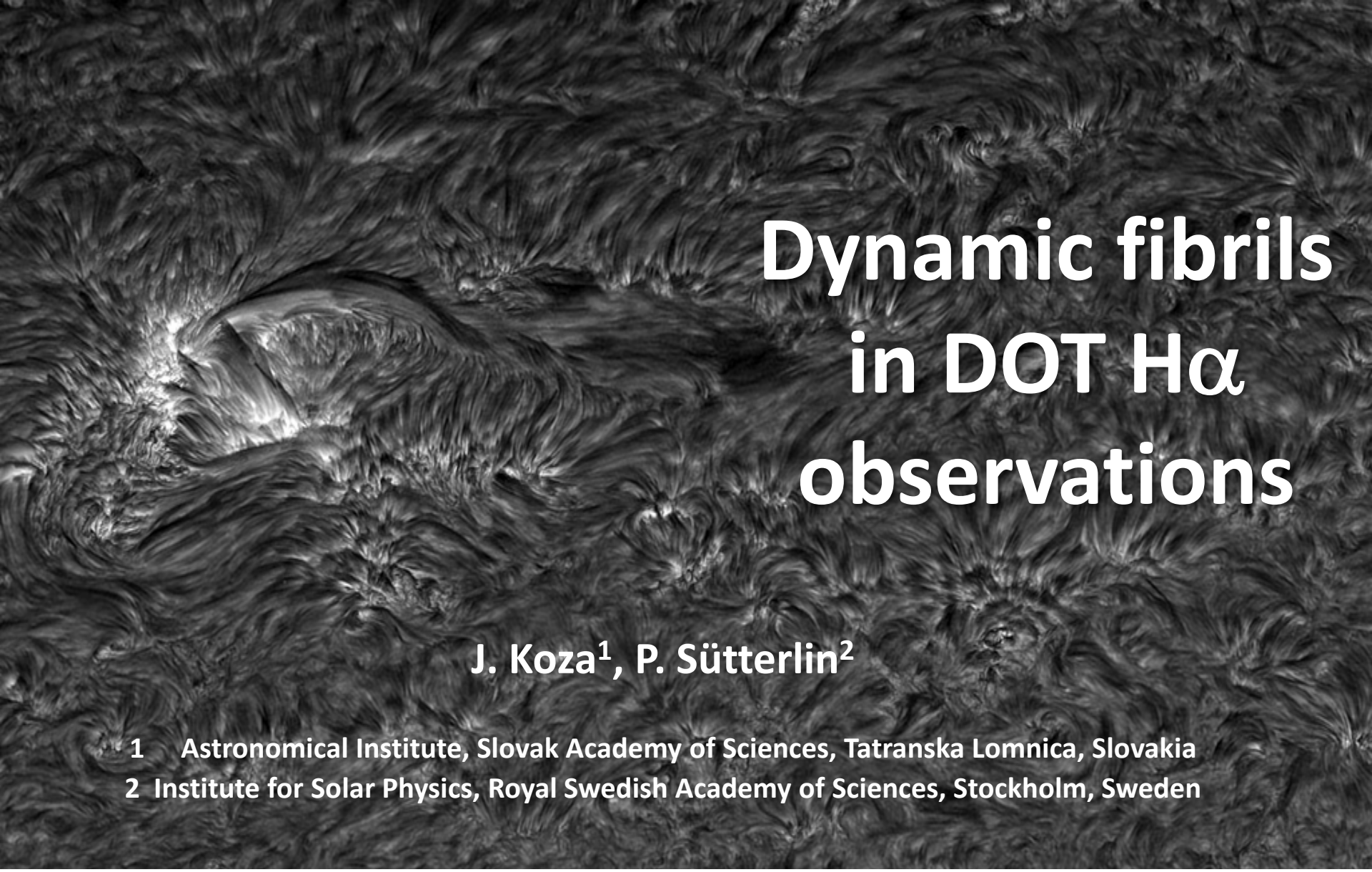

Dynamic fibrils in DOT Hα observations

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SLOVAK RESEARCH AND DEVELOPMENT AGENCY

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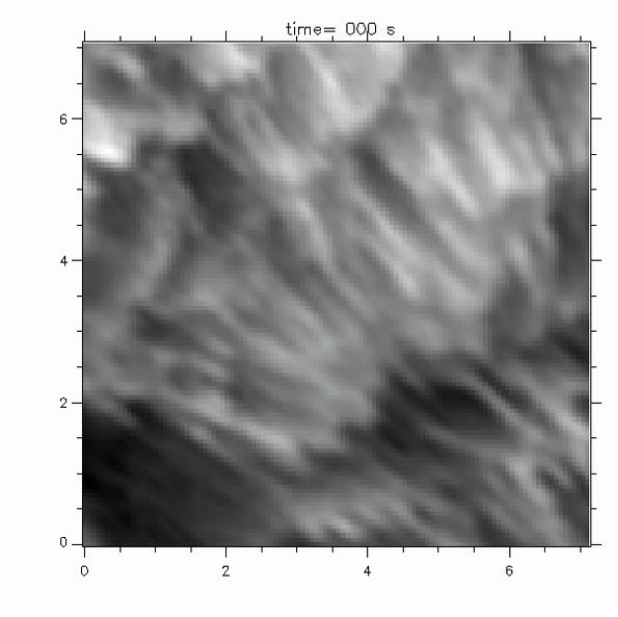
INSTITUTET FÖR SOLFYSIK

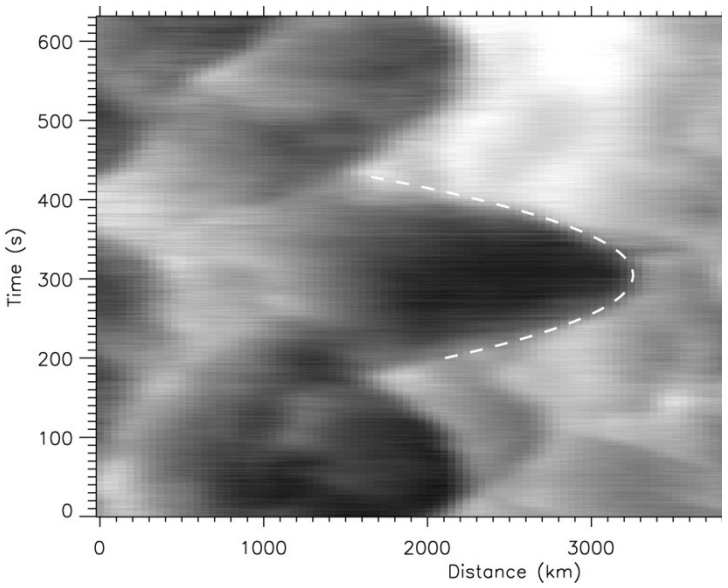
DOT
DUTCH OPEN TELESCOPE

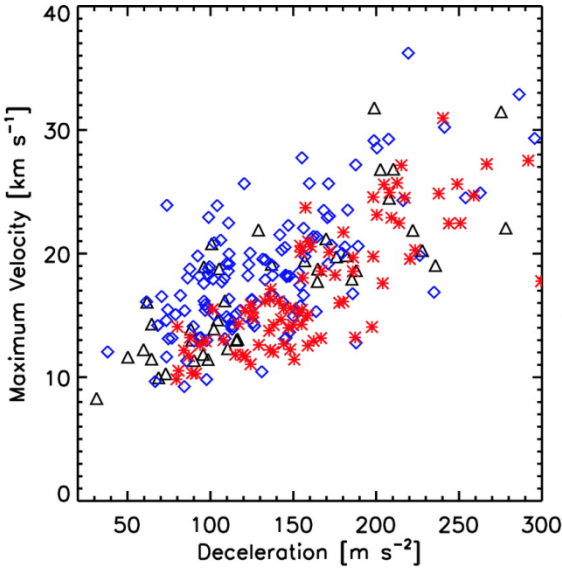
Searching an order in the mess

Dynamic fibrils in Hα

- extensions and retractions
- parabolic top trajectories
- positive correlation of maximum velocity and deceleration
- field-aligned magnetoacoustic shock excitation







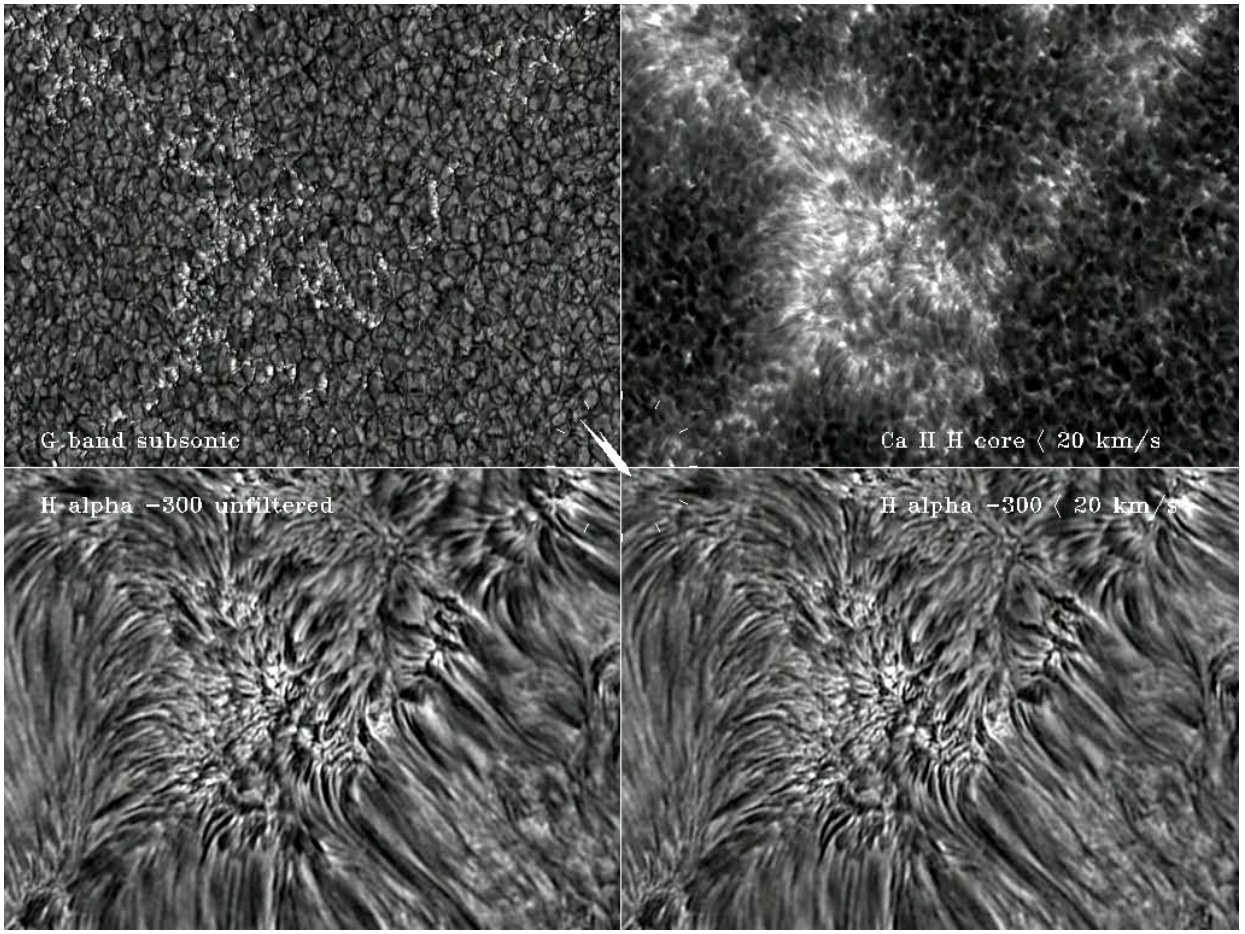
Swedish 1-m Solar Telescope

Hansteen et al.: 2006, ApJ, 647, L73 , De Pontieu et al.: 2007, ApJ, 655, 624

An aim of this study

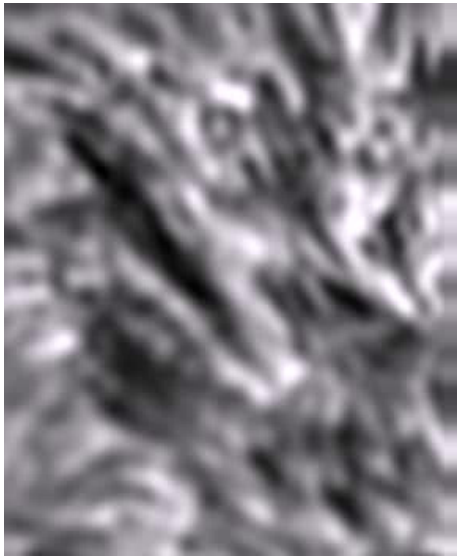
To find and study dynamic fibrils in Hα image sequence obtained by the Dutch Open Telescope (DOT).

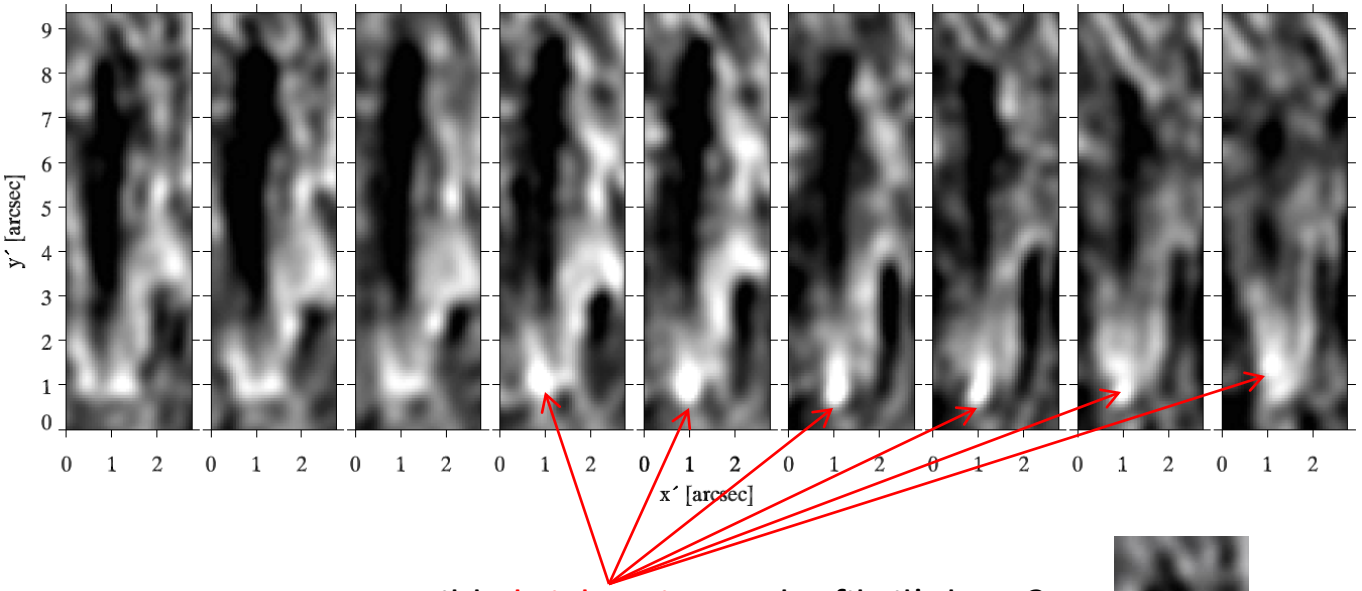
observations on 24 April 2006



target:	a small plage and network in quiet-Sun area 40° off the disk center
observations:	10-min speckle-reconstructed image sequences of 50 images
field of view:	83 arcsec × 66 arcsec
key diagnostics:	Hα images taken by a Lyot filter (FWHM 0.25 Å) at – 0.3 Å off the line center
time resolution:	12 s

Hα dynamic fibrils (DFs) in DOT observations





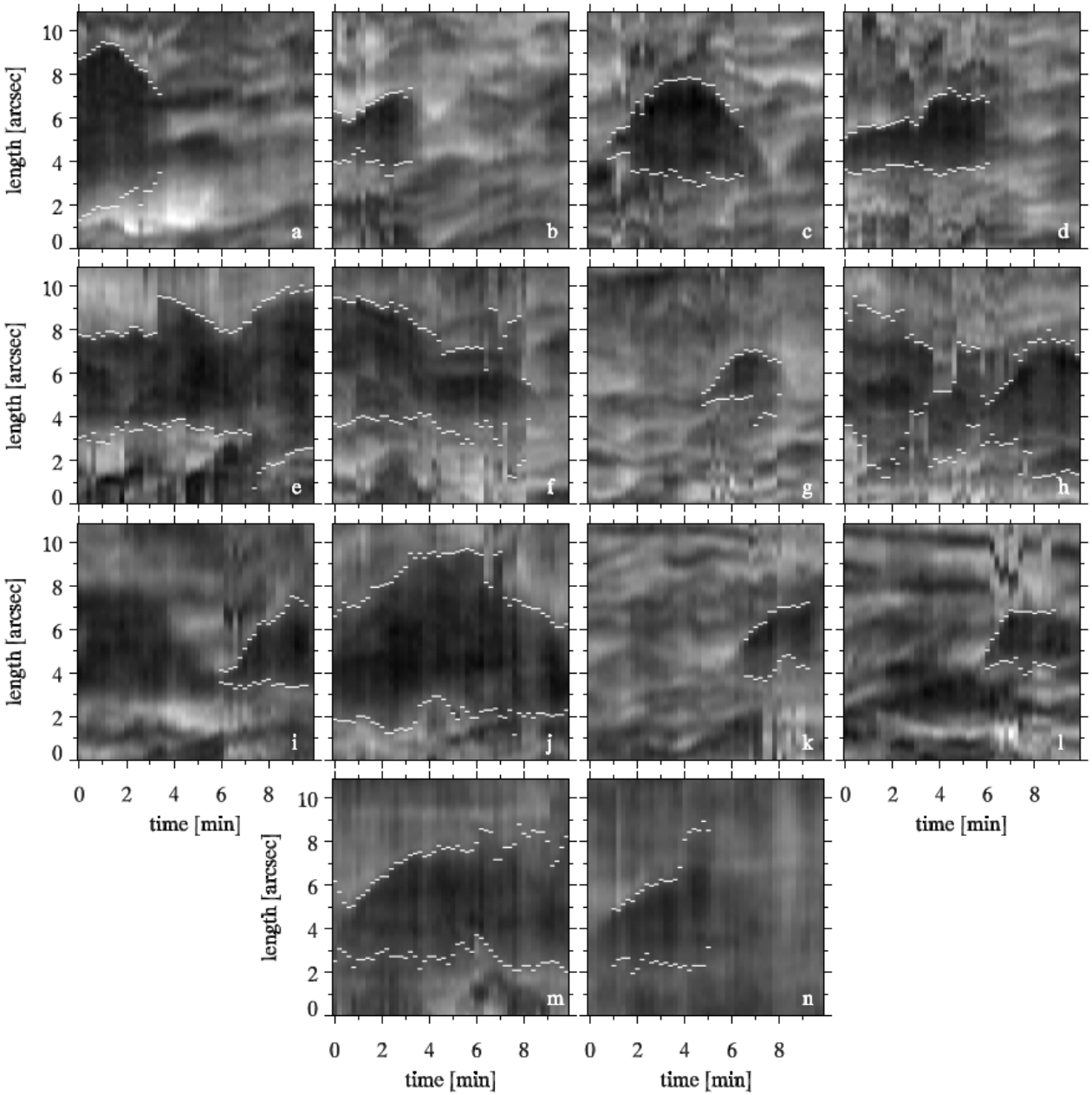
A possible brightening at the fibril's base?
Δt = 24 s, fibril's lifetime ≈ 3.5 min

Measurements of DFs:

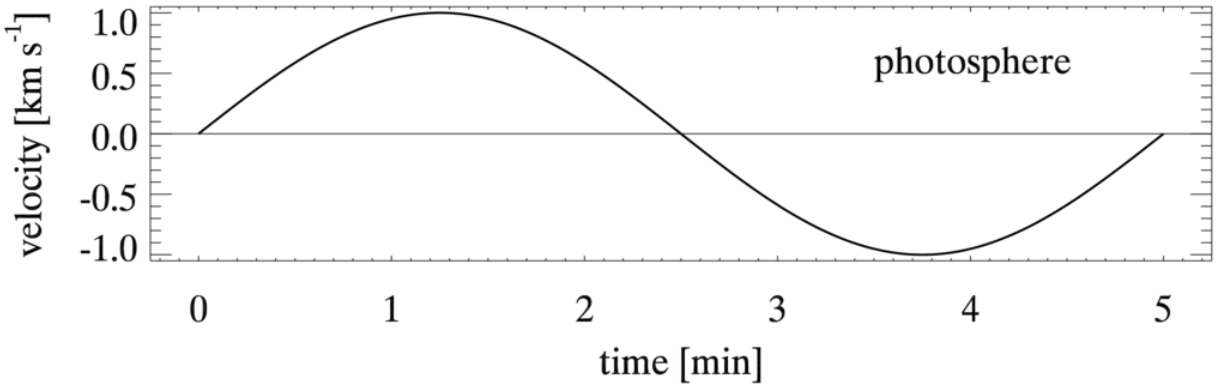
1. top trajectories
2. temporal variations in orientation

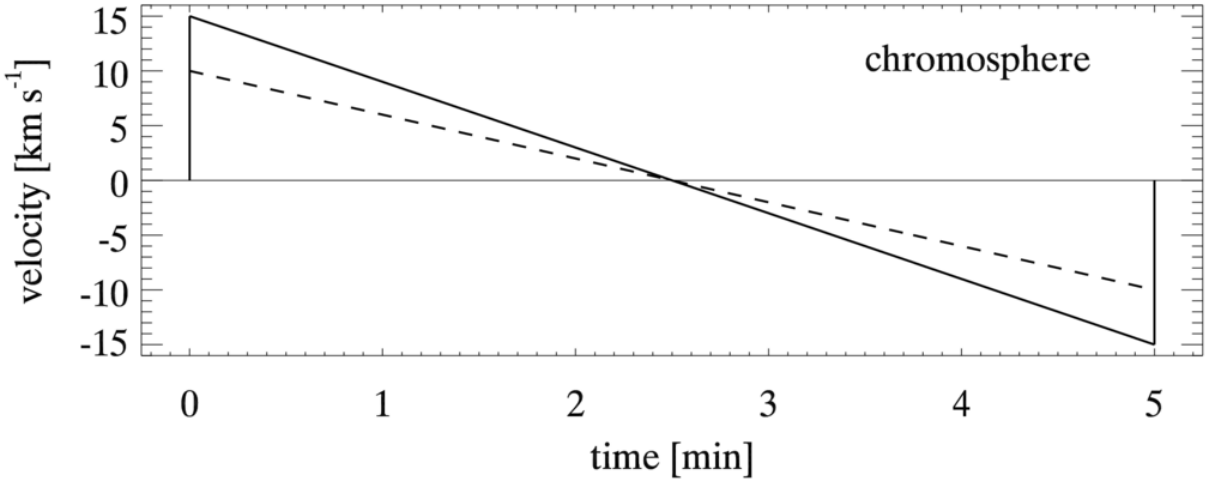
A parallel evolution of two DFs?

Top trajectories of DOT Hα dynamic fibrils



N-shaped magnetoacoustic shocks





acoustic cutoff period

$$P_{\rm ac} = \frac{4\pi}{g\cos\theta}\sqrt{\frac{RT}{\gamma\mu}}$$

from shock discontinuity to parabola

$$v = v_{\rm max} - at$$

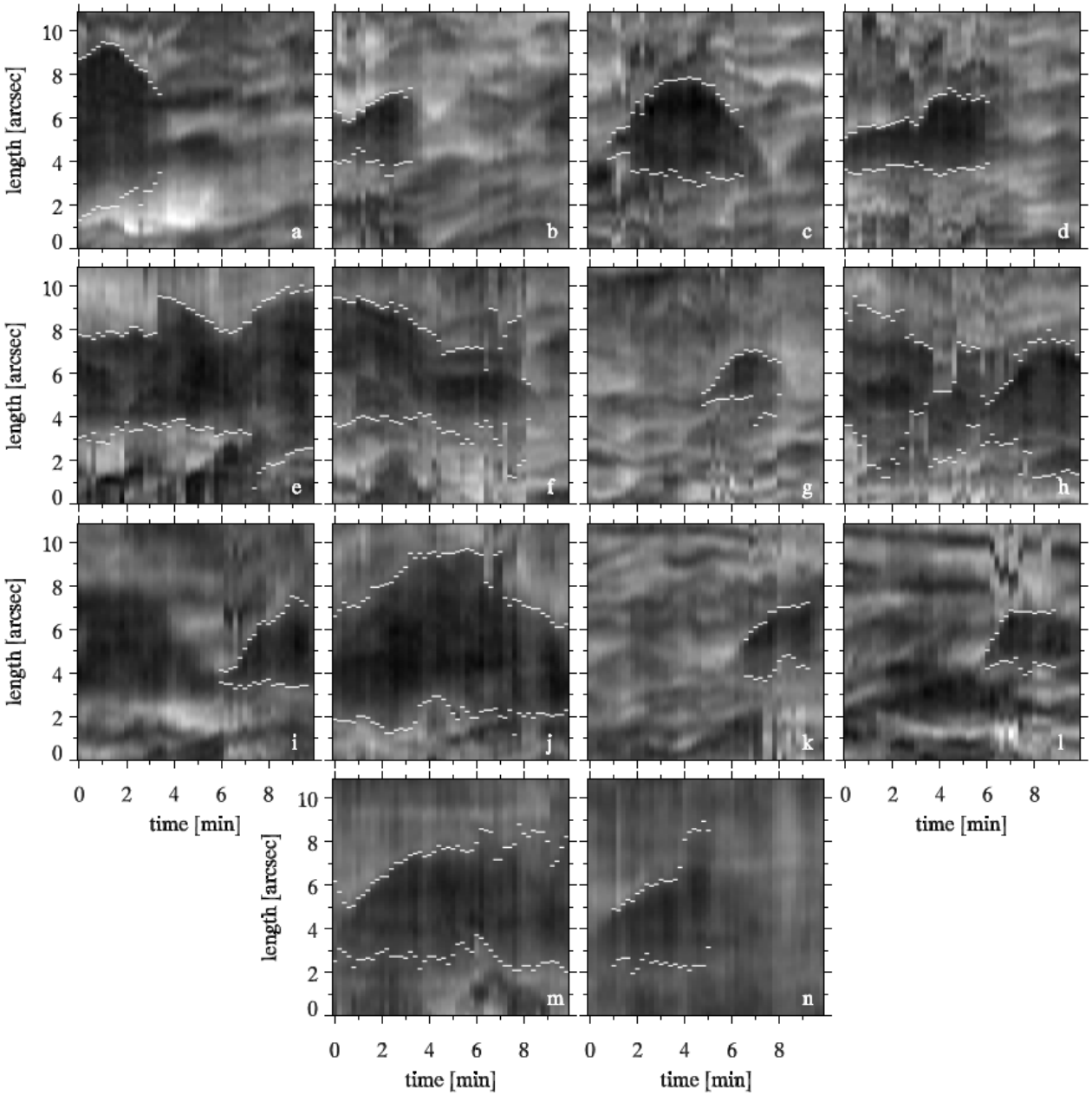
$$y = y_0 + v_{\rm max}t - \frac{a}{2}t^2$$

$$v_{\rm max} = \frac{P}{2}a$$

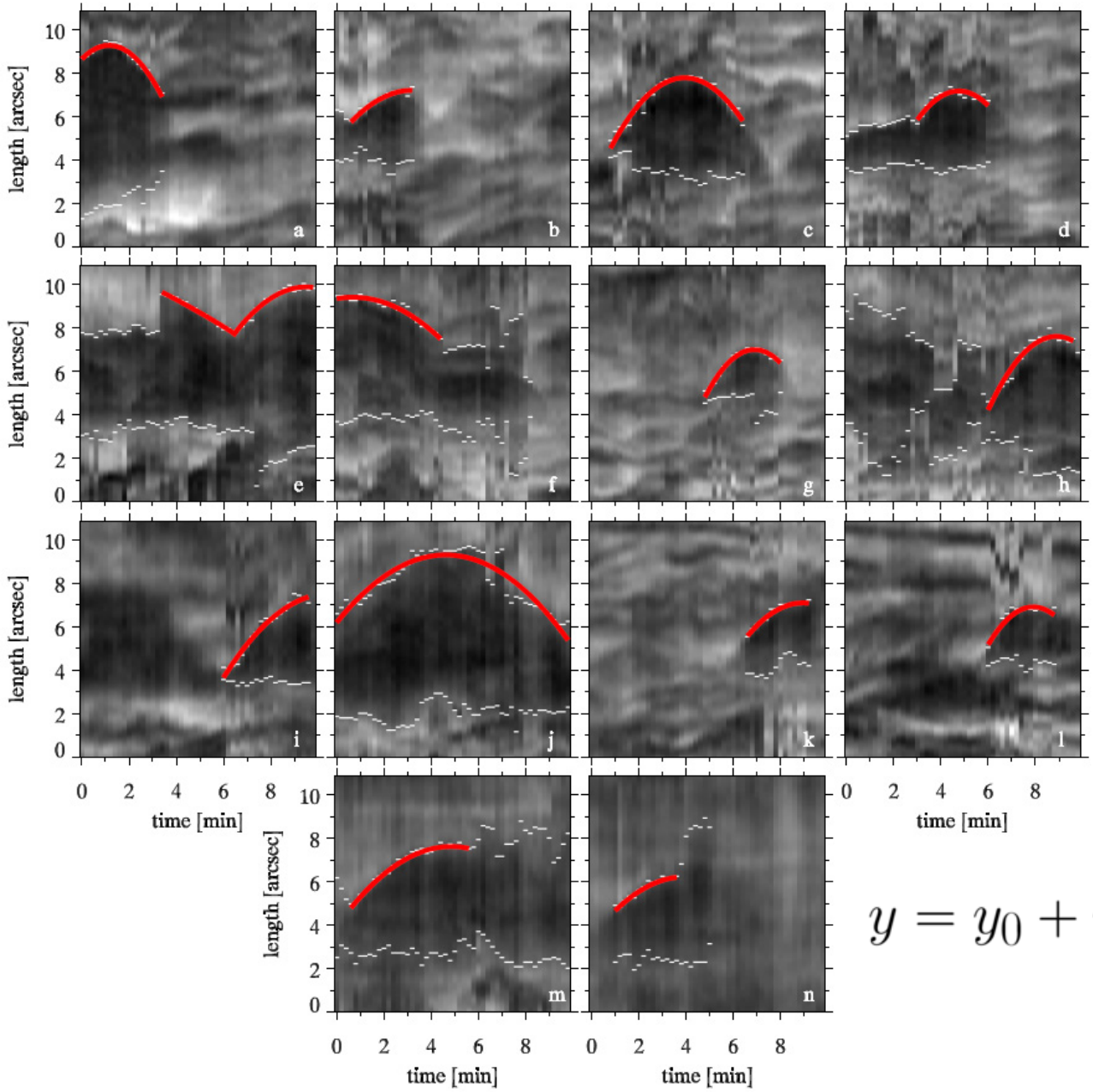
Reduction of the effective gravity $g.\cos\theta$ along inclined magnetic flux tubes:

- ⇨ increasing of the acoustic cutoff period P_{ac} , *i.e.,* lowering of the cutoff frequency
- ⇨ propagation of p-modes into the chromosphere as N-shaped shocks
- ⇨ lift of the chromosphere-transition region interface seen as a fibril

Top trajectories of DOT Hα dynamic fibrils



Parabolic fits of top trajectories

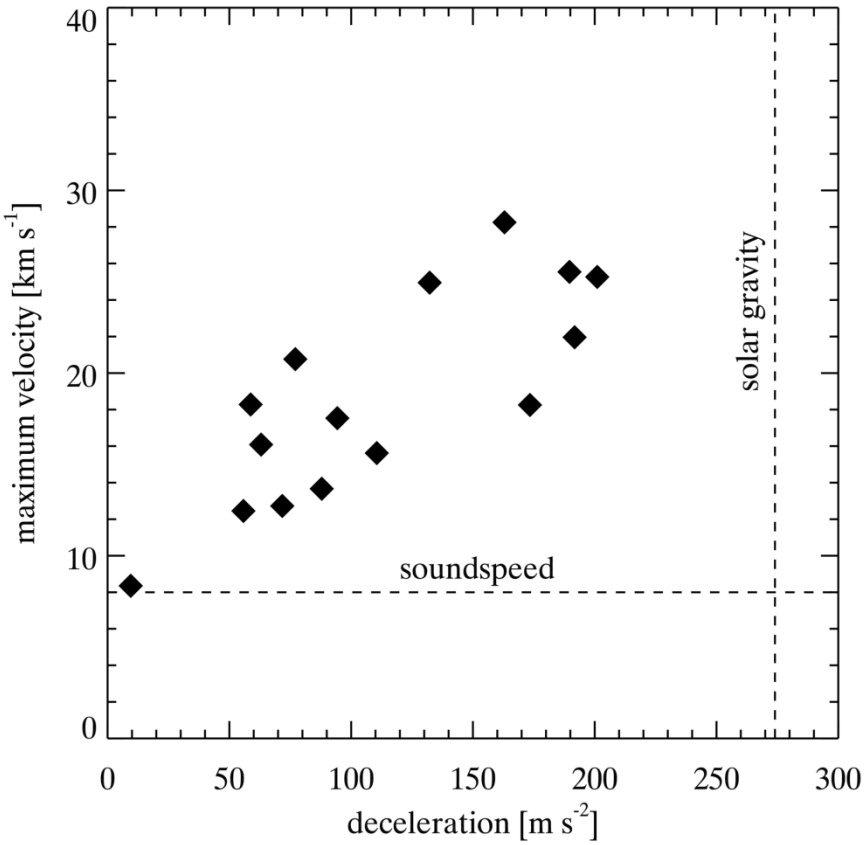


$$y = y_0 + v_{\max} t - \frac{a}{2} t^2$$

Kinematic characteristics

Positive correlation of the maximum velocity and the deceleration

No correction for projection effects.



$$v_{\max} = \frac{P}{2} a$$

The linear relationship is free of projection effects.

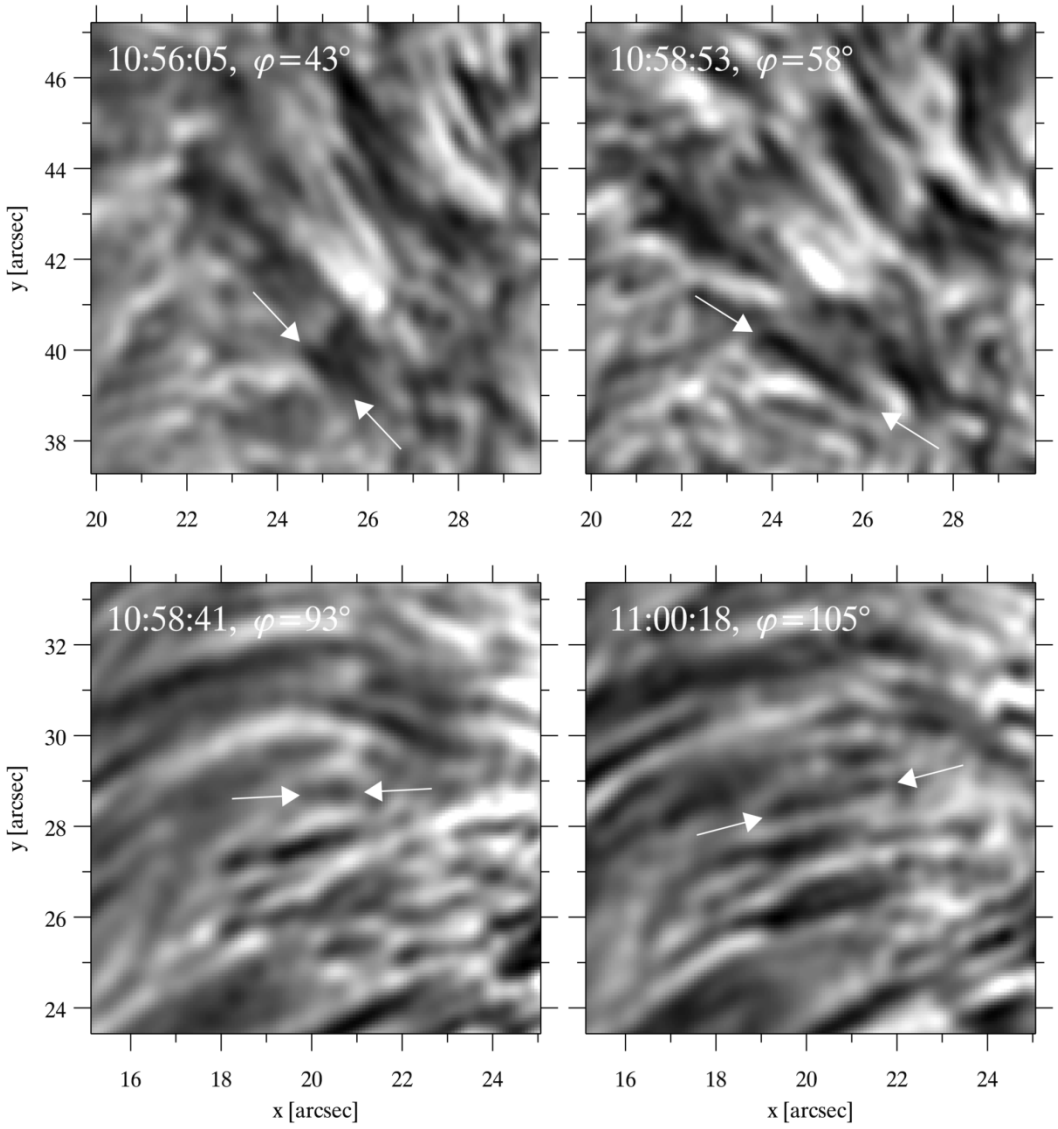
a deceleration

$v_{\max}$ maximum (or onset) velocity

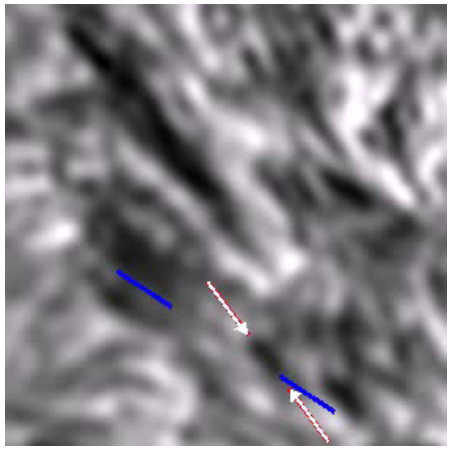
P duration of parabolic motion, i.e., lifetime of dynamic fibril

Dynamic fibrils – supersonic, average max. velocity ≈ 19 km s^{-1}
– sub-ballistic, average deceleration ≈ 110 m s^{-2}

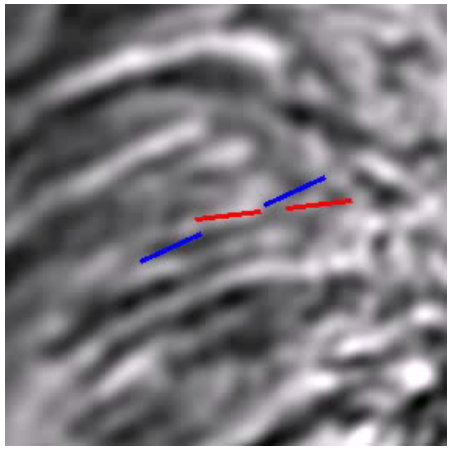
Temporal variations in fibril orientation



Δt = 2,8 min
Δφ = 15°
ω = 5,4°/min

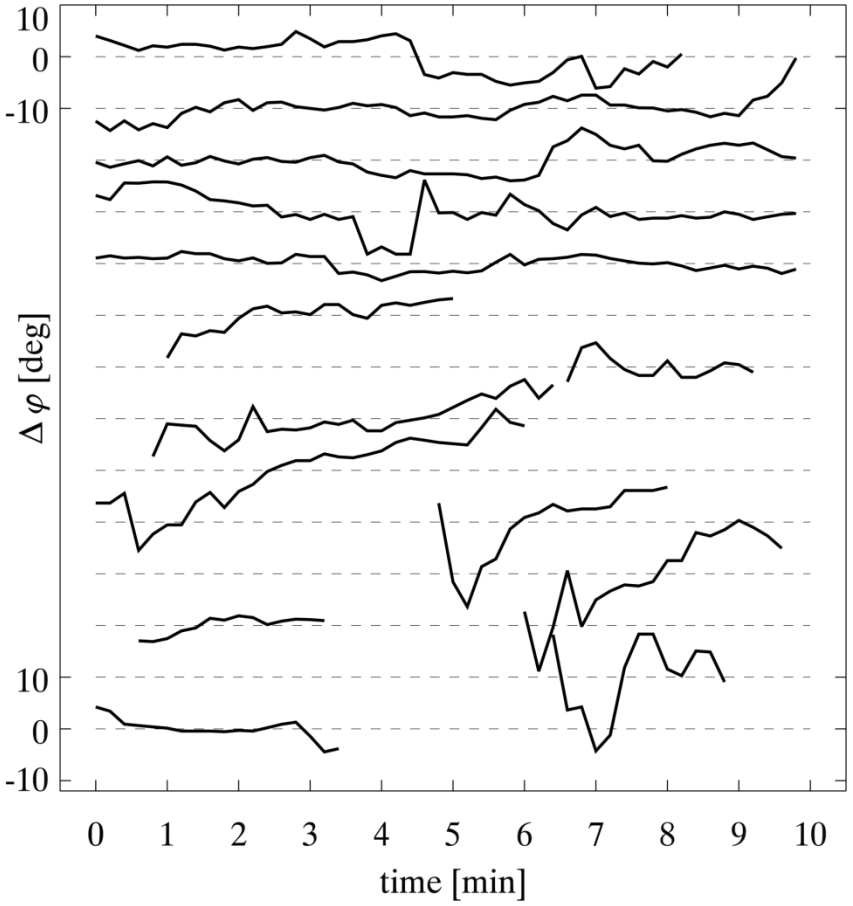


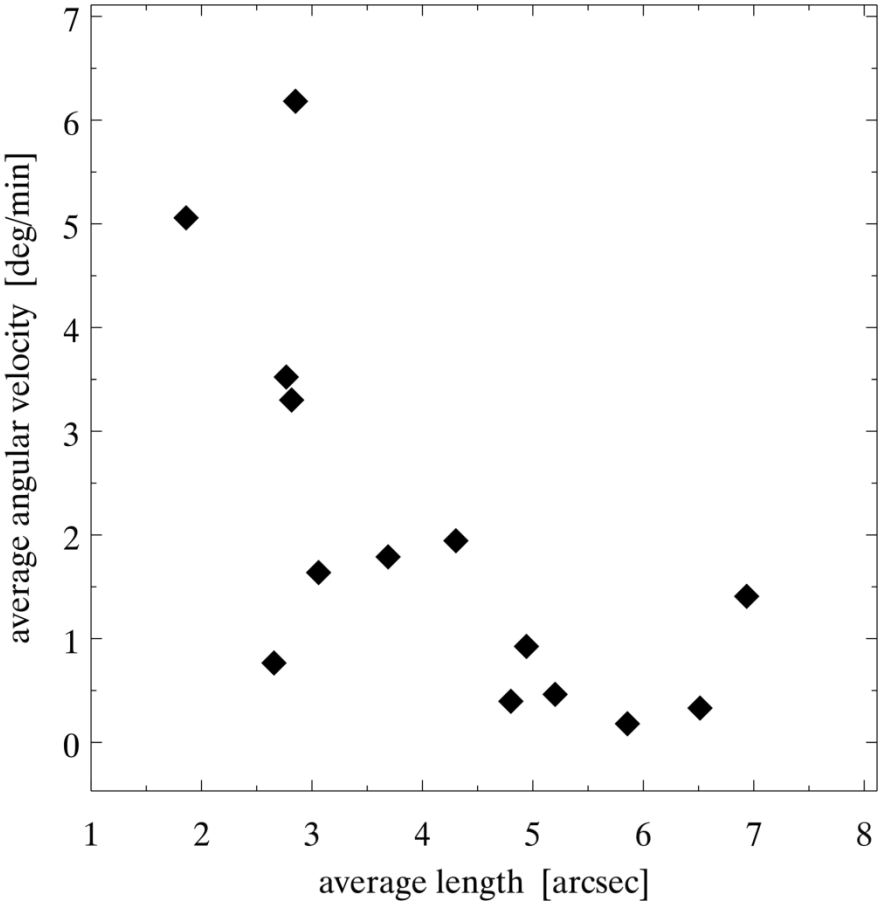
Δt = 1,6 min
Δφ = 12°
ω = 7,5°/min



Koza et al.: 2007, ASP Conf. Ser. 368, p. 115

Temporal variations in fibril orientation





- the variations indicate turning motions with angular speeds of the order of 1°/min
- shorter fibrils tend to turn faster than longer ones

Koza et al.: 2007, ASP Conf. Ser. 368, p. 115

Conclusions

- tops of dynamic fibrils follow parabolic trajectories with:
  - supersonic maximum velocities of ≈ 19 km s^{-1} in average
  - sub-ballistic decelerations of ≈ 110 m s^{-2} in average
- the positive correlation of maximum velocities and decelerations supports the idea of the magnetoacoustic shock excitation
- temporal variations in orientation indicate turning motions with angular speed of the order of 1 deg min^{-1}
- shorter dynamic fibrils tend to turn faster than longer ones

What next

- to identify counterparts of the Hα dynamic fibrils in the Ca II H images
- a need of new fibril measurements both in Hα and Ca II H due to different data formats