MG2016+112: A DOUBLE GRAVITATIONAL LENS MODEL

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MG2016+112, discovered by Lawrence et al. (1984) is one of the best–studied among multiply–imaged systems, but is still only partially understood. Ostensibly a three–image system consisting of images A, B and C of a quasar at $z = 3.273$, the observed lensing galaxy D (a giant elliptical at $z = 1.01$) at the centroid of the image system seems inadequate to provide the minimum mass of $\sim 2.5 \times 10^{12}$ $M_\odot$ within 10 kpc of its center (in projection along the l.o.s.) required to produce the observed 3.″9 image–splitting. C itself appears to consist of two components, radio emission that may be associated with the faint optical image counterpart of A and B (called C_2, see Garrett et al. 1994) and flat–spectrum C_1, which dominates radio observations of the system and apparently consists of at least three linearly stretched subcomponents, C_{11} to C_{13} (see Garrett et al. in these proceedings).

The observationally suggested second lens in region C (e.g. Lawrence et al. 1993) is strongly supported by lens modeling, because of the presence of the faint image C_2. The two elliptical lenses produce a five–image configuration with two core–captured images demagnified to levels of undetectability; see Fig.1. Each lens consists of two non–singular oblate spheroidal mass distributions, one compact (the 'galaxy') and the other extended ('dark matter', DM). The DM associated with lens plane D has a scale length of about 25 kpc, and appears to have a high eccentricity (axial ratio about 0.6 in a typical model). Hattori et al. (these proceedings) suggest that there could be a cluster here. The redshift of lens plane C is assumed to be greater than that of D, for definiteness (this is not constrained by the configuration). Masses (in $M_\odot$) of the lenses in the present model are: lens plane D: galaxy — 2.7×10^{11}, DM —2.3×10^{12}; lens plane C: galaxy —6.5×10^9 *(high eccentricity)*, DM — 7.0×10^{12} *(scale length of* $\sim$ *65 kpc; spherical)*. Lens plane C is at $z_C = 1.2$, and lens plane D is at $z_D = 1.01$. The modeling code used is a version of Narasimha, Subramanian and Chitre (1982, 1984).

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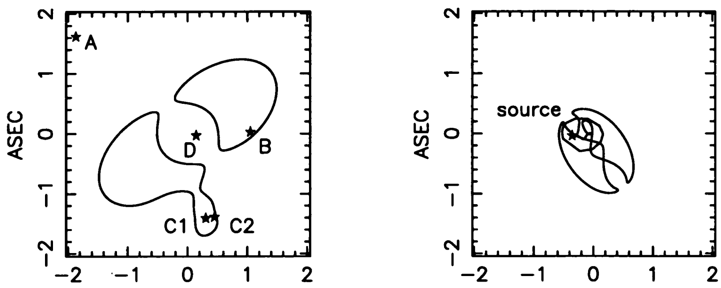

Figure 1. (a) Image and (b) Source Planes for the Two–Lens Model, with the position of the second galaxy, after single–imaging by the foreground lens D, near C_1 in (a). The model is constrained by the image separations (the average error $\sim 10\%$, being the largest with the position of image B), image intensity ratios and vlbi observations of this system.

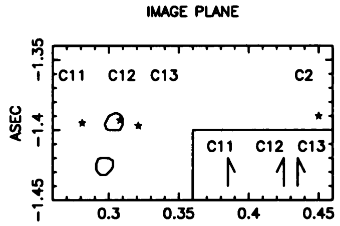

Figure 2. Is C_1 multiply–imaged radio emission? *(Main Fig.:)* The images C_{11} to C_{13} as formed by a 2^{nd} radio source just behind Galaxy C, near a cusp of the 'lips' caustic that develops. C_2 is shown for reference. *(Inset:)* Predicted parity relations between the subcomponent images in the case of C_{11} to C_{13} being formed at the lips caustic. If C_{12} and C_{13} are formed by some relatively extended radio emission (at $z = 3.273$ and related to the core–jet source that gives rise to A, B and C_2) which may be imaged with high magnification between C_{11} and C_2 as it crosses a radial critical curve just east of the source position in Fig.1(b), then the predicted parities for C_{12} and C_{13} are the same as in the previous case. In this picture, C_{11} is the core-captured image near Galaxy C (demagnified version of A, B and C_2). The corresponding images near A and B of this extended radio flux could well be resolved out in VLBI observations. Note high magnification gradient near image C_2; image flux ratios can vary with wavelength.

C_1 could be the second lens as a peculiar (singly–imaged) radio emitting galaxy; else, if it is multiply–imaged background radio emission from a second source or fuzz associated with the source at $z = 3.273$, see Fig.2 for predicted substructure. *Acknowledgements: S.N. thanks the Raman Research Institute, Bangalore, India, for the use of computing facilities.*

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