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Rational astrophysics.

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February 3, 2017

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Abstract

Rational astrophysics builds models which are studied using only usual, laboratory verified physics. Except close to stars and planets, molecular free paths are larger than duration of pulses making thermal electromagnetic radiations, so that Einstein's theory on optical coherence of light-matter interactions (Einstein1917), in particular *Superradiance* and *Impulsive Stimulated Raman Scattering* (ISRS) apply. A shell of excited atomic hydrogen surrounding a Strömgren's sphere is superradiant, transfering all energy received from stars to bright limbs around optical black holes. Around quasars, optical excitation of cold hydrogen atoms increases 2P state population until a Lyman alpha superradiant flare bursts and, by competition of modes, absorbs a Lyman forest line. Impulsive stimulated Raman scatterings by hyperfine resonances in 2P state transfer energy from light to cold microwaves, redshifting light, except if energy was previously absorbed at alpha frequency, so that gas lines are visibly absorbed. Thus, quasar spectra, optical black holes, and many other observations are simply explained.

Keywords: Line:formation. Radiative transfer. Scattering. 98.62.Ra Intergalactic matter; quasar absorption and emission-line systems; Lyman forests; optical black holes. 290.5910 Scattering, stimulated Raman

1 Introduction

1.1 Rationality of science.

Rational mechanics uses ideal models as close as possible to observed systems, sometimes successfully, as celestial mechanics, sometimes roughly if friction is present. Here, we use Strömgren's model of stars [1] : around a very hot, almost black source of light, a stellar wind mainly made up of protons and electrons cools on a sphere by adiabatic expansion into excited hydrogen atoms, then mixes with interstellar and intergalactic very low pressure atomic hydrogen. At time-scale (1 nanosecond) of electromagnetic pulses of ordinary light, this gas is collisionless so that Einstein's theory of coherent light-matter interactions [2, 3] applies.

1.2 Some problems set by fundamental physics.

Scientific development during the nineteenth century was prepared by encyclopedic rationalism of eighteenth century. But evolution of scientists from amateurs to professionals at the end of this century led to a search for productivity neglecting sometimes basic principles, from where inconsistencies. For instance :

• Planck showed in 1911 [4] the need for the introduction of the "zero point field" into the black body radiation law, but addition of the corresponding half-quantum of energy is often forgotten. Thus, calculations of electromagnetic energies are sometimes false. In particular an error by a factor 2, often appears in the interpretation of measurements of low luminous radiances by *photons counting*. Some deduce from that error that classical electromagnetism is erroneous ! Let us remind that, according to Planck, the spectral radiance of a polarized ray at frequency ν, in a black body at temperature T is:

$I = \frac{h\nu^3}{2c^2}[1 + \frac{2}{\exp(h\nu/kT)-1}]$.

This relation between spectral radiance, frequency and temperature allows, for instance, to assign a temperature to a light ray with given ν frequency.

• The theory of electromagnetic waves interactions with a large number of identical particles, that Einstein established through thermodynamics in 1917 [2] was, for a long time, ignored by almost all physicists : one made much fun of Townes when he was building the first maser. The development of lasers theory and applications interested only a small number of physicists. Many physicists and almost all astrophysicists (*devotees of big bang* is implied) still neglect the importance of coherent interactions of light with matter, appearing to be unaware that refraction is its most elementary and useful application. To explain redshifts of light and stability of spiral galaxies, these astrophysicists support a disputed theory (Big bang, ΛCDM), little fertile, because observations oblige them to supplement it by doubtful physical concepts (dark energy, variation of fine structure constant, MOND,. . .)

1.3 Rational Astrophysics.

Rational astrophysics is exclusively based on theories verified in laboratory experiments (with obviously adapted space and time variables), and from observations of many stars. It is fertile, having no need for complementary theories. It is opposed to astrophysics based on the construction of a house of cards: a set of debatable theories, often introduced to solve the problems raised by previous theories.

Scientific strictness requires the use of words whose meaning is well defined. But two spectroscopic concepts are not correctly used by astrophysicists:

• Firstly, for a physicist, a *laser* (or *maser*) consists of a light-amplifying medium located inside an optical resonator (formed, for example, by two mirrors, each one superimposing on the other mirror its own image); thus, by neglecting energy losses by mirrors absorption and diffraction, a light ray is indefinitely trapped.

• Secondly, in spite of the invention of lasers, it seems that astrophysicists are unaware of coherent spectroscopy, following Menzel's opinion written in 1931 [5]: *It is easily proved that the so-called stimulated emissions are unimportant in the nebulae.* The point of view of physicists is exactly opposed since, for them, light interactions with very low pressure gases are exclusively coherent, which allows gas lasers operation.

Sky is black above stratosphere, in spite of the presence of gas observed by refraction of solar light. Our blue sky results from incoherent scatterings by impurities consisting of molecules in a collisional state.

Section 2 points out the theory of optical coherence and its major applications, superradiance and coherent impulsive Raman effect.

Section 3 shows that superradiance of the shells surrounding Strömgren spheres can be or become intense enough to make disappear the stars in an *optical black hole* encircled by a possibly dotted ring. This transforms SN 1987A into SNR 1987A.

Section 4 establishes that Karlsson's law introduces redshifts which bring H atom Lyman beta and gamma frequencies to Lyman alpha one. This shows that redshifts known as *cosmological* arise from a coherent Raman effect in excited H atoms. From where a calculation of spectrum due to H atom around quasars.

Section 5 introduces a model for a general view of spectra of quasars.

Section 6 underlines other applications of optical coherence such as dispersion of multiplets spectra emitted by remote stars without variation of the fine structure constant, the so-called abnormal acceleration of Pioneer 10 and 11 probes, bubbles in galaxies maps, black matter and energy, etc ...

2 Optical coherence: Huygens' construction.

A wave is represented by some continuous function versus space variables and sinusoidal versus time. It does not take into account energy exchanges between waves and matter. This representation can be generalized to more complex cases, in particular by Fourier decompositions of temporal variations.

Equiphase surfaces are called Huygens' wave surfaces.

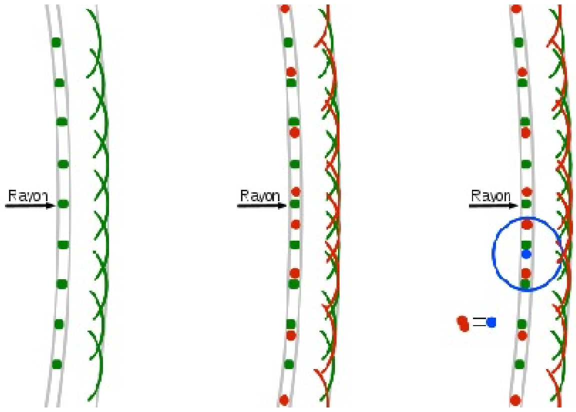

Figure 1: Huygens' constructions

To deduce an unknown wave surface from two very close wave surfaces, space contained between the latters is divided into infinitesimal, equal volumes, emitting spherical wavelets (in green, fig 1, left) with the same frequency than the incident wave.

After the same short propagation time, the envelopes of these wavelets are two waves, one is the sought wave and the other, retrograde, is destroyed by addition of the retrograde wave emitted at a quarter of a wavelength of the initial surface, because the phase of the latter is opposite.

In the center of fig 1, identical molecules (in red) excited by the incident wave at its frequency (Rayleigh excitation) also generate wavelets. But it is possible that these are out of phase, which phaseshifts the final wave: it is refraction, an example of coherent diffusion. It is also possible that the amplitude be modified without variation of frequency (See section 3), or that the frequency is modified (See section 4.5).

On the right of figure 1, two molecules are in a collisional process. The properties of the system formed by two colliding molecules (blue) depend on many parameters. For example geometric ones, so the emitted wavelets are all different, do not interfere to form a new wave surface: thus the light is scattered into all directions (blue circle). This incoherent diffusion produces the blue of sky which disappears in stratosphere.

In this paper, we assume that interactions of light with rare colliding molecules of nebulae may be neglected.

3 Coherent quantified interactions between non-colliding molecules and electromagnetic waves.

3.1 Einstein's Theory

In 1917, Einstein [2] showed through thermodynamics that spectral radiance I of a monochromatic and polarized light ray, propagating along a path dx in a medium made of *identical* molecules varies according to the law of classic look $dI = BIdx$, where B is Einstein's coefficient depending on frequency, polarization, and possibly direction of the ray, and on the nature and state of the medium. I cannot be null, in agreement with the existence of zero Kelvin field introduced by Planck [4] in 1911 to modify the formula of black body radiation which he had proposed in 1900.

Assuming that B does not notably depend upon orientation of rays in a common volume of interaction, an intense ray is more amplified than a weak one. If B is positive and constant, the increase of I is exponential, in a limited region because the medium must provide energy. For absorption B is negative.

Assume that two rays of equal frequency exchange energy with a resonant medium so that medium excitation remains negligible. For this catalytic process, thermodynamics says that energy must flow from the hottest ray to the coolest one. This *competition of modes* may seem paradoxal because, in accordance with Planck's law, temperature depends on frequency and *radiance*, so that, for geometrical reasons, energy may flow from the ray which has the lowest *irradiance*.

3.2 Strömgren's sphere and shell.

Strömgren [1] showed that stars are surrounded by a sphere of *stellar wind* made out of protons and electrons too fast (too hot) to combine into atoms. Decrease of temperature around the sphere generates under-shells of H atoms, the excitation of which decreases with the distance from star. For instance the Earth is in the solar wind detected through aurorae borealis. This wind cools, mainly by adiabatic expansion, into excited hydrogen atoms at around 10 AU from the Sun, and de-excited atoms at around 15 AU.

In figure 2, the comparison of paths of rays in each under-shell shows that the longest path in a layer forming the shell is maximum for a ray which is tangent with the sphere. By taking account a radial reduction in the gas excitation by absorption of the stellar radiation, and the competition of modes, the limb of the sphere is particularly brilliant.

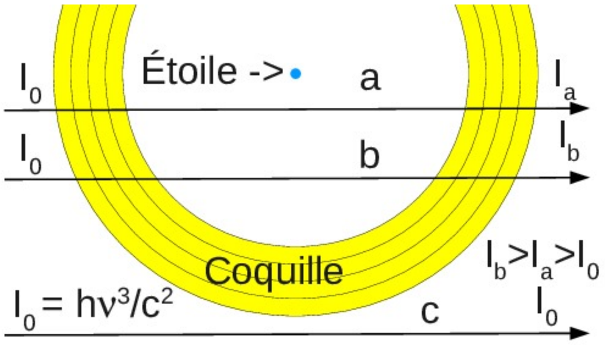

Figure 2: Sphere and Strömgren's shell (coquille).

3.3 Multiphotonic interactions.

A ruby laser absorbs white light emitted by a flash tube and emits a sharp red spectral line whose large spectral radiance shows that there is an energy transfer from the white continuous spectrum to a red emission. In a dye laser pumped by a neodyme yag laser, an energy transfer from a frequency to another one occurs. Likewise, subjected to a flow of intense white light, atomic hydrogen can be simultaneously excited at several frequencies whose algebraic sum is an eigen-frequency of the atom. In the presence of superradiance, the atoms transfer energy from white light to superradiant one.

In a collisionless gas, all energy exchanges are radiative, so that energy transfers of from star-light to superradiant light is efficient both for absorption and emission. Light temperature being deduced with Planck's formula from spectral radiance and frequency, almost all hot light is absorbed, its energy being transferred to colder superradiant beams, thus increasing entropy.

The radiant flux (irradiance) received by a telescope from a far star is low, but, without previous absorption able to decrease it, radiance remains high so that light from far stars is absorbed: Strömgren's shell of excited hydrogen being opaque for star lights, it is a spectroscopic black hole; however, if it happens that far star rays are close to superradiant rays, they are amplified: weak background stars make a bright circle [6].

3.4 Observation of SNR1987A

The usual study of SNR1987A supernova poses many problems:

- The formation of the outer rings [7] is not understood.

- When its rings appeared, the star progressively disappeared. Persistence and brightness of rings are not explained.

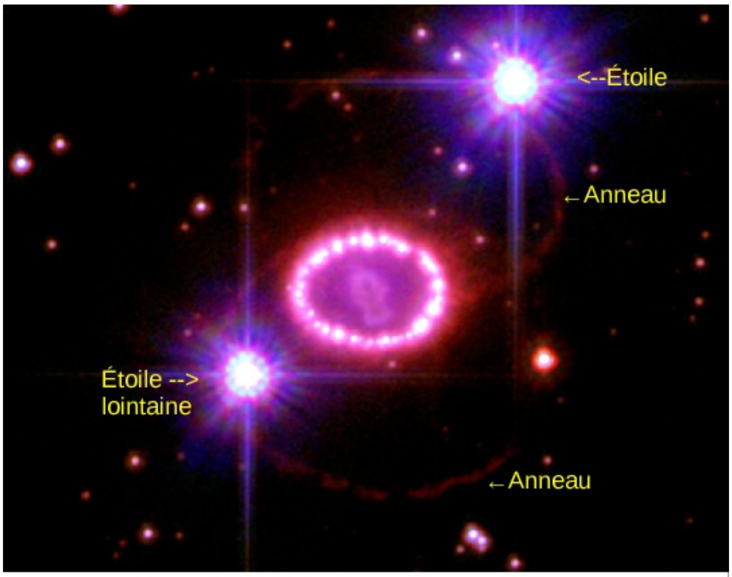

Figure 3: Supernova 1987A (Hubble)

It is clear that atomic hydrogen plays a large part in rings spectroscopy [8], but the needed hydrogen distribution cannot be explained [9]. Before lighting the rings, incoherent light-scattering by clouds was observed, establishing the hourglass-like geometry.

Assuming that a Strömgren sphere has been distorted in an equatorial plane by absorption or scattering (by planets) of light which heats the stellar wind, then many problems are solved:

• Formation of the hourglass does not result from an unequal distribution of hydrogen, but mainly from an unequal excitation of atoms.

• Energy radiated by the rings simply results from a quasi instantaneous transformation of energy received from the star.

• Light emitted by SN1987A is totally absorbed, while that received from other stars, usually absorbed (because it is hot), can be amplified if it coincides with a ring. An *optical black hole* is formed.

• The black hole is transparent for cold light: while no star is observed inside inner ring, a glow persists, due to a weak emission by external regions of the hourglass: under Strömgren's shell, protons and electrons collisions may induce a production of atoms stable enough to allow emission of their spectral lines. This low atomic density, thus emission, increases with radius. On its way towards the hourglass surface, the emitted light is redshifted. Thus, the more light is redshifted, the less its radiance is.

Above surface, these rays are too cold to be absorbed or scattered into superradiant rays. But they are strongly redshifted [10]. Such line profiles are usually observed in nebulae.

SNR1987A shows the most beautiful black hole of our galaxy !

4 Spectroscopy of Lyman α lines of quasars.

4.1 Periodicities of Karlsson and Burbidge.

Let us call *redshift* Z the ratio of a reduction in frequency with respect to initial frequency. Karlsson and Burbidge [11, 12] noticed that most quasars redshifts observed during twentieth century are close to remarkable values given by the empirical formula $Z(m) = mK$, where m is integer $3, 4, 6, 7, 8, \ldots$, and $K = 0,061$ is Karlsson's constant.

These researchers could not use this formula to study quasars spectra, and it does not apply to presently observed highly redshifted quasars. The lack of values 1, 2, 5 of m is surprising and brings to rewrite the formula:

$Z(p, q) = p \times (3K) + q \times (4K)$, where p and q are nonnegative integers.

Compute the redshifts $Z_{(\beta,\alpha)}$ and $Z_{(\gamma,\alpha)}$ which transform Lyman beta (Ly_β) and Lyman gamma (Ly_γ) frequencies (ν_β and ν_γ) of H atom into ν_α frequency. As Rydberg's constant simplifies:

$Z_{(\beta,\alpha)} = [\nu_\beta - \nu_\alpha]/\nu_\alpha = [(1 - 1/32) - (1 - 1/22)]/(1 - 1/22)] \approx 5/27 \approx 0.1852 \approx 3 \times 0.0617 \approx 3K$;

$Z_{(\gamma,\alpha)} = [\nu_\gamma - \nu_\alpha]/\nu_\alpha$ =[(1-1/42) -(1-1/22)]/(1-1/22)] = 1/4 = 0,25 = 4*0.0625 $\approx 4K$.

Thus, in spectrum, fundamental 3K (or 4K) redshifts bring the *absorbed* Ly_β (or Ly_γ) line onto the Ly_α line. **Noting that only one Ly_β (not redshifted) and no Ly_γ line is observed in quasars spectra, P. Petitjean [13] shows perfect coincidences of missing lines with α lines, hence the validity of improved Karlsson's law for (p,q)= (0.1) or (1,0) , $3K$ or $4K$ being replaced by $Z_{(\beta,\alpha)}$ or $Z_{(\gamma,\alpha)}$.** Is it also good for others values of p and q ?

Why do these coincidences which correspond to absence of Lyman α absorption stop redshift ?

4.2 Redshifted Ly_α lines.

Assume that Lyman spectrum is absorbed, next that a redshift process starts. A stop of redshift when an absorbed line reaches Ly_α frequency produces Karlsson's (corrected) redshift for the absorbed line.

How to apply this redshift to all frequencies in the spectrum ?

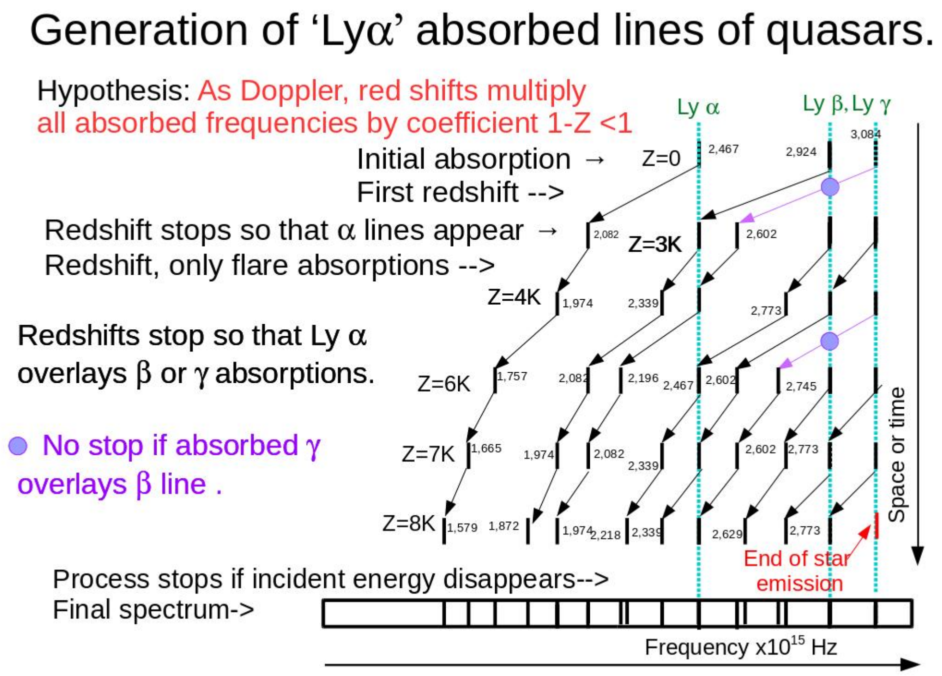

Figure 4: Building Lyman$_\alpha$ spectrum of a quasar.

By a Doppler effect, all light frequencies are multiplied by a constant, ratio of source and observer speeds. Are all frequencies multiplied by the same constant in quasar redshifts ? No, but though the error is not large, it shows that redshift does result from an interaction with matter (as dispersion in refraction). Remark that successive redshifts multiply the frequencies several times, but do not add redshifts as Karlsson's law does.

4.3 Building approximate absorption spectrum of Ly_α lines.

Assume that when Ly$_\beta$ line is shifted to Ly$_\alpha$ one, all absorbed frequencies are roughly multiplied by ν_α/ν_β, and also that 3P atoms resulting from Ly$_\beta$ absorption produces a very weak redshift.

A quasar spectrum shows generally sharp, saturated lines. Assuming this applies to all α lines, and neglecting dispersion the principle applied in fig. 4 is very simple :

Initially, the quasar emits a blackbody spectrum of an extremely hot source. It extends to UV-X region. Sharp, almost saturated lines will be absorbed, as seen in spectra. Then, it is assumed that light (thus its absorbed lines) is redshifted if Lyman α absorption is possible.

- A- At the beginning, Ly_α, Ly_β and Ly_γ lines of H atom, eventually strong lines of other gas, are absorbed.

- B- Let ν_x be the frequency of an absorbed line greater than and closest to ν_α. The spectrum, that is all absorbed lines and emission profile, is redshifted so that ν_x is shifted to ν_α. This multiplies all frequencies by ν_α/ν_x .

- C- As redshift produced by Ly_β absorption is very weak, redshift is nearly stopped. Ly_β and Ly_γ lines are absorbed, if it is possible, in the shifted emission spectrum. Other gas frequencies may be absorbed.

- D - If a new frequency ν_x is found, and if enough energy remains at Ly_β frequency to push absorbed line off Ly_α frequency, go to A.

- E - Else, by successive shifts, it does not remain enough energy at Ly_β frequency to shift absorbed line off alpha absorption line, the process stops, and laboratory frequency absorbed Ly_β line is visible.

Remark: Increasing m, Karlsson's law adds redshifts, a wrong way to combine successive absorptions. Thus Karlsson could not obtain good results.

4.4 Dispersion of redshifts.

Previous results are obtained assuming that by a redshift, all absorbed frequencies are multiplied by a constant. This neglects that redshifts being ruled by H atom, as refraction, it depends on atomic resonances, thus on frequencies.

However, comparison of computed and observed spectra shows that, in first approximation, dispersion may be neglected. More accuracy would require the multiplication of frequencies by a dispersion function obtained either experimentally or through ab initio computations.

4.5 Physics of redshifts in quasars spectra.

4.5.1 Conditions for a physical redshift: Impulsive Stimulated Raman Scattering: ISRS.

Stop of redshifts corresponds to that of Lyman α absorption, therefore to the non-creation of 2P excited hydrogen atoms from non-excited 1S ones. (We have already deduced that redshift of spectra occurs through light propagation in 2P hydrogen). Redshifts are subjected to the following conditions:

- So that spectral lines be very sharp, atomic hydrogen pressure must be low.

- So that gas excitation results only from Lyman alpha absorption, it is necessary to avoid a thermal excitation which implies a temperature lower than 50,000 K.

- Interactions must be coherent for images not to be destroyed.

- For the light frequency to change, energy must be exchanged with gas, that is the interaction must be a Raman's one.

But, as wavelengths of exciting and Raman scattered beams are different, the phases difference δ between a scattered ray at a fixed point A and one scattered at a variable point M is proportional to the length ℓ of arc AM, so that where δ reaches π, scattered rays cancel.

A solution is to use an optically anisotropic medium to have the same wavelength at two frequencies (with different polarization). For instance, using crystals allows to double frequency of an infrared laser ray to obtain a blue one.

A solution applicable to a gas, named *Impulsive Stimulated Raman Scattering* (ISRS) is studied by many equivalent models such as:

- In incident light, sharp lines linewidths are increased by pulsing the source, so that spectra of incident and scattered lines are expanded. Lines become broad enough for a common, intermediate spectral region corresponding to a shifted frequency.
- Figure 5 shows addition of two waves having same initial phases. Before apparition of beats, addition gives mainly an intermediate frequency selected by a stop of experiment. Use of pulsed light restarts experiment.
- More precisely, a Fourier computation extracts shifted frequency from the sum of incident and Raman scattered pulsed electromagnetic fields.

ISRS experiments are mainly used to study chemical reactions dynamics; the source of pulses is a femtosecond laser.

G. L. Lamb wrote the conditions for coherence, thus ISRS [12]: *length of light pulses must be shorter than all implied time constants.*

4.5.2 Variation of ISRS versus length of light pulses.

Michelson interferometers allow to split a light beam, then mix obtained beams after different paths, to observe interferences. Using light emitted by a thermal source, interferences may be observed only if difference of paths is lower than 0.3 meters. This shows that usual, thermal light may be represented by 1 nanosecond long coherent light pulses.

Thus, pulses making usual light are $k = 10^5$ times longer, for example, than the 10 femtoseconds pulses of common laboratory lasers.

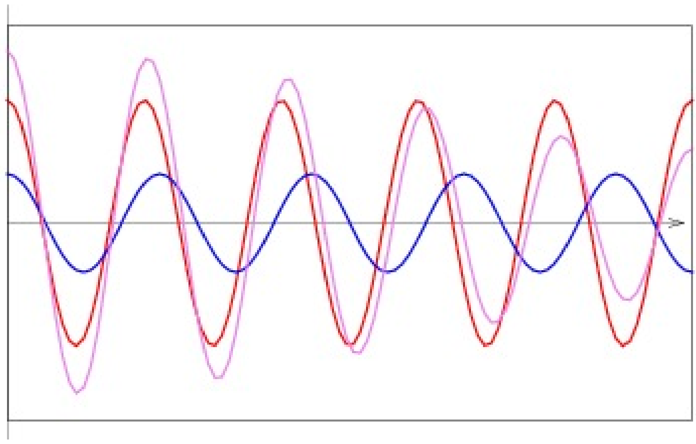

Figure 5: Addition of different frequency sinusoids (red and blue), before beats.

Compared to laboratory ISRS experiments, the use of natural light requires lower time constants, longer paths:

• Time separating (on the average) two molecular collisions must be increased, thus pressure must be reduced by factor $k = 1ns/10fs = 10^5$. This reduces scattered Raman amplitude, thus frequency shift by k factor.

• A reduction of Raman resonance period has a direct effect in the calculation of frequency mix, and an indirect effect by reducing population difference between resonant levels at equilibrium by the factor k.

Thus, the effect is reduced by factor $k^3 = 10^{15}$: observation of frequency shift requires an astronomical path.

According to Lamb's conditions, Raman period must be larger than 1 nanosecond (frequency less than 1 GHz).

The periods of hyperfine resonances in excited levels of H atom are larger than 1ns, so they are suitable, whereas in the ground state, the 1420 MHz resonance has a period of 0.704 nanosecond, too short for an ISRS . As resonant frequencies decrease with the principal quantum number of atom, they produce generally negligible frequency shifts.

As excited hyperfine levels of H atom cannot be de-excited by too rare collisions, de-excitation of atoms requires other ISRS involving generally thermal, low frequency electromagnetic radiation.

Such sets of ISRSs, called *Coherent Raman Effects on Incoherent Lights* (CREIL), form *parametric interactions* which exchange energies between light beams, increasing entropy of sets of rays, without significantly altering 2P atomic hydrogen which plays a catalyst role.

4.6 Balance of coherent Raman effect in nebulae.

The *Coherent Raman Effect on Incoherent Light* (CREIL) modifies the frequency of a light ray by exchanging energy with other electromagnetic waves via catalysis involving hyperfine levels of a population of excited hydrogen atoms. Energy stored by hyperfine excitation, or exchanged by collisions is negligible.

Excited hydrogen atoms exist in hot hydrogen of nebulae (temperature above 100,000K). At a lower temperature, it is created by absorption of Lyman alpha line by atomic hydrogen.

5 Spectrum of a quasar surrounded by pure hydrogen.

Theory of neutron stars introduces *accreting neutron stars*, objects which should be seen despite a size comparable to Earth one, and the mass of Sun, because gas accretion makes them extremely hot.

We assume that the quasars are the missing *accreting neutron stars*.

Here, we construct the spectrum of a neutron star immersed in a nebula of pure hydrogen, following light emitted by the star to the Earth without worrying about the scale of distances; the following subsections correspond to steps characterized by different types of interaction of light-matter interactions.

5.1 Kernel of quasar.

The quasar nucleus consists of neutrons resulting from atoms compression during collapse of mother star. In the absence of charged particles, it does not emit electromagnetic radiation.

5.2 Layer of very hot atoms.

Close to the nucleus are heavy atoms that are very hot, but have resisted star collapse because pressure was insufficient. These atoms emit a spectrum of hard X-rays.

5.3 Dense layer

Closer to the surface, temperature decreases, thus lighter atoms emit radiation at longer wavelengths.

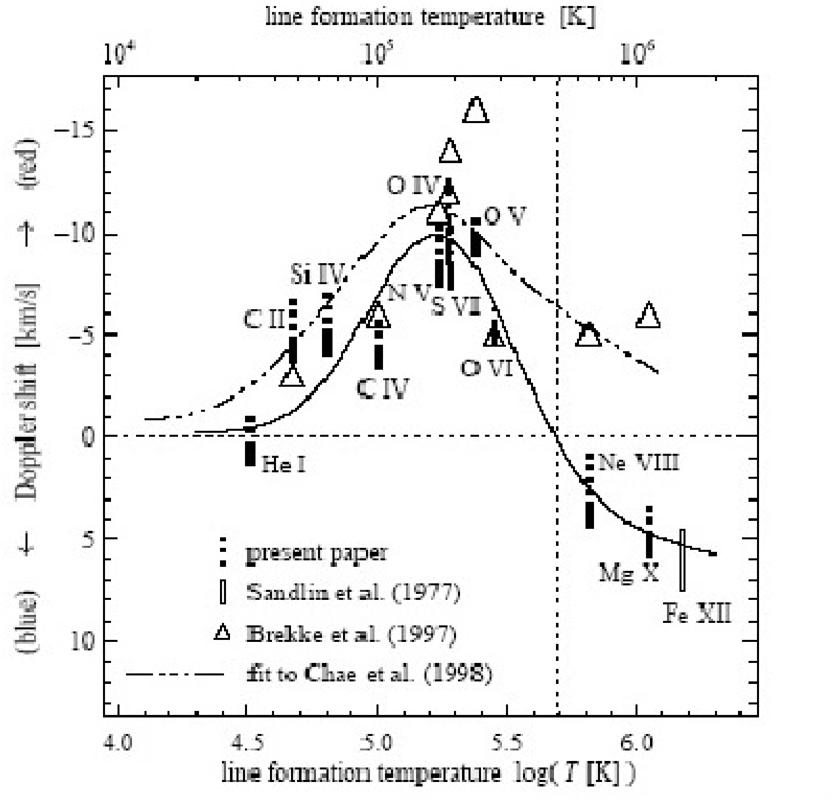

Figure 6: Variations of the Sun's X-emission frequencies after Peter and Judge. [15].

The authors changed the observed signs of shifts thinking that there was a systematic error while processing measures.

In the highly compressed matter, the atoms can practically not move on the scale of light pulses duration; as in a crystal, their spectrum is not widened by Doppler effect. Thus, a CREIL effect is possible, which transfers energy from hot rays emitted near the core, to rays emitted above, that is to say from hard X-rays to rays emitted at a lower frequency.

However, rays emitted near the surface do not have a large enough common path participate in such exchanges. Thus frequency variations are represented by the sinusoidal aspect curve recorded by a UV-X spectrometer carried by the SOHO probe (fig 6).

5.4 Gas.

We can define the surface of a star as the region where atoms acquire a freedom that forbids a CREIL effect. The atmosphere, mainly composed of hydrogen, cools more rapidly than in other stars, for quasar is small. The atmosphere then strongly absorbs broad atomic hydrogen lines, which was first noticed by Gunn and Petersson.

5.5 Ionosphere.

If atmospheric conditions are favorable to the presence of a layer strongly ionized by the radiation or by the accretion of the nebula in which the quasar is found, violent electromagnetic storms occur, and the quasar is said to be noisy.

The Lyman lines of the H atom, which are fine at this pressure, are absorbed by the gas.

5.6 Very high region.

The light reaches a region where the pressure remains too high for a CREIL effect. The temperature is low enough for the hydrogen to be slightly excited.

The pumping of 1S atoms to more excited levels is not veryS atoms effective, because the lines are fine, which saturates absorptions. Gas pressure and temperature decrease, so that redshifts by CREIL appear.

5.7 Propagation of white light in very low pressure, cold atomic hydrogen.

We suppose that white light emitted by a very hot star propagates through low pressure, collisionless, atomic hydrogen, the temperature of which, between 3 000 and 50 000 K, breaks the molecules but does not excite the atoms.

Absorption at Ly_α frequency excite atoms from 1S to 2P state. This has two consequences:

A- Population of excited atoms increases, so that Einstein's B coefficient for Ly_α increases until a superradiant ray bursts in the gas. This flash produces a flare, observed around the star. The beam which was amplified to start the flash has stochastic parameters, depending upon the history of a large volume of gas.

Superradiant emission de-excites atoms and, by a *competition of modes*, absorbs energy from all modes, in particular from observed mode, so that a line is absorbed in observed light. Pumping of atoms restarts, an other flash bursts, and so on. This relaxation process absorbs a lot of sharp lines making a *forest*.

B- Excited atoms produce a CREIL which redshifts the observed ray, so that absorbed spectral element is permanently renewed. This absorption of a very broad line is weak, invisible, except when it is increased by competition of modes, during the short flares.

C- If a strongly absorbed line is redshifted to Lyman α frequency, the redshift stops, all lines of gas, in particular Lyman β and γ are absorbed. See section 4.5.

However, if it remains enough energy at Ly_β frequency, atoms pumped to 3P state produce a weak redshift until it comes energy at alpha frequency. Then go to A. Else, that is if the spectral element of spectrum shifted to β frequency was out of emission spectrum of the star, there is no more frequency shift.

5.8 Structuring space.

There are regions (spherical shells) in which light pumps atoms to 2P state, and is redshifted, other regions in which the latter does not arise because there is no energy in spectrum of light at ν_α frequency. Other stars may try to superimpose their own structure. Difficult problem !

5.9 To the Earth.

There is no longer any noticeable interaction between light and gases until the spectrum is observed.

6 Other applications of CREIL.

6.1 Dispersion of redshifts.

Observation of multiplets emitted by atmosphere of quasars and other much redshifted stars, shows the dispersion of CREIL. Thus, there is no need to imagin a variation of fine structure constant. This dispersion is a strong argument for a redshift resulting from an interaction of light with matter.

6.2 Anomalous accelerations of Pioneer 10 and 11

The Strömgren shell of the Sun is between 10 and 15 AU.

Distance and acceleration of the probes are deduced from frequencies of microwave exchanged between probes and Earth. Anderson [16] observed an anomalous increase of frequencies when the probes crossed this region. He thought its origin was a Doppler shift due to an acceleration. But it was difficult to find an agreement between various considered sources of acceleration.

In Strömgren's shell, excited hydrogen allows a flux of energy from sunlight to microwaves, frequencies of which are increased. Thus, there is no anomalous acceleration to Sun.

6.3 Hubble's law.

Hubble's law does not measure distances, but approximately column densities of excited (2P) atomic hydrogen. We write "approximately" because many electromagnetic waves may perturb measurementss. However, this interpretation explains errors due to use of Hubble's law which assumes implicitely that density of excited H atoms is constant. This density is large close to hot stars.

Remarkable consequences of improper use of Hubble's law:

Distance of spiral galaxies is exaggerated, so that, for mechanical stability, it is necessary to increase their mass by *dark matter*.

Hot objects generate a lot of excited atomic hydrogen. Thus bubbles appear in maps of galaxies, universe seems spongy.

7 Conclusion.

Contemporary astrophysics introduces, like theories of the past, fantasy notions.

While, thanks to the discovery of gas lasers, many physicists understood that interactions of light with ultra-low pressure gas are exclusively coherent, astrophysicists did not use two fundamental effects of coherent spectroscopy: superradiance and coherent, pulsed, stimulated Raman effect. Willing also to imagine an origin of the Universe, they have built a wonderful and complex model.

Construction of a quasar model explaining previous observations has proved the importance of a coherent impulsive Raman effect which solves difficulties arising from an erroneous interpretation of frequency shifts in stars spectra.

Superradiance and multiphotonic interactions in atomic hydrogen shells explain the observation of rings around stars and generation of optical black holes.

Why make it simple when you can make it complicated ?

In this paper, hoping to no longer play the role of Cassandra, we avoided calculations, limiting ourselves to a qualitative representation of the universe.

Now we must cultivate our garden.

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