

POLARIMETRIC CORONAGRAPHY TO RECORD THE INITIATION OF CMES

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Abstract. A new type of polarimetric coronagraph is proposed for permitting citizen Astronomers and Amateurs involved in $H\alpha$ and coronal observations using the Pic du Midi (PdM) Observatory Facilities (so-called CLIMSO) to apprehend and analyze the dynamical processes inside the solar corona. It includes relevant for economic reasons observations of the initiation phase of Coronal Mass Ejections (CMEs) and of recurrent geo-active quasi-polar coronal holes (CHs).

Keywords: coronagraphy, polarimetry, solar corona activity, CMEs, white-light coronal ejections

1 Introduction

The solar activity of the coronal levels modulates different components of the solar wind, CMEs, flares, solar energetic particles (SEPs) and associated disturbances initiated in 3D magnetic separatrices and in open regions. It is today parts of the Space Weather studied before in the frame of solar-terrestrial relationships. Important investment are planned for developing the Space Weather. So the next decades will see new facilities to cover observations of the dangerous for many Critical Economic reasons (including the survival of sensitive Space Systems) of i/ Coronal Mass Ejections (CMEs) and disturbances especially numerous during the Years of sunspot maximum; ii/ Geoactive recurrent fast events from CHs related to X-ray jet activity from open regions. The important phase of the initiation process at the origin of CMEs is still mysterious: filament eruptions, prominence destabilization, rising coronal cavity inside the hot corona, flares and explosions of active regions coronal enhancement and loops of the low corona, EUV (EIT) coronal waves, arch system interactions with subsequent magnetic reconnections, restructuring in singularities of the 3D magnetic separatrices, etc. are suggested. The sophisticated X-EUV space-borne routine instruments will provide coronal temperature sensitive images taken in different coronal emission lines. Unfortunately, no direct measurements of coronal mass storage and motions in the very inner corona and higher can be done in Space. Only a K-coronagraph extracting the pB intensities in white-light (WL) can provide this diagnostic related to electro densities. Today advanced commercially available components permit to define a miniature but performing instrumental set-up offering appropriate for advanced Amateurs opportunity to take part in this important routine and exciting research.

2 A prototype: discussion and conclusion

It is proposed to use a new adapted coronagraph to perform this study in the frame of the association called O.A. (Observateurs Associés) of the Pic du Midi Observatory to generously collect data up to 3 solar radii, by recording polarized WL images like it is well done at the MLSO for a long time using sophisticated pB rather large coronagraphs. Note that i/ p is the measured effective linear polarization ratio of the observed total intensities B see Fig. 1; ii/ B is the total intensity observed at ground around the Sun; it includes both the instrumental and the sky background see Koutchmy et al (1990) of very low polarization ratio. ; the superposed K-corona intensities are well polarized in the tangential to the solar limb directions but with a variable amount in both the radial and the tangential directions see Fig. 1. This 2-parts externally occulted instrument will take

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advantage of the excellent large equatorial mount already in use in the big dome of PdM for the "CLIMSO" cluster of coronagraphs that routinely analyze the very inner corona. The instrumental parameters of this new instrument we call "2APC" (Amateur Advanced Polarimetric Coronagraph) are preliminary outlined based on the available space of the mount. The distance between the External Occulter (EO) system see Aime (2020) and the doublet lens of the entrance aperture (effective pupil is of 38 mm diameter aperture) is 6 m. The newly available polarimetric CMOS 6 Mpx polarimetric camera (Sony chip) will be used to reach a large multiplexing gain compared to the parameters of the former PdM K-coronameter that was used in the 70ies see Noëns et al. (2000). The first results of laboratory measurements performed with a prototype of the instrument (so-called technological model put on an optical bench) behind a specially designed artificial WL Sun (AS) put at the focus of a 20 cm aperture collimator lens lead to the definition of a model of the inner K-corona around the AS to permit the optimization of the instrumental parameters. We simultaneously plan to work on the software of the polarimetric camera, including its fast recording part to damp the fluctuating sky background Koutchmy et al (1990) and the polarimetric calibration parts to extract the tangentially polarized intensities. Excellent data available from the analysis of solar total eclipses are used as reference. Observations at Pic du Midi could start in 2022-23, well before the forthcoming solar maximum of 2025-26.

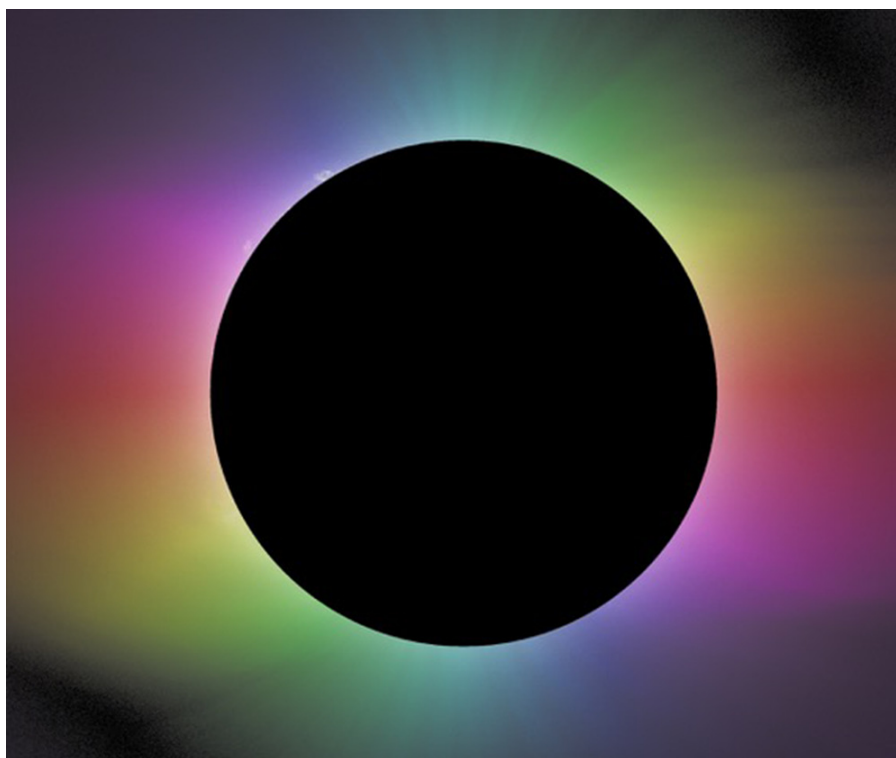


Fig. 1. Map of pB (intensities coded with different color intensities to show as well the directions of polarization observed during the solar total eclipse of 2019. Note the directions of p everywhere in tangential to the limb directions and also the low polarization ratio observed on the prominence at NE. Picture provided by David Elmore-private comm.

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