Cosmological consequences

10/01/2020

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In the note of 17/12/2022 we presented a new approach to relativity. This leads to certain differences compared with the theories of special relativity (SR) and general relativity (GR), which may have consequences in the field of cosmology.

A) Expansion of the universe. Hubble constant

We have seen that the spectral shift differs from that given by the RR[1] :

$$\nu = (1 - \mathbf{u/c})\, \nu_S \qquad \text{(DUB)}$$

instead of :

$$\nu = ((1 - \mathbf{u/c})/(1 + \mathbf{u/c}))^{1/2}\, \nu_S \qquad \text{(RR)}$$

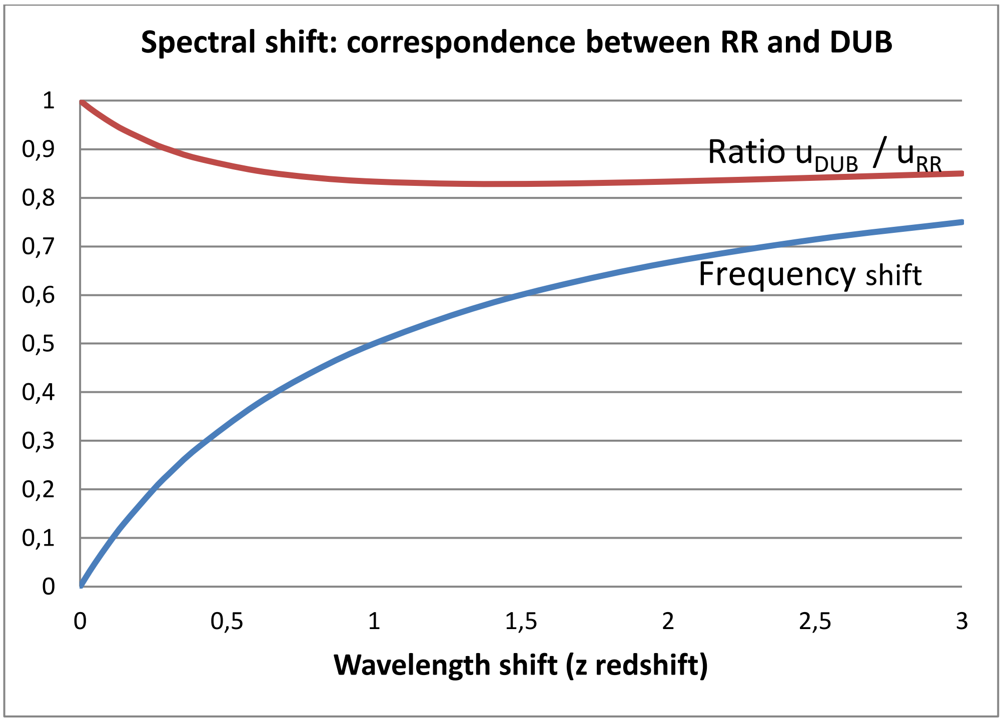
when the source (of frequency ν_S) moves away from the observer at speed u.

The graph below gives, as a function of the parameter $z = (\lambda - \lambda_S)/\lambda_S$:

- frequency shift: $(\nu_S - \nu)/\nu_S = z/(1 + z)$

- the ratio between the speeds calculated from the frequency shift by the two previous formulas:

$$u_{DUB} / u_{RR} = (2 + 2z + z^2)/(2 + 3z + z^2)$$



[1] cf. paragraph 4.1.4 of the note "Another approach to relativity".

In the approach we propose, the recession speed of celestial objects is therefore reduced compared with that calculated from the RR.

If we refer to the various measurements of the Hubble constant[2] , this is likely to bring the expansion measurements of the current universe very close to those of the primordial universe, which currently differ by around 10%.[3]

B) Dark matter. Gravitation and neutrinos

Our new approach to relativity rejects the hypothesis of invariance of mass at rest: when there is a change of reference frame, it is the total energy of a particle that is conserved, not its mass.

This leads to the formulation of laws of gravitation in which it is no longer the mass of the bodies involved that is important (as in Newtonian gravitation) but their energy.

If we take the frame of reference where the first body (of mass M_1) is at rest and exerts a gravitational attraction on the second, of velocity v and total energy E_2 , the variation in potential energy as a function of distance is written as[4] :

$$dE_g = 2\,(GM_1/\,\mathbf{c}^2 r^2)\,E_2\,dr \qquad \text{with} \quad E_2 = \Upsilon\, M_2\, \mathbf{c}^2 \qquad (\Upsilon = 1/(1-v^2/c^2)^{1/2})$$

When the body exerting the gravitational attraction is in motion, it is its total energy that must be considered. The previous formula must be written in the form :

$$dE_g = 2\,(G\,E_1 E_2/\,\mathbf{c}^4 r^2)\,dr$$

If the body is a particle moving at relativistic speed, the deviation from Newtonian gravitation can become very large.

In the light of this observation, shouldn't we reconsider the contribution of neutrinos to the gravitational equilibrium of galaxies and clusters of galaxies?

Could this rehabilitate neutrinos as candidates for the answer to the dark matter enigma?

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[2] see for example "Pour la Science - Hors-série n° 106, Février-Mars 2020".

[3] We do not have the detailed results (z parameter and distance value) for each object taken into account in the experiments, which would make it possible to calculate a corrected value of the Hubble constant. A recent experiment gives an intermediate result, which could involve lower values of z, also implying a lower correction factor.

[4] cf. relation (5.3) of the note "Another approach to relativity".