PREDICTED LENS REDSHIFTS AND MAGNITUDES

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Abstract. For gravitational lens systems with unknown lens redshifts, the redshifts and brightnesses of the lenses are predicted for a variety of cosmological models. Besides providing hints as to which systems should be observed with a realistic chance of measuring the lens redshifts, which are needed for detailed lensing statistics and for modelling the lenses, these calculations give a visual impression of the influence of the cosmological model in gravitational lensing.

1. Introduction and Basic Theory

The singular isothermal sphere produces an image separation twice the radius of the Einstein ring *independent* of the relative angular positions of source and lens (Turner et al. 1984) and allows one to define a cross section for multiply imaging a background source by a single (galaxy) lens. The relative probability p of the lens being at a given redshift is proportional to this cross section, the relative numbers of lenses of the appropriate mass and to the volume element $\mathrm{d}V/\mathrm{d}z$ at the given redshift. The cross section for a single lens is not constant as a function of redshift since the cross section depends on redshift-dependent angular size distances and since the mass ($\rightarrow$ velocity dispersion) needed to produce the observed image separation depends on the redshift. The relative numbers of such galaxies one can get from the Schechter function (Schechter 1976) after converting the velocity dispersion to an absolute magnitude *via* the Faber-Jackson relation (Faber & Jackson 1976) for ellipticals or the Tully-Fisher relation (Tully & Fisher 1977) for spirals (Kochanek 1992). The volume element can be calculated in the standard way (Feige 1992). Both the angular size distances and $\mathrm{d}V/\mathrm{d}z$ depend on the cosmological model. Since the Faber-Jackson/Tully-Fisher relation provides the absolute magnitude, the apparent magnitude can be calculated with standard methods.

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2. Calculations, Results and Discussion

Values of $(-0.5, 0.3)$, $(0.0, 0.3)$, $(0.0, 1.0)$, $(1.0, 0.0)$, $(0.7, 0.3)$ and $(1.0, 1.0)$ were used for (λ_0, Ω_0). These values were chosen to satisfy the majority of the following constraints: (a) compatibility with all relatively certain and well-understood observations (b) maximization of the differences due to the cosmological model within the above area, (c) inclusion of several 'standard models' for purposes of comparison, (d) limitation of the size of the poster. The cosmological models examined here are thus not meant to be exhaustive but merely illustrative and somewhat representative.

For each lens system, for each cosmological model $p(z_\mathrm{d})$ as well as the lens brightness were calculated (separately for elliptical and spiral galaxies). Except in the case of $1104 - 1805$, since $m(z_\mathrm{d})$ is so steep, selection effects will probably cause those lenses which happen to have a low redshift to be found, regardless of the cosmological model. Neglecting the extreme de Sitter model (1.0,0.0) one can make a relatively robust prediction for the redshift and brightness of the lens galaxy in $1104 - 1805$, since in this case $p(z_\mathrm{d})$ peaks at approximately the same redshift in all cosmological models, the width of the probability distribution is small, and $m(z_\mathrm{d})$ is comparatively not very steep. (All are consequences of the relatively large image separation in this system, larger than that in any of the comparable systems with *known* redshifts. This system also has the smallest source redshift of the systems with unknown lens redshifts, which also contributes somewhat to the effect.) The lens should lie in the range $0.3 < z_\mathrm{d} < 0.7$ and be brighter than about 21.5 in R, which means that it could be detected. Since here there is not a strong selection effect in favor of spirals over ellipticals, one would expect the lens to be an elliptical. This is probably the case, and a spiral lens would be so bright that it probably would have been found already. The fact that no lens has yet been found in this system can have one (or more) of three reasons: our cosmological model is near the de Sitter model, there is an unseen cluster responsible for the large image separation and thus the approximations used here break down, or the brightness of the images makes measuring the lens redshift difficult.

The complete poster text and figures can be obtained from
`ftp://ftp.uni-hamburg.de/pub/misc/astronomy/aus_poster.uu`

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