

## Description

Mauna Loa Solar Observatory (MLSO) is a ground-based solar observatory located in Hawaii. Automated code measures CME speed, generates coronagraph imagery, and sends out alerts of CME lift-off with advanced warning time compared to current space-based coronagraph imagers.

## Inputs

**Coronagraph Imagery:** From the MLSO K-Cor telescope at a 15 second cadence and 1.05 to 3 solar radii field-of-view.

## Outputs

**K-Cor CME Alert:** Automated alert containing all-clear boolean, CME first-detected time, position angle, speed, and time at height

**K-Cor CME Observer Alert:** Human-initiated alert containing a comment about the CME in addition to the all-clear boolean, CME start time, position angle, and time at height

**Heartbeat:** JSON file every 5 minutes containing an all-clear boolean

**Summary:** Automated alert at the time the CME is considered to be over containing all-clear boolean, CME start time, position angle, speed, and time at height. Also includes confidence levels and an estimate of CME width.

**Cancellation Alert:** Alert indicating an observer has retracted an automated alert considered to be a false alarm

**NGRF Images/Movies:** Coronagraph images with a normalized radially-graded filter (NGRF)

**Difference Images/Movies:** Coronagraph images with 5-minute differencing. Current images are averaged over the previous 33 seconds (about 3 images) and subtracted from the same image similarly processed 5 minutes earlier

## Alert Lag Time

**Level-0 Image Processing Time:** Under 15 seconds

**Level-2 Image Processing Time:** 1-2 minutes

**CME Detection:** TBD minutes

**Alert Email:** About 2 minutes for the K-Cor CME Alert or about 48 minutes for the K-Cor CME Observer Alert

## Interpretation and Caveats

**Volcano:** MLSO alerts currently not on Scoreboards due to Mauna Loa eruption

**Observing Window:** From about 1700-0300 UTC. Including issues due to weather, the average observing window is about 5 hours.

**Detection, not Characterization:** The automated code is meant to detect CMEs and not characterize them, so it is not able to identify specific features or measure properties such as CME width.

**Brighter Core:** The automated code detects the CME leading edge, but if the core is brighter, the core will be tracked instead. These speeds often differ, though not dramatically.

**CME Over:** A CME is considered to be over when the no longer detected in the K-COR FOV and includes a 1 hour wait period, or if there is no CME motion detected for  $\geq 20$  minutes.

**FOV:** Although the K-Cor telescope has a FOV down to about 1.05 solar radii, images are clipped to about 1.15 solar radii to reduce noise.

**False Alarms:** Most false alarms are due to sky noise, dust, poor pointing, instrument noise. With clear conditions, false alarms are then mainly due to material rising in the low corona that stopped or faded from view below 2 solar radii.

**MLSO Operators:** The main role MLSO operators is to maintain the facility. Detecting CMEs is a secondary role, which may delay the K-Cor CME Observer Alerts.

## Validation

	FOH	FAR	AWT* (min)
Automated	0.72	0.25	44.3
Human	0.81	0.14	3.8
All	0.77	0.19	23.4

\* Compared to SOHO/LASCO.

## Additional Links

[iSWA Data Tree](#)

[MLSO Homepage](#)

[CCMC MLSO Description](#)