of the kind discussed by Kopal[3] for V444 Cygni. This means that the star which is in front at primary minimum has an extended and partly opaque atmosphere.

1. *Ann. Harv. Coll. Obs.* **105**, 509, 1937; *Bull. Astr. Obs. Harv.* 917, 14, 1943.
2. *Ap. J.* **97**, 406, 1943.
3. *Ap. J.* **104**, 160, 1946.

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Omer, Guy C., Jr. A relativistic model for a cluster of nebulae.

A numerical relativistic model based upon the Coma cluster of nebulae has been constructed. Following F. Zwicky, it has been assumed that the Coma cluster can be represented by an Emden isothermal distribution which is bounded at $r_1 = 85$. The cluster is considered as forming the central portion of a cosmological model and as extending out to a present radius of 2×10^6 light years. Beyond this boundary the model is taken as being identical with the cosmological model which was previously presented by the author.[1] Thus the model is subject to the assumptions of spherical symmetry, co-moving coordinates, and zero-pressure. These assumptions appear to be reasonable for the Coma cluster at the present time. The choice of a particular cosmological model outside of the cluster specifies a cosmological constant of 8.78×10^{-19} (lt. yrs.)$^{-2}$ for the entire model and a time-scale of 3.64×10^9 yrs. at the boundary of the cluster.

Since the dimensions of the cluster are small as compared to the rest of the model it is reasonable to require that the time-scale everywhere within the cluster must be equal to the time-scale at its boundary. This allows the local radius of curvature to be calculated for points within the cluster. Approximate calculations were made by assuming that certain selected interior points were contained within Friedmann zones. Since all of the relativistic parameters are now specified throughout the model, its local behavior can be determined. It was found that there was a change in local behavior at a present radius of 2.5×10^5 lt. yrs. Beyond this radius the cluster expands with the rest of space, although at a slower rate. The local behavior of this part of the cluster is similar to the expansion of an M_1 model in the homogeneous cosmologies. The gravitational field within this radius is sufficiently high so that the nucleus of the cluster does not expand monotonically, but oscillates instead. This local behavior is similar to an O_1 model in the homogeneous cosmologies. The nucleus, therefore, should be a permanent feature of the cluster.

The physical state of the model at the earlier epoch of 10^9 yrs. after the beginning of the expansion was calculated. The local density within the cluster was found to vary from the center to the boundary by a ratio of only 2 to 1. This may be compared to the present assumed ratio of 4100 to 1. Further extrapolation to earlier epochs indicates that the cluster may have been formed from a small initial fluctuation in the local density at the beginning of the expansion. A similar calculation for the later epoch of 7.5×10^9 yrs. after the beginning of the expansion shows the persistence of the nucleus and the continued expansion of the remainder of the cluster towards an eventual empty end-state.

1. *A. J.* **54**, 46, 1948.

University of Oregon, Eugene, Ore.

Omer, Guy C., Jr. Local behavior of spherically symmetric relativistic solutions.

The fundamental non-linear partial differential equation of spherically symmetric, zero-pressure, nonhomogeneous, relativistic cosmology has been solved in terms of Weierstrassian elliptic functions. The allowed range of the parametric variable in this solution can be delimited by the physical requirement that all measures of length and time within the model must be real. This allows the determination of the local behavior of a nonhomogeneous model in the immediate neighborhood of any given point. H. P. Robertson's convenient notation for the behavior of homogeneous models can be readily generalized for the nonhomogeneous models to describe the local behavior within the neighborhood of any given point. Robertson has also given a two-dimensional plot which specifies the behavior of any particular homogeneous model. This geometrical representation can also be generalized into a three-dimensional plot which specifies the local behavior of nonhomogeneous models.

University of Oregon, Eugene, Ore.

Pearce, J. A. HD 215835—a new massive eclipsing system.

This ninth magnitude star in the galactic cluster NGC 7380 was independently discovered to be a spectrographic binary by Trumpler and the writer. Thirty-six single-prism spectra having a dispersion of 51 A/mm at $H\gamma$ were secured between January 8 and October 19, this year. The following orbital elements were deduced from twenty-seven plates on which the velocities of both components were measured.

SPECTROGRAPHIC ELEMENTS OF H.D. 215835

1900 α, $22^h\,42^m\!.9$; δ, $+57°\,33'$;
Vis. mag. 8.6; Spectral types O5–O5

Element			
T =	JD 2432759.807	± 0.0241	
P =	2.11104	± 0.000017	days
e =	0.127	± 0.0083	
ω_1 =	107°.4	± 4°.19	
ω_2 =	287°.4	± 4°.19	
V_0 =	−35.4	± 1.80	km/sec
K_1 =	261.7	± 3.03	km/sec
K_2 =	321.4	± 3.06	km/sec
$m_1 \sin^3 i$ =	23.4☉		
$m_2 \sin^3 i$ =	19.1☉		
$A \sin i$ =	24.2 solar radii		

The radial velocity of the strong interstellar K-line measured on every plate is -26.8 ± 0.30 km/sec. The intensity of the K-line was measured on five plates, from which a distance of 2100 parsecs was derived. This agrees well with Trumpler's adopted value of 1840 parsecs for the cluster.

The components have the earliest spectral types of all spectrographic binaries. The stars have similar spectra, being normal absorption O5 stars. The difference in magnitude, $\Delta m = 0.28$, was spectrophotometrically determined from the intensities of λ4542 and $H\gamma$ on six plates.

The following physical characteristics were deduced upon the assumption that the stars are normal O-type stars, conforming to Eddington's mass-luminosity relation.

The orbital inclination is estimated to be 62° and an eclipse of 0.1 mag. at primary minimum is predicted.

No observations of the tenth magnitude class B stars in this cluster have been obtained at Victoria, B. C. It is to be observed, however, that the systemic velocity of HD 215835 is 4.6 km/sec, *more* positive than Trumpler's provisional value, so that the present investigation does not support his relativity red-shift hypothesis. The estimated maximum mass of 62☉ while quite large is quite normal for this interesting O-type system. The star is being observed by Dr. Kron at the Lick Observatory in order to determine an accurate light curve.

Dominion Astrophysical Observatory,
Victoria, B. C.

Sen, Hari K. The radiative equilibrium of a spherical planetary nebula.

The effect of curvature of the layers of a spherical planetary nebula on the fields of ultra-violet as well as Lyman-α radiation has been investigated by the spherical harmonic method. Allowing for the dilution of the radiation in the extended nebular shell, the following effects have been found, which may be attributed to the curvature of the nebular shell:

(1) The ultra-violet flux monotonically increases from the inner to the outer boundary of the nebula (the plane case has a maximum in the range), and is greater than that of the plane nebula by a factor of 2 to 3.

(2) The L_α flux for the static nebula increases as in the plane nebula monotonically from the inner to the outer boundary of the nebula, but is less than that of the plane nebula by a factor of 2/3.

(3) If the nebula be supposed to expand with a uniform velocity large compared with the mean velocity of molecular motion, the L_α fluxes for the moving plane and spherical nebulae are of the same order of magnitude towards the outer parts; the flux decreases much more rapidly towards the interior in the plane nebula, so that the inner parts which suffer inward radiative accelerations are much more extensive in the plane than in the spherical nebula.

PHYSICAL CHARACTERISTICS OF H.D. 215835

		Brighter Star			Fainter Star
Spectral Type		O5.0			O5.5
Temperature	Te	36300°K			35500°K
Apparent Magnitude	m_v	9.2			9.5
Absolute Magnitude	M_v	−4.2			−3.9
Mass	M	33.8 ☉			28.2 ☉
Radius	R	9.7 ☉			8.5 ☉
Density	ρ	0.04☉			0.04☉
Separation	A	27.4	Solar radii		
Axial Rotation	$Vr \sin i$	200	km/sec		180 km/sec
Distance of System	D	= 2100	parsecs	W_K =	0.70 ± 0.02 E.A.
		= 6850	lt. yr.		
Orbital Inclination	i	= 62°			
Light Ratio	l	= 0.77 ± 0.06		Δm =	0.28
Apsidal Motion		= 2.6	years		