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Radio Microlensing: Past, Present & Near Future

L. V. E. Koopmans[1,2,3], A. G. de Bruyn[2,4], C. D. Fassnacht[5], J. Wambsganss[6] & R. D. Blandford[1] + CLASS collaboration

[1] *Caltech, mail code 130–33, Pasadena, CA 91125, USA*
[2] *Kapteyn Institute, PO Box 800, NL-9700 AV, Groningen, The Netherlands*
[3] *JBO, Lower Withington, Macclesfield, Cheshire, SK11 9DL, UK*
[4] *NFRA-ASTRON, PO Box 2, NL-7990 AA, Dwingeloo, The Netherlands*
[5] *NRAO, PO Box 0, Socorro, NM 87801, USA*
[6] *University of Potsdam, Inst. for Phys., Am Neuen Palais 10, D-14469, Potsdam, Germany*

Abstract. Strongly correlated *non-intrinsic variability* between 5 and 8.5 GHz has been observed in one of the lensed images of the gravitational lens B1600+434. These non-intrinsic (i.e. 'external') variations are interpreted as *radio-micro -lensing* of relativistic μas-scale jet components in the source at a redshift of z=1.59 by massive compact objects in the halo of the edge-on disk lens galaxy at z=0.41. We shortly summarize these observations and discuss several new observational and theoretical programs to investigate this new phenomenon in more detail.

1. Radio-Microlensing: B1600+434

Multi-frequency observations of the CLASS gravitational lens (GL) B1600+434 with the VLA and WSRT radio telescopes at 1.4, 5 and 8.5 GHz has unambiguously shown *non-intrinsic variability* in the lensed image that passes through the dark-matter halo of the edge-on disk lens galaxy (Koopmans & de Bruyn 2000; Koopmans et al. 2000a). Based on the amplitude–timescale and frequency dependence of these non-intrinsic variations *and* the difference in variability between the two lensed images, separated by only $1''.4$, the *non-intrinsic variability* is interpreted as *radio-microlensing* of relativistic μas-scale jet components in the source by massive compact objects in the halo of the edge-on disk lens galaxy. The alternatives, i.e. scintillation and extreme scattering, have considerable difficulties in explaining the time-scale and frequency dependence of the observations (e.g. Koopmans & de Bruyn 2000; Koopmans et al. 2000a). An example of these variations at 5 GHz is shown in Fig.1. The strong non-intrinsic event between days 70–100 is interpreted as a *radio-microlensing caustic crossing*. This type of event is extremely difficult to explain in terms of scattering (ISS) by the ionized interstellar medium (e.g. Koopmans et al. 2000b).

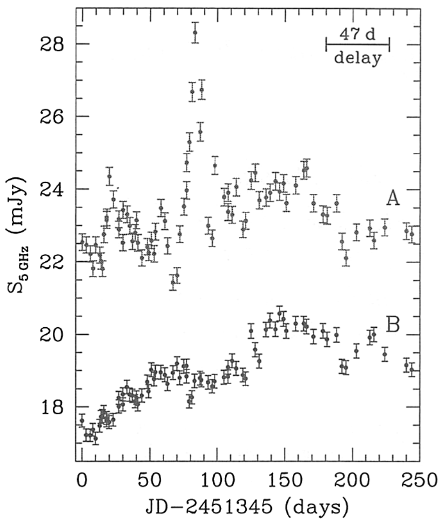

Figure 1. Preliminary results (at 5 GHz) from the 1999/2000 VLA monitoring campaign of B1600+434. The upper light curve (image A) passes through the dark-matter halo of the edge-on spiral lens galaxy. Note several strong (up to 30%) events in the upper lightcurve and the complete absence of these events in the lower light curve (image B) after the measured time delay of ∼47 days.

2. Radio-Microlensing: Other Lens Systems & Future

To investigate *radio-microlensing* in B1600+434 and other lens systems in more detail, we have started a number of new monitoring programs with the WSRT, VLA and MERLIN radio telescopes. With the WSRT and VLA, we have been and are currently monitoring B1600+434 at 1.4, (1.7), 5.0, 8.5, 15 and (22) GHz. (Wavelengths between parentheses cover only part of the light curves.) This will enable us to further constrain the microlensing and ISS hypotheses based on their frequency dependence. In addition, we are currently monitoring 8 CLASS GL systems with the VLA at 8.5 GHz to measure additional time-delays for the determination of H_0. These lightcurves, however, also provide information on *radio-microlensing*. In addition, a MERLIN Key–Project to monitor 12 CLASS GL systems (2/3 quads) at 5 GHz will conditionally start around Dec. 2000/Jan. 2001, with the aim of finding new cases of *radio-microlensing*. Combined, we will be able to search for this phenomenon in 14 aditional radio GL systems.

Besides this ongoing observational effort, we are theoretically studying *radio-microlensing* in B1600+434, using numerical microlensing simulations, to place constraints on the fraction and mass-function of massive compact objects in the lens galaxy (Koopmans & Wambsganss, in prep).

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