

On-disk Coronal Rain and Dynamical H α Fibrils

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Introduction

◆ Paper review

On-disk Coronal Rain

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■ New Observation

July. 5, 2012; AR11515; M1.6 Flare

NST H α – 0.7 Å & TiO

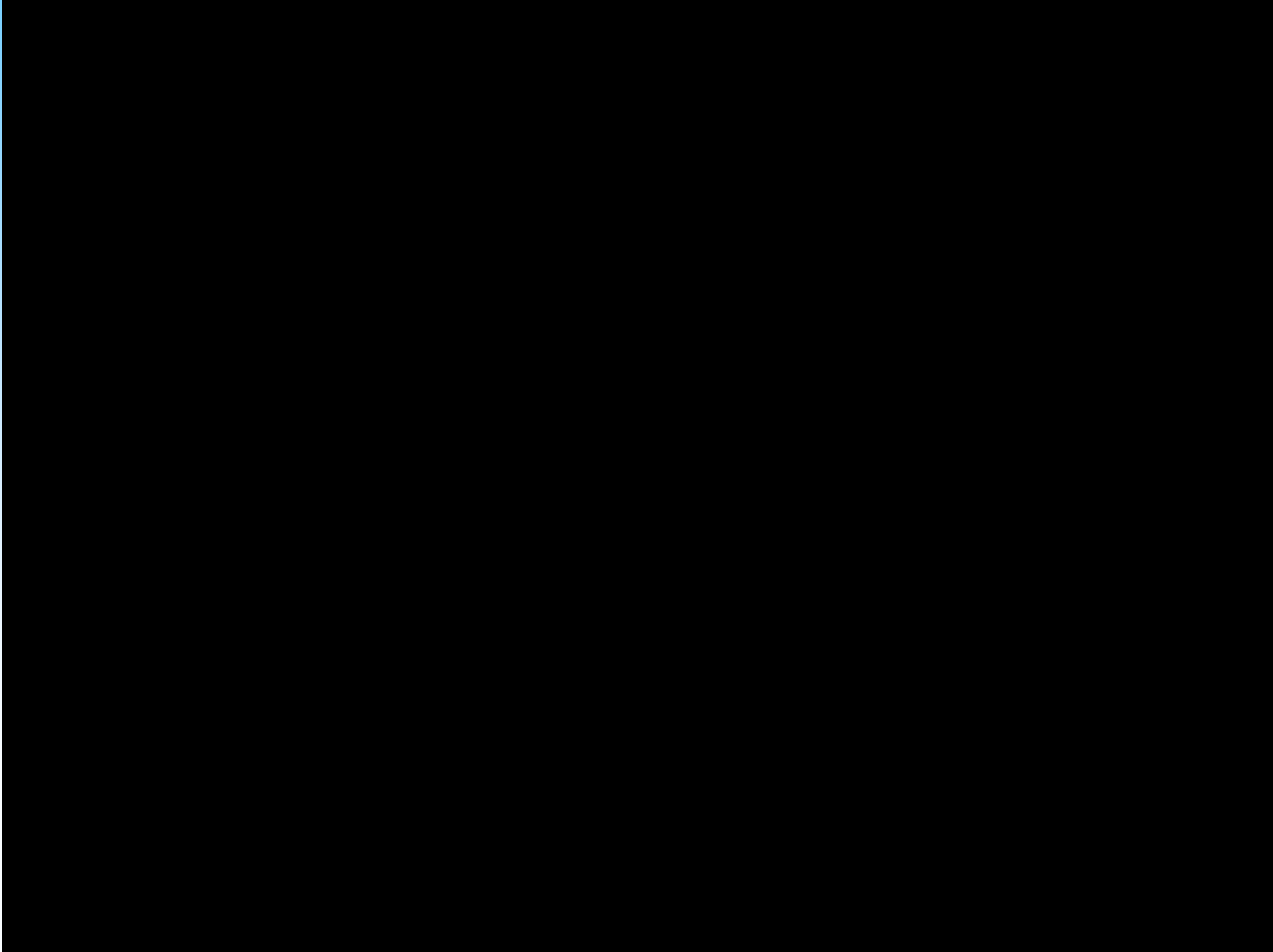
SDO / AIA & HMI

Coronal Rain

- Phenomenon of active region corona
- Consist of cool and dense matter
- Falling from coronal heights down to the lower solar atmosphere along loop-like paths
- Typically observed **off-limb**,
 - In Chromospheric lines, such as H α or Ca II
 - Also in EUV spectral lines (absorption)

Movie from 2nd citation

Coronal Rain



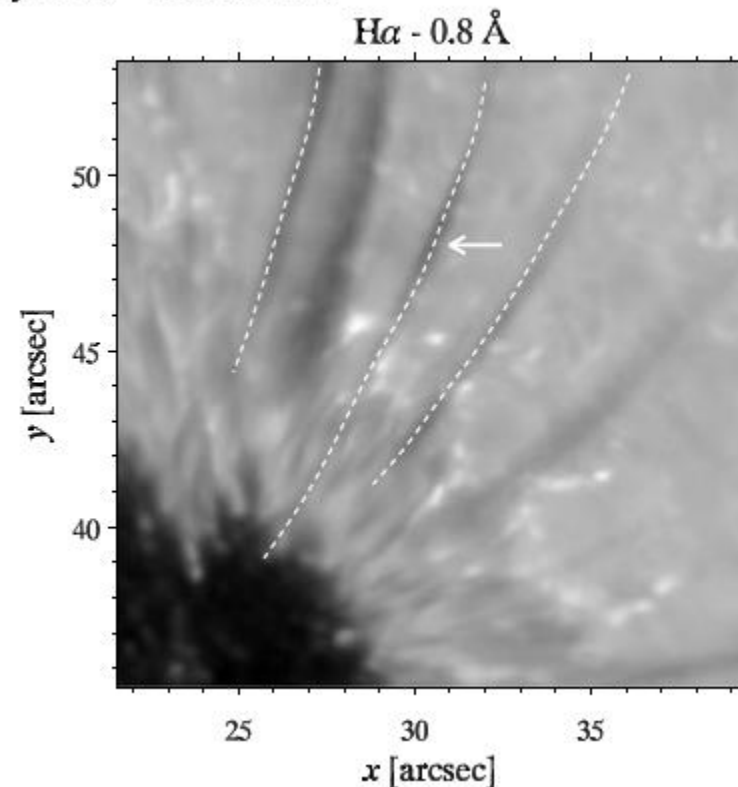
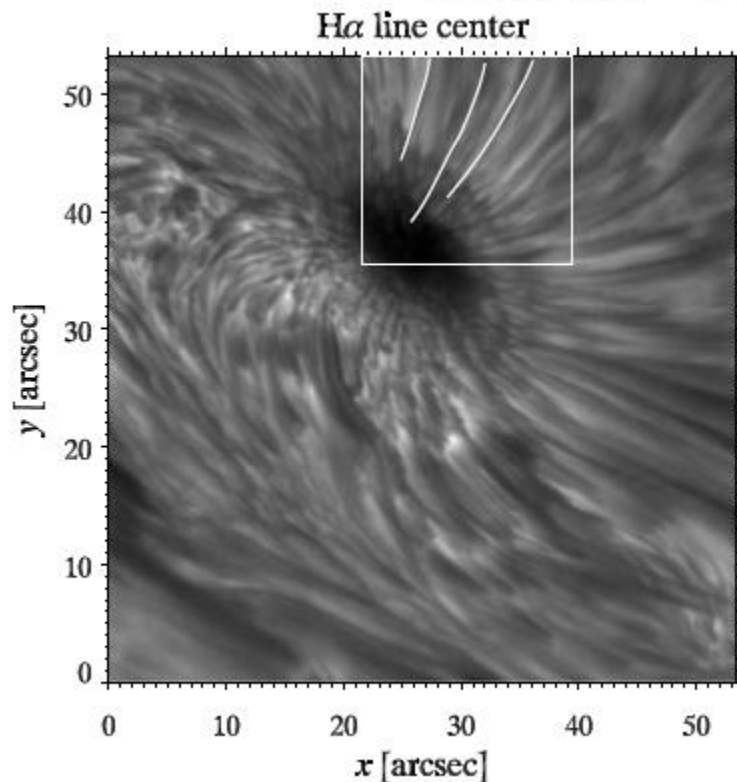
Coronal Rain

- Myriad of small blobs, as large clump --- “showers”,
Size (average) of 700 x 300 km (L x W)
- Broad distribution of falling speeds,
average values around 60~70 km s⁻¹, up to 120 km s⁻¹
- Downward accelerations less than gravity
- Mechanism: thermal instability

On-disk Coronal Rain

CRisp Imaging SpectroPolarimeter (CRISP) at the Swedish 1-m Solar Telescope (SST)

(e) SST/CRISP 6 July 2010 08:58:28 UT

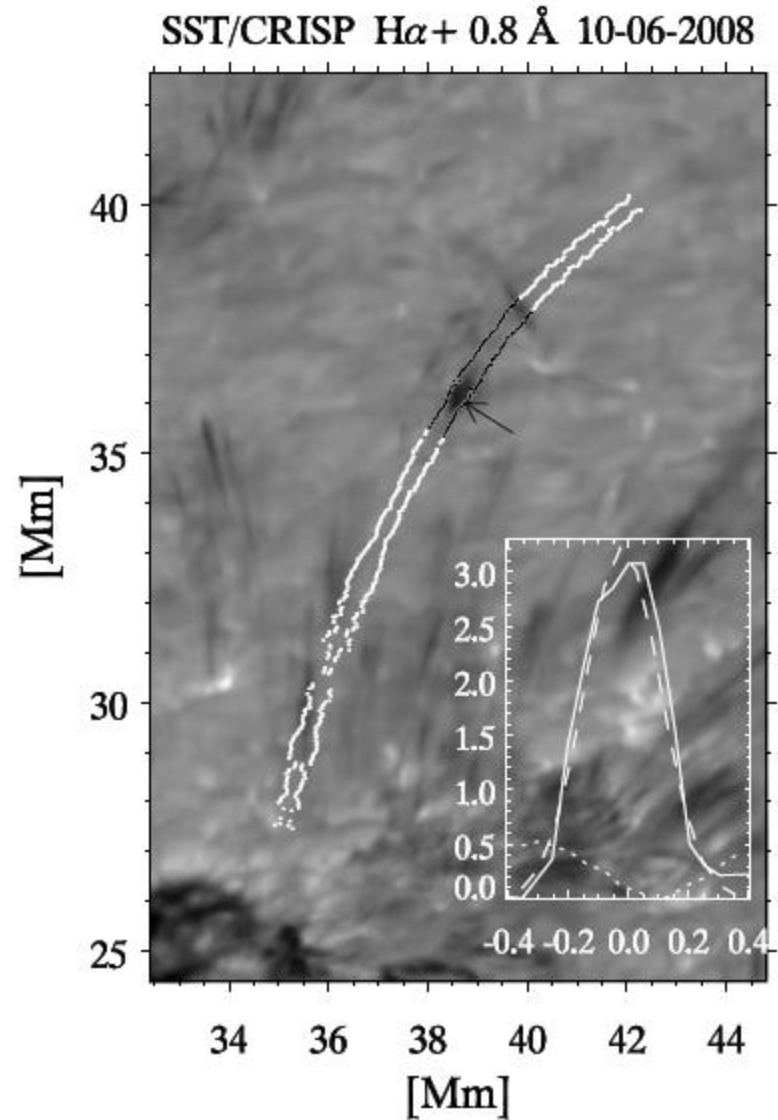
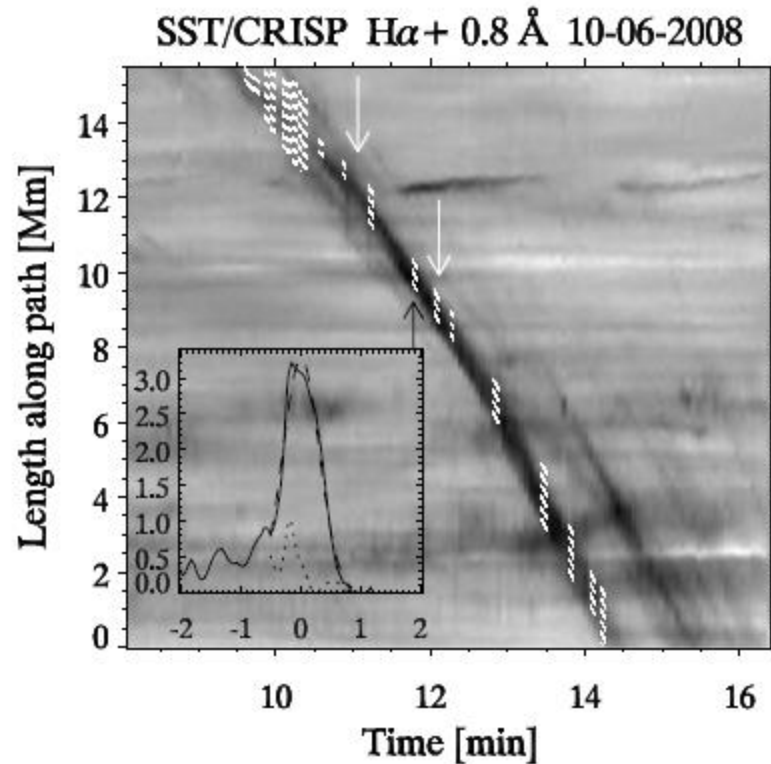


On-disk Coronal Rain

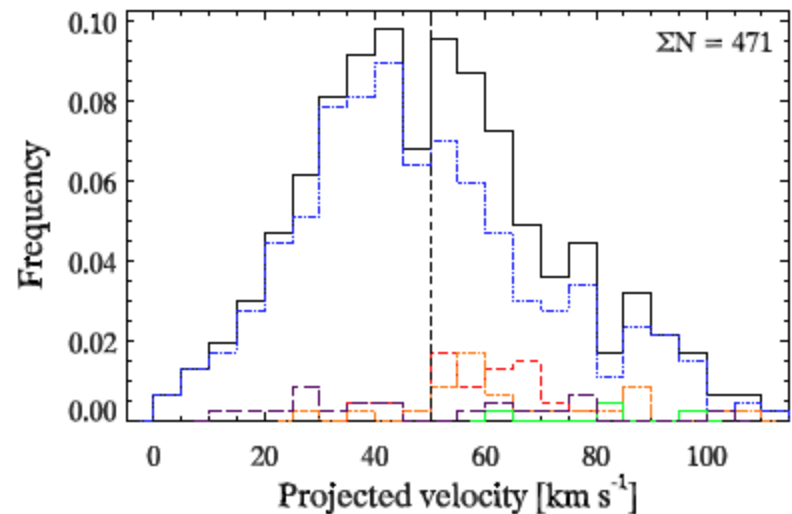
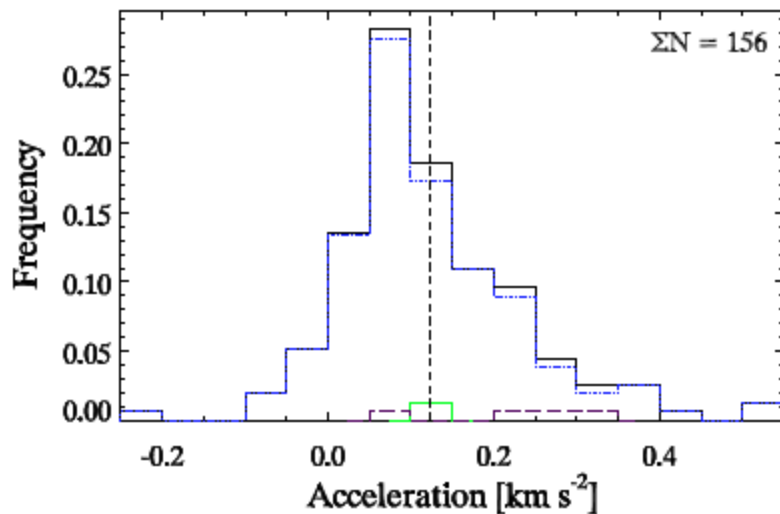
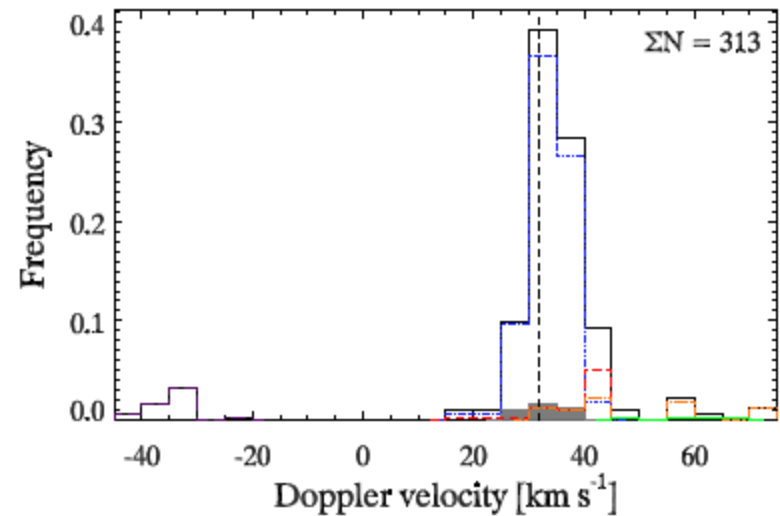
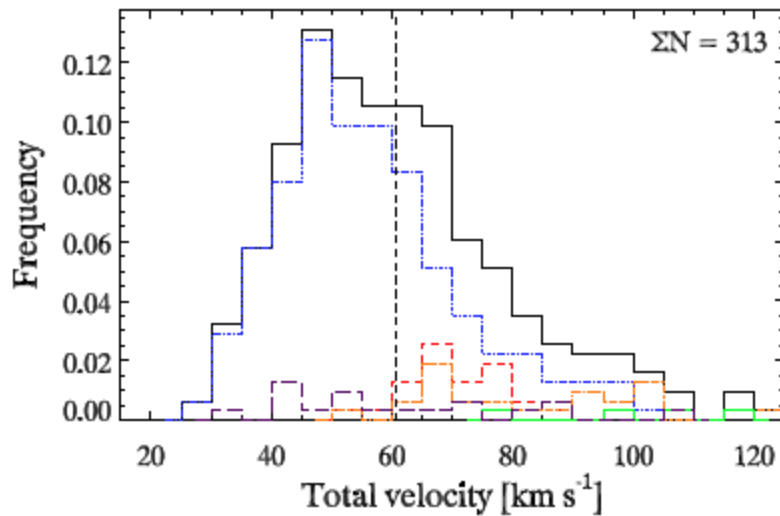
Data set	Target	Date	Location (μ)	λ [\AA]	$\Delta\lambda$ [m\AA]	Δt [s]	Duration [min]
1	AR 10998	10 June 2008	0.43	-0.4 ~ 0.5	100	4.2	34
2	AR 10998	11 June 2008	0.67	-1.1 ~ 1.1	100	6.2	37
3	AR 11084	27 June 2010	0.25	-1.7 ~ 1.7	85	17.1	27
4	AR 11084	28 June 2010	0.64	-1.9 ~ 1.9	85	22.4	52
5	AR 11084	06 July 2010	0.61	-1.9 ~ 1.9	85	22.4	68

On-disk Coronal Rain

- Dynamics
- Size

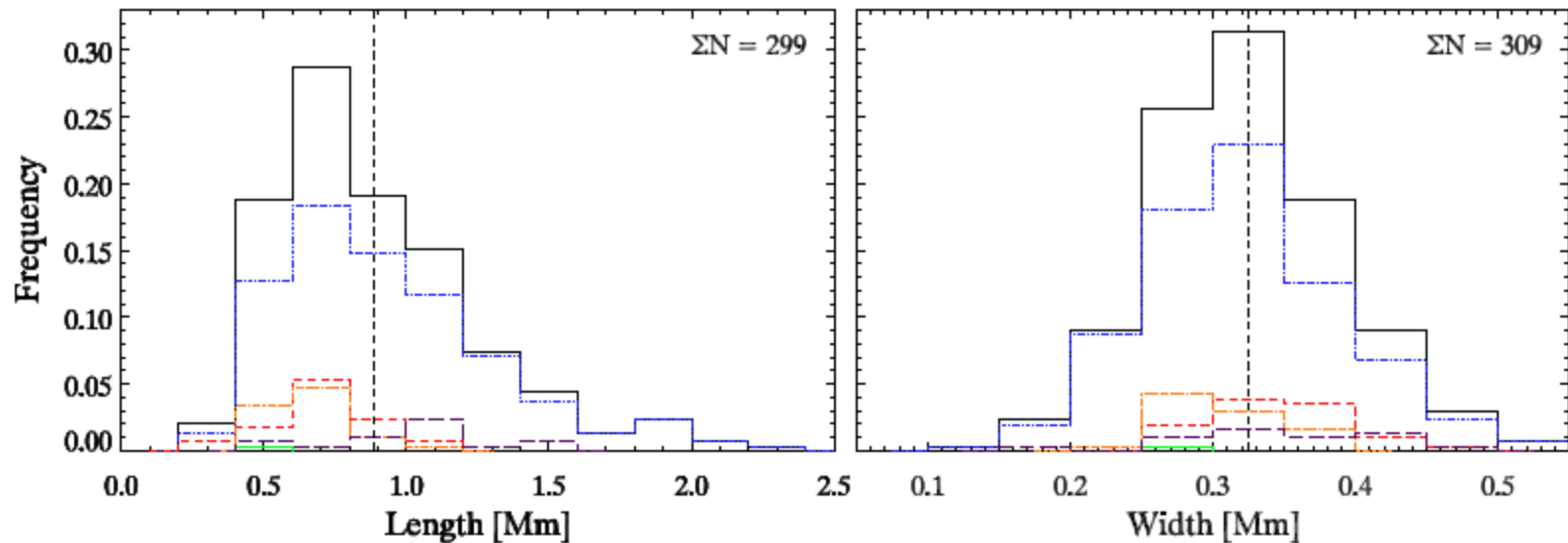


On-disk Coronal Rain



On-disk Coronal Rain

Size: small difference between 5 data sets



On-disk Coronal Rain

- Compare to the off-limb case
(average value, same author & instrument)
- Also similar with other off-limb reports

Case	Total blob Number	Total velocities [km s ⁻¹]	Accelerations [km s ⁻²]	Lengths [Mm]	Widths [Mm]	Temperatures [10 ³ K]
Off-limb	2552	67.1	0.0835	0.74	0.31	9.6
On-disk	309	60.7	0.1224	0.88	0.32	7.8

On-disk Coronal Rain

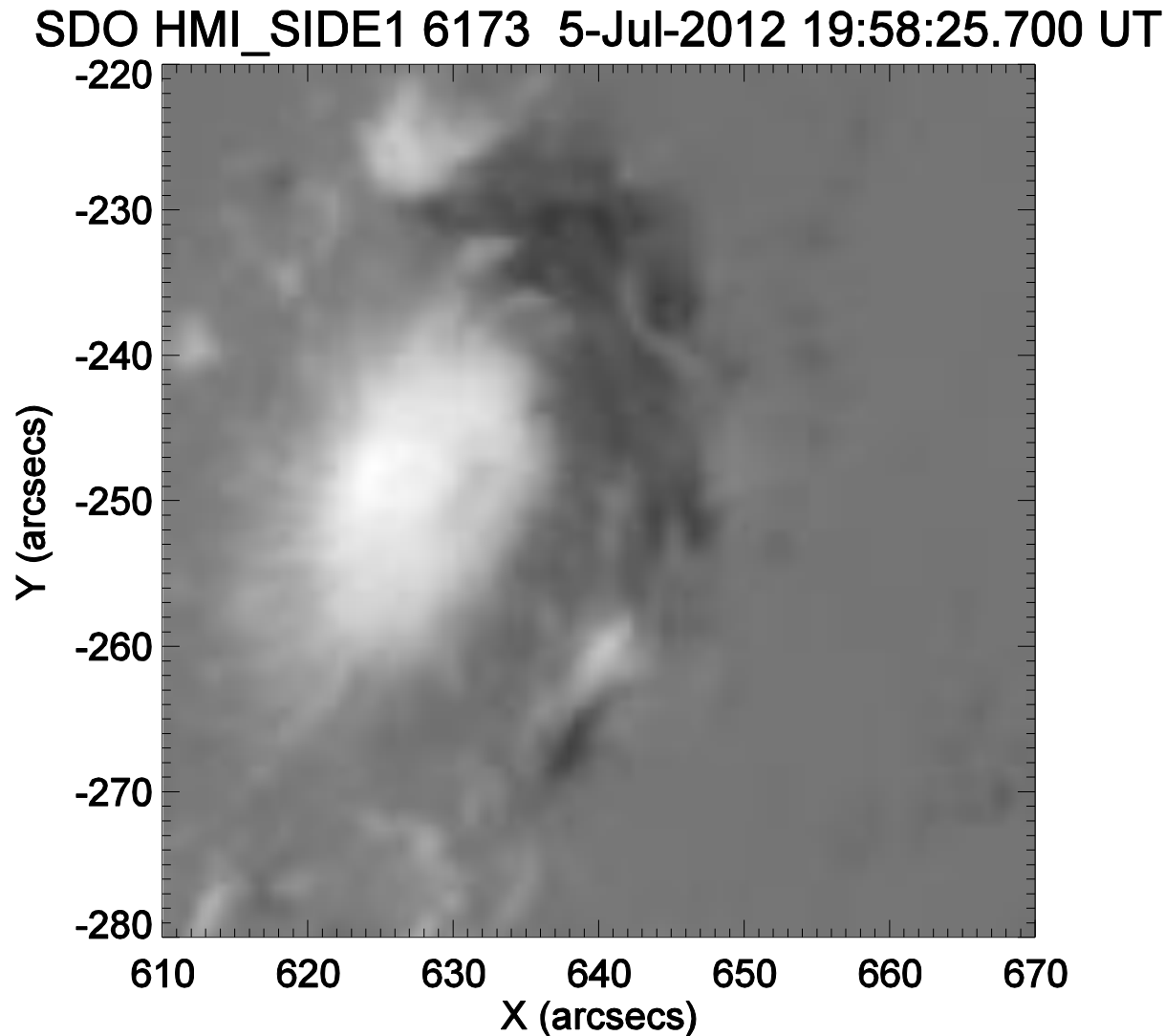
- On-disk counterpart
off-limb coronal rain also has spread distribution
- Signature
fast-falling cool and dense blob
- Link to Coronal observation
sudden appearance in the corona and subsequent fall
along loop-like structures
- Sample size
difficulty of detection

Dynamical H α Fibrils

July. 5, 2012

AR 11515

Several
M-class flares



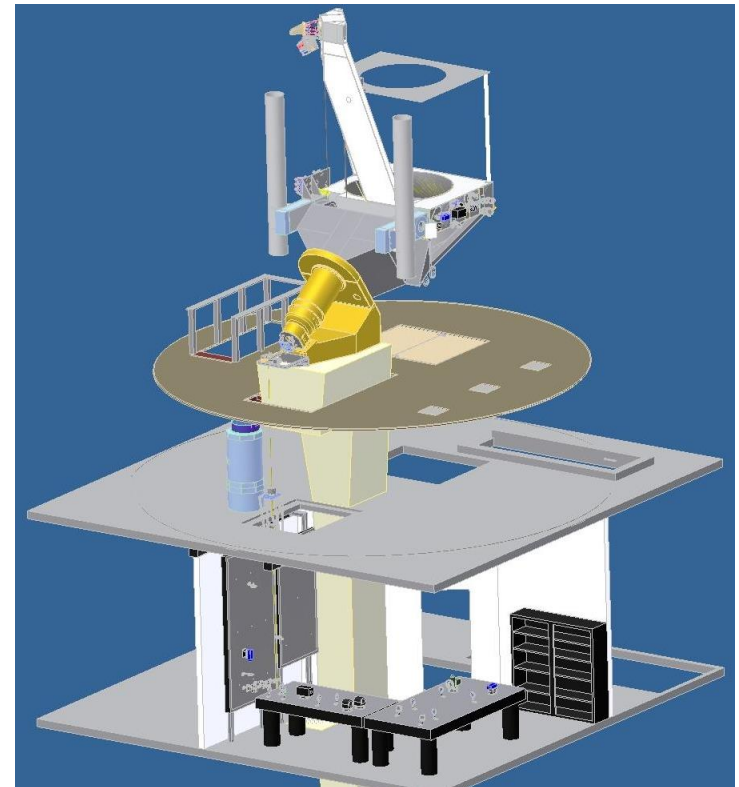
Dynamical H α Fibrils

➤ NST / VIS

- H α blue-wing & line-core
- Cadence: 6~7 sec
- Image scale $\sim 0.05''$ / pixel
- FOV: $\sim 60'' \times 60''$ (movie)

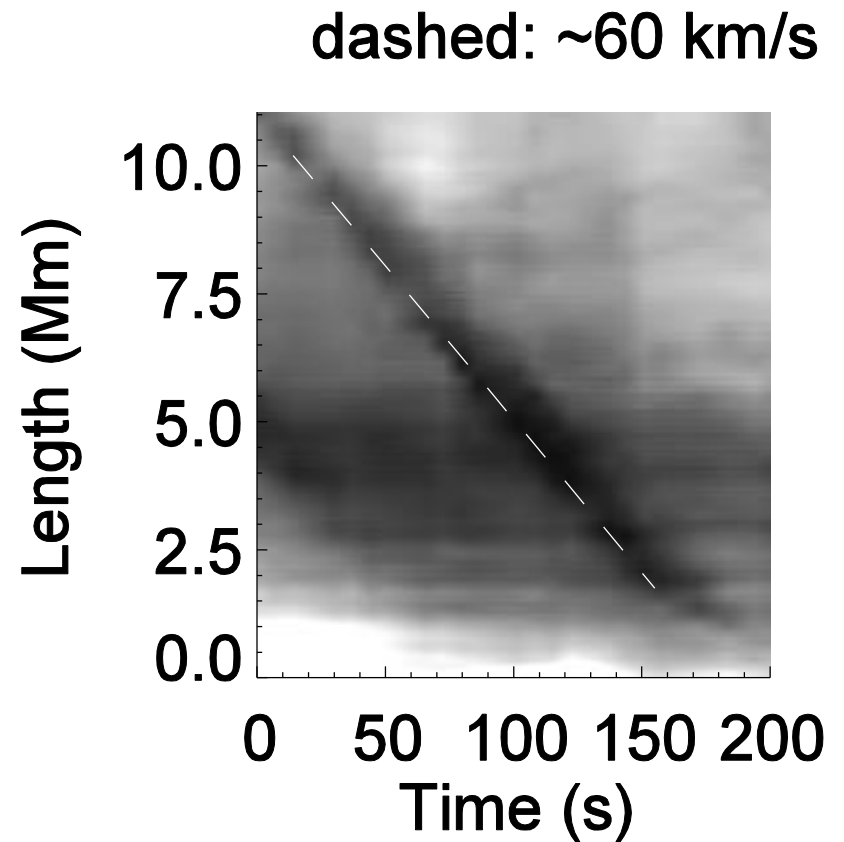
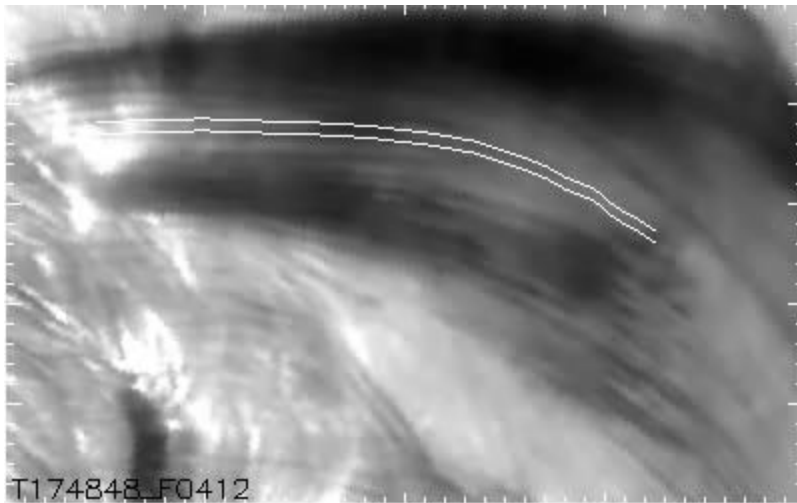
➤ NST / BFIs

- TiO (705.7 nm)
- Cadence: 15 sec
- Image scale $\sim 0.034''$ / pixel
- FOV: $\sim 70'' \times 70''$



Dynamical H α Fibrils

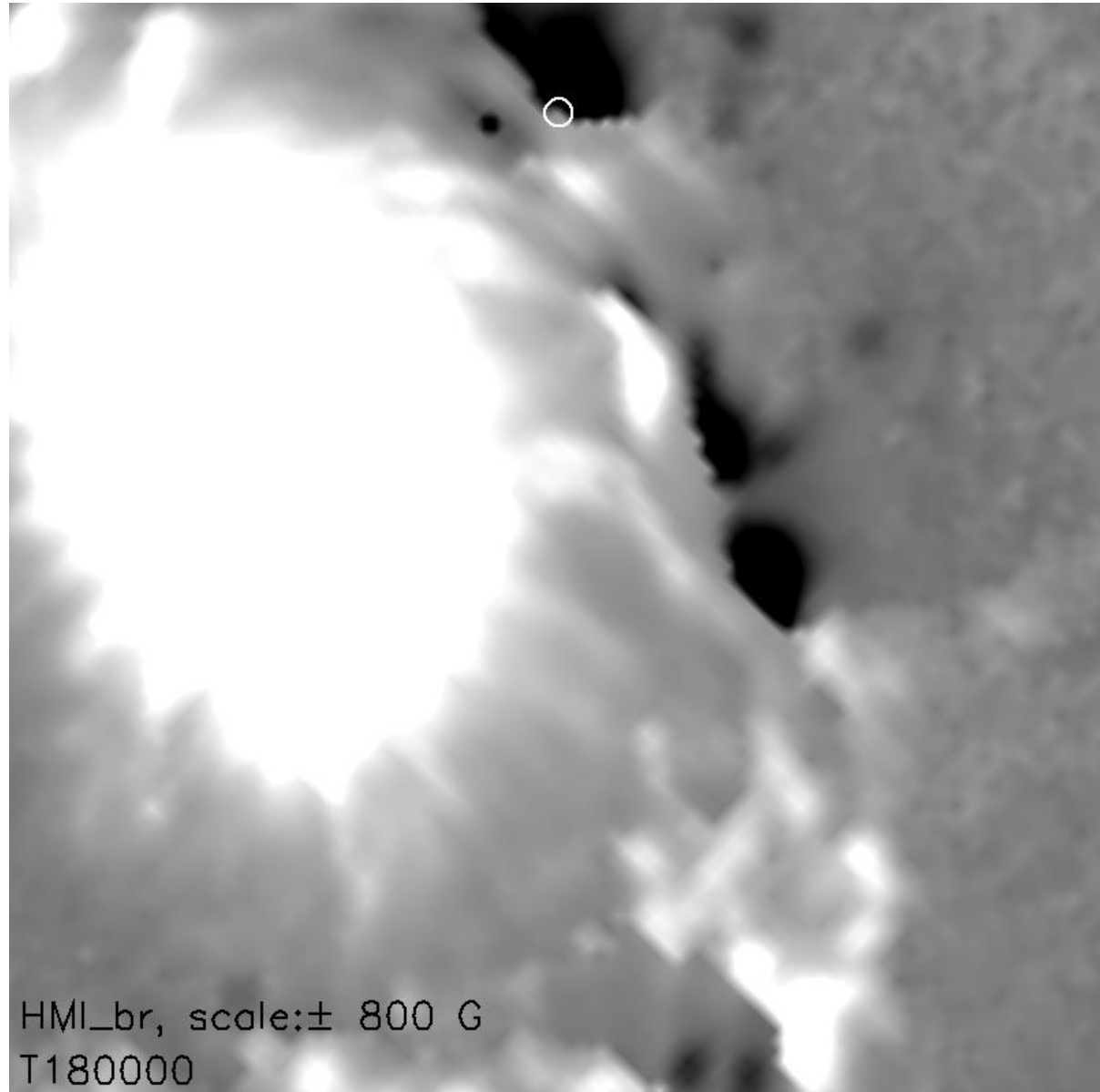
- Track projected velocity



Dynamical H α Fibrils

Co-align
with HMI

Compare to
the radial
magnetic
field (Br)



Dynamical H α Fibrils

Discussion?

- H α Fibrils trace chromospheric magnetic field lines
- Upflow or downflow
- The footpoint of fibrils
- Energy & mass transporting before flare

Thank you!

Reference:

Antolin, P., Vissers, G. & Voort, L. van der. 2012, Sol. Phys., 280, 457

Antolin, P., Rouppe van der Voort, L.: 2012, ApJ. 745, 152.