Investigation of macrospicules with TESIS/CORONAS-PHOTON EUV telescope

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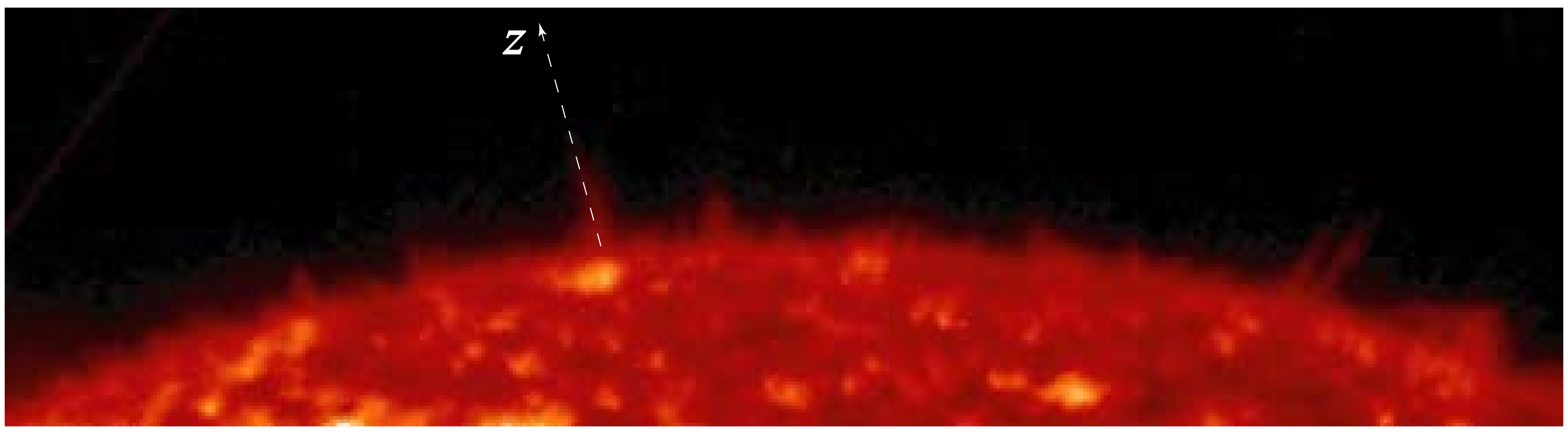
Introduction

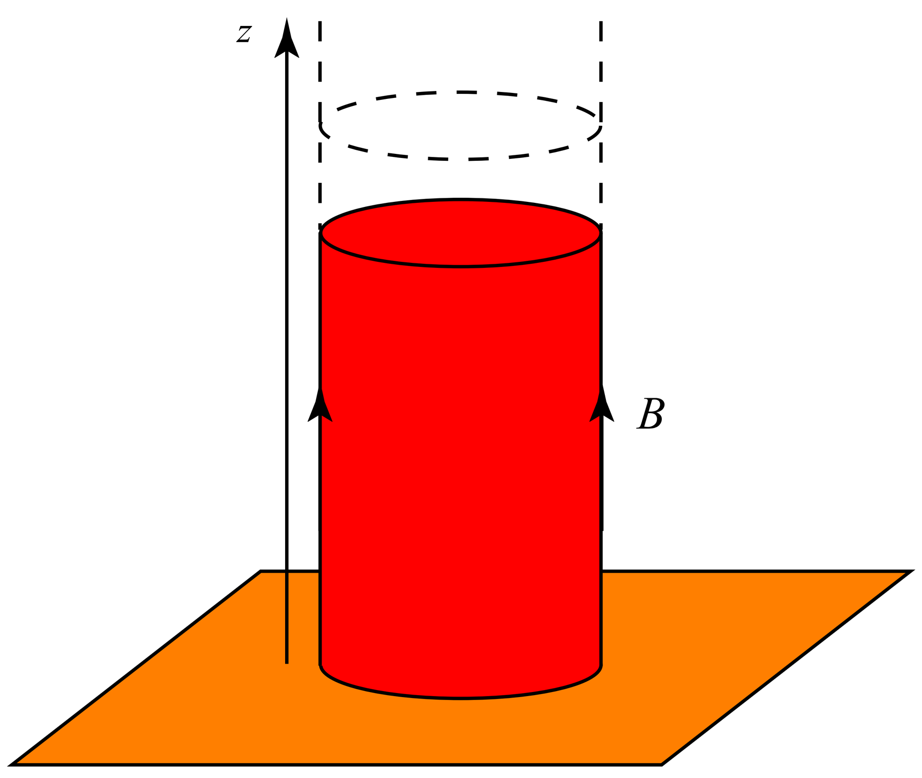
TESIS is an instrumentation complex for investigation of solar corona in EUV and soft X-ray. It was launched in 2009 on CORONAS-PHOTON satellite. TESIS had EUV telescope, which built images in 304 A with 1.7 arc second resolution. For macrospicule investigation we carried outa series of high cadence observations: only polar region was recorded, but with 3 second cadence. In this work we use this data to determine macrospicule velocity distribution over its height.

Data processing



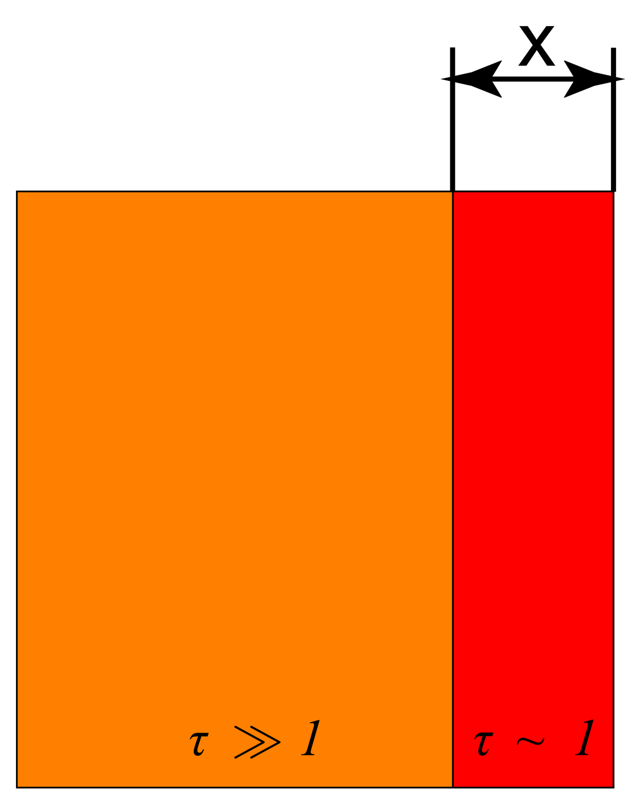
extract macrospicule intensity → $I(z,t)$

Assumptions



1) $\tau \gg 1$
2) $n = n(z, t)$
3) constant cross section (A)
4) $T = const$

Intensity and Density



1) Emitting layer
$\tau = x\sigma n \rightarrow \tau \sim 1, \; x \sim \frac{1}{n}$

2) Emitting volume
$V = xS$

3) Observed Intensity
$I = G(T) V n^2 \sim x n^2 \sim n$

Method

Apply the continuity equation for macrospicule

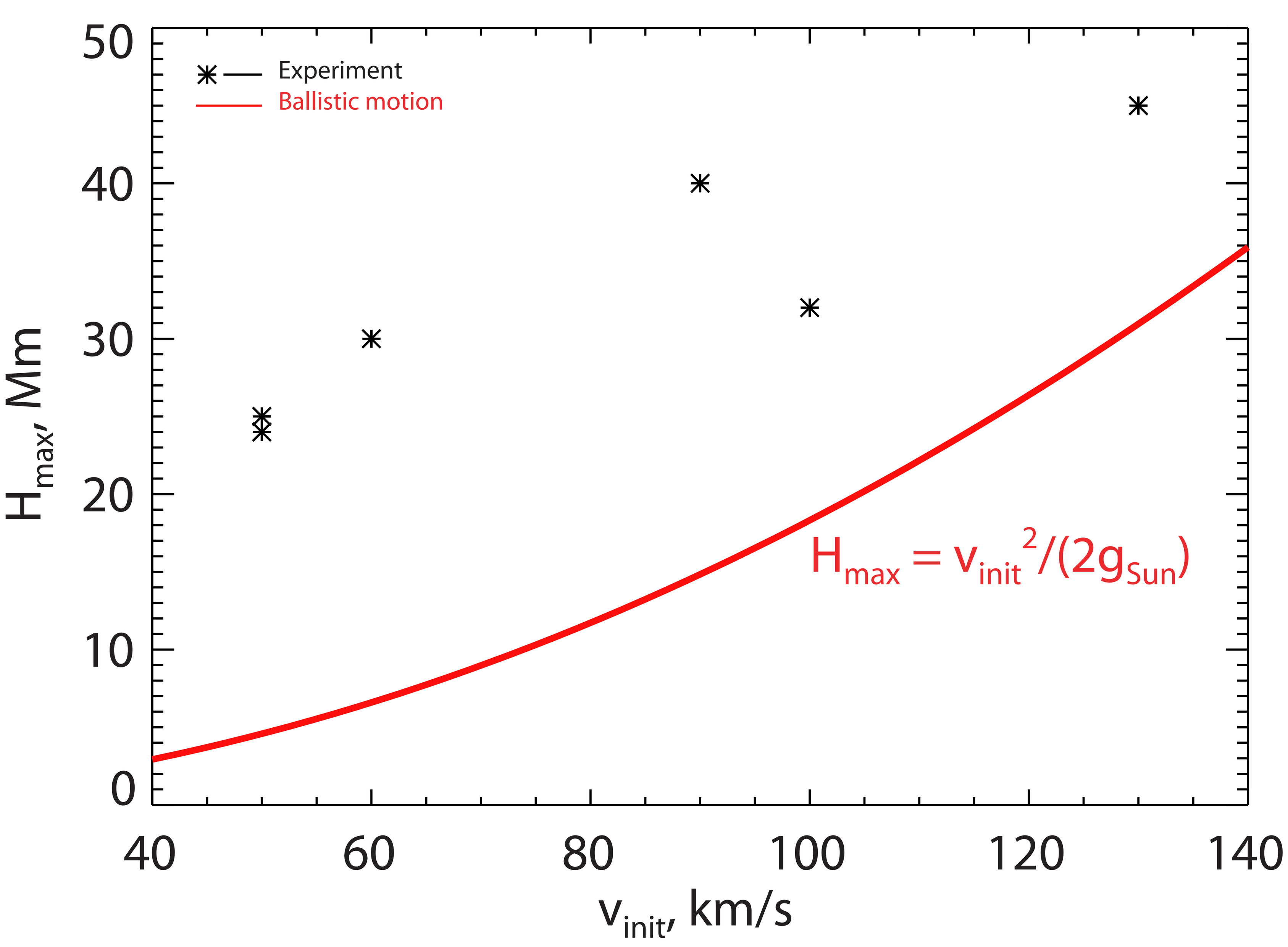
$$\frac{\partial}{\partial t}(\rho A) + \frac{\partial}{\partial z}(\rho v A) = 0$$
$$\rho = m_e n$$
$$A = const$$
$$I = C n$$

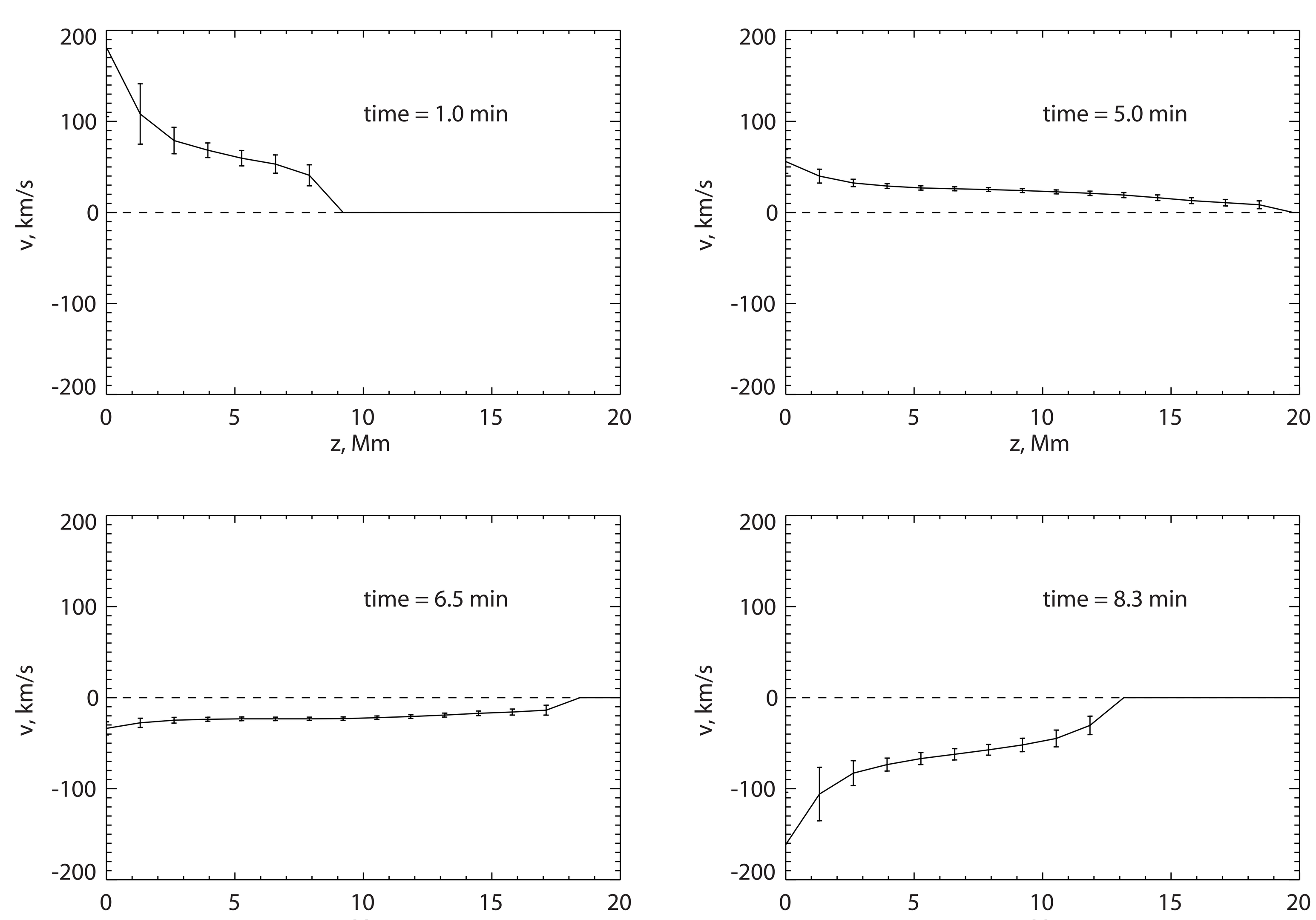
Simplify it using assumptions →

$$\frac{\partial I}{\partial t} + \frac{\partial}{\partial z}(I v) = 0$$

Solve it using experimental I(z,t) → $v(z,t)$

Results





We registered 6 macrospicules from thier start to the end. Macrospicule initial velocity lies in the range 50 - 130 km/s, maximum hight in the range 25 - 45 Mm.

Macrospicule maximum hight is greater than its ballistic hight. This means that some "driving force" affects macrospicule during its lifetime, or our model is too rough.

By temporal behaviour of macrosicule velocity and density we divided its lifetime in 4 phases: 1) velocity increases, hight increases; 2) velocity decreases, hight increases; 3) velocity increases, hight decreases; 4) velocity decreases, hight decreases.

Conclusion

Our findings suggest, that some "driving force" affects macrospicule during its lifetime. The nature of this force is the subject of further investigations.

In future we plan to apply the same approach to AIA data and use automatic macrospicule detection algorithm. Better statistics will help testing the existence of "driving force", and hopefully reveal its nature.