A LENS MODEL FOR B0218+357

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The smallest radio Einstein Ring, B2018+357, discovered by Patnaik et al. (1993), shows much promise as a tool to constrain the parameters of cosmological models (Refsdal 1964). Dominating this system is a pair of 0.″335–separation compact radio images, with image A between 2.7 to 3.9 times as strong as image B ($\lambda\lambda$ 18 to 2 *cm*). Observations have established the lens redshift (z_l = 0.685, O'Dea et al. 1992, Browne et al. 1993), a possible source redshift ($z_s = 0.96$, Lawrence, *this conference*), and a tentative value for the time–delay between the highly polarized images A and B (12 ± 3 days, Browne, *this conference*). Recent *mas*–resolution observations have made it possible to understand the imaging of A and B in sufficient detail as to provide constraints on an elliptical lens model for B0218+357; this work presents a model and provides an estimate of Hubble's Constant.

Wilkinson et al. (in preparation) point out that in their VLBI map at 18 *cm* (Polatidis et al. 1995), the ratio A/B of the apparent sizes of these images far exceeds that of their total flux densities (the map suggests 18.9 as against 2.65, respectively). For a pair of simple, compact but resolved images, the ratios should agree. The central surface brightness of A is also considerably lower than that of image B. The VLBA observations at $\lambda 2$ *cm* of Patnaik et al. (1995) show a core–knot structure in each image. A is dominated by tangential, and B by radial stretching; I derive a transformation matrix (A to B) from the knot images, which are not likely to be affected by new features developing near the cores. This matrix ($t_{xx} = 0.81, t_{xy} = 0.66, t_{yx} = 0.17, t_{yy} = -.18$) is applied to the VLBI images of A at 6 and 18 *cm* (Xu et al. 1995, and Polatidis et al. 1995) to obtain image B, and *vice versa* using the inverse matrix. The eigendirections remain roughly the same over $\lambda\lambda 2 - 18$ *cm*. The relatively minor discrepancies at $\lambda 6$ *cm* between the observed and transformed images are easily understood as a function of increasing source size with wavelength. The large size of image A at 18 *cm* is explained if the source is viewed as lying

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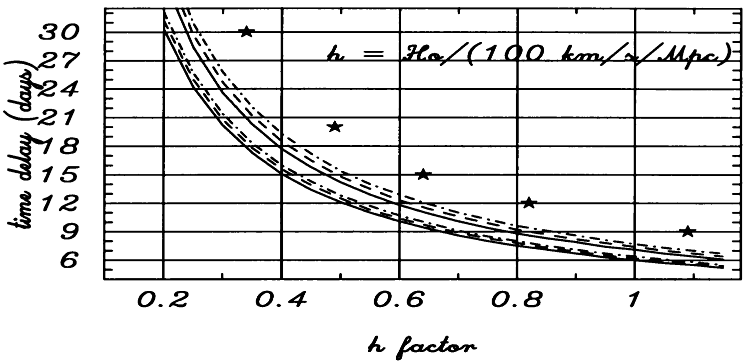

Figure 1. Estimates of Hubble's Constant, H_o, with a q_o=0.5, FRW Universe, having a smoothed–out background matter distribution, for lensed system B0218+357. The plots are for point mass *(lowest three)* and singular isothermal sphere *(middle three)* models, and the elliptical mass model *(stars)* in the present work. The A/B flux ratio is set at 3.6 *(solid)*, 3.8 *(dash)* and 4.0 *(dash-dot)* in the first two cases, and 3.8 for the last case. A time-delay of 12 days puts H_o at 52, 62 and 82 *km/s/Mpc*, respectively, for the three models.

very near the radial caustic in the source plane; as the source size increases, it laps over from the triply–imaged region to the singly–imaged one, and image B therefore consists of *two* merging images at 18 *cm*, which are seen as one compact feature of relatively high central surface brightness, whereas image A contains a significant fraction of singly-imaged source, thus with a lower surface brightness. The picture is consistent with image B lying very near the centre of the radio ring. An elliptical lens mass model for the system (mass = 3.9×10^{10} $M_\odot$; axial ratio 0.65) shows that the source size must grow from about 10 to 20 *mas* between 6 and 18 *cm* in this picture. The model matches the overall image separation to within 1.5% and the VLBA features of Patnaik et al. (1995).

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