

# **LOFAR and the search for spatial resolution in the outer solar corona**

Jean-Claude Vial

**Institut d'Astrophysique Spatiale, Orsay, France**

# LOFAR characteristics of interest

**Frequencies : 10 – 240 MHz**

**$f_p \rightarrow n_e : 1.2 \cdot 10^6 - 7 \cdot 10^8 \text{ cm}^{-3}$**

**Angular resolution : 0.64 arcsec at 240 MHz**

**Sensitivity of 0.03 mJy at 200 MHz**

**Large fov**

**High time resolution**

**...**

# What I will not talk about

**Radio Bursts (Type III, ..)**

**Space Weather (Coronal Mass Ejection (CME) warning, ...)**

**Active sounding**

**...**

# **A few evidences of fine structure in the solar atmosphere**

**Magnetic flux Tubes in the photosphere  
< 100 km**

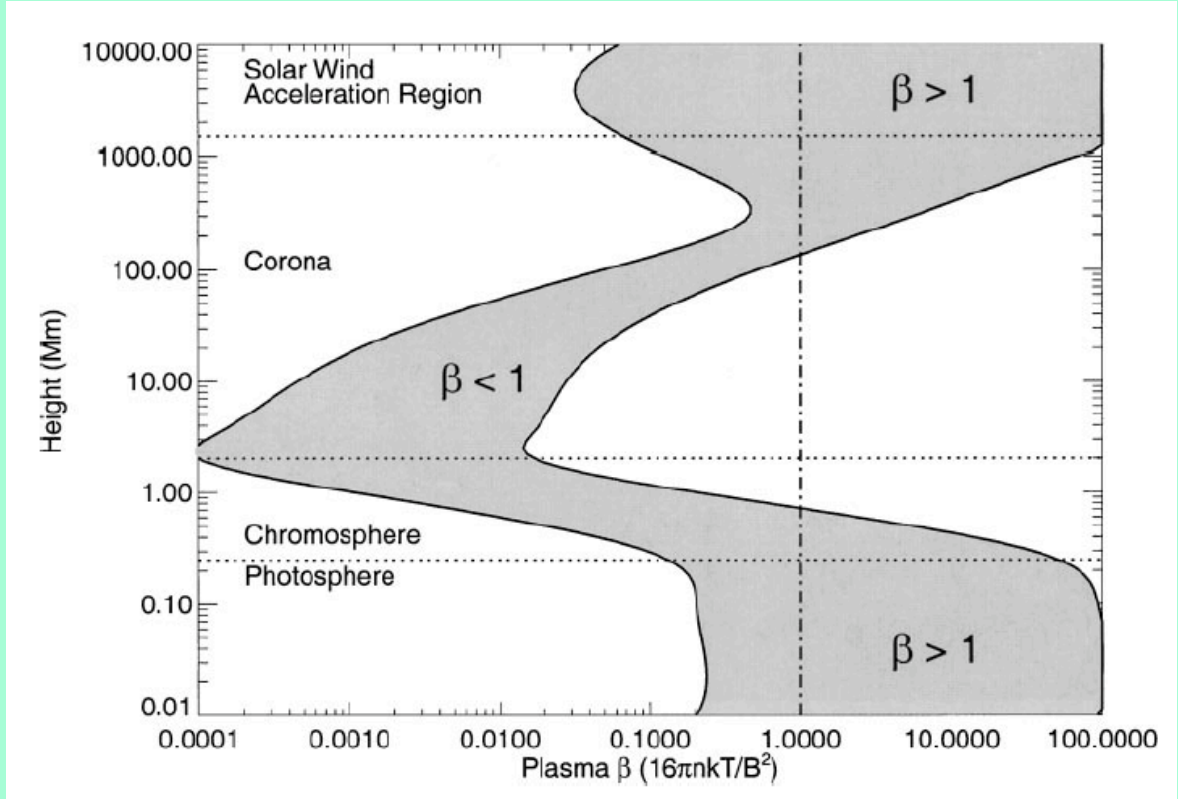
**Spicules in the chromosphere  
fibers of 20 km diameter**

**Tangential discontinuities in the corona  
one order of magnitude change of the density across a  
100 km boundary (Koutchmy)**

**Radio Scintillations in the corona  
density fluctuations at 1 km scale !**

**Fibers in prominences  
diameters of about 10 km ?**

**Indirect evidences (spectroscopic filling factors (ff), ...)**



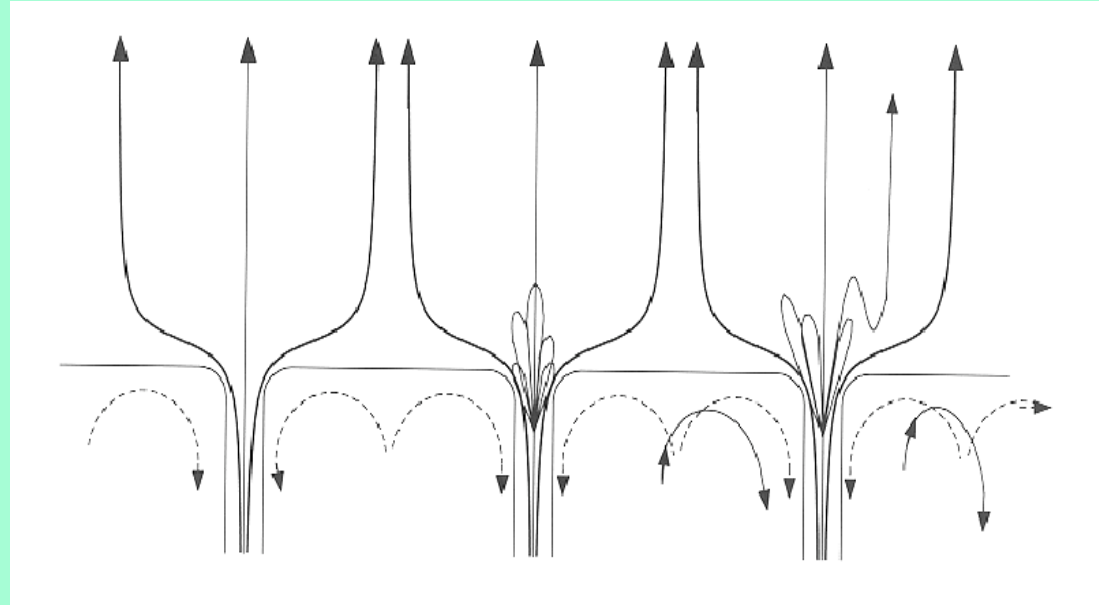
Aschwanden et al. 2000

# The case of the solar corona (1)

Expansion of flux tubes

Models

$ff \rightarrow 1$  ?

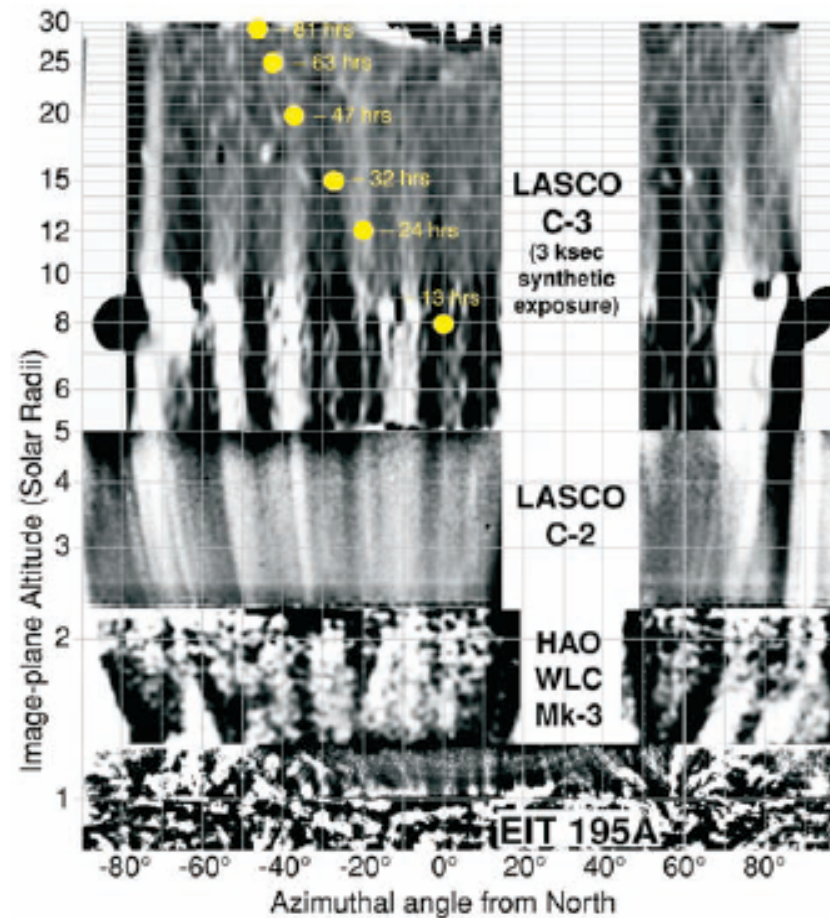


**But (very) small structures are required :**  
scale of processes (Current Sheets :  
a few km ? A few 100 m ?)

**turbulent cascade : dissipation at smaller scales**

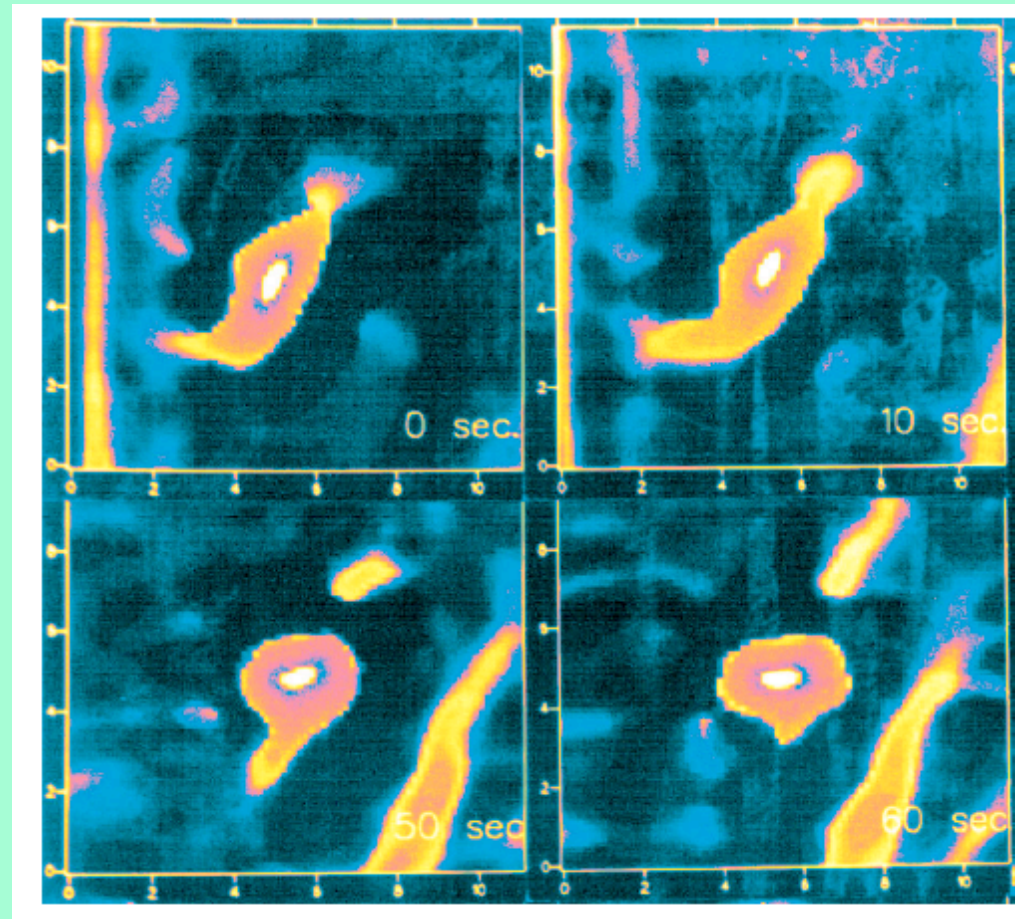
# The case of the solar corona (2)

**Origin of the fast wind :**  
**the fine structure of polar plumes is lost above 4 Rs**



# The case of the solar corona (3)

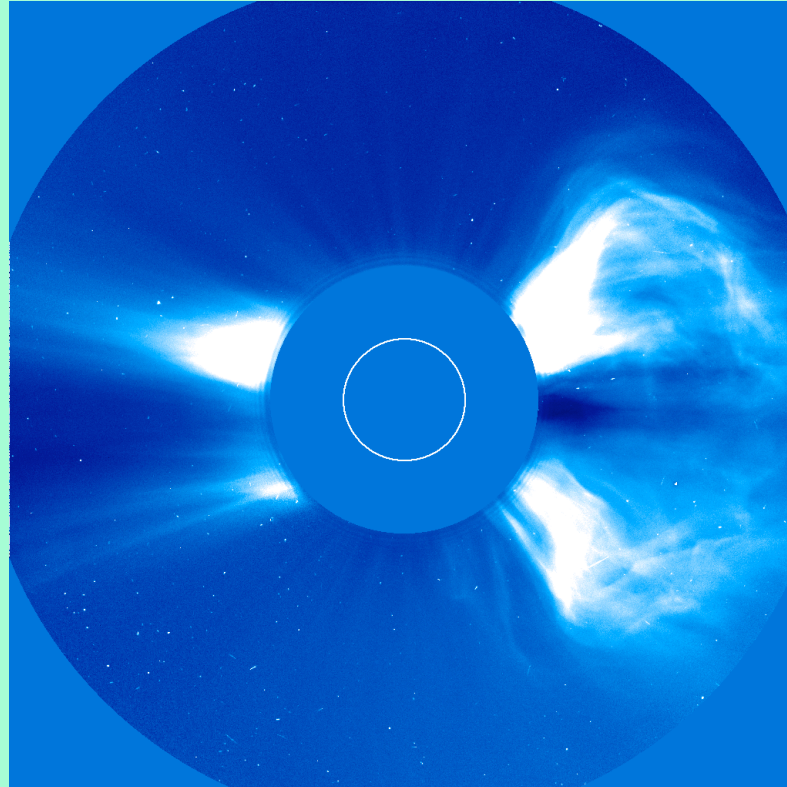
**Propagation of magnetic clouds (plasmoids) :  
Source of wind if enough events**



Koutchmy et al. 1994



# Fine structure of CMEs



Topology (helicity) :  
help for determining the best model

# LOFAR Detectability

**1 sfu = 10 000 Jy**

**A one arcsec pixel receives less than  $10^{-7}$  sfu  
(2 Rs Sun) or  $10^{-3}$  Jy above LOFAR sensitivity ?**

**Take large spectral bands ?**

**Pros :**

**“Quiet Sun” : possibility to add up signal ->  
arcsec resolution -> in the corona !!**

**“dynamic Sun” : possibility to detect any event (plasmoid,  
reconnection/heating episode, ...) with a msec resolution ?!**

**Unknown (to me) : background subtraction in out-of-limb**