolution of photon wave packets into Doppler shifted wave packets.

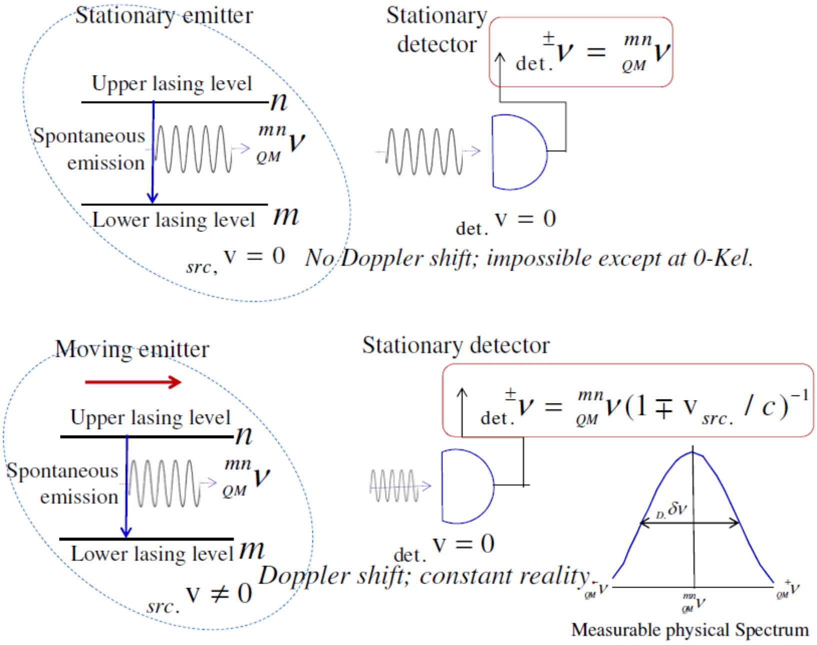


Figure 5. A graphic depiction of the spectral line broadening, $_{D.}\delta\nu$,due to thermal velocity distribution of the atoms, even though all the spontaneous emission frequency during the quantum transition between the levels $n \rightarrow m$ remains fixed to $^{mn}_{QM}\nu$, but it evolves into $^{\pm}_{med.}\nu$ in the stationary medium due to the source velocity.

Considering the broad successes of QM predictions, validated through wide variety of terrestrial and stellar spectrometry, it logically self-consistent for us to assume that the space between the atoms in a low pressure discharge tube in our laboratory and the space between the atoms in the corona of stars must fundamentally identical, except for the gravitational gradients, whose effect on quantum energy levels are usually weak. We have already suggested that this all-pervading cosmic space as a Complex Tension Field (CTF).

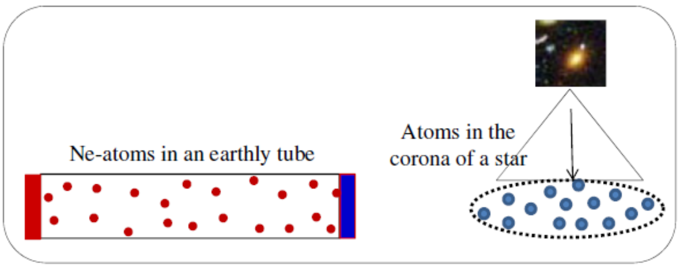


Figure 6. The space between the atoms in a discharge tube on earth and the space between the atoms in the corona of any distant star are same, which we have proposed as CTF. Their quantum level transition properties remain essentially same.

Then we can safely assume that the physical processes behind the generation of emission and absorption spectral lines remain identical. We should find that the classical statistical physics modeling the velocity distribution for a given temperature and the quantum physics modeling the level transitions in atoms, remain same under careful spectrometric analysis of light, either due to emission, or due to absorption, carried out on earth, or near the corona of a star (in a space vehicle in a stationary orbit around the star). In fact, this is the foundational assumption behind all astrophysics spectrometry. Fig.7 presents a pictorial view of this assumption.

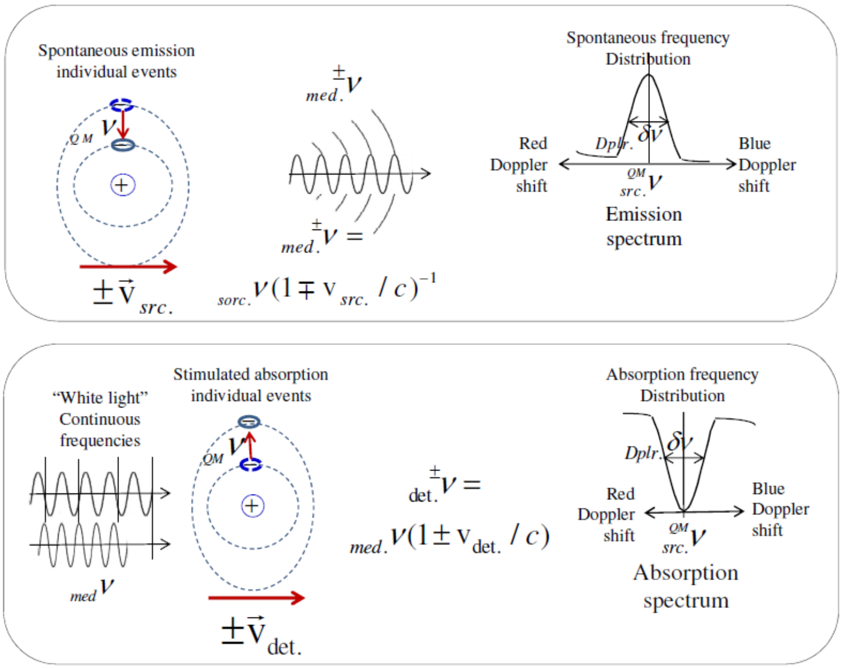


Figure 7. Fundamental spectral characteristics of atoms, either in emission or absorption, remains same, whether the atoms are in a discharge tube on earth, or in the corona of a distant star.

4. A REVIEW OF THE ORIGIN OF GAS LASER MODES: $_{QM}\nu$ REAMINS UNCHANGED DUE TO THERMAL VEL.OCITIES OF ATOMS.

A reasonable high resolution Fabry-Perot spectrometer can be used to separately display the spectral characteristics of light from a He-Ne laser tube. Laser emission along the axial direction will display a unique set of longitudinal modes, which are very narrow and are spaced by the cavity resonance condition set by classical wave propagation, c/2L, where L is the distance between the cavity mirrors. This is pictorially depicted in Fig.8.

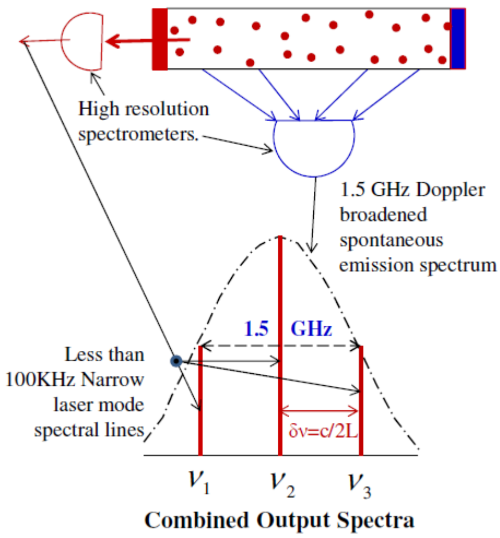


Figure 8. The analysis of the spectral characteristics of light from a He-Ne laser tube is presented. Spontaneous emission from the side of the tube gives a Doppler broadened continuous spectrum. Stimulated emission out of the axial direction displays a set of characteristic longitudinal modes, which are extremely narrow and separated by the mode spacing expression c/2L, L being the cavity length.

In laser terminology, a gas laser is an inhomogeneously gain broadened system because the velocity of the atoms are given by Maxwell's velocity distribution relation, which dictates not only spontaneous emissions process, but also the stimulated emissions process. In fact, as mentioned earlier, for thermal velocities, quantum energy level spacing inside atoms remains unaltered, whether it is downward spontaneous emission, or the downward stimulated emission. We know that it is the stimulated emissions triggered by the axially propagating spontaneously emitted wave packets. But, Maxwell's velocity distribution introduces a spread in the frequency distribution of the spontaneous emissions. So, most of these wave packets are Doppler shifted and do not correspond to ${}^{mn}_{QM}\nu$ necessary for the ***detecting*** atom perceive it as the right stimulating signal. However, detectors (atoms) moving with different velocities with respect to the stationary tension field, will perceive the frequencies in the medium ${}^{\pm}_{med.}\nu = {}^{\pm}_{\det.}\nu$ as various different effective frequencies. Then, those excited atoms (in the upper level) that have exactly the same vectorial velocity (magnitude and direction) equal to the original atom that generated the spontaneous wave packet, would be perceived as the correct quantum mechanical stimulating frequency ${}^{mn}_{QM}\nu$. This can be appreciated from the mathematical expression given in the Fig.9 (see Eq.xx). Of course, this also corroborates that when the relative velocity between a pair of atoms is vectorial zero, then the Doppler shifted frequency due to source-atom movement ***appears*** nullified due to the movement of the detector-atom movement. Note that, because of statistical nature of the velocity distribution, a large number of gas atoms can never have vectorial zero velocities at any time. This is the key reason why gas lasers are usually much less efficient than the so-called homogeneously broadened solid-sate lasers [xx].

Our key point is that the physical process behind optical Doppler shifts due to excited moving atoms (moving source), and responding moving atom (moving detector) are distinctly different and their separate absolute velocities with respect to the stationary CTF clearly discernible. Note also that by the time a spontaneous wave packet from a Ne-atom arrives to stimulate another excited Ne-atom after, say 1ns (30cm far), the original atom most likely is in a totally different quantum state and a t a different physical place with a different velocity. So the interacting photon wave packet and the excited atom-to-be-stimulated, cannot have any knowledge (interacting force) with the original atom that had contributed the stimulating wave packet. Thus the relative velocity between this specific pair of Ne atoms at the moment of stimulated emission by the second Ne-atom has absolutely no physical relevance. Unless, of course, we can declare that atoms can be time-entangled at vast distances between past and the present. This is clearly an un-acceptable proposition to develop causal physical models.

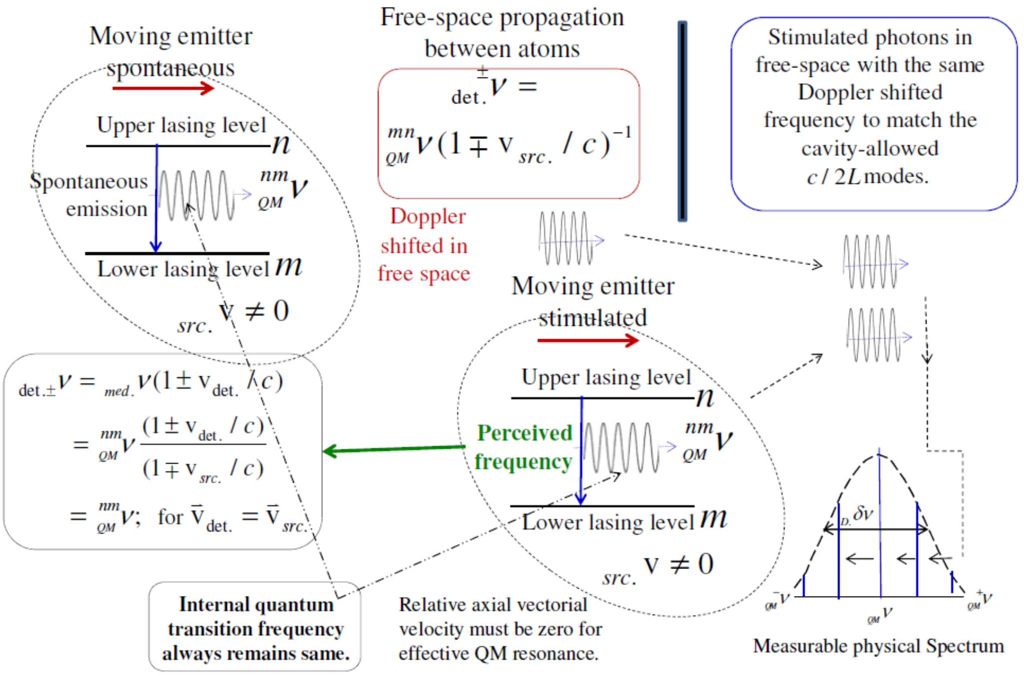


Figure 9. xxx

5. DISCERNING THE COSMOLOGICAL RED-ONLY SHIFT FROM THE RED-&-BLUE DOPPLER SHIFTS IN STELLAR SPECTRA.

We have established that light emitting and light detecting Ne-atoms many centimeters apart cannot recognize their past-and-present relative velocities. Let us now extend the same logic to light emitting (absorbing) atoms and detecting atoms in different galaxies, the earth in our Milky Way and another arbitrary far galaxy.

5.1 Atomic absorption spectra generated by atoms should show identical physical characteristics on earth and in the corona of a star

Fig.10 is a pictorial presentation of our prevailing assumption that the characteristics of absorption spectra of gas atoms on earth and in the corona of a distant star. However, the absorption spectra generated in the corona of a distant star in a distant galaxy, but measured on earth, the absorption line center shifts towards lower and lower frequency (red shift) depending on the inter-galactic distance.

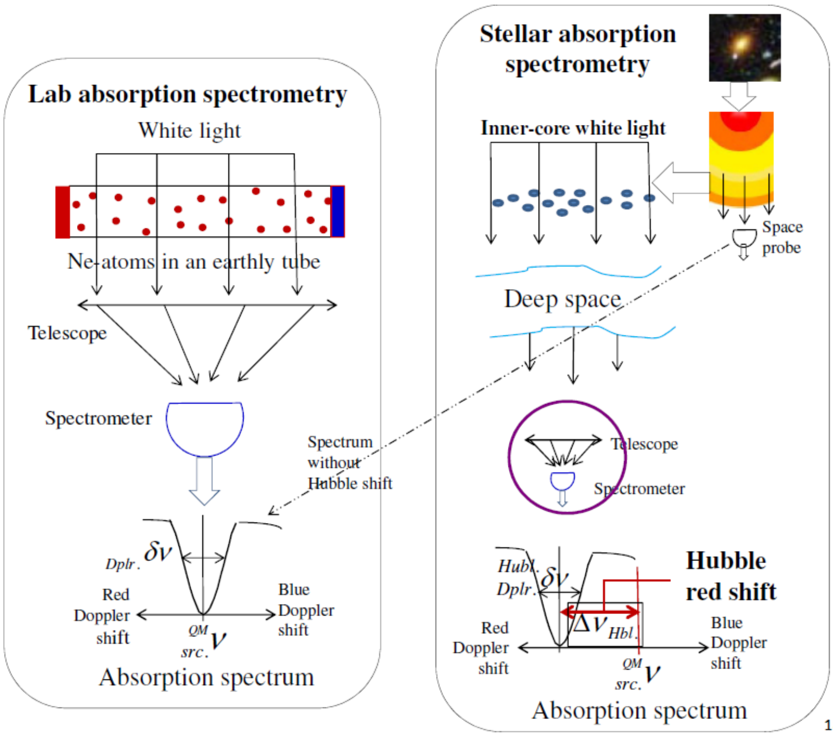
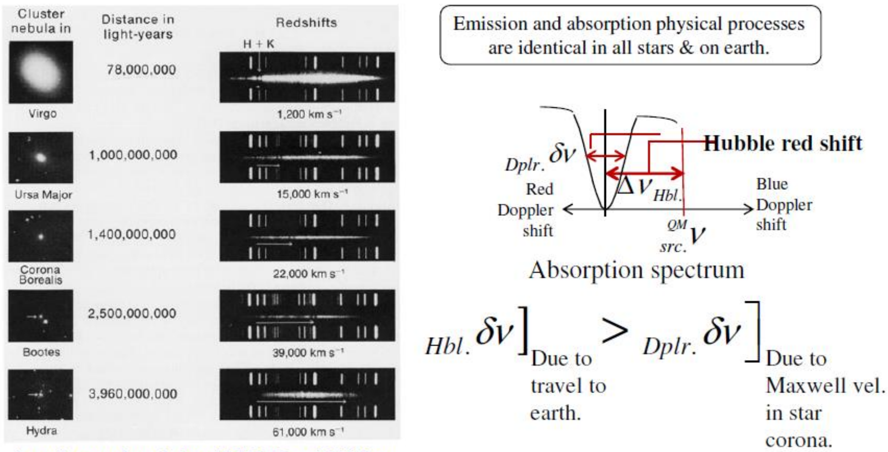


Figure 10. xxx

5.2 Proposal to measure absorption spectra on a space vehicle with controllable velocity.

The physical characteristics of the absorption line spectra are set by the Doppler velocity distribution of the atoms in the outer corona of a star. The width follow the Maxwell's velocity distribution rule set by the mean temperature at the corona. The absorption line spectra are represented by the absence of optical frequencies over a narrow band out of the emerging white light from further inside the star. So, the real physical signals consist of this white light with absence of narrow bands of signals at characteristic atomic and molecular emission frequencies. Absorption lines are non-signals, or absence of signals. Non-signals (or "nothing") cannot undergo physical changes like Doppler frequency shifts. But the entire "white light" shows cosmological (or Hubble) red shift when we measure on earth. The measured width of the absorption lines remains congruent with the corona temperature induced absorption broadening. This can be seen in the spectra given in Fig.11. Note that the cosmological red shift ${}_{Hbl.}\Delta\nu$ consistently becomes larger and larger for galaxies farther and farther away from us. However, the Doppler induced absorption line width ${}_{Dplr.}\delta\nu$ remains determinable essentially by the corona temperature. Accordingly, we are proposing [xx] that the physical process(es) behind the distance dependent cosmological redshift is distinctly different from the optical spectral Doppler shifts generated due to velocity distribution of atoms. It is possible that the CTF itself possesses capability to very slowly assimilate some of the energy deposited externally by some de-excited dipoles back into its tension field energy. This could be a mechanism for the CTF to be a self-re-generating system for particle and waves. Alternately, it could be due to some weak nonlinear property induced in the CTF by the densely present wide variety of cosmic entities, giving rise to this distant dependent frequency degradation:



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

Figure 11. xxxx

5.3 Proposal to measure absorption spectra by a space vehicle with controllable velocity.

The apparent Doppler shift in a wave packet propagating through CTF as perceived by a detector (spectrometer) is given by Eq.xx. This perceived frequency shift is immaterial whether the carrier frequency of the wave packet under measured, has been introduced by the source velocity, or by the subtle dissipative property of the CTF, as mentioned in the previous section. Although, the state of our technology and the affordability of the necessary cost, may not yet be encouraging, we would like to propose a potential of space probe that can occupy a stationary orbit in a star carrying a high resolution spectrometer. Then it can send the absorption spectra that would not suffer from cosmological distance dependent red-shift. It will only show temperature dependent Doppler broadening (see Fig.12).

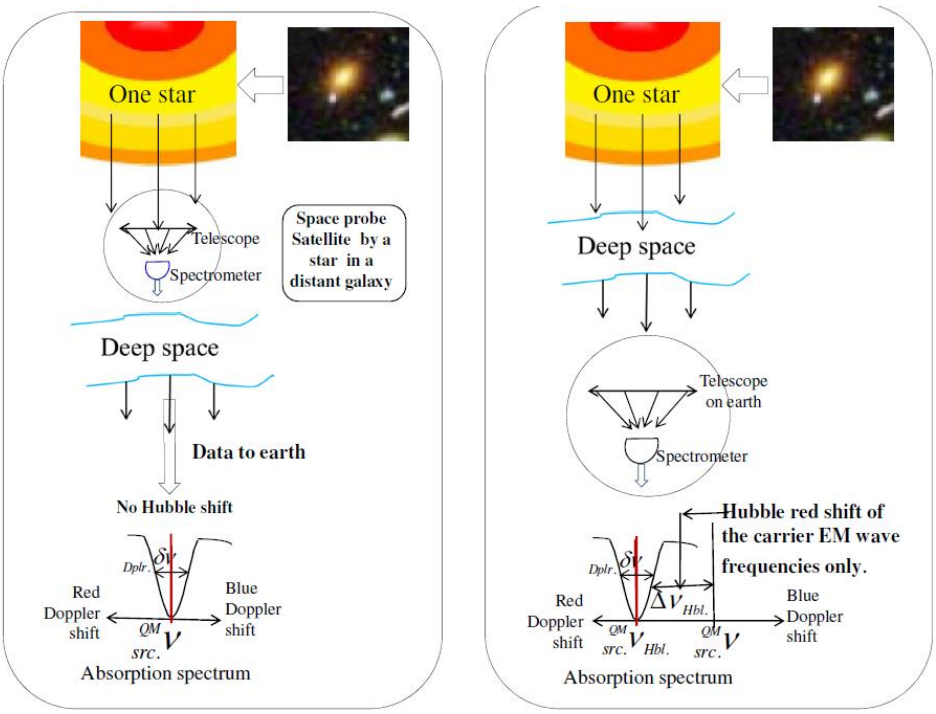


Figure 12. xxx

5.4 Logical incongruence in the assumption that only relative velocity between a pair of distant galaxies determine the Doppler redshift

We have identified five galaxies in the diagram below, 1, 2, 3, 4 and M (our Milky Way). According to prevailing cosmology, the relative velocity between any pair of galaxies is fixed by the measured Hubble shift. Consider only one particular absorption line center identified between a pair of galaxies as ν-M1, ν-M2, ν-M3, etc., measured on our Milky Way and the galaxies "1", "2", etc. Similarly, the frequencies for the same line measured by some advanced species on a planet in the galaxy "3" would be ν-31, ν-32, ν-3M, etc. According to the current cosmology, ν-3M would be identical to ν-M3. Suppose a wave packet is emitted by the galaxy "1" with the chosen characteristic absorption frequency. It is diffrcati

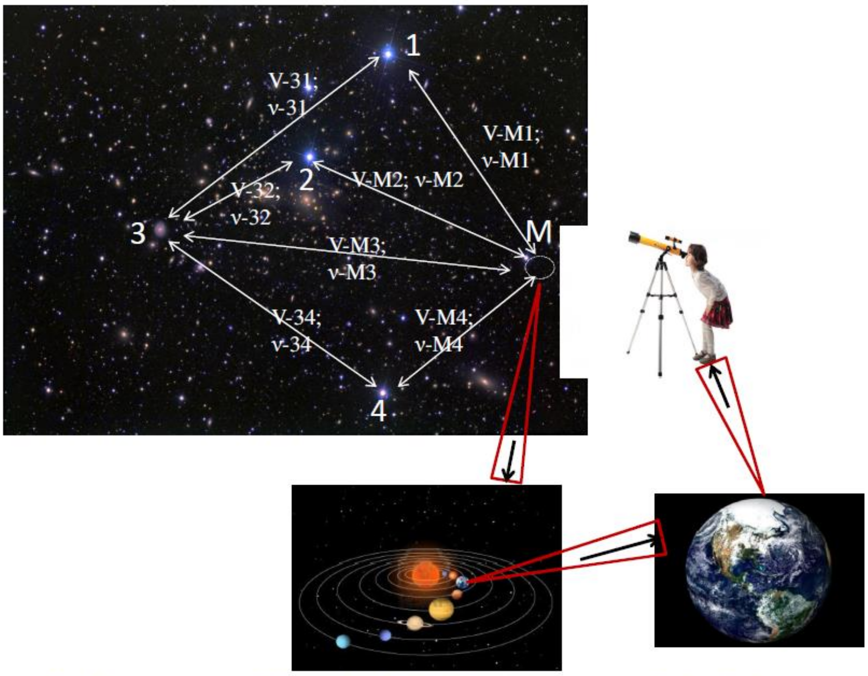


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Figure 13. xxxx

5.5 Conclusions

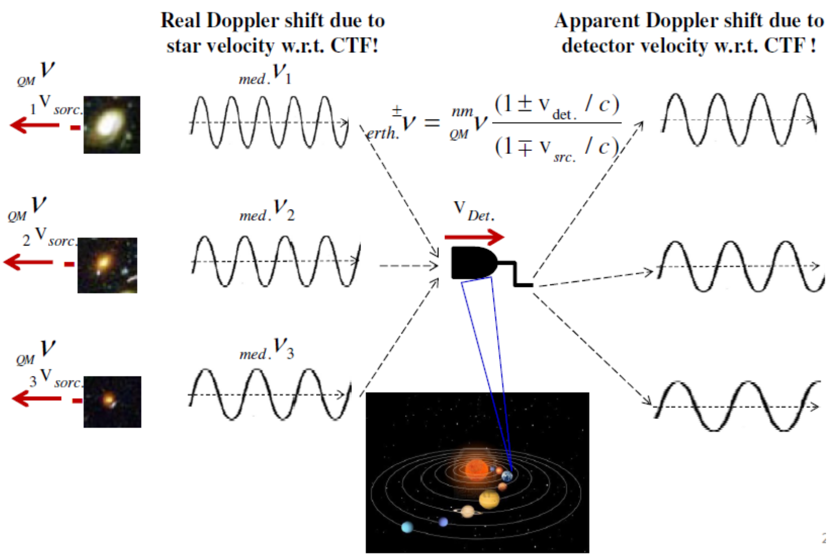

Figure 14. xxxxx

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