VERY LONG BASELINE INTERFEROMETRY OF SOLAR FLARES.

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The aim of the VLBI experiment was a search for the occurrence of sub-arc-second microwave emission centres as tracers of the initial energy release in solar flares. The observations extended over the period April 28 to May 3, 1981 and were performed with the 25 m telescopes at Onsala (Sweden) and Dwingeloo (Netherlands) at a wavelength of 18 cm (1663 MHz). The baseline was 619 km long giving a minimum angular width of the interference fringes of 0.06". This corresponds to a spatial scale of 40 km at the solar disc centre.

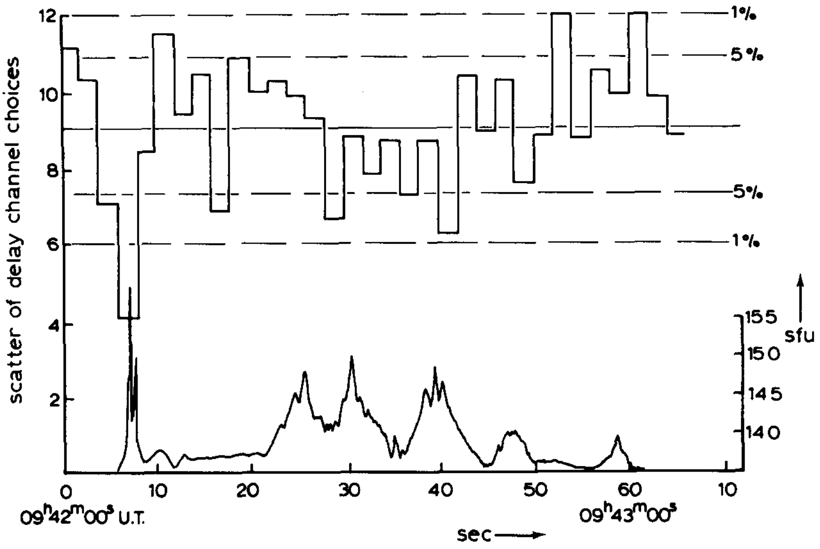

Figure 2. Total flux at 18 cm on 29 April 1982 (below) (1 sfu = 10^{-22} $Wm^{-2}Hz^{-1}$) and scatter in channel number (above).

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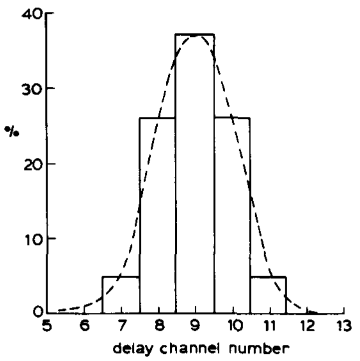

Figure 1. Distribution of standard deviations in channel no. of maximum correlation in absence of bursts.

We used the data recording system of the European VLBI network. The pre-correlation bandwidth was 250 kHz. The data were processed at the MPIfR in Bonn. The shortest available integration time was 0.2 sec and is dictated by the basic correlator cycle-time. The output from the correlation process consisted of a listing for each 0.2 sec time interval of the correlated signal amplitude and fringe phase for each of 31 delay channels (separation 2 μsec) centered around the delay calculated for the estimated source position and baseline orientation. The annual solar motion and the solar rotation were taken into account by a differential fringe rate correction.

During the observing period three weak outbursts occurred. No large correlations were observed. However a strong indication was found for an unresolved source with a signal to noise ratio of order unity during the impulsive bursts preceding the main phase of one event (Fig 2.). During the impulsive bursts the spread in number of the channel

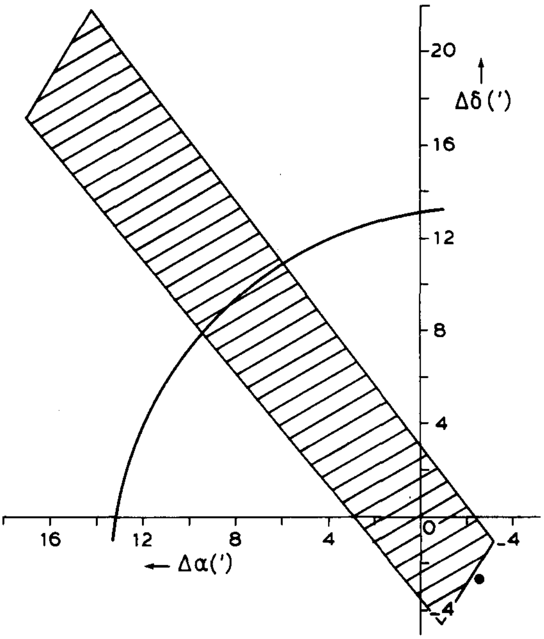

Figure 3. Probable error box for the source position.

which showed the maximum correlation amplitude was reduced significantly below the value for random behaviour (99.5% confidence, see Fig. 2). The spreads were determined for intervals of 2 sec containing ten datapoints; their distribution in the absence of bursts is shown by the histogram in Fig. 1, for 190 intervals, together with the expected normal distribution. At the time of the impulsive bursts Fig. 2 shows a clear reduction in the amount of scatter from the expectation value for the standard deviation of 9. The derived brightness temperature is of order 10^{12} K (flux of ~ 1 sfu). At lower frequencies a small group of type III bursts occurred; no Hα flare was observed (NOAA, Boulder). Both other outbursts showed only gradual flux variations in time.

From the offsets in delay and fringe frequency from the values for the estimated source position the actual position can be determined. The error box in Fig. 3 overlaps Hale region 17609. The curve represents the solar limb, the dot the solar centre and the estimated position is at the origin.

It is important to repeat this experiment for a larger flare.

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