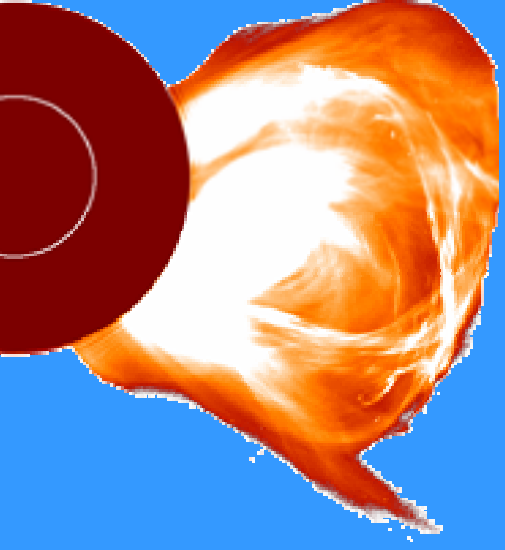

Automated detection of CMEs

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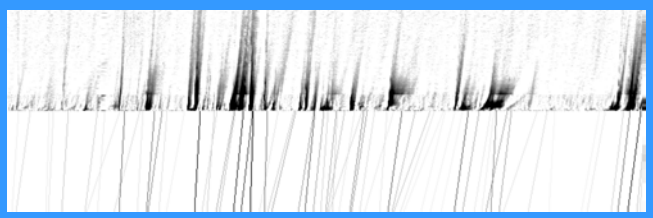
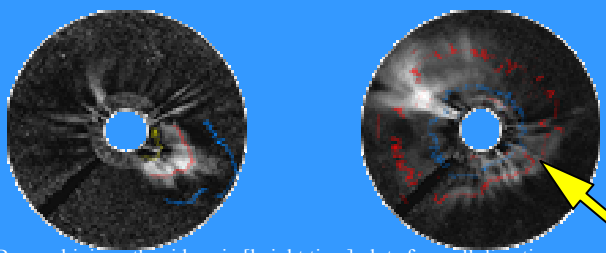
We have developed software that autonomously detects CMEs in image sequences from LASCO. The output of our software is a list of events, similar to the classic catalogs, with principle angle, angular width and velocity estimation for each CME. In contrast to catalogs assembled by human operators, these CME detections by software can be faster, which is especially important in the context of space weather, and possibly also more objective, as the detection criterion is written explicitly in a program. About 75 % of the catalog CMEs are recovered by the software. Since our software also found CMEs that were unreported in the catalogs, we prove that also these catalogs do not have a 100 % success rate.

THE METHOD

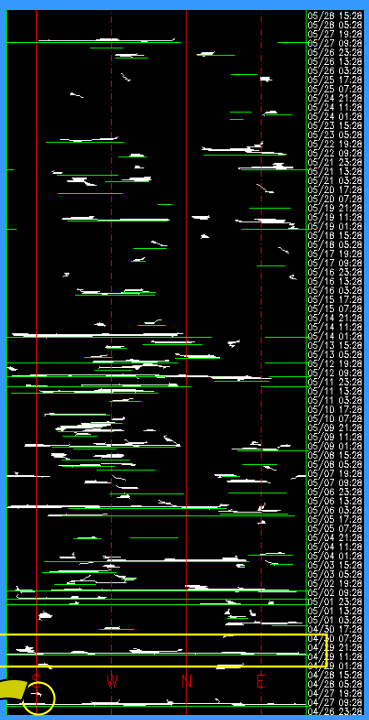


CMEs can be seen in [height, time] plots (top) as inclined ridges with the inclination angle corresponding to the propagation speed. Time runs horizontally over May, 1998, the vertically height covers the combined C2/C3 FOV. The ridges are detected with the Hough transform (bottom).



By combining the ridges in [height,time] plots from all directions, one can reconstruct the CME front as it propagates outwards. The red lines in the above images track the front of a fast halo CME (left) and a slow, regular CME (right). The blue and yellow lines correspond to the position of the front at earlier and later times, giving an indication of the time evolution.

VALIDATING THE PERFORMANCE



In this combined map we show the 95 events found by the software (white) as compared to the 71 CMEs reported in the catalogs (green). Time is running vertically over May, 1998. The horizontal dimension is the poloidal angle around the sun, the left side corresponding to the C3 occulter.

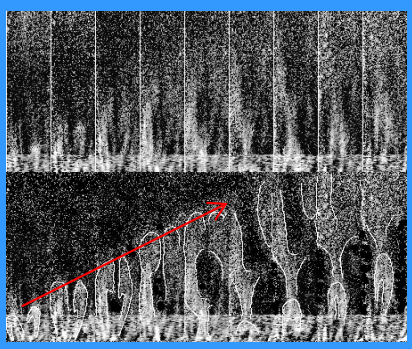
The software reproduces 27 % of the catalog CMEs with nearly identical time of appearance and angular location. Allowing for some tolerance on the time of appearance and on the angular span, the number of reproduced CMEs increases to 75 %.

For space weather applications it is important to note that out of the 4 catalog halo CMEs, 2 are indeed reproduced as halo CMEs. The remaining 2 are missed because of a data gap.

MAIN CONCLUSIONS

1. **Automatic CME detection is possible.**
2. **We recover about 75 % of the catalog CMEs. Improvements are under development.**
3. **We detect weak, unreported CMEs which were missing in the catalogs.**

UNREPORTED CMES



The software discovers 14 CMEs more than in the catalogs. Most of these are false alerts or undesired 'splitting' of events.

Yet, at least some are real. On the left we show an 'unreported' CME taking off at April, 27 1998, 19h28 UT, with a speed of about 200 km/s

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