THE RADIO-GAMMA-RAY CONNECTION: THE RADIO PROPERTIES OF GAMMA-RAY-BRIGHT BLAZARS

M. F. ALLER, H. D. ALLER AND P. A. HUGHES
University of Michigan – Ann Arbor, MI, 48109-1090

1. Introduction

Forty AGN have been detected at high significance level by EGRET in the γ-ray band. Previous studies based on radio observations near or at the times of the EGRET detections suggest that there is a causal connection between individual events in these two wavebands. Here we examine the question of whether the cm-λ and the γ-ray activity are related.

2. Results

The integrated total flux and polarization observations discussed here were obtained with the UMRAO 26-meter telescope operating at 14.5, 8.0 and 4.8 GHz. The time-sampling of these radio data for 32 of the 40 EGRET-detected sources was sufficient for defining the long-term variability, but not all of the objects were observed intensively during the EGRET detection period. The time coverage of the data is up to $\sim$ 30 years. The γ-ray measurements are fluxes, or an upper limit if no detection was measured by EGRET; the time sampling is infrequent; the time coverage is April 1991 through current; and the source material is Thompson *et al.* (1995) for phases 1 and 2 and private communications subsequently (R. C. Hartman 1995).

Even a casual inspection of the radio light curves indicates that these objects are highly active in the cm waveband; when resolved, new events typically occur at 2-year intervals (see also, Hughes, Aller and Aller 1992). As we quantify in Figure 1, all the EGRET-detected objects exhibited variability during 1991-1995, ranging from only moderate levels to impulsive large-amplitude variations. Comparison with a flux-limited radio-loud sample clearly shows that the EGRET-detected objects exhibited a higher

R. Ekers et al. (eds.), Extragalactic Radio Sources, 283–284.

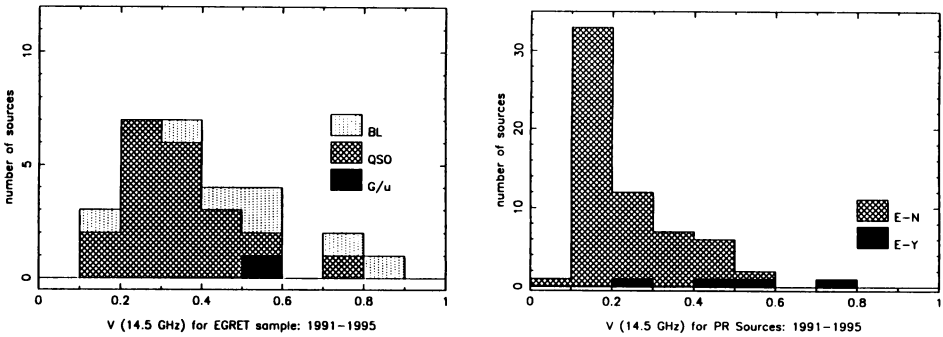

Figure 1. **Histograms of a variability index for 1991-1995: a) the EGRET source sample; b) the Pearson-Readhead sample. Black shading denotes EGRET objects.**

level of activity. Three of the 4 EGRET-detected sources in the Pearson-Readhead (1988) sample are those with the highest degrees of variability.

Because of the undersampling of the γ-ray data, one cannot carry out a correlation analysis to quantify the existence or absence of associated activity. Inspection of the behavior of the radio-flux light curves at the times of γ-ray detection, shows that: in 20 out of 22 sources detections occurred during burst rises (49 cases), in 2 cases they occurred during plateaus, and in 0 cases they occurred during major declines. The UMRAO data are *integrated* fluxes, and hence not ideally suited for separating contributions from individual evolving source components; thus, it is not always possible to determine unambiguously at what phase of the radio outburst's development the EGRET detection occurred. Nevertheless, the data show that during burst rise they ranged from onset to peak, with no apparent preferred phase. Also, there is no clear correlation between gamma-ray flux and radio flux: 3C 273 which is one of the brightest sources in the radio has been found to be only moderately bright in the γ- ray band, although possibly it has not been viewed at an optimum time; conversely 1156+295 and 1633+382 have been unusually bright in the γ-ray band but relatively weak during the past two decades of observation at Michigan.

We conclude that the data are *suggestive* of causally related activity in the two wavebands, but that better sampling is required to firmly establish this association. We thank R. Hartman for invaluable input, M. C. Aller for help in data preparation, and the NSF for partial support (AST-9421979).

References

Hughes, P. A., Aller, H. D. and Aller, M. F. 1992, *ApJ*, **396**, 469.
Pearson, T. J. and Readhead, A. C. S. 1988, *ApJ*, **328**, 114.
Thompson, D. J. *et al.*, *ApJ Suppl*, in press.