A DRAMATIC (AND INVISIBLE!) FLARE IN NRAO 530

3 mm λ VLBI Observations

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3 mm λ VLBI observations of the extremely flat spectrum QSO NRAO 530 at the peak of its brightest recorded flare show a resolved core only slightly changed from its pre-outburst state. Observations with Haystack, Kitt Peak and Owens Valley observatories in April 1994, prior to the onset of the flare found a single component with $T_b = 8 \times 10^{10}$ K. One year later, within one week of the peak of flare at 3 mm λ, observations with Haystack, Kitt Peak and Hat Creek observatories revealed a component comparable in size and flux density with $T_b = 7 \times 10^{10}$ K. Table 1 details the source models for the two experiments.

The 3 mm λ light curve taken at Hat Creek Radio Observatory (Figure 1) shows the sudden rise in flux density between the two experiments. The peak in April 1995 is the highest in 10 years of monitoring at HCRO. Furthermore, the UMRAO database shows that this is the brightest flare at centimeter wavelengths in almost 30 years (Aller, H. & Aller, M. 1995, private communication). The flare may be associated with a gamma ray flare observed with EGRET in Spring and Summer of 1994 (Mattox, J.R. 1995, private communication).

Despite the sparse *uv*-coverage and the difficulty of calibration at millimeter wavelengths, we can place limits on the structure external to the core. In the April 1994 data, the closure phases are consistent with no structure while the short-baseline amplitudes account for most of the zero-baseline flux. In the April 1995 data, the amplitudes reach a maximum of 6 ± 1 Jy on the shortest baselines, about half of the the zero-baseline flux of 12 ± 1 Jy. Much of the flux is, therefore, resolved or hidden by destructive interference. Unfortunately, technical problems in the determination of the closure phase in this experiment currently prevent us from addressing this issue more specifically. We hope to settle this issue in the near future.

If the flux is resolved, it may be in the form of either isolated components

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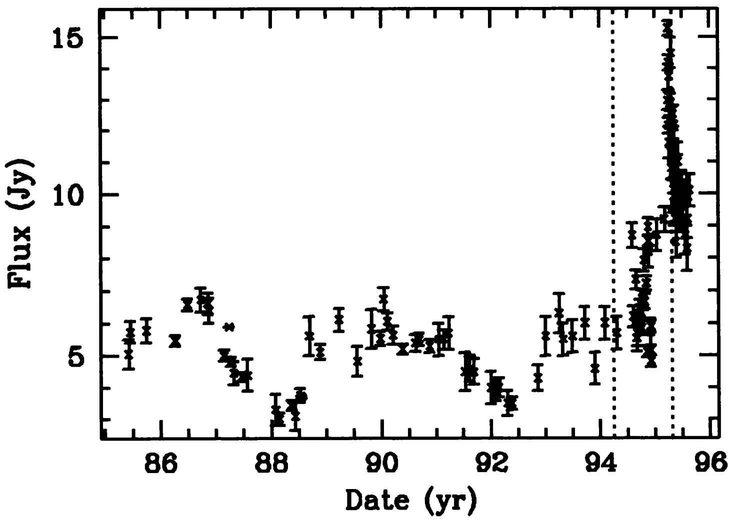

Figure 1. 3 mm λ fluxes of NRAO 530 from Hat Creek Radio Observatory. The vertical bars mark the dates of the VLBI experiments.

or a halo but it must be separated from the core by greater than 0.5 milliarcsec. Associating the creation of the component with the onset of the flare in Fall 1994 requires an apparent velocity $\beta_{app} > 9h^{-1}$ for $q_0 = 0.5$ and $H_0 = 100h$ km/s/Mpc. This velocity falls near the upper limit of the distribution presented by Vermeulen in these proceedings, making NRAO 530 one of the most beamed sources known. The detection of NRAO 530 by EGRET further confirms the connection between superluminal blazars and gamma ray sources (von Montigny, C. *et al.* 1995, *ApJ*, **440**, 525).

The simple structure apparent at this and other wavelengths suggests that the spectrum, flat from 80 MHz to > 230 GHz, cannot be accounted for by the superposition of distinct components. Instead, a self-similar model for the emission is favored (*e.g.*, Blandford and Konigl 1979, *ApJ*, **232**, 34).

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TABLE 1. NRAO 530 Model Parameters

Experiment Date	Size	Flux	Total Flux	T_b
April 1994	85 μarcsec	4 ± 0.5 Jy	6 ± 1 Jy	8×10^{10} K
April 1995	120 μarcsec	7 ± 1 Jy	12 ± 1 Jy	7×10^{10} K