A tentative elementary model of quasars.

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ABSTRACT
A very simple model of quasar and Seyfert galaxy is obtained using the "Coherent Raman Effect on time-Incoherent Light" (CREIL) to explain a part of the observed redshifts. As its redshift is mostly provided by the CREIL, a QSO is not very far, its kernel may be a neutron star fed by the accretion of a disk, fed itself by the fall of many satellites. Disk and satellites are slowed by a relatively dense halo. The electric charges resulting of the friction of the disk produce flat lightnings, thus radio noise emitted mostly perpendicular to the disk, and X rays. The optical spectrum, including the shape of the spectral lines is explained without uncommon physics such as dark matter, by a splitting of the very wide lines resulting from simultaneous absorption and frequency shift, splitting due to a modulation of the redshift resulting from variations of a magnetic field.

Key words: Quasars – redshifts

surface. If molecules are placed on the initial wave surface, they scatter true wavelets, whose envelope gives a scattered wave surface nearly identical to a certain incident wave surface; as the number of molecules is finite, the generation of the envelope is not perfect, its flaws correspond to incoherently scattered light. If there is no frequency change, the interference of the scattered light which is late of $\pi/2$, decreases the phase of the incident beam, it is the refraction. The transfer of energy which produces a frequency change cancels the $\pi/2$ phase shift between the exciting and scattered beams *at the beginning of the excitation*; as this phase increases with the time, maintaining the time-coherence of the molecules to preserve the wave surfaces requires that the molecules do not restart by collisions: the scattered wave surface is identical to the incident one only if the length of the impulsions is shorter than the collisional time.

Multiple Raman scatterings blur a spectrum, because each shifted frequency is partly scattered, so that the initial frequency remains beside frequencies resulting from many scatterings. Thus, avoiding a blur of the spectrum requires an interference of the scattered beam with the incident one into a single frequency beam.

This interference is geometrically possible because the incident and scattered wave surfaces are identical. A mixture of two frequencies cannot be observed by a spectrometer if the resulting amplitude is constant enough, that is if beats cannot be observed. At the start of a Raman scattering the exciting and scattered beams have the same phase so that the modulus of the elongations may be simply added provided that it does not appear a notable phase shift: the interference requires the equality of the initial phases and a time of observation, that is a length of the pulses, much shorter than the period of the beats. This explanation is weak, but it is verified by an elementary computation which shows also that the frequency shift of the incident light is proportional to the product of the relative Raman scattered amplitude by the Raman frequency and by the frequency of the incident light. Thus the relative frequency shift $\Delta\nu/\nu$ is almost independent on ν.

A spectral element in a beam, a mode, has a temperature given by Planck's law. Just as in refraction, the molecules do not perform fully transitions between the states connected by the Raman transition, they polarise. Acting as catalyst by their polarisations, the molecules transfer energy from a hot redshifted mode to a cold one which is blue-shifted; in fact at least all modes making the thermal radiation are blue-shifted, that is the thermal radiation is amplified.

3   PROPERTIES OF THE CREIL

The CREIL transfers by frequency shifts, energy from modes having the density of energy of a hot source to the thermal radiation, without a blur of the geometry of the beams.

The relative frequency shift $\Delta\nu/\nu$ is nearly constant, it depends on the dispersion of the polarisability of the molecules which play the role of catalyst. Remark that supposing that the redshifts have a Doppler origin, some spectra

of quasars appear distorted (Webb et al. 1999)[1]. The dispersion of CREIL explains it without the hypothesis required by the standard theory: variation of the fine structure constant.

To be active in CREIL, a gas must have a collisional time longer than the length of the light pulses. The corresponding pressure depends on the gas, on the temperature, on a convenient definition of the collisions... Thus it is difficult to evaluate it; a rough order of magnitude is some Pascals. The gas must have low energy Raman transitions, in the radio-frequencies range. This is hyperfine transitions which may be between:

i) Genuine hyperfine levels if the molecule has nuclear non-zero spins. The H_2^+ molecule has probably convenient levels; as it self-destroys by collisions, its stability requires a very low pressure, thus working CREIL, so that its absorption lines are spread, mixed, invisible. An homogeneous density of undetectable H_2^+ may explain the Hubble redshift without expansion of the universe, and may be a source of 2.7K thermal radiation.

ii) Stark or Zeeman levels. Excited atomic hydrogen having a non-zero secondary l quantum number works. The redshifting power of atomic hydrogen depends on the excitation of the atoms and on the fields. Magnetic fields are detected by Faraday rotations (Welter et al. 1984).

iii) Other levels in heavy mono- or poly-atomic molecules, uncommon in astrophysics.

4   A MODEL OF QUASARS AND SEYFERT GALAXIES: NON-SPECTROSCOPIC PROPERTIES

In the standard theory, a quasar is surrounded by jets of mainly atomic hydrogen, and the line of sight goes through intergalactic clouds. Problems appear: conceiving the acceleration of the jets and the confinement of the clouds is difficult, requiring, for instance dark matter; the source of heating of the clouds is not clear; finally, the physico- chemical parenthood, the similar density of jets and clouds having close redshifts is strange (Tytler 1987).

A simultaneous absorption and redshift of a line produces a wide absorption line; a modulation of the redshift which may be done by a variation of a magnetic or electric field modulates the absorption, so that the wide lines appears split into pseudo-lines. Thus, suppose that the kernel is surrounded by a halo whose density and metallicity decrease with the distance to the kernel, and in which there are variable fields.

The distance of the quasars is generally evaluated applying Hubble's law to the most redshifted lines; if it is applied to the less redshifted ones (Petitjean et al. 1996; Shull et al. 1996), the distance decreases much, so that the kernel of the quasar may be simply a neutron star.

It is often supposed that a quasar has an accretion disk. This disk is slowed by its friction against the halo, so that it falls, feeding the star with matter and thus with energy; as

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[1] Most references describe observations illustrating effects explained in the text.

a disk is not homogenous, this feeding is irregular, so that the magnitude of the star changes slowly.

Set θ $(0 \leqslant \theta \leqslant \pi/2)$ the angle between the axis of the disk and the line of sight.

The friction of the disk electrifies it, as drops of rain in a cloud, but at a higher scale, with higher potentials and charges. The electric currents which appear as local lightnings are in the plane of the disk, thus flat, so that they radiate radiowaves as a flat homogenous antenna or a diffraction hole; thus the radio noise is maximum for $\theta = 0$.

As the pressure is low, the disk works locally as a Crookes tube, X rays are emitted in the volume of the disk; for $\theta \approx \pi/2$, the X rays are partly absorbed while they propagate in the disk (Brandt et al. 1999): $\theta \approx \pi/2$ appears the condition for a BAL quasar.

We follow the analogy of quasars and Seyfert galaxies which is often outlined (Weedman 1976; Stein et al. 1976); thus, it appears natural to suppose that the quasars have satellites as the kernels of the Seyfert galaxies, so that the main differences between these objects seem the number and the size of the satellites. The existence of a lot of satellites is backed by the observation of large decreases of magnitude during times of the order of the day: it may be occultations of the kernel by the satellites. The satellites may be planets rather than stars because in despite of their number they are not really visible, and the occultation of a neutron star does not require a big object. The satellites may be slowed by the halo, then broken into the disk, compensating the absorption of the halo by the kernel.

5 OPTICAL SPECTRUM OF QUASARS AND SEYFERT GALAXIES

The halo may be divided into layers which give different types of spectra; starting from the kernel:

Near the surface of the quasar.

The pressure of the halo forbids a CREIL, but it is low enough to produces sharp emission then absorption lines, as an ordinary star.

The broad lines region.

If a neutral atom of hydrogen has absorbed light at Lyman$_\alpha$ frequency, it returns to its ground state by a collision with an other atom or a free electron, heating the translational energy of the gas; the process is reversible, the hot gas (temperature larger than 10 000K) being able to emit a Lyman photon. These partly coherent interactions tend to reach an equilibrium between the translational energy of the gas and the mean temperature of the modes at the resonance frequency.

The equilibrium is reached near the quasar for the strong lines, so that the intensity of light absorbed or amplified, at the strong resonance frequencies, corresponds to the temperature of the gas, not anymore to the temperature of the source. If the gas is slightly active for CREIL, the equilibrium is maintained during the frequency shift, so that a trough appears in the spectrum; small variations of the CREIL leave the light intensity constant in the trough, provided that the interaction is high enough to reach the equilibrium. The absorption does not depend on the column density and a lack of saturation does not need an explanation by a covering factor.

Leaving electric charges in the halo, the disk charges, so that its rotation induces a space-variable magnetic field close to it. This field may be increased by magnetic properties of the elements of the disk. The disk produces an electric field too. Thus, in some places close to the disk, hydrogen atoms pumped by Lyman transitions may be active for CREIL; where the field is high, a spectral element of the light resonates only along short path, so that it is not much absorbed; elsewhere the resonating spectral elements get the temperature of the gas. Thus, if $\theta \approx \pi/2$, BEL and BAL appear and their correlation with the radio-quietness is clear.

Observing the quasar in radio-loud conditions ($\theta \ll \pi/2$), there is no magnetic field, no CREIL, the absorption which corresponds to the BAL is confused as an excess of absorption near the emission redshift (Briggs et al. 1984; Anderson et al. 1987). The propagation does not introduces a redshift, while it does in the other case; consequently the thermal radiation issued from the kernel is less amplified, the "dust emission" is lower than for BAL quasars (Omont et al. 1996).

The damped Lyman lines forest

At a larger distance, the space-variable magnetic field necessary to split a wide Lyman line into pseudo-lines making the forest may be produced by the satellites.

The density of radiative energy is lower than close to the disk, that is the number of exciting modes coming from the kernel becomes low; the mean temperature of the exciting modes is low, so that the population in the excited states is almost negligible and the absorption may saturate. If a magnetic field shifts the lines by CREIL the simultaneous absorption is low. The computation (Moret-Bailly 2001, 2002) shows that the pseudo-lines may be sharp, but with strong feet, so that, by an increase of the absorption, they are damped more than a line having a collisional or Doppler profile.

The Lyman forest

In the outer part of the halo, the lines of the forest may be sharp in despite of slow variations of the field because the absorption/redshift process produces a bistability: Suppose that a high field produces in a certain region a high CREIL; the spectral element whose frequency equals the Lyman frequency is permanently renewed, so that the atoms of hydrogen are strongly pumped and able to produce CREIL. Thus CREIL remains large until the field becomes very low, then, there is a brutal disappearance of CREIL. On the contrary, if CREIL is low, energy is not renewed at Lyman frequency, there are few excited atoms, a large magnetic field is needed to start a visible CREIL.

A large fraction of the energy of the light is absorbed by the redshift and transferred to the thermal spectrum; it just happens that the most redshifted objects radiate a relatively hot thermal spectrum; is it produced by dust or by CREIL?

6 CONCLUSION

CREIL was found from a dependable theory which explains refraction and Bragg scattering; during a long time only its

nonlinear version the "Impulsive Stimulated Raman Scattering" (ISRS) was commonly observed and used in the labs, so that it could appear careful to ignore CREIL. Now CREIL itself is observed (Kandpal 2002), stronger than expected from a too cautious application of the theory, so that it must be taken into account.

The present simple model of quasars explains qualitatively more usual observations than the standard model, for instance the radio-quietness and the X absorption of the BAL quasars, and, however, requires only elementary physics.

The model must be improved to become quantitative and adapted to all elements of the large family of quasars and Seyfert galaxies; it remains much work!

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