The hatched region of 8-3 represents the subset of QSOs with $z_e > 2.6$, further illustrating the possibility of increased variability at high redshift.

8.3.4 : Discrete Auto-Correlation Function

To get an idea of the typical timescale for variability, we have calculated the Discrete Auto-Correlation Function (DACF) as a function of time in the QSO rest frame (*cf.* Edelson and Krolik 1988 and Trevese and Kron 1991). This function is defined by: $\mathrm{DACF}_{ij} = (a_i - \bar{a})(a_j - \bar{a})/(\sigma_{a_i}\sigma_{a_j})$, where a_i is the relative flux at time t_i, σ_{a_i} is the calculated error, and $\bar{a}$ is the mean flux over all epochs. For each pair of observations, i,j, in every QSO, DACF and a lag time $\Delta t_{ij} = |t_i - t_j|$ (in the QSO frame) was calculated. Each of these values is plotted as a point in the lower right graph of figure 8-3. Note that any given QSO will contribute $N(N-1)/2$ pairs, where N is the number of epochs. The objects used include QSOs of all classes which have a probability of constant flux less than 0.001 ($\log(P) < -3.0$), *i.e.* all QSOs with detected variability. The large open circles represent the means within 0.1 year bins.

We expect that smaller time lags relative to the characteristic timescale should yield larger correlations, and that the mean DACF should approach zero as the lag becomes much larger than the variation timescale. In practice, the "zero-point" will be noticeably shifted towards anti-correlations (negative values) if the variation timescale is comparable to the timespan of observations, since the mean flux will lie between the flux at the maximum point in the variation and the flux during the "quiescent" (less variable) epochs.

In our DACF graph, it appears that the characteristic timescale for variations is $\sim$0.3 years in the QSO rest frame. Two problems exist with this result: (1) It is assumed that all variations have similar timescales; since they almost certainly do not, this tends to distort the curve. (2) Since the timescale is comparable to the timespan for observations, there will be many cases where the start or end of the observing period will occur in the middle of a variation. This means that the characteristic timescale is actually $\Delta t \gtrsim 0.3$ years. However, since the DACF values do appear to level off, it is evident that we are