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On the Physical Validity of the LANE-EMDEN Equation in $(y;z)$-Plane

LANE-EMDEN equation of index n[1]:

$$\frac{1}{\xi^2}\frac{d}{d\xi}\left(\xi^2\frac{d\theta}{d\xi}\right) = -\theta^n, \tag{1}$$

in $(y;z)$-plane, takes the form

$$y\frac{dy}{dz} + (2w-1)y + w(w-1) + z^n = 0; \tag{2}$$

where equations connecting $(y;z)$- with $(\xi;\theta)$ are

$$z = \xi^w\theta; \quad w = \frac{2}{n-1} \tag{3}$$

$$y = \frac{dz}{dt} = -\xi^{w+1}\frac{d\theta}{d\xi} - wz; \quad \xi = e^{-t}. \tag{4}$$

It has generally been believed that all parts of the solution-curves which correspond to $\theta \geqq 0$, $z \geqq 0$ have astrophysical validity. This gives the impression that every point on the y-axis is of interest. But, actually, only points on the positive y-axis have a relevancy.

Equation (3) shows that z vanishes for either $\theta = 0$ or $\xi = 0$. In other words, the neighbourhood of $z = 0$ in $(y;z)$-plane maps two different regions in $(\xi;\theta)$-plane: the regions being the neighbourhood of $\xi = 0$ and that of $\xi = \xi_1$, where solutions of (1) have their first zero at $\xi = \xi_1$. Further equation (4) clears that the former region, in $(\xi;\theta)$-plane, corresponds to the neighbourhood of the origin $y = z = 0$ and the latter one to the immediate neighbourhood of the y-axis. The author has shown recently[2] that in a complete polytrope, whatever be the index of the polytrope, the immediate neighbourhood of the origin is an interfacial region and at the origin solutions for $n = 0$ and $n = -1$ only are relevant. Hence the point $y = z = 0$ cannot have any relevancy when discussion of solution curves for general values of n is made. When $z = 0$ corresponds to $\xi = \xi_1$, equation (4) shows that y remains positive, since $d\theta/d\xi$ is negative in every part lying in the configuration. Thus we see that the point $y = z = 0$ and the negative y-axis have no physical validity[3].

Zusammenfassung. Es wird bewiesen, dass die Lösungen der Emden-Gleichung nur für $y > 0$ eine physikalische Bedeutung haben.

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[1] S. CHANDRASHEKHAR, *An Introduction to the Study of Stellar Structure* (University of Chicago Press 1939).

[2] S. SRIVASTAVA, *A New Concept of the Structure of Polytropic Configurations*, Proc. natn. Acad. Sci. India [Sect. A] *35*, 909 (1966).

[3] The author is indebted to Dr. B. BASI LAL, Head of the Department of Mathematics, K.N. Government College, Gyanpur, for his guidance, and to the University Grants Commission for the award of a Junior Fellowship.

Infrared Spectrum of Strontium Hydroxyapatite

The apatites form a group of structurally very closely related substances and hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$, is well known. Relatively little is known about the strontium hydroxyapatite, $Sr_{10}(PO_4)_6(OH)_2$. The ionic radii ('crystal' radii of PAULING, in Å) of Sr(1.13) and Ca(0.99) are very close together[1] and strontium can substitute for calcium in the $Ca_{10}(PO_4)_6(OH)_2$ lattice. The X-ray powder diffraction patterns confirm the isomorphous substitution of strontium for calcium; the resulting strontium hydroxyapatite crystallizes in hexagonal lattice. Measurements of the unit cell dimensions of strontium hydroxyapatite are given in Table I and are compared with those of hydroxyapatite.

The sample of this investigation was prepared according to the method described by CHRISTENSEN[7]. The X-ray powder diffraction pattern resembled that reported by COLLIN[6]. As far as we know, this is the first IR-spectroscopic study on strontium hydroxyapatite.

The IR-spectrum was recorded on Beckman IR-12. The instrument parameters on the chart legend were: diluent, sample CsI, reference air; concentration, 1.0 mg; phase, solid; gain, 3.0%; ordinate scale, % T; SB/DB energy ratio, 1; speed, 80 cm^{-1}/min.

Under the conditions used, the spectrum resolution was approximately 2–3 cm^{-1} throughout most of the region. The sample was prepared as a cesium iodide pellet using the following procedure. A small amount of the sample was hand ground in an agate mortar and pestle. 1.0 mg