$$\frac{(\alpha^2)\text{ Cyg. }A}{(\alpha^2)\text{ local}} = 1\cdot0036 \pm 0\cdot0032$$

E. Salpeter (private communication) points out that if the red shift is understood as arising from a change in α^2, then:

$$\frac{(\alpha^2)\text{ Cyg. }A}{(\alpha^2)\text{ local}} = \left(1 + \frac{\Delta\lambda}{\lambda}\right) = 1\cdot057$$

The observed wave-length of the hyperfine structure hydrogen line at 21 cm. is assumed to be given by the following equation:

$$\lambda_{\text{Cyg. }A} = \lambda_{\text{local}}\,(1 + \Delta\lambda/\lambda)\,\frac{\left(g\frac{m}{M}\alpha^2\right)_{\text{Cyg. }A}}{\left(g\frac{m}{M}\alpha^2\right)_{\text{local}}}$$

Since Lilley and McClain report $c\Delta\lambda/\lambda = 16{,}700 \pm 50$ km./sec. we find

$$\frac{\left(g\frac{m}{M}\alpha^2\right)_{\text{Cyg. }A}}{\left(g\frac{m}{M}\alpha^2\right)_{\text{local}}} = 1\cdot0003 \pm 0\cdot0007$$

This corresponds to

$$\frac{\left(g\frac{m}{M}\right)_{\text{Cyg. }A}}{\left(g\frac{m}{M}\right)_{\text{local}}} = 0\cdot9967 \pm 0\cdot0032$$

It must be mentioned, however, that the difference of 100 km./sec. could also be understood as resulting from an expanding hydrogen envelope of which only the front surface projects on the source.

Note that α is the coupling factor for quantum electrodynamics. The proton gyromagnetic ratio is observed to be 2·8 times the ratio predicted by quantum electrodynamics and is apparently determined by interactions with the meson field. My conclusion is that, within the precision of current measurements, the above physical constants of Nature are indistinguishable in two galaxies 3×10^8 light years apart.

Similar conclusions were mentioned by E. M. Purcell at a symposium in April 1956.

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Suggested Experiment on the Relativistic Contraction of Time

It has been questioned whether a discrepancy in time would be observed when comparing clocks at the completion of a space journey. It seems to me that one need not await the advent of space travel at extreme speeds for experimental evidence, since a closely analogous experiment could be performed on the Earth. A suitable clock exists in the form of unstable particles of known half-life. Particles possessing charge in combination with a convenient mass and half-life could be injected into a synchrotron and circulated for a measured time-interval before emerging. Some would disintegrate within the synchrotron and fail to emerge. By comparing the number entering in unit time with the number emerging, any increase in the life of the particles, as measured by the stationary observer, could be determined.

In case it should be objected that motion in a circular path, implying continuous acceleration, does not correspond to a flight path which would be adopted in space travel, an alternative technique is possible. The particles could be accelerated in an electric field, allowed to coast for a relatively long distance in a field-free region, reflected by a second electric field or a magnetic field, and finally brought to rest at the starting point after retraversing the field-free region and the first electric field. To obtain maximum velocities the electric fields could take the form of linear accelerators.

Incidentally, if an increase in life of the particles were in fact observed, there might be interesting applications for this technique of 'freezing' short-lived particles.

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A Determination of the Line-width of the λ6300 Line of Oxygen in the Twilight Sky

The red doublet (λ6,300–λ6,363) due to oxygen in the upper atmosphere of the Earth is greatly enhanced in twilight, as was shown by Elvey and Farnsworth[1] and others. The present study has been undertaken to determine the temperature of the emitting layer from the contour of the λ6,300 component.

A Fabry–Perot interferometer with multi-layer dielectric reflecting surfaces, described in an earlier study of the λ5,577 line in the night sky[2], was placed in front of a camera with an effective focal ratio of 3·9. The interferometer plates were coated with five layers—two of cryolite and three of zinc sulphide—giving a reflectance of 0·87 in the spectral region under study. A quartz spacer of 11·7 mm. was used.

In front of the system a multi-layer dielectric interference filter (Baird Associates) with a band-width of 60 A. was inserted to reduce the scattered light from the twilight sky and to isolate the λ6,300 line from the weaker λ6,363 component. The entire instrument was contained in an airtight enclosure to provide constant density of the air between the interferometer plates, and this, in turn, was placed in an insulating case to permit careful temperature control.

Observations were made at the Geophysical Institute at College, Alaska (lat. 64° 52′ N.), at a time when twilight conditions favourable for the study existed at midnight. This permitted long exposures during which the depression of the Sun below the horizon remained nearly constant. Exposures of from one to two hours were necessary to obtain satisfactory results. The optical axis of the instrument was directed to the north and at a zenith distance of 70°.

The instrumental effect on the contour of the fringes was determined from a comparison of the observed line-width with the width of the λ6,438 line