AVERAGE MASSES OF THE DOUBLE GALAXIES

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1. Abstract

It is possible to observe the line-of-sight projection of the orbital motion of one galaxy moving around another in a close pair, and also the separation projected on the tangent plane. The unknown orientation of the orbit is specified by two angles that can be considered independent random variables. Since there is a dynamical relation between mass, space separation, and orbital velocity (assuming circular orbits), and since the distribution of space separations has been determined from other data, it is possible to derive a statistical relation between the observable quantities and the mean mass, $\overline{M}$. Observations of apparent brightness can also be included, leading to a second statistical relation between observables and the mean ratio of mass to luminosity, $\overline{M/L}$.

New observational data are presented for 15 pairs of galaxies, and these are combined with data for 20 pairs previously reported [1] and 95 individual measurements in 44 close pairs reported by Humason and Mayall [8] to determine the average mass of one galaxy, $\overline{M} = (30 \pm 10) \times 10^{10}/h$ suns, and $\overline{M/L} \fallingdotseq 12h$ solar units, where h is the ratio of the Hubble constant to the value assumed here, 100 km/sec/megaparsec, and the errors are root mean square.

When the data are considered in three groups: 14 pairs of spirals and Irr. types, 13 pairs of elliptical and SO types, and 14 mixed systems, it is found that the average mass of the ellipticals and SO types is $\overline{M}_E = (60 \pm 15) \times 10^{10}/h$, $\overline{M_E/L_E} = (94 \pm 38)h$, and of the spirals, $\overline{M}_S = (2. \pm 1.5) \times 10^{10}/h$, $\overline{M_S/L_S} \fallingdotseq 0.33h$, and that the data for mixed systems substantiate these figures. A formula is developed for the intrinsic variance of M in terms of the residuals, but σ^2_M proved indeterminate for the small samples ($n = 13, 14$).

Since the results for $\overline{M/L}$ are inconsistent with expectations based on other astrophysical data, several alternative hypotheses are investigated, and it is found (1) that an intergalactic medium is not likely to account for the discrepancy, and (2) that the assumption of radial motion (rather than circular

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