OBSERVATIONS OF THE STRUCTURE OF TYPE IIIb RADIO BURSTS

Ch. V. Sastry, K.R. Subrahmanyan and V. Krishnan
Indian Institute of Astrophysics
Bangalore-560034, India

We observed short duration, narrow band Type IIIb radio bursts that occur just before the onset of a normal Type III burst. These observations were made with a multichannel radiometer with a center frequency of 25 MHz, time constant of 10 milliseconds and frequency resolution of 100 KHz. The average half power duration of a typical element of a Type III burst was determined. It was found to be very similar to the time profile of a normal Type III burst, i.e., sharp rise and exponential type decay. The duration of the exciter, t_E, and the decay time constant, τ, determined from the average time profile were 0.88 and 0.31 seconds, respectively. The corresponding quantities for the associated Type III bursts are 6.0 and 2.1 seconds, respectively. It is interesting to note that the ratios

$$\frac{'t_E' \text{ Type III}}{'t_E' \text{ Type IIIb}} \quad \text{and} \quad \frac{'\tau' \text{ Type III}}{'\tau' \text{ Type IIIb}}$$

are the same, and equal to 0.98. We found that there is no difference between the time profile of a Type III burst associated with a Type IIIb burst and that of an isolated Type III burst. We also found that the two quantities $'t_E'$ and $'\tau'$ are positively correlated in the case of isolated Type III bursts. The linear correlation coefficient is 0.70. This correlation seems to break down in the case of Type III bursts associated with Type IIIb bursts. We looked for a relation between durations of the elements of the Type IIIb bursts and that of the associated Type III bursts, and found that the two quantities are positively correlated. Lastly, we would like to point out that the elements of Type IIIb bursts observed by us are more intense than the associated Type III burst.

It is possible to explain some features of the Type IIIb bursts in the following way: An energetic electron beam passing through a stationary plasma along the magnetic field generates Langmuir turbulence. Once the electric field associated with the beam-plasma instability saturates, one can consider the stationary plasma in the presence of electric field oscillating at the plasma frequency ω_0, the direction of the electric

field being that of the magnetic field. Eventually, instead of the beam
particles travelling with a uniform speed along the magnetic field, one
ends up with a plasma system in which the particles are executing gyro-
motion in a plane perpendicular to the magnetic field and a quivering
motion along the magnetic field, the quiver speed being $u_e = eE_o/m \, \omega_o$.
The normal mode analysis of this system shows the presence of growing
electromagnetic modes at $\omega = \omega_o \pm K_o u_o$, and its harmonics, where K_o is the
wave vector of the electrostatic beam plasma instability. We have deter-
mined the growth rate, the direction of propagation and the frequency
drift rate. The results agree well with the observed parameters.