THE TROUBLE WITH BINARY GALAXIES

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The statistical analysis of magnitude and center-of-mass velocity data for binary galaxies will **never** provide an adequate estimate of the mass within the orbit, and will therefore never furnish useful information about the mass-to-light ratios of galaxies. There are three main reasons. Firstly, it is very difficult to find a sample which is both objectively selected and dynamically isolated, and in those cases with obvious tidal distortions it is not clear which two points of the confused systems can be taken to be the centers of mass. Secondly, there are several different ways to produce a mass estimator from the available data, and it is not clear which estimator corresponds most closely to what is normally thought of as the gravitational mass of the system. Finally, those mass estimates which include it as a variable depend quite strongly on the orbital eccentricity, and any analysis method is necessarily least sensitive to just this parameter. Therefore, variation even within a single estimator is both considerable and only weakly constrained.

In addition, there are subsidiary observational problems. The comparison between data from different observers demonstrates that optical redshifts are not known accurately enough to permit a believable analysis, even were such a thing possible. (A secondary result is that the claimed 72 km s^{-1} periodicity, although present in the data with high statistical significance, cannot be a property of the physical pairs themselves, and must be some kind of artefact. Regrettably, this approach provides no clues as to just what could be causing such an unusual error.) Although velocities derived from radio observations are more accurate, samples of radio-observed binaries have other serious problems. Pairs with angular separations less than the beam size must be separated in velocity by more than their mean velocity width to be unambiguously resolved. The other unconfused pairs are those separated by more than the beam size. However, since surveys are almost always flux limited, this angular restriction introduces a strong correlation between the linear separation and the absolute luminosity. These two extra selection effects are difficult to incorporate into any method of analysis.

Quoted values of masses and mass-to-light ratios for binary galaxy samples are not reliable estimates of the real physical properties of the sample. However, they **are** acceptable as ways of intercomparing different studies, as long as the same estimator is used in each case. It is very important to be aware of the large differences caused simply by using different definitions. If, at some future time, some members of any sample can be studied in a way which gives unambiguous physical masses, then, and only then, can the statistical results be correctly normalized. Such physically meaningful results can be derived by the careful dynamical simulation of pairs for which both kinematical and morphological data are available. This is a much better way to use binary galaxies to study mass distributions, and more observational effort should be expended in this direction.

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