footing, and there is no infinite dilation or contraction of one interval of proper time with respect to another. Consider, for example, an oscillating universe in which the pressure is negligibly small and the density is uniform. The time taken in the final stage to collapse from a density ρ_u to an infinite density is:

$$\tau_u \simeq \frac{2}{3}\left(\frac{3}{8\pi\rho_u G}\right)^{\frac{1}{2}} \qquad (7)$$

By setting $M = 4\pi\rho_m r_s{}^3/3$ in (6), where ρ_m is the density of the collapsing body, it is seen that the time of collapse, τ_m, of the body and the time of collapse of the universe, τ_u, are equal when ρ_u becomes equal to ρ_m. This means that a solar mass in free-fall gravitational collapse becomes part of the collapsing universe in the last microsecond of its career. Such a universe can presumably oscillate indefinitely: it emerges from the singular state, innumerable bodies collapse asymptotically to their Schwarzschild radii, these singularities are swept up and smoothed out as the universe returns to its singular state, and finally it re-emerges to commence a fresh cycle.

To the question: is it meaningful in an external system to consider the ultimate fate of a body that is gravitationally collapsing, the answer is: yes, if the universe is oscillating. For the external system itself participates in the final stage of the gravitational collapse.

E. R. HARRISON

Rutherford High Energy Laboratory,
National Institute for Research in Nuclear Science,
Chilton, Didcot, Berkshire.

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Cosmological Red-shift

HOYLE[1] has shown that for a steady-state universe consisting of uniformly distributed matter of density ρ a metric of the form:

$$ds^2 = -\,dr^2\left(1 - \frac{8\pi}{3c^2}G\rho r^2\right)^{-1} - r^2 d\theta^2 - r^2 \sin^2\theta d\psi^2 + c^2\left(1 - \frac{8\pi}{3c^2}G\rho r^2\right)dt^2$$

applies if it is assumed that a uniform creation of matter occurs.

From this metric Hawkins[2] has deduced an expression for a red-shift, arising in the absence of any galactic displacement, given by:

$$\frac{\Delta\lambda}{\lambda} = \frac{4\pi}{3c^2}G\rho r^2$$

I recently proposed[3] that a red-shift will occur in any model universe containing uniformly distributed matter if absorption or shielding of gravitational flux occurs on the cosmological scale, and will be given by:

$$\frac{\Delta\lambda}{\lambda} = \frac{2\pi}{3c^2}G\rho r^2$$

which differs by a factor of 2 from Hawkins's equation.

The purpose of this communication is to emphasize the fact that the very different initial assumptions of either (*a*) the continuous creation of matter, or (*b*) the shielding or absorption of gravitational flux, both lead to similar results. Of perhaps greater interest is the fact that in neither of these approaches is the red-shift expression related quantitatively with the initial assumption. This would indicate that a still more fundamental relationship exists.

L. M. STEPHENSON

University College,
London.

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ASTROPHYSICS

Forbidden Lines from Atomic Sulphur

FORBIDDEN lines from astrophysical and other sources are specially prominent from elements with an np^4 electron configuration. The best known are the auroral ($^1S_0$–$^1D_2$) and transauroral ($^1S_0$–$^3P_1$) lines of oxygen (OI). The present communication reports the laboratory excitation of the corresponding lines of sulphur (SI).

Conventional high voltage a.c. or d.c. discharges with positive columns were used. The tubes used varied in length from 12 to 200 cm, and in diameter from 1·5 to 3·0 cm. They were filled with xenon to a pressure of a few cm mercury after some sulphur had been distilled in, and were then sealed off and conditioned by passage of a current until impurities such as carbon monoxide had disappeared. With the smaller tubes local heating in the neighbourhood of the electrodes caused an increase in sulphur vapour pressure which tended to quench the forbidden lines, and limited the usable currents to less than about 1 m.amp. However, with the larger tube the intensity of emission was observed to be increasing even when currents as high as 15 m.amp were used. A detailed investigation of the excitation conditions is in progress.

Two spectrographs were used, a Recherches et Études d'Optique et de Sciences Connexes *HA* crossed grating instrument with a linear reciprocal dispersion of 3·5 Å/mm at 4600 Å and an aperture of *f*5, and a Huet *B*11 two-prism instrument which enabled the whole spectral range from 4000–8000 Å to be recorded on a single plate. The dispersion of the latter was 130 Å/mm at 7725 Å and the aperture *f*4. Kodak *OF*, II *L*, II *N* and 103 *aF* plates were used during the course of the investigation.

Using the large tube, with a current of 4 m.amp, it was found possible to record the lines in 4 min. The 4507 Å ($^1S_0$–$^3P_2$) line was not observed as it was obscured by a background of sulphur molecular radiation. It is hoped to record it using afterglow techniques.

Wave-length measurements were made using the xenon lines from the discharge as references. These measurements gave a wave-length of 4589·21 ± 0·05 Å for the $^1S_0$–$^3P_1$ transition and 7725·7 ± 1 Å for the $^1S_0$–$^1D_2$ transition. So far as we are aware, this is the first time the former line has been recorded.

These may be compared with the astrophysical value[1,2] of 7726·5 Å, and those computed from the accepted term values[3] of 4589·1 Å and 7724·4 Å.

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J. W. MCCONKEY
D. J. BURNS

Department of Physics,
Queen's University,
Belfast.

L. HERMAN

Laboratoire des Recherches Physiques,
Sorbonne,
Paris.

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