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Multi-Frequency VLBA+Effelsberg Observations of 1038+528 A/B

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Abstract. We made a November 1995 observation of the close (33 arc sec) pair 1038+528 A,B using the VLBA+Effelsberg at 2.3 and 8.4 GHz, and the VLBA alone at 15 GHz. Our analysis of the precise astrometric separation between the core peak in A and a component ~ 1.8 mas from the core in B sheds new light on the observed changes with time and frequency.

1. Temporal Changes

The change in angular separation between quasars A and B at 8.4 GHz in 1995 continues the trend of previous epochs (see Fig. 1a), and confirms that an outward motion of the B reference feature is the dominant contribution (Rioja 1997). We have used various methods to better quantify this, now that we have a longer time baseline: (a) a direct estimate of the separation rate between the core and reference-component from the B quasar hybrid maps; this gives a value of 12.8 μas/yr (see Fig. 1b). (b) a decomposition of the A-B changes along two preferred PAs in the sources (PA $-53°$ in B; 0–35° in A), with a linear fit to the changes deduced in B. The best fit, with PA=25° in quasar A, corresponds to a B reference component motion of 16.6 μas/yr; for the measured inner PA in A of 15° it is 15.6 μas/yr. All these values correspond to sub- or superluminal velocities, depending critically on the choice of the cosmological parameters H_o and q_o. The difference between the estimates from (a) and (b), if real, would correspond to an outward motion of the B core of ca. 3 μas/yr.

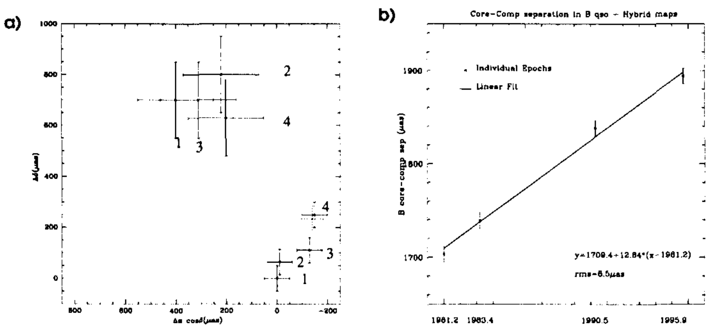

Figure 1. **a)** Relative position measurements between 1038+528 A,B. Large crosses = 2.3 GHz, small crosses = 8.4 GHz and hatched cross = 15 GHz. Numbers indicate epoch. Origin corresponds to 8.4 GHz separation at epoch 1. **b)** Linear fit to changes in core/ref-component separation in maps of quasar B at 8.4 GHz

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2. Frequency Registration

As in previous epochs, the separation between the A and B reference features differs significantly between 2.3 and 8.4 GHz, with an offset from 500 to 700 μas (Fig. 1a). Our measurement at the new frequency of 15 GHz, however, gives a separation essentially identical to that at 8.4 GHz. Marcaide & Shapiro (1984) ascribe all the 2.3/8.4 GHz offset to quasar A, and a wavelength-dependent position shift of the "core" proportional to λ^{β}, with acceptable values of β between 0.7 and 2. Our new results at 2.3, 8.4 and 15 GHz are compatible with a new lower bound for β close to 1, and an infinite upper bound. However, at both 8.4 and 15 GHz the maps of A reveal very similar core-jet morphology (see Fig. 2), with a prominent knot, k1, offset from the core by an amount remarkably close to the observed 2.3/8.4 GHz offset. These two components are blended together at 2.3 GHz by the $\sim$ 4 times larger beamwidth, so that at least part of the offset is a natural result of this blending at 2.3 GHz, enhanced by the different spectral indices of the core and k1 components. Moreover, the relative position of a second, weak knot, k2, and k1, seen at 8.4 GHz, is very similar to that between the "core" and first knot feature seen at 2.3 GHz (Fig. 2). We propose a new registration based on the identification of these features. This implies the existence of an offset of $\sim$ 250μas between the 2.3 and 8.4 GHz positions of the B reference features.

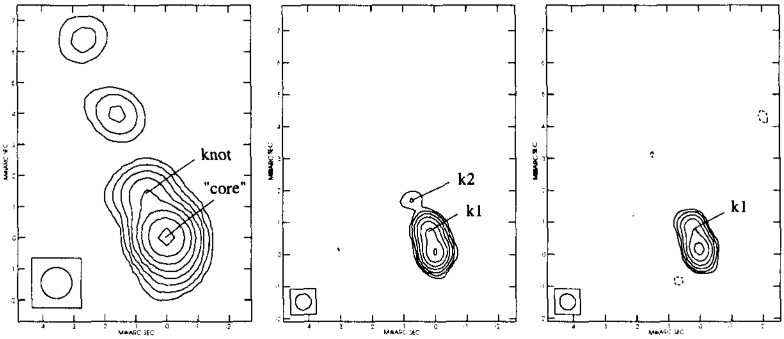

Figure 2. Super-resolved map of 1038+528 A at 2.3 GHz (left) and normal-resolution maps at 8.4 GHz (center) and 15 GHz (right).

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References

Marcaide, J. M., & Shapiro, I. I. 1984. *ApJ*, **276**, 56–59.

Rioja, M. J., et al. 1997. *A&A*, **325**, 383–390.