How are hidden β and γ lines in Lyman forest of quasars.

Jacques Moret-Bailly*

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Abstract

Apparent absence of Lyman β and γ absorption lines of hydrogen atom in Lyman α forest of quasars results from their superposition by redshift with Lyman α lines. Spectrum shows that redshift expands until it stops when an absorbed line reaches α frequency, thus both absorbed lines blend. Lyman alpha excitation of H to 2P state allows a space-coherent impulsive stimulated Raman scattering (ISRS) which shifts frequencies. This key of quasar spectra also demonstrates Karlsson's formula.

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290.5910 Scattering, stimulated Raman
190.2640 Nonlinear optics : Stimulated scattering, modulation, etc.

1 Introduction.

In a thermal emission profile of spectra of quasars, a large number of absorptions of very sharp and saturated lines, is interpreted as Lyman α absorption by atomic hydrogen gas. Multiple Lyman alpha lines (abbreviation: Lyα) result from redshifts (relative frequency decreases). For example, P. Petitjean [1] provides a good but partial description and interpretation of a spectrum. Frequencies of sets of lines "E" comprising a Lyα line may suffer same redshift. But a full interpretation of "Lyman forest" remains a mystery.

*email: jmo@laposte.net

2 Absence of Lyman beta lines

While many Lyα lines are observed in "Lyman forest", no redshifted Lyβ (or Lyγ) line is observed. This absence is surprising because, although these lines are less intense than Lyα, they should be seen since so-called Lyα lines are very saturated. In fact, the reason is very simple, although it does not seem to appear in the literature: In calculating position of a Lyβ line from a Lyα, we just find another Lyα line which hides Lyβ line !

Usual explanation of a gas compression into very thin filaments that would absorb sharp lines despite a "cosmological expansion", requires creation of new laws of physics. It seems best to avoid it, using previous coincidence.

During redshift of light, spectral lines emitted or absorbed by gas are written at variable frequencies, lines are broad, weak, unobservable. To write a set of lines E, redshift must stop: why do it does when absorbed Lyβ reaches Lyα frequency?

3 Result of Lyα absorption.

Why do disappearance of Lyα absorption by arrival of absorbed Lyβ line stops redshift of light? This arrival stops pumping of atoms from 1S state to 2P state. Jean Claude Pecker proposed to explain redshifts by a Raman effect. It must be spatially coherent so that geometry of light rays is not disturbed. This coherence requires equal exciting and scattered wavelengths, although frequencies are different.

This condition is commonly verified in optically anisotropic crystals in which an ordinary ray can have a different refractive index than extraordinary index; thus frequencies of laser beams are multiplied, added, ...

In a gas necessarily isotropic, the trick is a broadening of spectral lines by cutting light into pulses, so that exciting and Raman line spectra blend: spectra of incident and scattered rays interfere enough if conditions set by G. L. Lamb [2] are true: "Light pulses must be shorter than all involved time constants".

For a gas these time constants are: freepath time of molecules and period of a quadrupole resonance. Laboratory experiments designated by acronym "ISRS" [3] require use of pulses whose duration is generally less than 100 femtoseconds. Using pulses of about 1 nanosecond (30 cm) that form natural, thermal light, ISRS becomes very low, only observable with astronomical paths because order of magnitude of frequency shifts, under optimal conditions, is inversely proportional to cube of length of pulses.

It gives interaction a new acronym: CREIL (Coherent Raman Effect with Incoherent Light) because, to avoid saturation of hyperfine levels, it is necessary to produce interactions with multiple beams of light, gas playing only a role of catalyst. Energy exchanges which produce frequency shifts, increase entropy of the system. Neglecting dispersion of polarizability of atom, relative variation of frequency does not depend on frequency of light.

To perform CREIL, 1420 MHz quadrupole frequency (21cm) of unexcited H atom (1S) is too high. Frequencies of resonances decrease with principal quantum number: Excited states check Lamb's conditions, but lowering frequency reduces effect.

Observation of redshift of light, requires an astronomical path in excited hydrogen which can be produced thermally or by Lyα absorption in cold atomic hydrogen.

4 Karlsson's law.

Karlsson's law [4, 5], empirically obtained by statistics gives the most likely redshifts of quasars and some other types of stars. In vicinity of a quasar, temperature decreases fast enough so that atomic hydrogen is not excited where free path time of atoms becomes larger than 1 ns by lowering pressure: Thus, ordinary absorption spectrum of unexcited H atom is written into light. Then in successive regions:

a) Either: absorbed Lyβ line got Lyα frequency, so that there is no pumping of H 1S to 2P, no redshift by lack of excited hydrogen. All local gas spectrum is registered into light.

b) Or: let Lyα absorption create 2P hydrogen, light is redshifted by energy transfer to thermal radiation. Absorptions (and amplifications) of spectral lines are diluted, invisible. Return to case "a" when an absorbed line is shifted to frequency Lyα.

Case "a" is left by a small redshift mainly resultant of Lyβ absorption: resonances in 3P produce low redshift, and this level can decay into 2S, very active.

In fact, absorption due to Lyγ line (exceptionally, to an other ultraviolet line) is intense enough to play the role described above for Lyβ line. Rydberg formula shows that redshifts that put Lyβ and Lyγ frequencies to Lyα can be written, respectively, with a good approximation, 3K and 4K, where K is Karlsson's constant 0.061.

Initially, where free path of atoms becomes larger than 1ns, there is no redshift, light propagates in a region "a". However, various excitations, perhaps remaining collisions, excite atoms, shifting slowly absorbed line out of Lyα absorption line, so that fast frequency shift appears, light leaves "a" region. Regions “b”, “a”, “b” ... succeed, producing redshifts 3K or 4K. When intensity of thermal radiation in ultraviolet falls, due to redshifted shape of thermal radiation curve of star, pumping Lyβ becomes unable to initiate output from state”a”, so that, in principle, redshift of star Z is given by Karlsson’s law: Z is a sum of redshifts bringing frequencies of absorbed lines Lyβ or Lyγ to Lyα absolute frequency. In writing these redshifts 3K and 4K, Z = nK, where n takes values 3, 4, 6, ...[4, 5]. There may of course be accidents eg due to parasitic lines.

5 Conclusion.

Demonstration of Karlsson’s law is a key to interpretation of Lyman forest. This law, initially empirical is demonstrated by extending area of laws of physics commonly used in laboratories, using unusual orders of magnitude of some variables of space and time. It is noted that hydrogen must be structured by radiation of a quasar treated as a point source. This structure can not occur in presence of too many sources, in vicinity of galaxies.

Pulsed Raman effects in spatially coherent, temporally incoherent light (CREIL) could explain other observations:

- As coherent Rayleigh scattering produces refraction and its dispersion, polarization of atoms, therefore CREIL, depends slightly on frequency. There is no need to vary fine structure constant to explain dispersion observed in multiplets emitted by quasars.

- Neighborhood of hot stars contains much atomic hydrogen: their distances determined by Hubble law is exaggerated. Thus, in mechanical study of spiral galaxies, roles (data or variable) of distance and mass must be switched. Also, big, hot stars inflate voids in maps of galaxies.

- Microwaves exchanged with the Pioneer 10 and 11 probes receive energy from solar radiation in region (10-15 AU) where solar wind consists of excited H atoms. So goes their abnormal acceleration.

- Hydrogen atoms below solar surface are immobilized by high pressure, as in a crystal. Thereby spectral lines are sharp and allow exchange of energy between beams. These exchanges explain that sign of frequency shifts of X lines depends on depth of source.

Astrophysicists, like a majority of physicists believe that photons are elementary particles, while Charles Townes and Willis Lamb [6] received Nobel Prizes for discoveries that deny quantization of electromagnetic field outside perfect optical resonators, as suggests one of postulates of quantum electrodynamics. Photon leads to neglect spatial coherence of interactions of light with low pressure, chemically and physically identical particles, although refraction, also called "spatially coherent Rayleigh scattering" works at lowest pressures. Loss of use of coherence of interaction of light with low pressure gas, makes neglect many effects, superradiance for example.

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