# Short Time Scale Variability of Active Galactic Nuclei: Einstein IPC Observations of PKS 2155-304 - A Report of Rapid Variations of Instrumental Origin

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ABSTRACT. The Einstein IPC observed the bright (5 mCrab) X-ray emitting BL Lac Object PKS 2155-304 on 1979 November 4th and 5th through 7th and on 1980 May 16th through 18th. A total of 17.4 hours were spent monitoring the source. Changes in intensity of between 10-50% are evident in the data for time scales of days and months. The source was constant to within 10% of the mean intensity on hourly time scales for all intervals of data except one. Repeated factor of 2 variations in intensity, occuring on 10-30 second time scales, were observed during the first 50 minutes of the 1979 Nov. 5th observation. These variations, however, were anticorrelated with variations seen in an adjacent background region. Concurrent MPC observations also failed to confirm the rapid changes, although they should have been readily detected. Thus, we conclude that the observed rapid variations are not intrinsic to the source, but originated in the IPC. These results can have implications for other IPC reports of short time scale variability for active galaxies and for source models based on such observations.

TEXT. Variations on time scales of $< 10^3$ s have been reported at X-ray frequencies for a few active galactic nuclei (AGN's). Tennant et al. (1981) have reported variability in time scales of $10^2$ s by a factor of 5 in NGC 6814, while the (imaging) IPC experiment on Einstein (Giacconni et al. 1979) has detected rapid (30 s) time scale changes in intensity for H0323+022 (Doxsey et al. 1983, Feigelson et al. 1986). Variations at X-ray frequencies on time scales of order $\geq 10^3$ s have been reported in NGC 4051 (Marshall et al. 1983) and a number of other sorces (see, e.g. Pounds and Turner 1986). Variability of some AGN's on time scales $\geq$ hours thus seems well established.

Short time scale variability ($\leq 10^3$) is more controversial. Beall et al. (1986) have noted that the previously reported short time scale variability of NGC 6814 was correlated with the geomagnatic position of the HEAO A spacecraft. Since the NGC 6814 result is by far the most statistically significant short time scale variability reported thus far, it becomes increasingly important to confirm other reports (both imaging and non-imaging) of such variability.

PKS 2155-304 was observed with the IPC detector on six separate occasions during 1979 and 1980. Figure 1 (top) shows the data for the first 3000 seconds of the observation. These data are the only segment which show short time scale variability. The source count rate has not been corrected for background because of the small (i.e., 0.2 cts/sec) contribution of background to the total rate. The source count rate was determined by summing all counts within a 16 pixel radius (i.e., 8') of PKS 2155-304, while the background rate was obtained by summing all counts within a 16-60 pixel (8'-30') annulus centered on the source.



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This method is used to acquire a statistically significant background sample.

In the first fifty minute interval, repeated factor of 2 variations in intensity are evident on 30 second time scales. This pattern of variability is similar to that reported by Doxsey et al. (1983) and Feigelson et al. (1986) for H0323+022 using the IPC.

An analysis of the background data (Figure 1, bottom) for PKS 2155-304 shows that the variations are not intrinsic to the source. The background and source light curves are anticorrelated. Major dips in source intensity are correlated quite well with flares in the background. A linear correlation analysis shows that there is less than a $10^{-6}$ probability that the anticorrelation would occur by chance. Additionally, the source is bright enough to dominate the IPC Total Count Channel (a separate independent data channel), and to contribute significantly to the Monitor Proportional Counter (MPC) count rate which observes the source simultaneously with the IPC. The variations are also of a large enough magnitude that they should be clearly apparent in both data sets. We have analyzed both data sets and do not find any significant variation. Thus, there can be little doubt that the rapid changes observed during the first 3000 seconds of the observation are not intrinsic to the source, but are of instrumental origin.

Conversations with colleagues at CFA as to the origin of the variability lead us to believe that such fluctuations are rare. The method we have used here can test for the presence of such effects.

We will discuss this issue in more detail in a subsequent paper.

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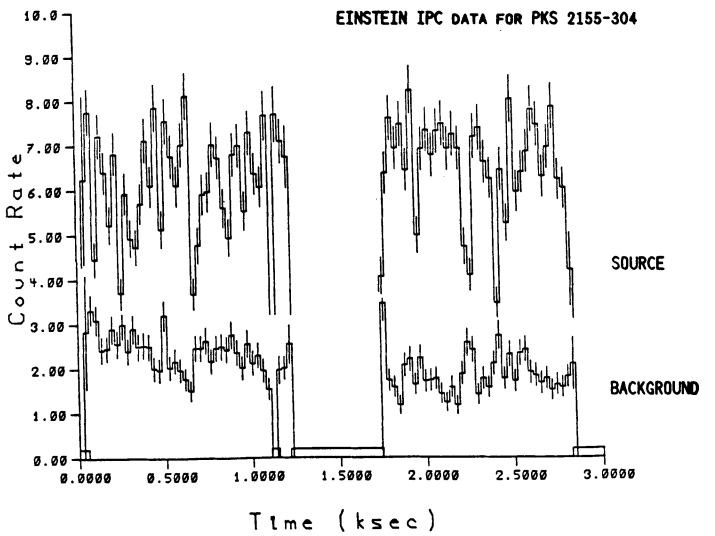


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