Three-dimensional Propagation of the Global Extreme-ultraviolet Wave Associated with a Solar Eruption on 2021 October 28

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CONTENTS

1. Background
2. Observations
3. Results
4. Summary
Background

- **The EUV waves** appear as propagating bright or dark fronts in coronal EUV images.
- Moreton-Ramsey Waves
- Propagating velocity: 200-700 km s$^{-1}$
- Deceleration: several hundred m s$^{-2}$
- Interaction with coronal structures
- Fast-mode MHD waves

Shen et al. 2012, ApJL
Background

- Dome-shaped structure

![Image of dome-shaped structure](image)

193 Å 06:26:10–06:25:55

Li et al 2012, ApJ

Veronig et al 2010, ApJL

- The wavefront propagates forwardly inclined toward the surface of the Sun

![Graph showing wavefront forward inclination](graph)

Wavefront forward inclination (degree)

Liu et al 2012, ApJ
Stereoscopic observations

- AIA/SDO: 171, 193 Å
- X-EUVI/FY-3E: 195 Å
- X-EUVI/STEREO: 304, 195 Å
- GONG: Hα
- Target: AR 12887
- Date: 2021-10-28
Results: overview of the EUV Wave

- The morphological evolution of the global wave
- Related to an X1.0 flare and a Halo CME
Results: propagation of the EUV Wave

- The propagation of the EUV Wave in AIA 193 Å, 171 Å, 304 Å and GONG H\(\alpha\)
- 150 Mm away from the eruption center
- The wavefront is bright in 193/195 Å and dark in 171 Å

Time-distance diagram of Cut 2
Results: propagation of the EUV Wave

In 193/195 Å and 171 Å

- Averaged propagating velocity: 420 – 510 km s\(^{-1}\)
- Deceleration: 110 – 320 m s\(^{-2}\)
- The initial propagating velocity: 600 – 720 km s\(^{-1}\)

In 304 Å and H\(\alpha\)

- Averaged propagating velocity: 310 – 540 km s\(^{-1}\)
Results: propagation of the EUV Wave

- The propagating tracks in 193 Å significantly precede those in the other passbands with lower temperatures such as 304 Å and Hα.

- The averaged difference in the 193 Å and 304 Å passbands is 50.5 Mm.
Results: propagation of the EUV Wave

- `scc_measure.pro`
- Height: 3-4 Mm in 304 Å and 40-90 Mm in 195 Å
- The averaged height difference between the 195 Å and 304 Å passbands is 67.4 Mm

- The wavefront propagated forwardly inclined to the solar surface with an averaged tilt angle of \( \arctan\left(\frac{67.4}{50.5}\right) = 53.2° \) in the time period of 15:32 – 15:38 UT
Results: heating of the Coronal Plasma

- **Heating**: Intensities in 193/211/335/94 Å and DEM (log(T/K)~6.2) all increase, while the 171 Å and DEM (log(T/K)~5.9) intensity decreases.

- **Cooling**: The 193/211/335/94 Å and DEM (log(T/K)~6.2) intensities begin to decrease and the 171 Å and DEM (log(T/K)~5.9) intensity increases.
CONTENTS

1. Background
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3. Results
4. Summary
Summary

• The EUV wave is associated with an X1.0 flare and a halo CME, and appears in the Hα and EUV passbands with different characteristic temperatures (e.g., 304 Å, 171 Å, and 193/195 Å).

• The EUV wave becomes evident at a distance of ~150 Mm away from the eruption center and propagates circularly outward with an initial velocity of 600–720 km s\(^{-1}\) and a significant deceleration of 110–320 m s\(^{-2}\).

• During the propagation of the EUV wave, the wave front propagates forwardly inclined to the solar surface with a tilt angle of ~53.2\(^\circ\). A dome-shaped structure.

• The plasma in the low corona is heated from log(T/K) ≈ 5.9 to log (T/K) ≈ 6.2 on the propagation path of the wave front.

• A fast-mode MHD wave or shock driven by the expansion of its associated CME.
THANKS