

CHROMOSPHERIC EJECTIONS ASSOCIATED WITH TYPE III RADIO-BURSTS.

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Abstract.

We study the dynamics of an $H\alpha$ absorbing structure associated with a type III radio-burst. We use a "Differential Cloud Model" to analyse the observed line profiles, in order to determine radial velocity and microturbulence (or shear) as functions of time. We assume that the material is flowing inside magnetic flux tubes, with a given velocity distribution. We analyse the motions in a phase-diagram (position x , velocity V). The evolution of velocity and microturbulence is compared to the observations. The model accounts qualitatively for the evolution of velocity, and qualitatively for the decrease of microturbulence.

1-Introduction.

We consider an absorbing $H\alpha$ structure associated with a type III radio-burst observed with the Multichannel Subtractive Double Pass (M.S.D.P.) spectrograph of the Meudon Solar Tower, and the Radioheliograph of Nançay observatory (France), on May 10, 1980. The connection between the $H\alpha$ structure and the type III is certified by a good temporal coordination and a good spatial association (Chiuderi-Drago et al. 1986). Carbone et al. (1987) propose a model of surge developing a turbulent energy cascade which produces electron acceleration and mass motion deceleration. To test this theory, we use a new treatment of the $H\alpha$ line profile: the Differential Cloud Model (D.C.M.) (Mein et al. 1988). The D.C.M. takes into account the variation of the background radiation. It allows us to determine the radial velocity V_r and the microturbulence ξ along the structure.

2.Observations.

We derive the mean velocity and the microturbulence (calculated with a temperature $T_e = 20000^\circ$) along the axis of the $H\alpha$ structure at $t_0 = 12:38:28$ and $t_1 = 12:43:28$ U.T. (fig 1). These times are before and after the type III radio-burst which occurs between 10:41:08 and 10:43:00 U.T. (Mein et al., 1985).

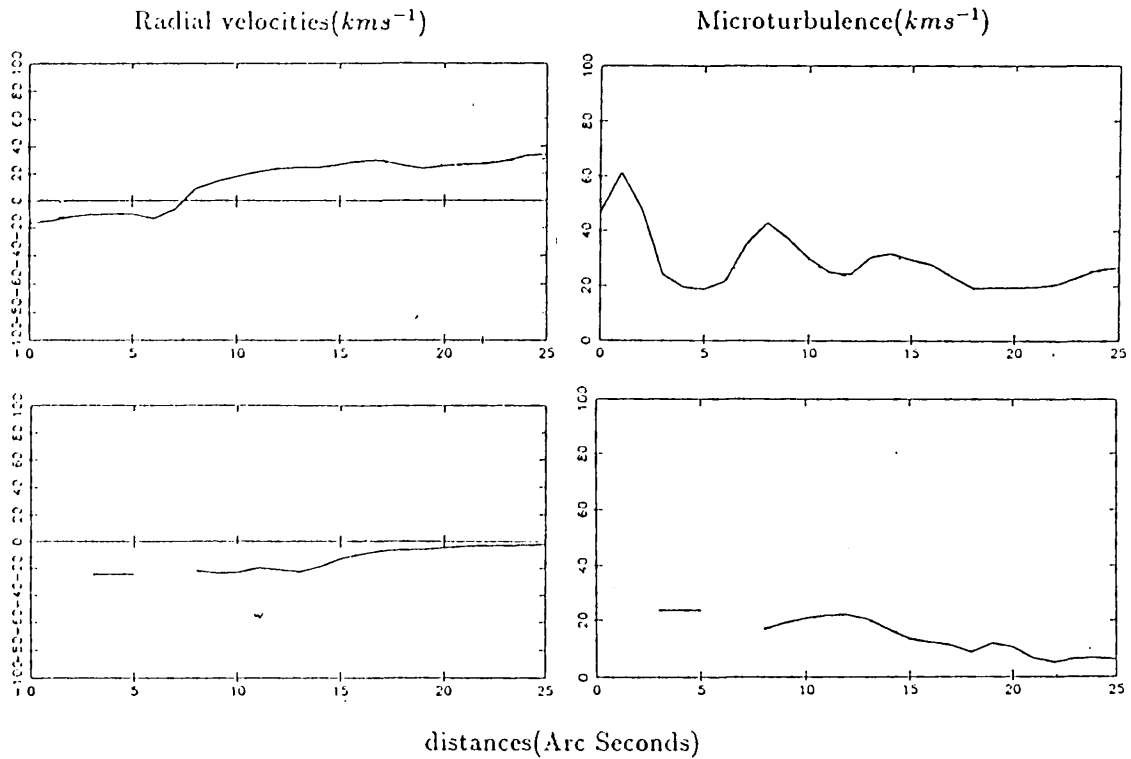


Figure 1-Radial velocity and Microturbulence along the axis of the structure; at $t_0 = 12 : 38 : 28$ (upper curves) and at $t_1 = 12 : 43 : 28$ (lower curves)

3-Dynamical model.

3-a- Geometrical structure

The structure has been located on the spectroheliogram giving its projection on the plane of the sky Γ . Figure 2 shows the geometry of the structure : MS is the position of the flux tube, ms its projection on Γ . The angles θ and β are measured on the spectroheliogram, D is unknown and will be determined by the fitting of the velocities between the two times t_0 and t_1 ; G is related to D and θ by :

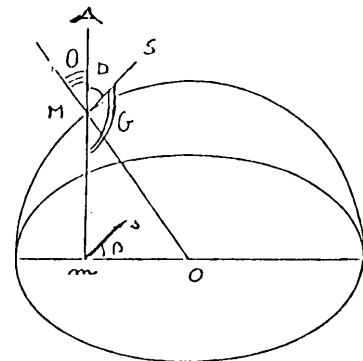
$$\cos G = \sin \theta \cdot \sin D \cdot \cos \beta - \cos \theta \cdot \cos D$$


Figure 2-
Geometry of the structure.

3-b Mechanical equations.

At time t , the material is supposed to be imbedded in a flux tube with a given set of velocities and turbulence (or shear). We take into account gas pressure and gravity only.

The equations of displacement along the structure between t and $t + \Delta t$ are:

$$\Delta x = V.tgD.\Delta t$$

$$\Delta V/\Delta t = g.\cos G.\cos D - \frac{\gamma k T_s}{M_H N_s^2 - 1} . N_s^{\gamma-2} \frac{dN_s}{ds}$$

with: N_s number of atoms between s and $s+ds$ along the structure MS, g acceleration of gravity on the sun, V radial velocity of a given atom, x location along ms , $N_o = 10^{11}$, $\gamma = 5/3$.

3-c Method.

We make our calculations in the phase-space plane (x, V) , using elementary boxes of $100km * 2kms^{-1}$. At time t_o , the number $N(x, V)$ of atoms located between x and $x + dx$, with radial velocity between V and $V + dV$, is

$$N(x, V) = \frac{N}{\pi.dx.dV} e^{-\left(\frac{x-x_o}{\delta x}\right)^2} e^{-\left(\frac{V-(a+b)}{\Delta v(x)}\right)^2} dx.dV \text{ with } \Delta v(x) = c.e^{-\frac{x}{d}}.$$

N is the total number of atoms. x_o and δx are determined by the initial opacity of absorbing material. The observed radial velocity $V_r(x)$ is the mean value of V at location x ; so, a, b are determined by the initial observed radial velocity. In the same way, the observed turbulence $\xi(x)$ is assimilated to the standard deviation (multiplied by $\sqrt{2}$) of V at location x . c and d are determined by the observed initial turbulence. A tentative value of D is assumed. The displacements of elementary boxes in the plane (x, V) between t_o and t_1 are deduced from mechanical equations, step by step ($\Delta t=2s$). Then we calculate the mean values $V_r(x)$ and the standard deviations of the new distributions of velocities at t_1 . We compare the velocities $V_r(x)$ and we modify the D -value until we get the best fit.

The figure 3 shows the isocontours of $N(x, V)$ in the plane x, V for t_o and t_1 , with the fitted parameters (see section 4).

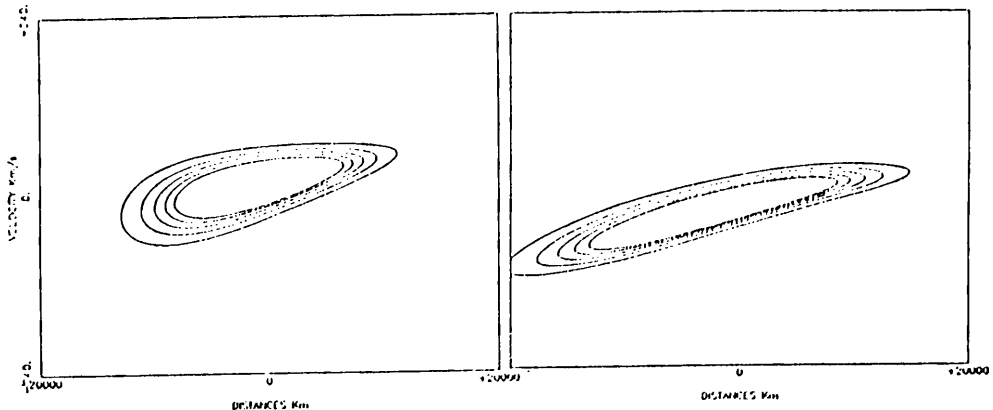


Figure 3- Phase-diagram at t_o and t_1

4-Results.

The figure 4 shows the comparison of the mean velocity and the microturbulence as deduced from the observations with the D.C.M and from our dynamical model.

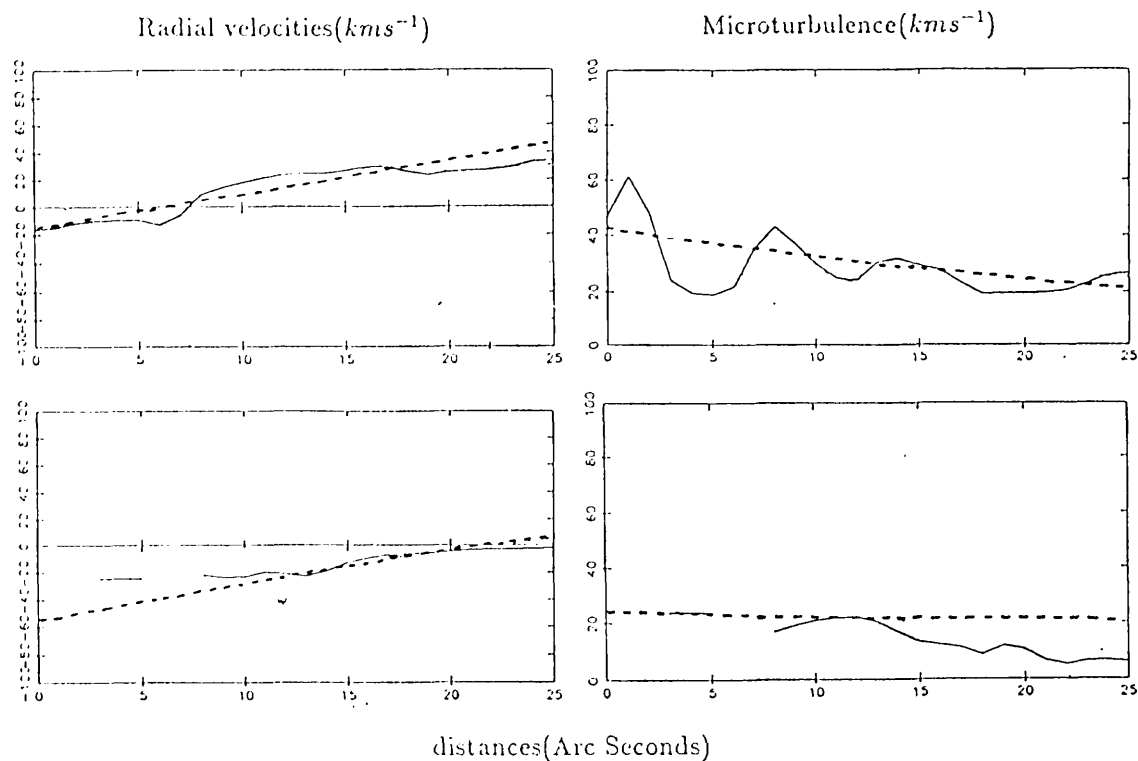


Figure 4- Comparison between the observation (full lines) and our model (broken lines)

The best fit is obtained with $D = 20^\circ$ ($G = 124, 30^\circ$), $a = 0.33 \cdot 10^{-2} s^{-1}$, $b = 15 km s^{-1}$, $c = 30 km s^{-1}$, $d = 2.5 \cdot 10^{-4} km$, $x_0 = -2 \cdot 10^3 km$, $\delta x = 7500 km$

5-Conclusions.

Some preliminary results can be deduced from this study:

- The pressure effects are negligible with realistic values of the density.
- The angle D is determined with an accuracy around 5° .
- The "microturbulence" observed at the top of the ejecta decreases more rapidly than the calculated one. This point should be tested again in connection with the assumed temperature of the ejecta.
- The decrease in time of the observed "microturbulence" can be interpreted by a decrease of the velocity shear.

Bibliography.

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