

an attempt to estimate the mass from the virial theorem is justified.

If L_i is the luminosity of the i th galaxy, V_i its space velocity in kilometers per second, r_{ij} the distance in parsecs between the i th and the j th galaxies, and K the mass-luminosity ratio in solar units, then the expression for the virial theorem transforms into

$$K = 231 \frac{\sum \frac{L_i}{L_\odot} V_i^2}{\sum_{i \neq j} \frac{L_i}{L_\odot} \frac{L_j}{L_\odot} \frac{1}{r_{ij}}},$$

where we have assumed the same M/L ratio for all the galaxies of the cluster. The luminosities have been corrected for galactic absorption with Shane's recent value for the galactic extinction at the pole; furthermore, the luminosity of the Andromeda Nebula was increased to account for self absorption.

The value of K thus found was 26 with a mass of $2.24 \times 10^{12} M_\odot$.

This integrated M/L ratio of the local cluster is several times larger than the ratios for individual galaxies in our own vicinity, but considerably smaller than the values for other clusters. As the cluster seems to be stable, additional intergalactic mass must be present either in the form of ionized gas—as recently proposed by Kahn and Woltjer—or stars.

21-Cm Absorption Studies of Galactic Radio Sources. V. RADHAKRISHNAN AND J. G. BOLTON, *California Institute of Technology*.—A study is being made at the Cal Tech Radio Observatory of the 21-cm absorption features in the continuum radiation from discrete galactic sources. Earlier investigations [Hagen, J. P., Lilley, A. E., and McClain, E. F., 1957, *IAU Symposium No. 4 on Radio Astronomy* (Cambridge, England), p. 80; Davies, R. D., and Williams, D. R. W., *ibid.*, p. 71; Muller, C. A., 1958, *Proc. URSI-IAU, Radio Astron. Symp.* (Paris), Paper 69] have clearly demonstrated the efficacy of absorption measurements in determining the fine structure of the distribution of neutral hydrogen in the galaxy. In addition to the higher resolution obtainable with the absorption method when the angular size of the source is smaller than the antenna beamwidth, it is also possible to detect the presence of cold dense concentrations of hydrogen that do not contribute substantially to emission profiles.

A frequency-switched radiometer with a 7 kc/sec bandwidth was used with a 90-foot equatorially mounted paraboloid. The sources observed were Cas A, Taurus A, the Orion Nebula, M17, W51, W75, and Vela X. The first three are among those investigated by Muller (1958) and a comparison of our results with his shows excellent agreement in

the radial velocities of the main features. The broad feature at +3.5 km/sec in Muller's spectrum for Taurus A, which he suspected of being a blend, shows splitting in our profiles. There are minor discrepancies in the computed optical depths for some of the features, but this may not be significant as the accurate intercalibration of the line and continuum temperature scales is very difficult, and hence subject to errors.

Of the four new sources, M17, W51, and W75 show substantial absorption. Vela X also appears to have absorption features in its spectrum, but the large angular size ($\approx 3^\circ$) and low antenna temperature of the source make it difficult to separate with certainty absorption features from the variations in the background 21-cm emission. With improved receiver sensitivity, further observations on the hundred or so galactic sources known will increase considerably our knowledge of their distances and of the fine-structure parameters of the interstellar medium.

This work was supported by the United States Office of Naval Research under contract.

Polarization and Angular Extent of the 960-Megacycle Radiation from Jupiter. V. RADHAKRISHNAN AND J. A. ROBERTS, *California Institute of Technology*.—Observations at 960 Mc of the polarization and angular extent of the radio source associated with Jupiter have established the existence of a radiation belt several times the size of the planet. The radiation is strongly linearly polarized with the electric vector in the equatorial plane.

The nonthermal component of the high-frequency radiation from Jupiter was discovered by Sloanaker [McClain, E. F., and Sloanaker, R. M., 1959, *Proc. URSI-IAU, Radio Astron. Symp.* (Paris, 1958), 61; Mayer, C. H., 1959, *Astron. J.* 64, 43] at 10 cm in 1958. Subsequent observations by others (Roberts, J. A., and Stanley, G. J., 1959, *Publ. Astron. Soc. Pacific* 71, 485; Drake, F. D., and Hvatum, H., 1959, *Astron. J.* 64, 329) led to the suggestion by Drake (1959) that the planet might have a belt of magnetically trapped electrons similar to the earth's "Van Allen" belt. The observations reported here were made at the Cal Tech Radio Observatory in April 1960 and amply confirm this hypothesis.

The instrument used was an interferometer comprising two steerable 90-foot paraboloids on railroad tracks, together with a highly sensitive receiving system. Both antennas had rotatable feeds—one motorized—permitting polarization measurements. The instrumental polarization was below one percent. For the integration times used, the receiver sensitivity was approximately $0.5 \times 10^{-28} \text{ w m}^{-2} (\text{c/s})^{-1}$, i.e., one-tenth of the maximum intensity of Jupiter.