

COST
Short Term Scientific Missions
Report – 15 December 2013

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Period: 13 – 26 October 2012

STSM Title: Polarimetry of the solar corona with the Turin-filter at Lomnický Observatory

Scientific Report

Background and Objectives of the STSM

The overarching goal of this STSM was to assess the possibility of integrating the liquid crystal Lyot filter developed by the INAF - Turin Astrophysical Observatory, Italy, to the ZEISS coronagraph of the Lomnický Peak Observatory, Astronomical Institute of the Slovak Academy of Sciences (AISAS), in Tatranská Lomnica, Slovakia. A positive result of this integration test would make possible to implement a long-term observation plan (1 year at least), to carry out spectro-polarimetric observations of the coronal “green-line” emission (FeXVI, 530.3 nm). The science goal of these observations is to study the coronal magnetic fields that drive the dynamics of the solar wind.

The Turin coronal magnetograph (CorMag) is a four-stage Lyot filter with an electro-optically tunable bandpass. The full width at half maximum of the filter is 0.15 nm. The center wavelength of the bandpass is tuned by using nematic liquid crystal variable retarders (LCVR's). A separate LCVR, in tandem with the filter, is used for the polarimetric measurements (Fig. 1).

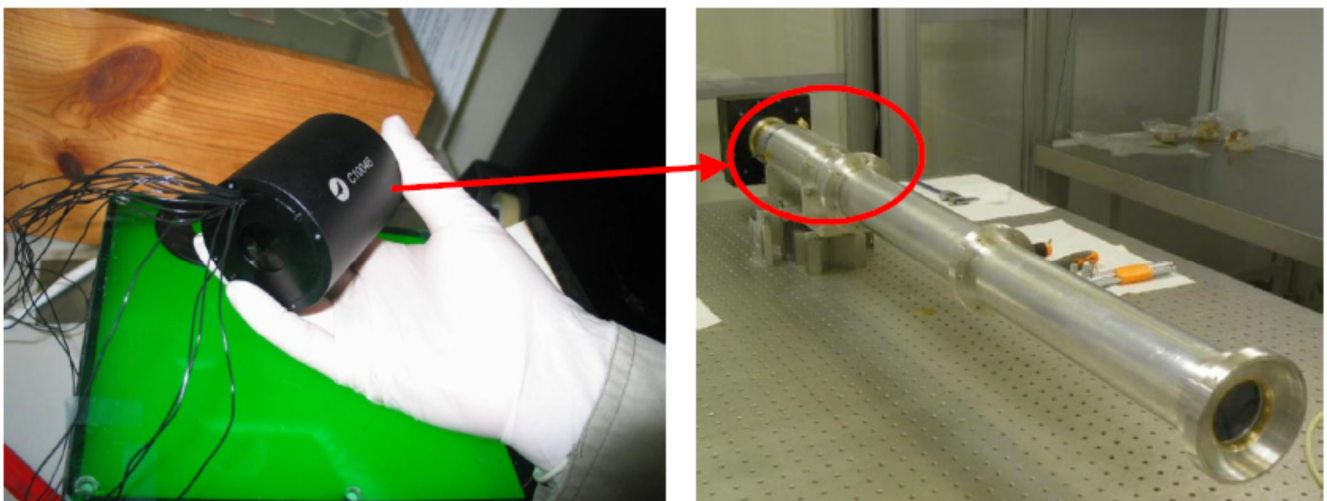


Figure 1 The CorMag Lyot filter (left) with the opto-mechanical interfaces (right)

The specific objectives of this STSM were:

1. Design and manufacturing of dedicated opto-mechanical interfaces to integrate the Turin CorMag to the Lomnický ZEISS coronagraph;
2. Integration of CorMag on the ZEISS coronagraph and optical alignment;
3. Integration of CCD camera detector and of Lyot filter driving electronics;
4. installation on local PC of the Lyot-filter/camera control & data acquisition (C&DAQ) s/w;
5. Training by the INAF team of the AISAS staff to operate the CorMag;
6. CorMag First-light and data archiving.

Activities performed before and during the STSM.

The work to achieve the above objectives started before the beginning of the STSM. The opto-mechanical interfaces were manufactured by both INAF-Turin (Fig. 2 and see Mr. Massone's report) and by AISAS.

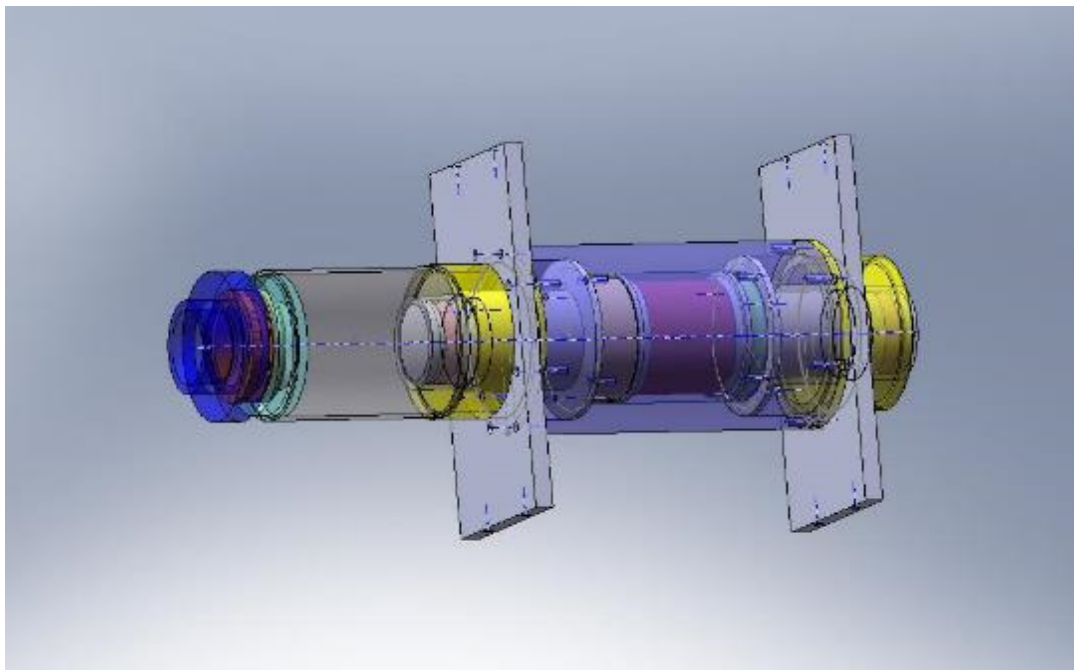


Figure 2 Mechanical configuration of the LCTF for Lomnický Stit Coronagraph

INAF-OATo developed the control and data acquisition (C&DAQ) software (s/w) for the synchronized control of the Lyot filter and of the CCD camera. A copy of this CorMag C&DAQ s/w was sent to the Lomnický Peak Observatory to be installed in the local PC platform and to check the s/w compatibility with the PC operating system (see Dr. Capobianco's report).

The original plan called for a 2-week stay at the Lomnický Peak Observatory to carry out the work plan proposed. However, the stay had to be shortened to 10 days because of the interruption in the operations of the cable car connecting the observatory, due to maintenance. Nevertheless, in this span of time the activity of the INAF-OATo team at the Lomnický Peak Observatory achieved the majority of this STSM goals. The INAF team was composed of

- Dr. Silvano Fineschi: coordination; calibrations and science observations planning;
- Mr. Giuseppe Massone: CorMag/coronagraph mechanical I/F and optical alignment;
- Dr. Gerardo Capobianco: CCD detector and Lyot filter electronics and C&DAQ s/w.

During the stay at the Lomnický Peak Observatory, the CorMag (i.e., Lyot filter and CCD camera) was successfully integrated to the 20-cm Zeiss Coronagraph (cfr Fig. 3) using the previously developed opto-mecahnical I/F (see Mr. Massone's report).

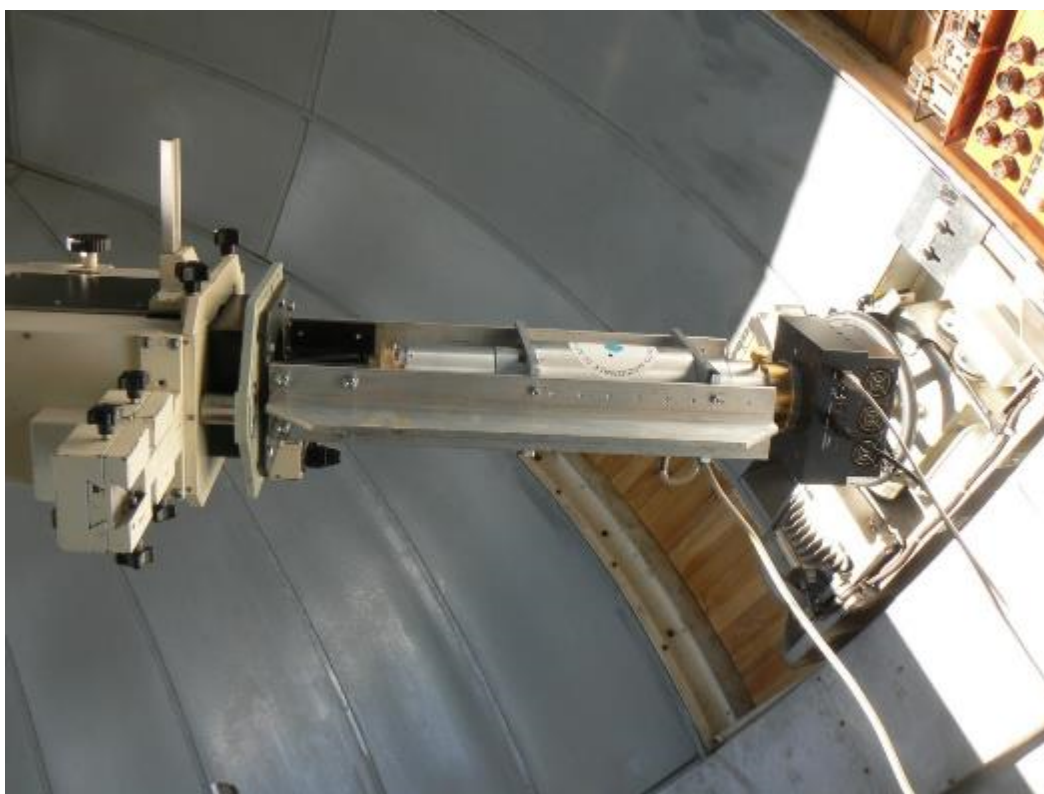


Figure 3 Turin CorMag, comprising the Lyot Filter (center) and the CCD camera (right), on the mechanical interface installed at the focal plane of the 20-cm Zeiss coronagraph at Lomnický.

Dr. Capobianco installed on the coronagraph spar the driving electronics of the Lyot filter and integrated the CCD camera to the focal plane of the CorMag. He also installed the C&DAQ s/w in the PC platform that was made available by the AISAS personnel at the Observatory (see Dr. Capobianco's report).

Finally, we run several, full end-to-end tests of the entire system CorMag/Zeiss-Coronagraph by pointing the coronagraph to the Sun when the weather offered clear sky for observations. The C&DAQ system worked according to design and we were able to acquire "first-light" frames through the CorMag.

The preliminary analysis of the data acquired has revealed a "light-leak" from the Sun-disk. This is most likely due to the open volume between the CorMag assembly and the Zeiss Coronagraph focal plane.

Any additional work to fix this problem could not be pursued locally because our stay had to be cut short due to the stop for maintenance of the cable car connecting the observatory.

Results achieved during the STSM and future work.

This Short-term Scientific Mission was highly successful and we fully achieved most of the original goals. That is:

1. Design and manufacturing of dedicated opto-mechanical interfaces to integrate the Turin CorMag to the Lomnicky ZEISS coronagraph;
2. Integration of CorMag on the ZEISS coronagraph and optical alignment;
3. Integration of CCD camera detector and of Lyot filter driving electronics;
4. installation on local PC of the Lyot-filter/camera control & data acquisition (C&DAQ) s/w

We partially achieved the remaining goals:

5. Training by the INAF team of the AISAS staff to operate the CorMag;
6. CorMag First-light and data archiving.

In order to complete the CorMag installation and achieve all the remaining goals, we have taken the Lyot filter and the CCD camera back to the Turin Observatory for a full laboratory calibration of the system including a new CCD camera –identical to the first one – specifically procured for the definitive deployment of CorMag at Lomnicky Observatory.

Additionally, we plan to return to Lomnicky in February 2014. By then the cable car operations will have resumed. In the meanwhile, we plan to complete the following tasks in Turin:

1. Baffle manufacturing to be installed between the CorMag and the focal plane of the Zeiss coronagraph in order to suppress the “light-leak”;
2. Laboratory calibration of the new CCD camera to be integrated in the CorMag;
3. Manufacturing of a mechanical interface to integrate a rotating polarizer that can be inserted between the CorMag and the focal plane of the Zeiss coronagraph in order to calibrate-out the sky polarization brightness.

We plan to complete the above tasks by January 2014, on time for the definitive installation of the Turin CorMag at Lomnicky, tentatively in February 2014.