THE GRAVITATIONAL FIELD OF THE GALAXY IN THE Z DIRECTION

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This is a progress report of a project designed to find the component, perpendicular to the Galactic plane, of the gravitational potential of the Galaxy. The principle is to measure the radial velocities and distances of a large number of K-giant stars near the North Galactic Pole. My student G. A. Radford is masterminding the project; collaborating with us are Drs. J. E. Gunn of the Hale Observatories and L. Hansen and K. Gyldenkerne of Copenhagen.

We have measured the radial velocities of all the HD stars of type K0 and later, and many of the G5 stars, within 15° of the Galactic Pole, using the Cambridge photoelectric spectrometer. In addition, we have observed all the stars classified as K giants by Upgren in his declination zones 25° to 31°, using the spectrometer on the Hale telescope. There are about 900 stars observed altogether, including about 200 Upgren stars, running down to twelfth magnitude or so, which are not in the Henry Draper Catalogue. To determine the distances of all these stars we are now trying to determine the absolute magnitudes by narrow-band photoelectric photometry in the Copenhagen system. Most of the observations have been made, thanks largely to the very generous grants of observing time given by the Hale Observatories earlier this year; but the reductions have only been completed for about 300 stars (including 244 K giants) which were observed last year at Kitt Peak, and the present, very preliminary, discussion is based on those stars alone.

The velocity dispersion shows an unexpected variation with distance from the Galactic plane. Within the uncertainties of its determination, it can be considered constant at 23 km/s up to 400 parsecs from the plane, and then to rise to 30 km/s at 600 parsecs. Using these velocity dispersions together with K-giant density distributions drawn from various sources, we infer a gravitational force towards the Galactic plane going from zero in the plane to a maximum at 300 parsecs, thereafter decreasing until it levels off at about 500 parsecs. The existence of this turning point, which has also been obtained by others, is in contravention of Poisson's Law, which states that dK_z/dz must be

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proportional to the local mass density and must therefore always be positive; so our preliminary result is certainly vitiated either by errors arising from inadequacy of the data — something that may be at least partly redeemed when the project is completed — or else by undetected falsehood in one or more of the premises of the discussion.

The presently-indicated value for the local mass density is 0.30 solar masses per cubic parsec — higher than the accepted value; if it is sustained by the complete investigation it will exacerbate the long-standing problem of the "missing mass".

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