OPTICAL IMAGING OF B1422+231 – PROSPECTS FOR DETERMINING THE HUBBLE CONSTANT

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Abstract. We report on observations indicating that the bright quadruple lens B1422+231 may be variable in the optical on a time scale of hours. We also find that a model can reproduce the optical positions and magnifications. Unfortunately, the system may be affected by possible microlensing and external shear. HST should provide a good model for the lens, the system should be monitored for several nights in superb seeing (0.3–0.4 arcsec FWHM), and the redshifts of the south-east galaxies should be determined. With this extra information, improved modeling will tell whether it is realistic to obtain H_0 from the time delays of B1422+231.

1. Introduction

B1422+231 (see Hammer, Rigaut, & Angonin-Willaime 1995 and references therein) is a prime candidate for a cosmological determination of the Hubble constant for several reasons. It is bright, quadruple, and has a short

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predicted time delay. It also appears to have all parameters known, to be simple, variable, achromatic, and to be well modeled.

We here present preliminary results from a pilot study carried out at the Nordic Optical Telescope to check for optical variability. On the night of March 31 1995 we obtained 6 I images each separated by one hour. On the night of April 17 1995 we obtained 9 images, 8 of which were taken within one hour. The seeing ranged from 0.5 to 1.0 arcsec FWHM.

The point spread function (PSF) was determined from stars in the field and a multiple fit to the four components of the gravitational lens was performed using DAOPHOT II and ALLSTAR. Assuming that the positions determined for the brightest component (B) were correct, the best data were singled out by requiring the position of A to be correct within 0.01 arcsec. The positions of A, C, and D were then fixed according to (updated) relative radio positions and a new (constrained) multiple fit was performed.

2. Results

We find that the magnitudes for the A and B components are strongly anti-correlated. This is expected when $|AB| \leq$ FWHM (see Schechter 1993). Average values are $A/B = 0.82 \pm 0.01$, $C/B = 0.52 \pm 0.005$ and $D/B = 0.038 \pm 0.002$. These values seem to differ from those reported from the Spring 1993 where $A/B = 0.76 \pm 0.03$ and $C/B = 0.49 \pm 0.01$. This may indicate that the system is affected by microlensing, which could also explain why the optical intensity ratios differ from those in the radio.

We find that the combined light from A and B is constant within the 1 h time span on April 17 (variation less than 0.003 mag for the best images) whereas the images taken on March 31 during the 5–6 h time span show a monotonic increase in the brightness of A+B of 0.02 mag. We consider this as tentative evidence for intranight variability. It also shows that high-precision relative photometry can be achieved in relatively bad seeing.

On the combined images there is no evidence for the main deflector. The galaxies to the south-east appear to be early-type galaxies at a redshift of 0.3–0.4.

We have modeled the system and find that the configuration with the optical magnifications can be accounted for by an elliptical lens located very close to D, possibly with the added shear from the galaxies to the south-east.

References

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