CONSTRAINING THE VALUE OF THE COSMOLOGICAL CONSTANT USING JVAS/CLASS LENSING STATISTICS

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1. Introduction

The Jodrell Bank VLA Astrometric Survey (JVAS) (Patnaik *et al.*, 1992) and the Cosmic Lens All-Sky Survey (CLASS) (Myers *et al.*, 1995) aim to observe 10,000 flat spectrum radio sources. So far $\sim 7,500$ have been observed with the VLA and mapped with a resolution of 0.2 arcseconds. One of the main objectives of the surveys is to obtain reliable statistics on the frequency and properties of lens systems for cosmological studies—Hubble's constant may be derived from time delays between variations of lens images (Refsdal, 1964) and the cosmological constant from lensing statistics (Turner *et al.*, 1984; Fukugita *et al.*, 1992; Kochanek, 1996).

2. Lensing Statistics

It is well understood that the probability of gravitational lensing is sensitive to the cosmological constant Λ (Turner *et al.*, 1984; Fukugita *et al.*, 1992; Kochanek, 1996). Theoretical arguments for expecting a null Λ are weak and hence the need to determine its value empirically—recently, Kochanek (1996) concluded that $\lambda_0 = \Lambda/(3H_0^2) < 0.66$ at 95% confidence in a flat universe. Current interest in the cosmological constant has been due mainly to the conflict between the estimates for the ages of the oldest globular clusters (Chaboyer, 1995) and some locally measured values of Hubble's constant ($H_0 = 100h\ \mathrm{km\,s^{-1}Mpc^{-1}}$) which have been somewhat high $h \sim 0.7$–0.8 (Tanvir *et al.*, 1995; Whitmore *et al.*, 1995), leading to a universe younger than some of the globular clusters for Λ=0 cosmological models. This conflict would not exist, for example, for a flat universe with Ω_0=0.3 and λ_0=0.7. We hope to constrain λ_0 from lensing statistics (especially considering our extensive redshift information) and the image separation/source redshift relation of the lenses that we are finding in our well-defined sample. Also, if the other factors are known, an independent constraint can be obtained from time delays of multiply-imaged sources (Refsdal, 1966; Kayser & Refsdal, 1983).

3. Lens Candidate Observations

To date, 2500 JVAS and 5000 CLASS flat spectrum sources have been observed with the VLA. For CLASS, we eventually aim to map ~ 7500 flat spectrum sources with a total flux density in compact components >20 mJy at 8.4 GHz; when added to JVAS the sample will total $\sim$ 10000 sources. In the $\sim$ 5000 sources carefully studied we have discovered 11 gravitational lenses. We have adopted a system of observing candidates at successively higher resolutions to confirm lensing. Recently, the final remaining 75 candidates were observed with MERLIN. Past experience shows that 15–20 of these will still be "live" candidates after the MERLIN maps are examined. Subsequent VLBA observations will complete the radio "discovery phase" of 7500 JVAS/CLASS sources and will tell us the lensing probability.

4. The Future

With the current limited statistics, the lensing constraints on the cosmological constant are not yet decisive. From our $\sim$ 7500 sources we expect to discover a total of $\sim$ 15 lenses. In the near future we hope to improve the constraints with gravitational lensing statistics and other methods from the JVAS/CLASS surveys. With our increased number of sources and a full appreciation of the astronomical uncertainties involved we hope to place the best constraints yet on the value of λ_0 given the observed frequency of lensing in our well-defined sample.

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