**The magnetic solar corona as revealed by polarimetry**

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# ABSTRACTS BOOKLET

# Prospects for coronal magnetic field measurements from space

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*Abstract:*
Despite its fundamental importance as a driver for the physics of the Sun and of the heliosphere, the magnetic eld of our star's outer atmosphere remains poorly understood. This is due in large part to the fact that the magnetic eld is a very di cult quantity to measure. Our knowledge of its strength and orientation is primarily based on extrapolations from photospheric observations, not from direct measurements. These extrapolations require strong assumptions on critical but unobserved quantities and thus fail to accurately reproduce the complex topologies inferred from remote-sensing observations of coronal structures in white light, EUV, and X-rays. Direct measurements of the coronal magnetic field are clearly identified by the international heliophysics community as a key element in the understanding of our star.

In the past ten years, reliable ground based coronal magnetic field measurements have emerged. However, these measurements will always be limited by the difficulty to observe the corona from the ground. Much like routine coronagraphic observations from space by SOHO/LASCO have revolutionized our knowledge of the solar corona, space based polarimetric observations are expected to lead to major breakthroughs. In this perspective, we will review the past and present projects of space missions designed to measure the coronal magnetic field from space.

# Evolution of Self-organized criticality in the solar corona and its role in solar flare occurrence

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The statistical behavior of power-law distribution of solar flare frequency versus respective energy released is known to be scale invariant. However, as individual solar flare originates from a completely independent magnetic-field configuration from other flare, the aforesaid behavior is puzzling. This riddle was solved by proposing solar coronal magnetic field to be in a state of self-organized criticality (SOC). As the magnetic field parameters are found to be a good proxy for build-up and trigger of flare energy release, we explore the signatures of SOC occurrence and evolution in the corona by employing photospheric magnetic-field and coronal X-ray flux. Firstly, we explored long duration statistical photosphere-corona coupling through studying the full-disk magnetic-field parameters and co-temporal disk-integrated coronal X-ray flux for very high flare productive months viz. October 2003, August 2004 and September 2005. We estimated photospheric magnetic flux and coronal X-ray flux to be varying in the range of $5 \times 10^{28}$ - $3 \times 10^{29}$ Mx and $1 \times 10^{-7}$ - $2 \times 10^{-4}$ Watts/m$^2$. This study revealed that photospheric magnetic flux and coronal X-ray flux have been co-varying non-linearly following a power-law relationship as shown in the left panel of figure 1.

Further, in order to explore the photospheric proxies leading to the criticality of the solar corona and subsequent flare, we study the temporal evolution of the photospheric and coronal parameters using high cadence observations. In this regard, we study the evolution of photospheric magnetic flux and associated coronal X-ray flux for 14 M class flares which occurred within preceding ~1 hour from the X-ray quiet corona. For these flares, we again estimated photospheric magnetic-flux of the leading and following polarities of the associated active region in contrast to the aforesaid study where we employed the full-disk magnetograms. This investigation also consistently revealed power-law relationship between photospheric magnetic flux and coronal X-ray flux as shown in the right panel of figure 1.

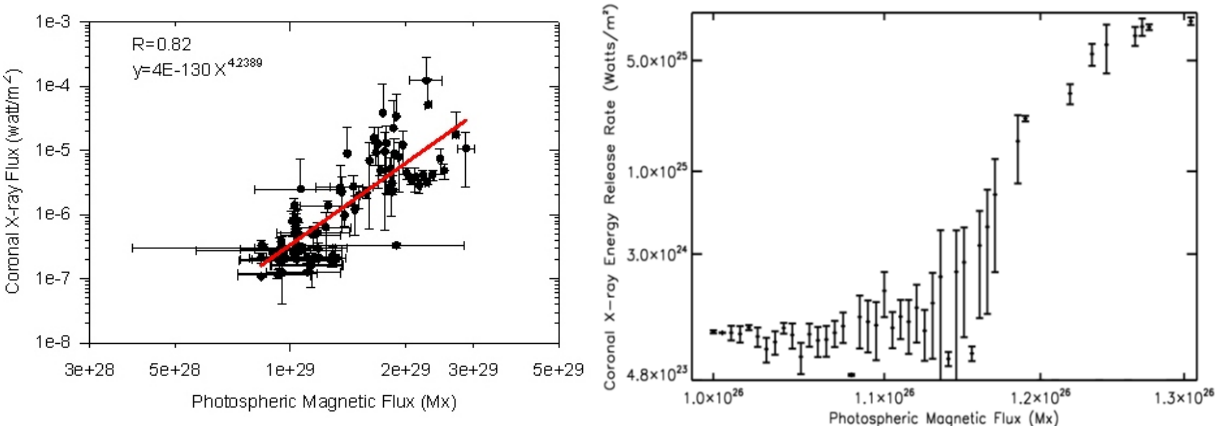


Figure 1. Left Panel: Correlation plot of the photospheric magnetic field with the coronal X-ray flux for the duration of October 2003. Right Panel: Coronal X-ray energy loss rate in 1-8 ˚A plotted versus photospheric magnetic flux for the M6.7 flare occurred on September 08, 2011.

In addition, we have also noticed a photospheric magnetic flux over which the flare X-ray flux undergoes avalanche. We have termed this magnetic flux as critical magnetic flux analogous to a term employed in the theoretical modeling (Lu and Hamilton, 1991). This flux is estimated to be an AR-dependent quantity and varies in the range of 1.2 - 3.5 × $10^{26}$ Mx for the flares considered in this study. This quantity serves as a potential candidate in the possible prediction of SOC state of the corona. Although observationally tough, the coronal magnetic field measurements over the flare and surrounding regions will lead this study more closer to the SOC models. In this regards, we aim to study such correlation study among the coronal magnetic field parameters/emission proxy of the field and co-temporal coronal X-ray energy release rate.

References:

1. Lu, E. T. and Hamilton, R. J.: 1991, *Astrophys. J. Lett.* **380**, L89 xxxi, 196, 206, 222

# Study of CME-driven shocks with remote sensing data: recent results and future prospects

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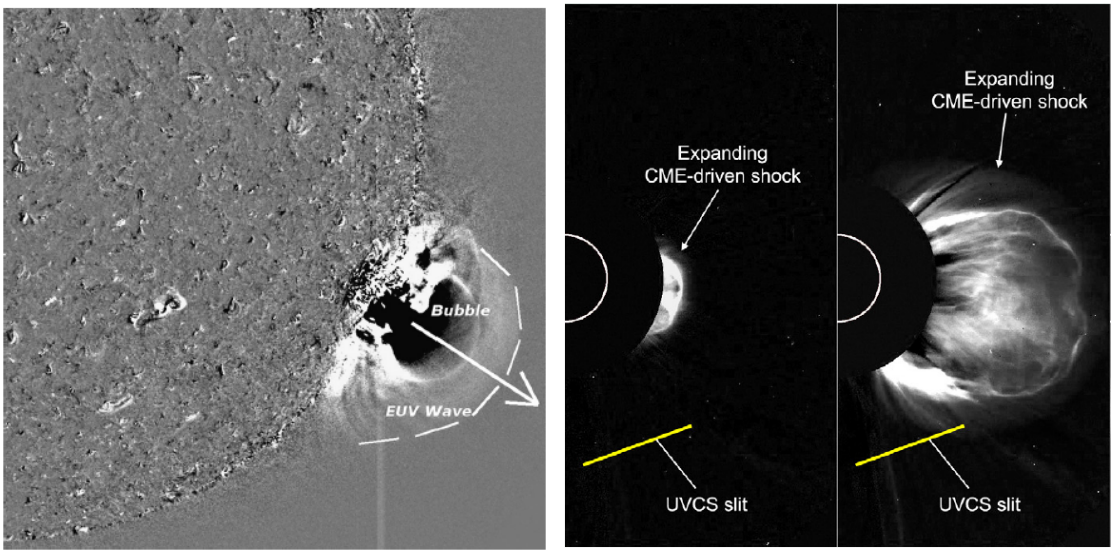


*Figure 1, left: expansion of a CME-driven shock in the base of the corona as in EUV (Kouloumvakos et al. 2014). Right: expansion of a CME-driven shock in the extended corona in White Light (Bemporad & Mancuso 2010).*

It is well known that flares and Coronal Mass Ejections (CMEs) drive coronal shocks accelerating Solar Energetic Particles (SEPs) and non-thermal $e^-$ beams resulting in kilometric type-II radio bursts. On the other hand, the origin of metric type-IIs occurring in the low corona (heights < 0.1 – 0.3 $R_{sun}$) is still uncertain and some authors think that they are associated not to the shock, but a flare related blast wave. Over the last few years, two major improvements in our knowledge of this problem occurred. First, thanks to the very high cadence and high resolution data acquired by actual space based EUV disc imagers (like SDO/AIA, STEREO/EUVI and Proba2/SWAP) it has been shown that CMEs drive shock waves already in the early phases of their propagation in the lower corona (Figure 1, left). Comparison with timing of radio data is now providing growing evidence that even in the low corona these radio bursts are excited by the CME-driven shock waves (e.g. Koloumvakos et al. 2014; Chen et al. 2014). Second, careful analyses performed over the last 11 years showed that coronagraphic White Light (WL) images contain much more information on CME-driven shocks than previously thought, and that not only the shock velocity and geometry, but also the shock compression ratio (Vourlidas et al. 2003) and coronal magnetic fields (Gopalswamy & Yashiro 2011) met by the shock wave can be measured. Moreover, recent combined analyses of UV and WL data allowed to develop an interesting technique to derive the full set of plasma parameters (density, temperature, velocity and magnetic field) both before and after the shock transit, together with the rotation induced by the shock in the magnetic field vector (Bemporad & Mancuso 2010; Susino et al. 2014).

In these presentation I will briefly review these results and show that, as we recently shown, under some assumptions it is possible to derive a 2D map for the strength of coronal magnetic fields met by the shock wave by using WL coronagraphic data alone. Possible applications for the development of future space-based and ground based coronagraphs will be discussed.

# Coronal Magnetograph (CorMag): A Spectro-polarimeter for the study of the coronal magnetic fields

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The Coronal Magnetograph (CorMag), initially developed by the Turin Astrophysical Observatory, Italy, for space-based solar corona spectro-polarimetry (ESA/PROBA3 mission), has been installed to the Zeiss coronagraph at the Lomnicky Peak Observatory, Slovakia. The study of the coronal magnetic fields, observing one of the most brights lines (FeXIV at 530.3 nm) in corona, is the scientific goal of the observations. The main characteristics of the instrument, the last adopted configuration and the lessons learned are shown in the presentation. The CorMag allows the fine scan of the FeXIV line using a 4 stages liquid crystals-based Lyot filter, where the central bandpass is electro-optically tunable. The polarimetric capabilities are obtained thanks to the use of a liquid crystals variable retarder (LCVR). The CorMag has been already successfully used during the 2010 total solar eclipse.

# ESCAPE: Extreme Solar Coronagraphy in Antarctica

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The coronal heating problem is still one of the most debated questions in solar physics. ESCAPE (the Extreme Solar Coronagraphy Antarctic Program Experiment) is designed to measure wave properties in the corona and their possible contribution to the coronal heating and solar wind acceleration. It measures the polarization of coronal line emission, allowing to map the topology and dynamics of the magnetic field in the corona. Furthermore, ESCAPE will be able of up to 3 months of mostly continuous monitoring of the coronal activity, such as CMEs that are relevant for space weather studies. The Dome C high plateau is unique for coronagraphic observations: sky brightness is reduced, water vapour is low, seeing is excellent and continuity of observations on several weeks is possible. ESCAPE will first perform 2-dimensional spectroscopy of the forbidden line of FeXIV at 530.285 nm, and later of FeXIII at 1074.7 nm and of the Sodium D3 line at 587 nm (precise line profile analysis will allow the diagnostic of the nature of waves by simultaneous measurements of velocities and intensities in the corona). ESCAPE is approved by CNRS/INSU for a test this year at Pic du Midi, to be followed by a first campaign planned at Dome C/Concordia in 2015/2016. Most subsystems are available thanks to the ESA STARTIGER R&D program "Toward a New Generation of Formation Flying Coronagraph" performed in 2010 in support of the ASPIICS ESA/PROBA-3 formation flying coronagraph mission. A Three Mirrors Anastigmat telescope and a 4 stages Liquid Crystal Tunable-filter Polarimeter have been developed that allow us to propose an automated Coronal Green Line full-field Polarimeter for unique observations (waves nature and intensity to address coronal heating) and with the best possible performances on Earth. No other ground site would allow such coronagraphic performances (the sky brightness is a factor 2 to 4 better than in Hawaii) and with high spatial resolution (better than an arcsec). ESCAPE will also help in validating the experimental approach of critical sub-systems of future space coronagraphy missions (e.g. the 587 nm filters of ASPIICS/PROBA-3), in bringing ground simultaneous/complementary observations to Space missions, and in opening the way to future and more ambitious projects in Antarctica (e.g. AFSIIC) and in Space (e.g. HiRISE/NEOCE ESA M4 proposal). ESCAPE is part of the SCAR/AAA (Astronomy and Astrophysics in Antarctica) research working group international effort.

# Magnetic field diagnostics based on scattering line polarization at the solar limb.

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The linear polarization of lines formed by scattering of photons is sensitive to the Hanle effect of weak magnetic fields. It may be measured at the solar limb where it gives rise to the very rich, still under investigations, « second solar spectrum » in the optical and near-UV domains. New windows to the scattering spectrum of the Sun will be opened by projects of solar coronagraphy in the UV and in the near IR, leading to possible Hanle effect based measurements of the magnetic fields in the chromosphere and corona.

In this presentation I will recall how the solar limb scattering polarization observed in various photospheric lines has been used to investigate the unresolved weak magnetic fields of the quiet Sun, and I will examine how the methods that have been implemented could be extended to the chromospheric and coronal context.

# Space- and Ground-based Coronal Spectro-Polarimetry: Synergies

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This presentation gives an overview of the near-future perspectives of visible-light and ultraviolet spectro-polarimetric instrumentation for probing coronal magnetism from space-based and ground-based observatories.

Magnetic fields in the solar atmosphere provide the energy for the solar activity, as well as powering the solar wind. Despite the key role of magnetic fields in solar physics, there exists only very limited measurements of the field above the base of the corona where the magnetic pressure dominates over the plasma thermal pressure.

Spectro-polarimetric imaging of coronal emission-lines in the visible-light wavelength-band provides an important diagnostics tool of the coronal magnetism. The interpretation in terms of Hanle and Zeeman effect of the line-polarization in forbidden emission-lines yields information on the direction and strength of the coronal magnetic field. As a study case for ground-based spectro-polarimeter for coronal magnetic field studies, this presentation will describe the Torino Coronal Magnetograph (CorMag) for the spectro-polarimetric observation of the FeXIV, 530.3 nm, forbidden emission-line. CorMag - consisting of a Liquid Crystal (LC) Lyot filter and a LC linear polarimeter - has been recently installed on the Lomnicky Peak Observatory 20cm Zeiss coronagraph. The results of the the CorMag observations of the FeXIV, “green line”, during the 2010 eclipse will be presented (see Fig. 1).

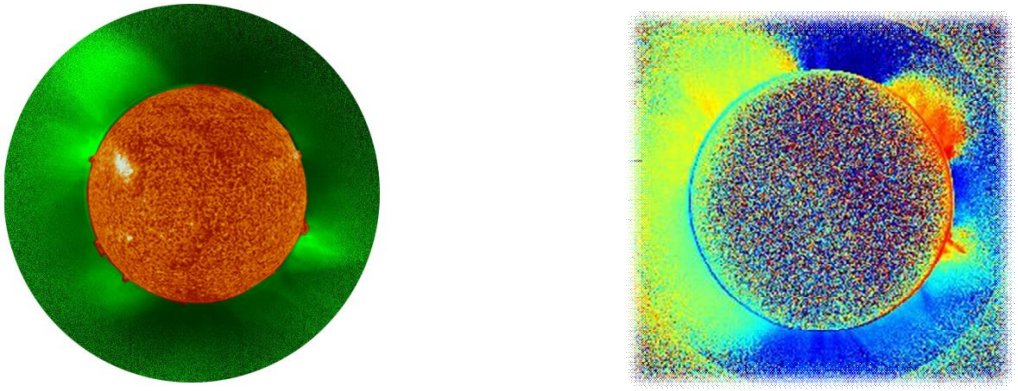

***Figure 1 Left:*** *Image of the FeXIV, 530.3 nm, coonal emission acquired by the Turin CorMag during the 2010 total eclipse.* ***Right:*** *Hanle effect induced by the coronal magnetic field in the FeXIV ”greem line”. The false colours represent the tilt of the local magnetic field with respect to the zero-field case.*

The CorMag represents a prototype of space-based spectro-polarimeters for coronal magnetic field diagnostics. A spectro-polarimeter for the coronal “green line” is planned for the ASPIICS coronagraph on board of the Proba-3 ESA mission to be launched in 2018. The two satellites of this mission will fly in formation (“formation flying”), aligned to the Sun and separated by 150 m. The first satellite in front of the second one, with the coronagraph, will create an artificial eclipse that will last hours. This is much longer than the few minutes duration of a natural eclipse. This will allow unprecedented opportunities for the study of the coronal magnetic field through visible-light and infrared spectro-polarimetry.

The linear polarization by resonance scattering of coronal permitted line-emission in the ultraviolet (UV) can be modified by magnetic fields through the Hanle effect. Space-based UV spectro-polarimeters would provide an additional tool for the diagnostics of coronal magnetism. As a case study of space-borne UV spectro-polarimeters, this presentation will describe the future upgrade of the Sounding-rocket Coronagraphic Experiment (SCORE) to include the capability of imaging polarimetry of the HI Lyman-$\alpha$, 121.6 nm. SCORE is a multi-wavelength imager for the emission-lines, HeII 30.4 nm and HI 121.6 nm, and visible-light broad-band emission of the polarized K-corona. SCORE has flown successfully in 2009, and it will fly again in 2015. This presentation will describe how in future re-flights SCORE could observe the expected Hanle effect in corona with a HI Lyman-$\alpha$ polarimeter.

# Measuring the magnetic field in eruptive prominences using the PROBA-3 Coronagraph- Polarimeter to understand the CMEs initiation

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Solar occultation in Space offer the opportunity to image the W-L corona up to several solar radii and to perform precise high S/N ratio polarimetric measurements of emission lines over a background 3 to 4 order of magnitudes fainter than at ground-based. The PROBA-3 mission will fly a spacecraft put in the shadow of a precisely occulting sister satellite orbiting "in formation" at a distance of 150 m in front of it to make artificial solar total eclipses. The region right above the solar limb will be studied for the first time over a coronal background not polluted by any spurious light. Although the priority will be the high-resolution fast imaging of the dynamic white-light corona, the use of a narrow filter centred on the relatively low excitation D3 line of He I, is planned for imaging prominences. Several coronal filters will also be used. Adding the precise linear polarization analysis will permit the measurements of the magnetic field using the Hanle effect. We evaluate the possibility offered during the eruptive phase of a CME with faint prominence material inserted inside, for studying the associated magnetic field changes related to both the heating process and the ejection of material. The detail of the background highly polarized K-corona is taken into account. Sequences of quasi- simultaneous white-light processed images at high resolution are an additional feature of great interest for interpreting the overall magnetic structure and disentangle the los integration complication.

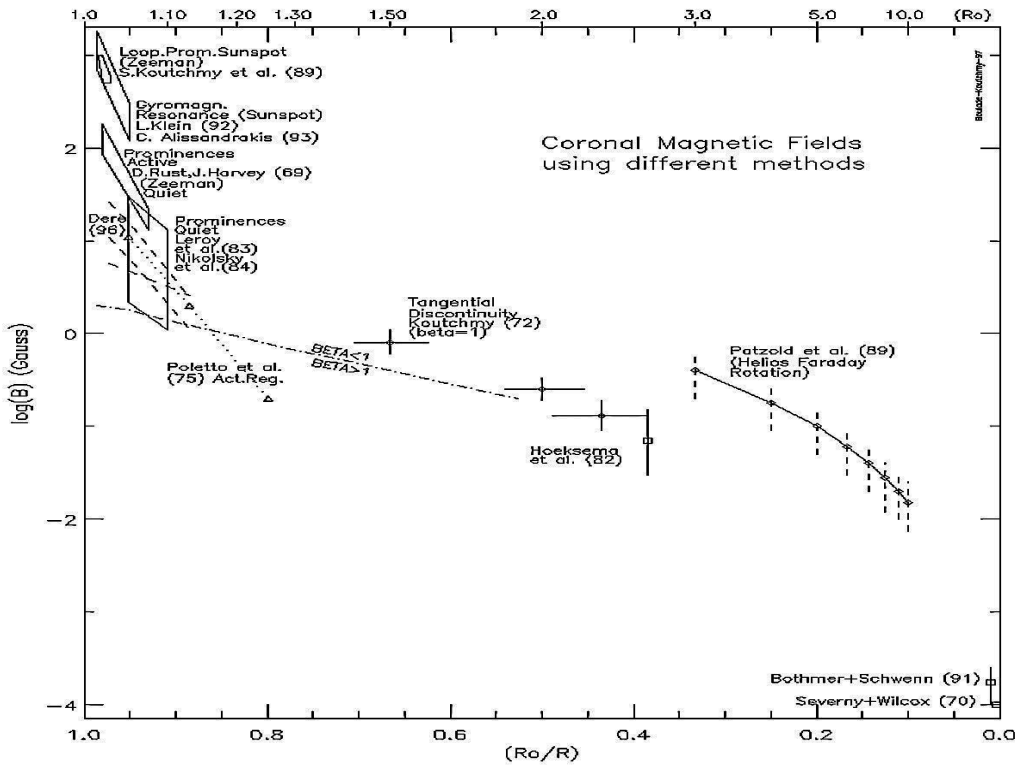


*Figure 1: Typical radial variations of strengths of the coronal magnetic field to be studied using the Proba3-Aspiics coronagraph/polarimeter, from historical observations. Note the radial scale in 1/R.*

# The Sensors Unlimited GA1280J SWIR Camera as a detector for the solar IR coronal polarimetry?

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The recently released GA1280J Mini-SWIR Snapshot Camera of Sensors Unlimited is now being integrated to a new camera module of the CoMP-S instrument which is attached to the ZEISS coronagraph at the Lomnicky Peak Observatory (AISAS, Slovakia).

This detector has been selected in particular for measurements of the SWIR emission spectral lines, e.g. Fe XIII 1074.7 nm, Fe XIII 1079.8 nm, and He I 1083.0 nm, originating in the solar corona and prominences, respectively. Combination of the 4-stage Lyot filter with polarimeter and this SWIR detector in the CoMP-S instrument should measure the polarizer light in the selected infrared spectral lines originating in the solar upper atmosphere.

Basic instrumental information and the very first photometric results of this camera will be presented mostly on results of tests performed before installation of the new camera module to the CoMP-S instrument.

Performance results of this detector could be of a particular interest also for other observatories and projects considering this camera as a possible detector for similar purposes (e.g. WAMIS project).

# LyNaCoPo: the observation of the magnetic field of the solar corona through a nano-wire polarizer

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The measurement of the component of the magnetic field along the line of sight (LOS) in the extended solar corona is an open issue in solar physics. The Hanle effect is fundamental in investigating the matter. The HI Lyman alpha 121.6 nm line in the solar corona is one of the most intense emissions. It is formed by resonant scattering of the underlying chromospheric emission. The Hanle effect in the extended corona at 121.6 nm is sensitive to the component of the coronal magnetic field along the LOS. In order to measure the Hanle effect, the polarization of the Lyman-alpha corona has to be detected. Spectrographs such as SOHO/UVCS have detected the intensity of the extended corona, but no instrument so far has ever investigated the polarization of the corona in the 121.6 nm line.

The main reason is that a coronagraph able to perform such an investigation is historically complex to manufacture. The difficulty does not lie as much in the coronagraph design, that can be derived from the classical Lyot refractor, but rather in the polarimeter that has to work at 121.6 nm. Past VUV polarimeters design have been both off- and on-axis. The off-axis ones take usually advantage of the birefractive properties of the $MgF_2$ crystal. This means a complication in the optical design. The on-axis involve the presence of a three-reflections-polarizer in $MgF_2$ working at the Brewster angle. A motorized rotator has to be implemented to move the polarizer, which increases the critical aspects for space borne instruments (more mass and mechanisms). In any case, the alignment of a three reflections device is really tricky.

A simple and effective alternative to the classical scheme is provided by the use of nano-wire grid polarizers. There is a large use of wires to polarize the light for wavelengths greater than or equal to the visible. Unfortunately, up to the first decade of 2000 there was a technological barrier that prevented the manufacturing of wires optimized to polarize the light down to 121.6 nm. A classical rule-of-thumb in the wire-grid manufacturing is that the polarizer maintains a good polarization performance for wavelengths that are about three times the pitch of the wires.

This means that a wire grid polarizer must have a pitch of about 40 nm in order to work at 121.6 nm.

The device can nowadays be manufactured by means of the nano-technologies and this gives a positive burst to the proposal of simple on-axis coronagraphs without moving mechanical parts.

A concept design is presented for LyNaCoPo, the Lyman-alpha Nano-wire Coronagraph Polarimeter. It is an on-axis refractive coronagraph of the Lyot type, with $MgF_2$ lenses, a nano-wire polarizer built on a $MgF_2$ thin plate.

It is thought as a focal plane device for a coming solar space mission, as, e.g., MASC (Magnetic Activity of the Solar Corona), that has been proposed to ESA in the frame of a joint scientific space mission with the Chinese Academy of Sciences (CAS).

Our group has the expertise to design and characterize the optical device and was funded to manufacture a practical laboratory set-up in order to perform the measurements.

# INSTANT – INvestigation of Solar-Terrestrial Activity aNd Transients

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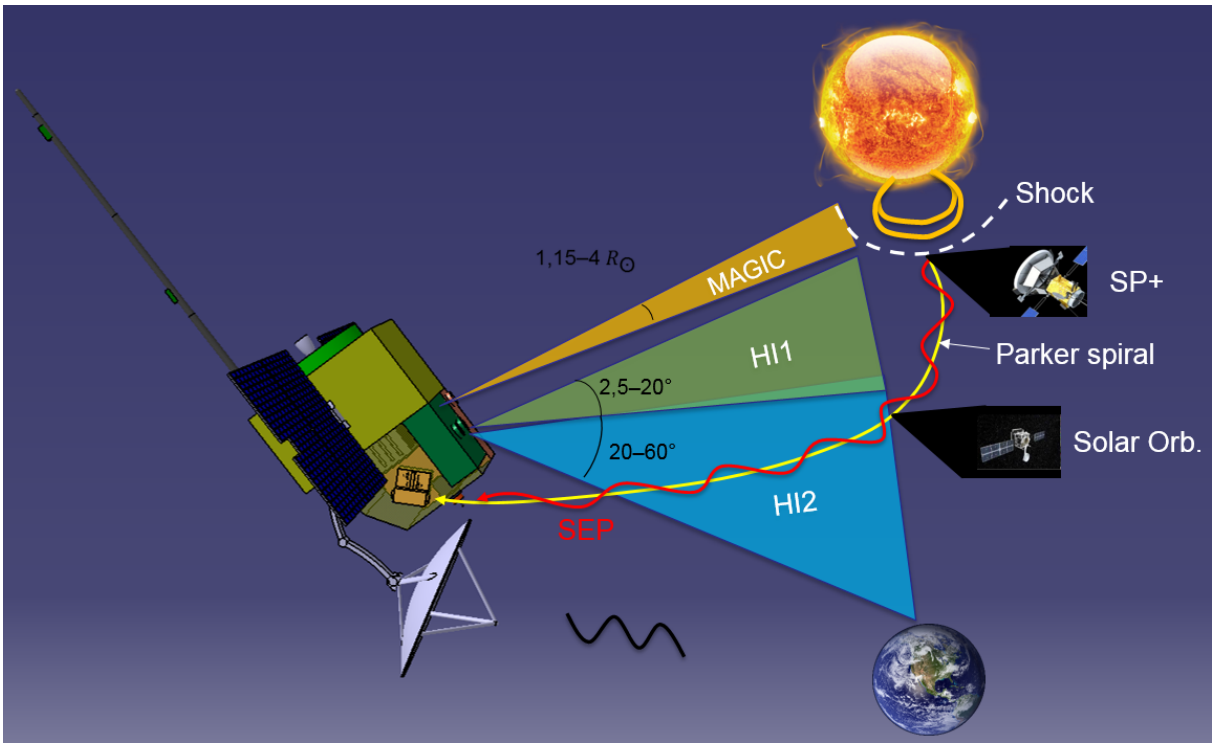


*Figure 1: Basic INSTANT spacecraft configuration*

We will present both the science objectives and related instrumentation of a small solar and heliospheric mission concept, INSTANT: INvestigation of Solar-Terrestrial Activity aNd Transients. It will be submitted as an opportunity to the upcoming ESA-China S-class mission call later this year. This concept was conceived to allow innovative measurements and unprecedented, early determination of key properties of Earthbound CMEs from the L5 vantage point. Innovative measurements will include magnetic field determination in the corona thanks to polarimetric Hanle measurement in Lyman-α and polarized heliospheric imaging for accurate determination of CME trajectories. With complementary in situ measurements, it will uniquely permit solar storm science, solar storm surveillance, and synergy with Solar Orbiter and Solar Probe Plus (the ESA-China S2 mission launch is planned in 2021).

# Inference of Magnetic Fields: from cold Prominences to the hot Corona

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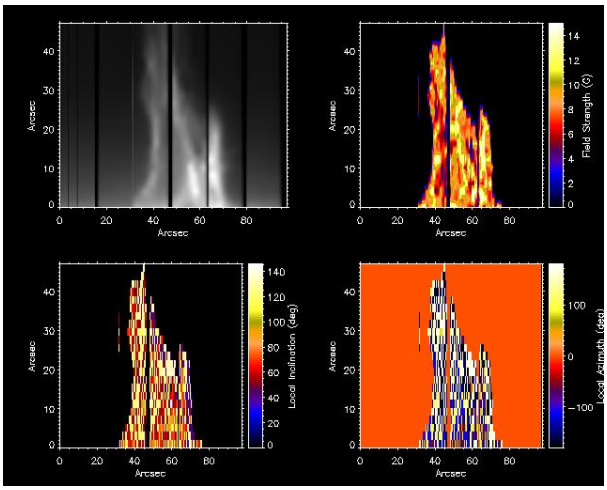
*Abstract:*

I will review the state of the art of the inversion of spectropolarimetric data in prominences. The inference of magnetic fields in prominences present some similarities but also many differences to the inference in the coronal case. I will focus on the similarities and discuss how they have been handled or left as standing problems in prominences as a harbinger of the coronal case.




Mapping of the magnetic field vector of a prominence observed with THEMIS in 2014

# Wavefront sensing in the absence of correlation features.

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*Abstract:*

Seeing is ubiquitous in astronomical observations, but contrast features on which to apply correlation techniques to measure the wavefront are not. The solar corona is one of those case: not just the visible structures are low contrast and weak, furthermore they are drowned in the scattered light from the disk. The usual Shack-Hartmann wavefront sensing techniques are of no use in these cases.

We propose a new concept to measured directly the tilt of the wavefront irrespective of the presence of an image. The proposed technique is inspired in the recent developments of quantum weak measurements, though fully classical in its explanation.

# Large-scale magnetic structure determination from coronal polarimetric (1074 nm) data

L. Rachmeler
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*Abstract:*
Large-scale magnetic structure determination from coronal polarimetric (1074 nm) data

Different polarimetric observations provide various pieces of information about the coronal magnetic field. Ultimately we would like to combine these parts into a full 3D magnetic reconstruction of the corona. I will present here how we have used CoMP linear polarization data to match specific observations to common large-scale magnetic structures such as flux ropes, streamers, and pseudostreamers using forward modeling techniques. I will also talk about 1074 nm Hanle polarization in general, and how to extract the magnetic information embedded in it.

# Probing the origin of solar energetic particles using combined remote sensing and in-situ measurements

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The origin of the most energetic solar particles released during solar storms is still debated. In this study, combined observations and modelling techniques are used to test the hypothesis that the most energetic solar energetic particles (SEPs) are accelerated by coronal shock waves. Combined STEREO SOHO and SDO observations allow us to reconstruct the 3-D extent of pressure waves formed during the eruption of coronal mass ejections. We concentrate on the proton-rich events detected by the near-Earth spacecraft and the STEREOs between 2011 to 2014. The SEPs measured in situ during these episodes of propagating coronal waves propagate along coronal and interplanetary magnetic field lines between the Sun and 1 AU. We use a combination of observations and modelling to reconstruct the 3-D location of magnetic field lines and thereby establish the magnetic connectivity between the shock near the Sun and the points of in-situ measurements near 1AU. This 3-D localisation allows us to determine the (1) the height and spatial extent of the pressure waves at the SEP release times near the Sun, (2) compare the longitudinal extent of SEP events with the extent of the pressure waves. We combine a 1D Solar Wind hydrodynamical code (VP code) with a potential model of the solar corona to compute the density, bulk speed, ion and electron temperatures and pressures along the relevant magnetic flux tubes. This allows us to compute the characteristic speeds of the medium and the fast and slow-mode speeds at the potential shock transition. We compare the properties of the inferred shocks with those of the SEPs measured in situ. **The study highlights the need of obtaining direct magnetic field measurements in the corona to derive more reliable shock properties.**

# The Lomnicky Peak Observatory - status report and coronal polarimetry prospects

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The Lomnicky Peak Observatory of AISAS (Slovakia) is nowadays one of just few ground-based high-altitude observatories (2633 m asl) devoted to coronagraphic observations of the solar prominences and emission corona. The observatory is equipped with two identical Lyot-type coronagraphs, produced by the Carl Zeiss (Jena, former GDR), attached to a common mount.

A fundamental upgrade of the post-focus instrumentation is now being performed with a final aim to perform at the observatory coronagraphic observations of magnetic and velocity fields in the solar corona and in prominences. The Coronal Multi-channel Polarimeter for Slovakia (CoMP-S) has been installed at the first coronagraph in 2011. The instrument was designed and manufactured by HAO/NCAR (Boulder, USA) with a tunable Lyot filter and polarimeter for visible and near IR spectral regions. An upgrade of this instrument is prepared with pair of near IR cameras in a new camera module. In September 2014 the Turin coronal magnetograph (CorMag), developed by the INAF - Turin Astrophysical Observatory (Italy), has been finally mounted at the second coronagraph. This Lyot filter with polarimeter is devoted exclusively for spectro-polarimetric observations of the solar coronal green line. A special pointing system, developed and installed for the observatory by the HANKOM company (Rotterdam, Holland), ensure simultaneous co-pointing of the two coronagraphs with their post-focus instruments to the solar disk center with a precision of 2".

Our contribution will describe current status of the observatory and its instrumentation in detail. A description of our prospects for future coronal polarimetry will also be given.

# Polarimetry of the Solar Corona in the FeXIII near-IR lines

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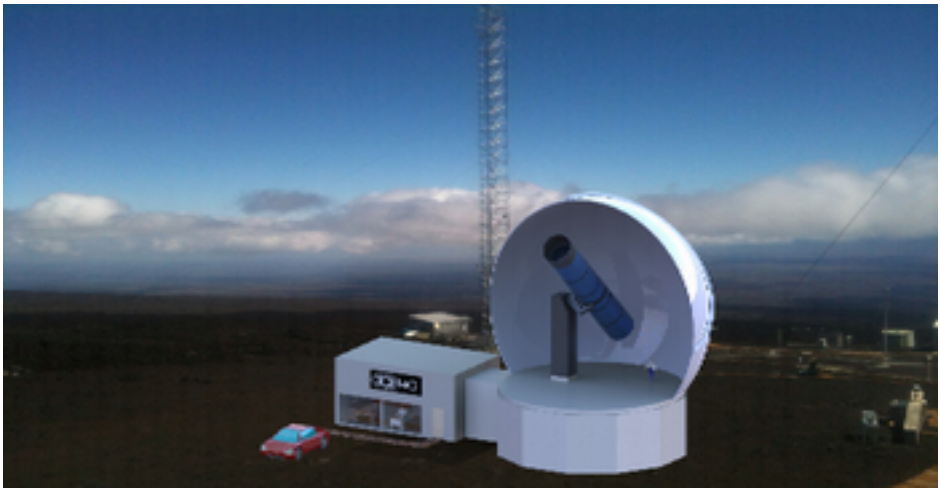
I will give a summary of work done over the past several years with the Coronal Multi-channel Polarimeter (CoMP) instrument. The CoMP is a 20-cm aperture ground-based coronagraph with a filter/polarimeter able to image the corona in the FeXIII 1074.7 and 1079.8 nm emission lines with a passband of 0.14 nm. The instrument measures the complete polarization state as well as the Doppler shift. The CoMP has obtained daily observations from the Mauna Loa Solar Observatory since May 2011. The performance of the instrument will be demonstrated through sample observations. I will discuss the performance of the instrument and describe sources of errors both random and systematic. I will conclude with the motivation for a large 1.5-m aperture refractive coronagraph which is part of the suite of instruments for the Coronal Solar Magnetism Observatory (COSMO) and describe the engineering developments which demonstrate its feasibility.



Concept rendering of the COSMO 1.5-m coronagraph.

# Is it impossible to measure the magnetic field in some coronal magnetic features ?

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*Abstract:*
Strong magnetic structures have been shown to play an essential rôle in the formation and eruption of solar prominences. One can have both (hot) descending material condensing into prominences (coronal condensation) and (hot) ascending material entering prominences from low-density "bubbles" or cavities (Berger et al. 2010, 2011). These cavities are possibly perturbed by an emerging flux rope and lead to eruption.In both cases, the regions of strong magnetic flux are filled by a low-density plasma which makes the thermodynamic diagnostic difficult and the magnetic measurement still more complex.
We will discuss the latest issue.