The Coherent Raman Effect on Incoherent Light (CREIL)

Jacques Moret-Bailly

Abstract text (Style: Abstract text)

Keywords: (Style: Abstract text)

1. Introduction.

This paper describes applications of the CREIL effect developed since the publication of papers 1-3.

The CREIL effect is an interaction between electromagnetic beams refracted by a medium obeying conditions set by G. L. Lamb Jr (4). This interaction increases the entropy of the set of beams by frequency shifts, usually a decrease of the frequencies of the light beams and an increase of the frequencies of the radio beams. Just as ordinary refraction, the CREIL is space-coherent, so that it does not blur the images, and it is parametric, so that the refracting medium is not excited permanently.

Using ordinary time-incoherent light, Lamb's conditions "length of the EM pulses (time-coherence) shorter than all relevant time constants" impose the

use of a low pressure gas (collisional time longer than some nanoseconds), and the existence of a Raman resonance in the 100 MHz range.
The CREIL explains completely the spectra of the quasars supposing that they are micro-quasars transformed into accreting neutron stars while they leave their galaxies, that the "Very Red Objects", observed close to the quasars have an anomalously large redshift. It explains the "anomalous acceleration" of the Pioneer 10 and 11 probes beyond 10 AU by a transfer of energy from the solar light to the radio during their refraction in excited atomic hydrogen produced by a cooling of the solar wind, the same transfer explaining that a part of the anisotropy of the microwave background is bound to the ecliptic.

Section 2 sets properties which must be fulfilled by a light-matter interaction able to be confused with a Doppler effect.
Section 3 shows that the propagation of light in a medium whose excitation by absorption induces a CREIL effect produces not only a spectrum, but a structuring of the medium too.
Section 4 shows that a particular structuring explains the pearl necklace of SN1987A.

2. General properties of Doppler-like light-matter interactions.

Many astrophysicists looked for alternatives to the Doppler effect. Some of them understood quickly that their solutions did not work, other persisted in their errors because the necessary conditions did not appear clearly. The conditions are:

2.1. As in a Doppler effect, the images must not be blurred: To avoid blurring of the wave surfaces, the interaction must be coherent, scattered waves generating by Huyfens' construction wave surfaces identical to the original ones provided that the number of scattering centres is large.

2.2. To avoid a blurring of the spectra, an elementary interaction must generate a single frequency. In the refraction, a coherent Rayleigh scattered wave delayed of $\pi/2$ interferes with the excited wave. In the CREIL effect, coherently scattered Raman waves interfere into a single frequency waves provided that Lamb's conditions are fulfilled. The CREIL appears as a set of coherent Raman interactions such that the balance of energy is zero for matter.

2.3. The relative frequency shift must be constant, at least approximately. An elementary computation shows that the CREIL relative frequency shift depends on the trace of the tensor of polarisability which, in a first approximation, does not depend on the frequency.

2.4. It is desirable to use only regular physics (optics, spectroscopy, thermodynamics) as the CREIL does.

2.5. The effect must be non-Doppler. This condition seems trivial, but its consequences are not.

Suppose that a continuous wave source S emits p cycles while a receiver R detects r cycles. The number of cycles on SR path increases of p-r, therefore the distance along SR increases of p-r wavelength: the effect is Doppler. Consequently, a Doppler-LIKE effect must fail using a CW source. Conversely, the theory of a Doppler-like frequency shift must contain a time-coherence parameter

3. Structuring of a medium which, absorbing light, becomes active in CREIL.

Atomic hydrogen has convenient Raman resonances in its first excited state. Consider hydrogen atomic, but not excited, at a temperature of the order of 20 000 K.

In a region (called absorbing or “A”) where there is few energy at the Lyman α frequency, there is few atoms in the first excited state, nearly no CREIL effect: this region absorbs light normally.

In a region (called redshifting or “R”) where there is much energy around the Lyman α frequency, much hydrogen is pumped to the CREIL-efficient 2P level, so that, before a full absorption, the spectrum is shifted off the Lyman line. Thus, the absorption is permanent, the shift is permanent. During the shift, the emitted or absorbed lines get the width of the shift, so that they are too wide to be easily observed.

Thus, there are shells of type A separated by R shells.

Propagating, the light jumps from a R region to a A region if the Ly α pumping becomes impossible because either there is no more hydrogen or because there is an absorption line in the spectrum. It may jump from A to R by small other type redshifts: by higher excited states or by a decay of these states to the first excited state. Leaving a A shell appears difficult, so that the A shells are generally thicker than the R shells.

4. Periodicities.

Suppose that there are only the Ly α and β lines. If a Lyman spectrum was regularly absorbed , the redshift which corresponds to a displacement of the beta line to the alpha corresponds to a multiplication of the initial β frequency by ν_α/ν_β=108/128 (Lamb's and spin corrections neglected). Each time a newly written beta line is shifted to the alpha, the frequencies of the previously written lines is multiplied by 108/128, so that one obtains a frequency multiplied by $(108/128)^p$ after p shifts.

Set q=3p; the frequencies are multiplied by $(108/128)^p=[(108/128)\{1/3\}]^q=(0.94494)^q$.

All values of q are not valuable !

A similar computation from the alpha and gamma gives a multiplication by $((0.8)^{1/4})^r=(0.94574)^r$.

The numerical factor is the same with a 1/1000 relative precision, so that q and r may be identified, mixed, keeping almost all values. keeping the log, a periodicity observed by Karlsson in the spectra of the quasars is obtained.

Observing the galaxies, Tifft and Napier observed much shorter periodicities. It seems that they may be explained by a similar computation using the Lyman pumping of molecular, cold hydrogen. Compared to the observed value, 72 km/s, the fundamental computed shift 81 km/s is too high if the log law is not taken into account. An other value, 36km/s, may result from a moiré effect.

Thus, the galaxies are surrounded by shells, just as the quasars, but these shells correspond to much smaller shifts, in cold hydrogen.

5. The pearl necklace of supernova SN1987A.

Suppose that the kernel of SN1987A is a neutron star heated by the accretion of a cloud of hydrogen less dense than the clouds which surround the quasars, so that the hot spots are smaller.

Close to the kernel, hydrogen is fully ionised, any hydrogen atom absorbing energy to be ionised. Thus the temperature is high, and the gas is transparent.

A combination of the protons and the electrons is difficult because the pressure is low; it requires a low temperature, so that the obtained hydrogen is not strongly excited. The UV light pumps the atoms, producing a CREIL effect which renews the energy at the Lyman alpha frequency, so that, a relatively thin spherical “R” shell appears.

The state 2P being strongly excited, a strong superradiant emission appears in directions where the thickness of excited medium is the largest, that is tangentially to the sphere. This emission limits the redshift, so that the light is fully absorbed at the Lyman α frequency.

The final result is a full transfer of a wide band energy coming from the kernel to a tangential, wide band superradiant emission. In a superradiant emission, the competition of the modes selects a particular set of modes: the pearls appear just as in a multimode laser.

6. Conclusion

The CREIL effect is a powerful tool in astrophysics. It allows to explain more and more observations with only trivial hypothesis.

1. Moret-Bailly, J., arxiv: physics/0503070.
2. Moret-Bailly, J., arxiv: physics/0507141.
3. Moret-Bailly, J., (2006) *AIP Conference Proceedings*, **822**, 226-238.
4. Lamb G. L. Jr., (1971) Rev. Mod. Phys., **43**, 99-124.