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Introduction of spatial, optical coherence in astrophysics

Propagation of star light in very low pressure gas.

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Abstract.

Light emitted by a star generates far, in relatively small volumes of interstellar space, parallel, plane waves. Coherent interactions with free, identical atoms on a plane wave surface, can only generate identical Huygens wavelets, envelopes of which are plane, so that Raman scattered light may only be emitted into the same direction than incident rays. They can because star light is fully incoherent, containing Raman frequency, amplification of which absorbs quanta of a resonant Raman energy. Assuming a low energy of a very large number of weak quanta, light spectrum is visibly redshifted. The lack of use of optical coherence in interstellar hydrogen has led astrophysicists to an unlikely theory “hated” by James Peebles.

1 - Introduction: Can stellar light be redshifted without a large energy loss ?

Some astrophysicists thought that a Raman interaction of star light with interstellar gas can redshift star light. But, before the discovery of lasers, the interaction was implicitly an usual Raman using collisions to disperse Raman emitted light into all directions. Can *coherent Raman effects* avoid this geometrical dispersion and only shift the frequencies of a star ray ?

2 - Raman redshift of white and temporally incoherent star light, by collisionless atoms of space.

We study relatively small regions of space far enough from stars, so that collisions of gaseous molecules are negligible, so that stars appear punctual, and so that light wave surfaces are flat and parallel.

Wave surfaces built by Huygens wavelets, in particular coherently issued from Raman interactions with molecules, are identical to incident wave surfaces, so that Raman rays emitted by sets of identical atoms are confused with incident rays.

Following the conditions for a coherent emission, this Raman emission must be a positive or negative amplification of a received wave. Assuming, as usual, that star light is perfectly temporally incoherent, it may be amplified by Raman emission.

In a Raman process, an atom may win a resonant quantum of energy $h\nu$ by absorption of any incident quantum at frequency F and emission of a quantum at frequency $F-\nu$. As in a gas laser, identical atoms are equally excited by star light, but an electromagnetic exchange of energy with atoms is not local, only a few atoms win energy $h\nu$.

Energy $h\nu$ won by atom is easily transferred to cold radiation, so that entropy grows.

3 - Redshift of an incident spectrum: chromatic dispersion.

The previous demonstration shows that a quantum of energy hF in incident ray may be replaced by a quantum of energy $h(F-\nu)$. A small number of such Raman interactions with ν large, would destroy the incident spectrum. It can remain if there is a large number of interactions at all frequencies F , with a low variation of probability in function of F . This interpretation requires a small value of $h\nu$, of the order of natural noise in incident light. As Raman interaction depends slightly on incident frequency, the redshift has a chromatic dispersion, as observed in star spectra of alkaline earth metals: it is useless to vary the fine structure constant.

4 - Search for Raman resonance frequency ν .

It is necessary to find in interstellar gas an intense transition whose energy is of the order of magnitude of noise of natural light, ie whose frequency is of the order of magnitude of hashing frequency, that is, around 1 GHz. It was hard to find a convenient transition.

The study of redshifts of stars and interstellar filaments showed existence of remarkable redshifts [1] leading to Karlsson's law [2,3], well verified by superposition of lines having different redshifts [4]:

$$\nu(n) = nK \text{ with } n = 3, 4, 6, \dots \text{ and Karlsson's constant } K = 0.062.$$

This result for $n = 3$ or 4 shows, using Rydberg's formula, that Lyman β and γ lines of H atom are shifted to α :

$$Z(\beta, \alpha) = (\nu_\beta - \nu_\alpha) / \nu_\alpha = [(1-1/3^2) - (1-1/2^2)] / (1-1/2^2)] \sim 5/27 \sim 0.1852 \sim 3 \cdot 0.0617;$$

$$Z(\gamma, \alpha) = (\nu_\gamma - \nu_\alpha) / \nu_\alpha = [(1-1/4^2) - (1-1/2^2)] / (1-1/2^2)] = 1/4 = 0,25 = 4 \cdot 0.0625;$$

Thus, redshifts stop if an absorbed line reaches Lyman alpha frequency, so that gas lines are visibly absorbed at new positions.

This interpretation is confirmed by many coincidences, in spectra of quasars, of lines having different redshifts [4]. A restart of redshifts requires initially a weak redshift possible if energy in light at Lyman beta frequency pumps atoms to high states.

We conclude that redshifts require a pumping of H atoms to 2P (or higher levels). In H_{2p}, fine structure (11 GHz) or Lamb shift (1,06 GHz) frequencies are convenient resonant ν frequencies.

5 – Examples of applications.

- **Hubble's rule does not evaluate distances, but column densities of H_{2p} atoms.** As these atoms are abundant near hot stars:

* Distances of spiral galaxies are overrated. Closer, thus smaller, these galaxies are stable without "dark matter".

* Hot stars inflate bubbles in galaxy maps.

* and so on .

- **Chromatic dispersion of the redshifts is explained without variation of fine structure constant.**

- **Lyman forests of quasars are explained:**

i) Around the star, H atoms are pumped to 2P state. Observed light is redshifted by these atoms.

ii) If, as in an aurora borealis, an accidental collision of excited atoms initializes a flare, a coherent Lyman α emission of light bursts, which:

- is seen close to quasar
- de-energizes the gas
- absorbs strongly light by super-absorption at α frequency, writing a very dark line in

spectrum.

iii) If it remains energy at Lyman α frequency, go to i).

iv) Else, Lines shifted to Lyman β frequency may pump atoms to levels which produce a weak redshift. Thus absorbed line which was shifted at alpha frequency may be shifted off, so that strong redshifts by 2P levels may restart... The spectrum becomes complicated !

6 - Conclusion.

Spectroscopy obtains more and simpler explanations than big bang theory hated by James Peebles.

7 - References:

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