MASC:
MAGNETIC ACTIVITY OF THE SOLAR CORONA

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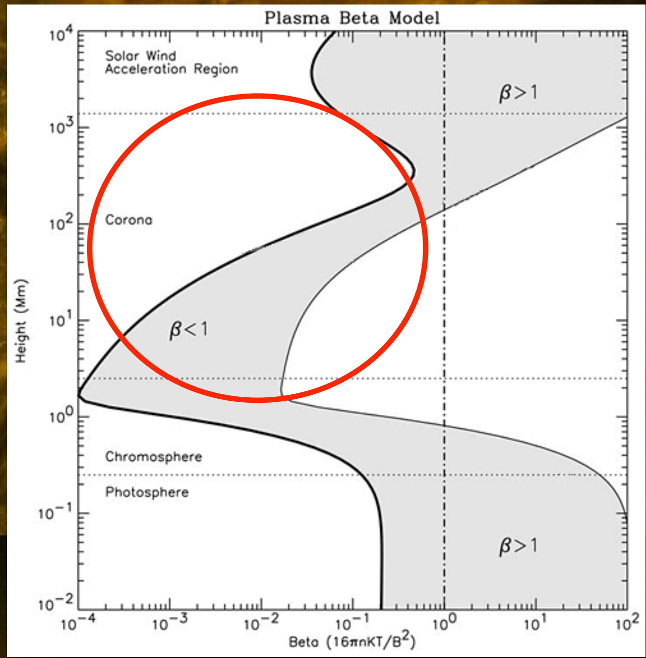
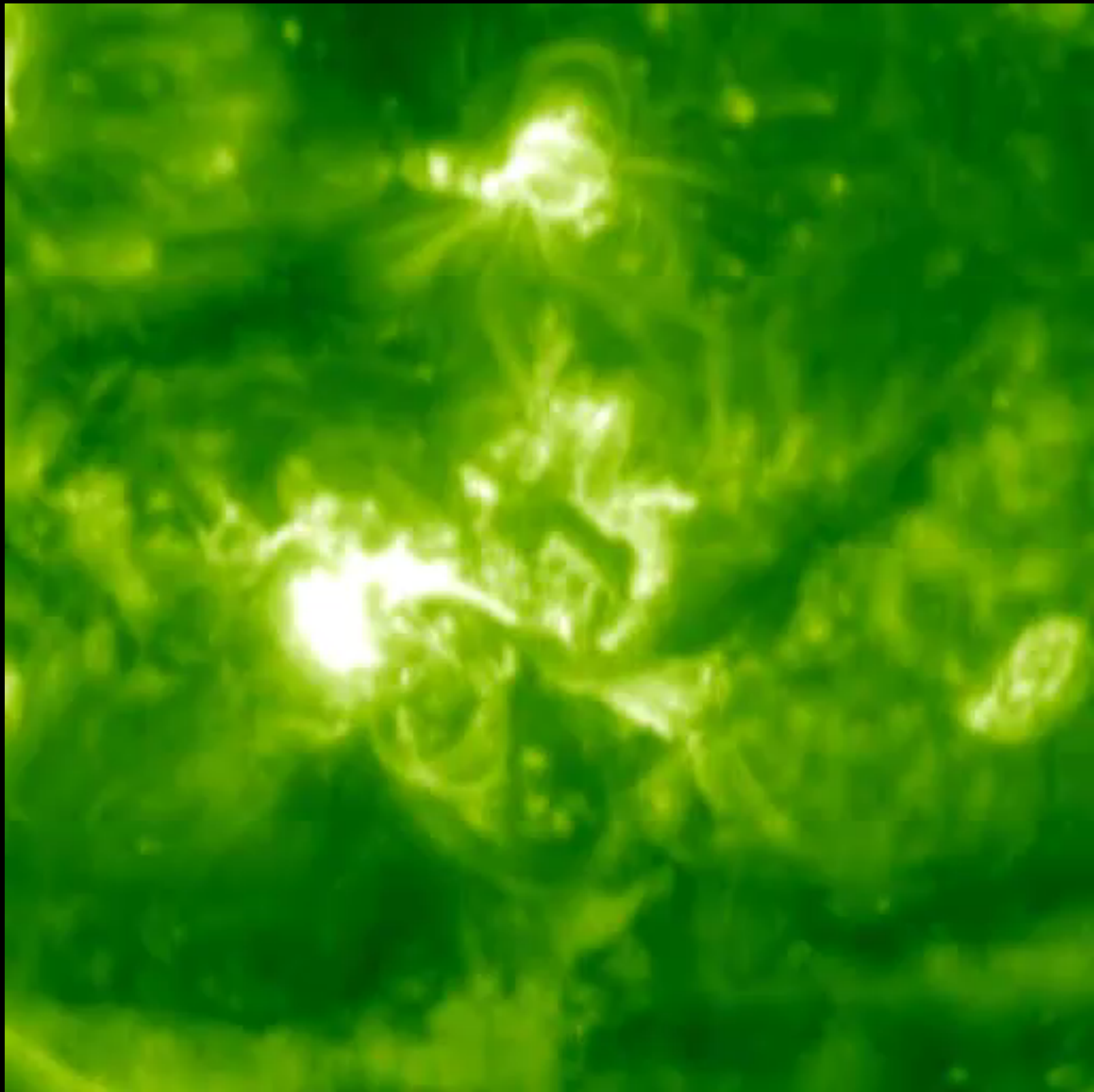
The magnetic field shapes the corona



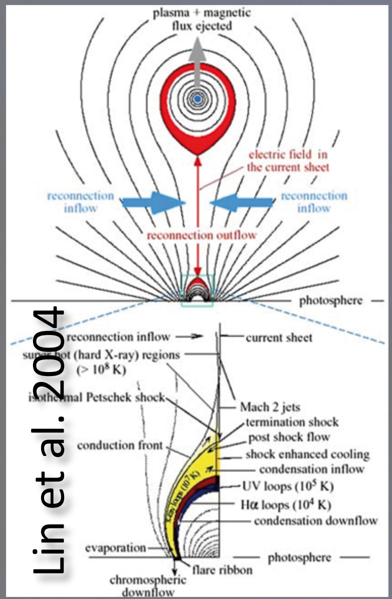
The structuration of the plasma by the magnetic field is the key to understand the fundamental physical processes of energy dissipation in the solar corona

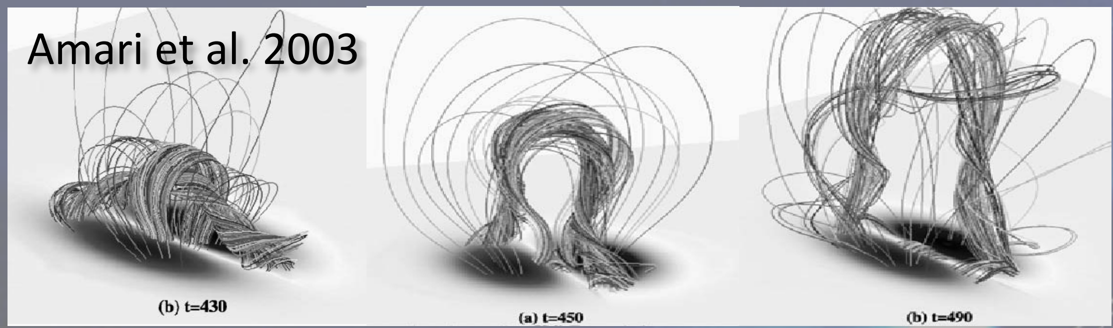
The magnetic field drives the coronal dynamics



The magnetic field drives the dynamics

Many models of the flare / CME process





What is the real field topology & strength?

But… How is the magnetic energy stored ?

What triggers the instability ?

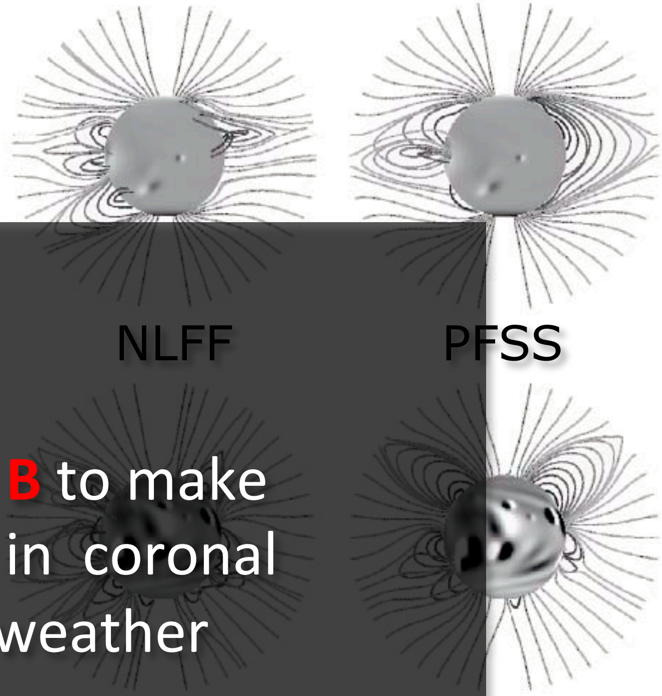
The magnetic field is the key to understanding coronal dynamics … and space weather !

FESTIVAL

SECCHI

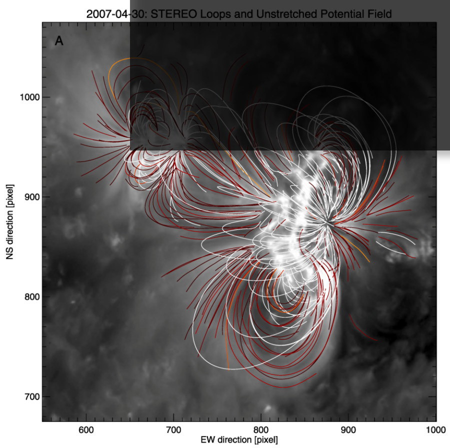
Coronal B is known mainly from *photospheric* extrapolations

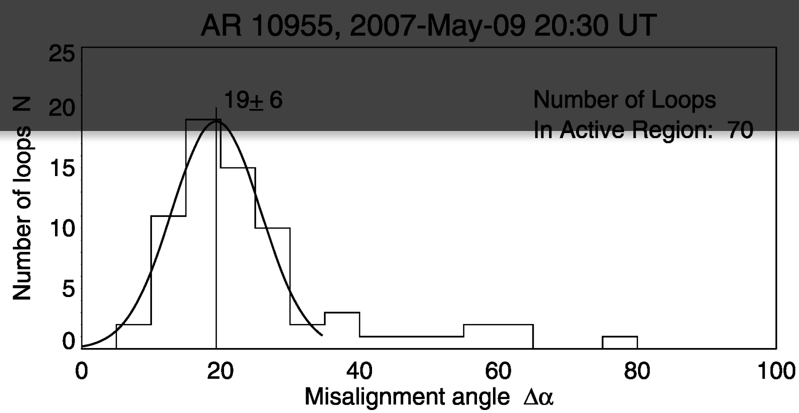
- The extrapolated field is strongly model-dependent.
- The extrapolated field is static
- Realistic extrapolations also require difficult horizontal photospheric field measurements
- The extrapolated fie… reproduce the complexity of the solar corona



Yeates et al. 2010

We **need** to **measure B** to make significant progresses in coronal physics and space weather





DeRosa et al. 2009

MASC: Magnetic Activity of the Solar Corona

MASC is aimed at understanding dynamic plasma processes in the solar corona using unprecedented space-borne measurements of the coronal magnetic field.

The top-level scientific objectives are

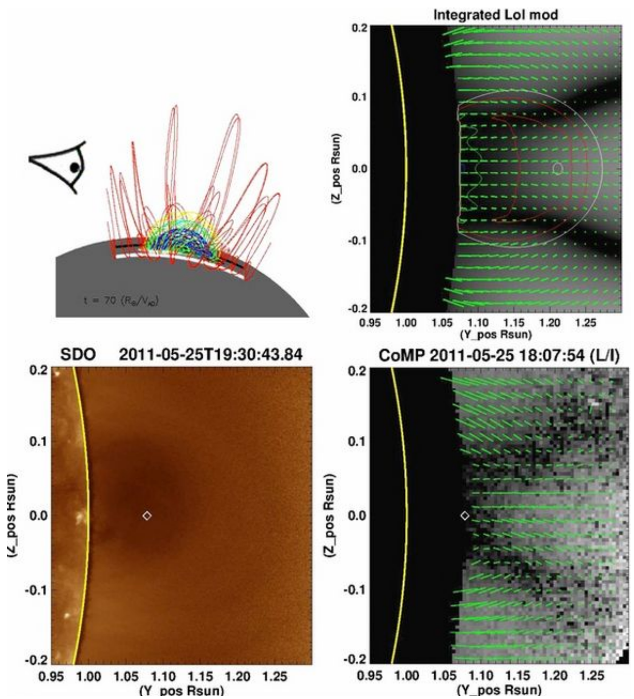
1. What is the global magnetic field configuration in the corona?
2. What is the role of the magnetic field in the triggering of flares and CMEs?
3. What is the link between magnetic configuration and energy release?

To fulfill these objectives, we need

1. High cadence high spectral resolution X-ray spectra of the eruptions
2. High cadence high spatial resolution EUV imaging of the source regions
3. Measurements of the coronal magnetic field

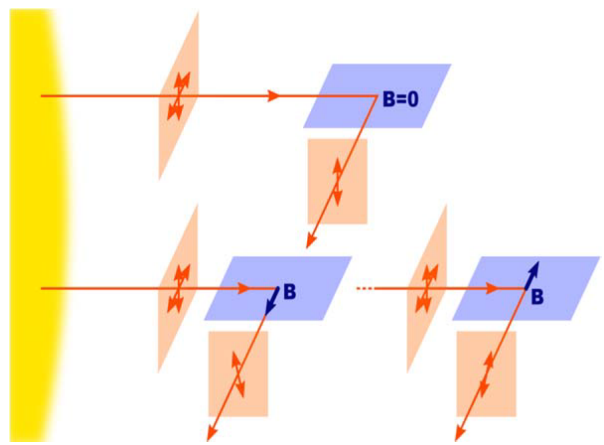
How to measure the magnetic field magnitude & topology?

- **Zeeman effect**
  - Compared to photospheric conditions
    - B_{corona} ↘, Zeeman splitting ↘
    - T_{corona} ↗, Line width ↗
  - Limited to strong fields above Active Regions



Bak et al. 2013

- **Hanle effect !**
  - Modification of the linearly polarized scattered radiation by the magnetic field
  - Sensitive to weaker fields
  - Successful in prominences (Bommier et al. 1994)

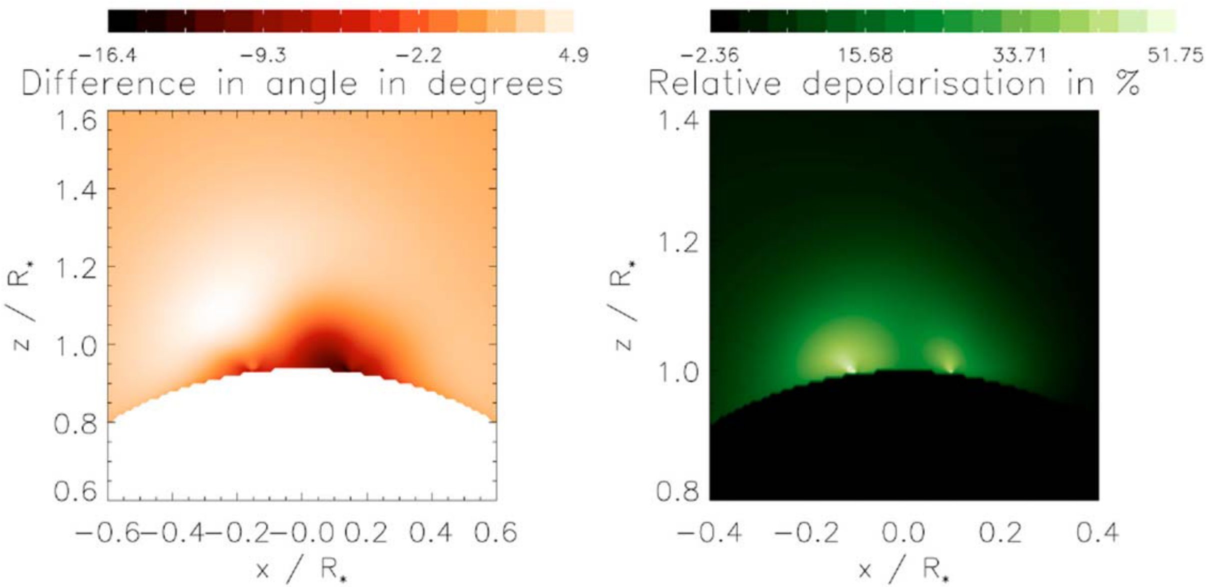


Trujillo Bueno et al. 2005

Hanle effect for the H Lyman series

- **The Hanle effect is sensitive to much weaker fields than the Zeeman effect**
    - [5, 500] G for H I Ly-α (1216 Å)
    - [1, 160] G for H I Ly-β (1026 Å)
    - [0.5, 70] G for H I Ly-γ (992 Å)

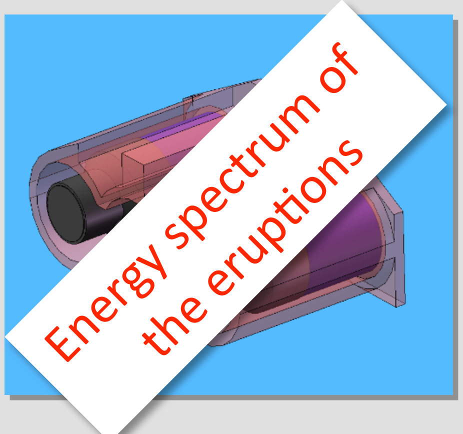
- **Lyman α is the prime candidate for the first measurements**
    - Strongest coronal UV line
    - The physics is well understood (e.g. Bommier & Sahal-Bréchot 1982)
    - The technology is available
    - Strong expected signal (e.g. Derouich et al. 2010)



Khan & Landi degl'Innocenti 2011

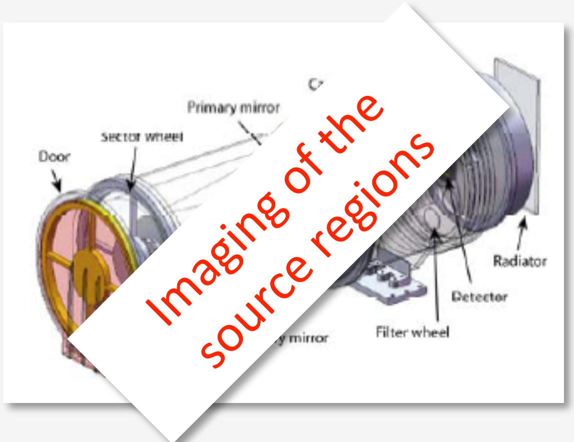
The MASC payload

HXR spectrometer (HEBS)



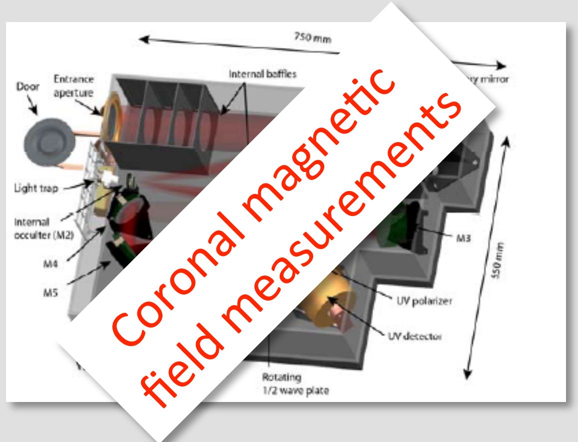
- E range: 10 keV – 600 MeV
- Resolution: 3.0%@662keV
- Cadence 1 to 4 s
- Mass: 16 kg
- Power: 18 W
- Volume: 31 x 23 x 16 cm^3

Disk Imager (WIFI)



- Disk & corona up to 3Rs
- Lyman α + 3 EUV bands
- Cadence up to 1 sec
- Mass: 15 kg
- Power: 10 W
- Volume: 75 x 28 x 22 cm^3

Coronagraph (MAGIC)



- Coronagraph 1.15 – 3 Rs
- Visible light & Lyman α
- Cadence up to 2 min
- Mass: 26 kg
- Power: 20 W
- Volume: 75 x 28 x 22 cm^3

Developments since 2000+: SMESE, ECLIPSE, SIGMA, etc.

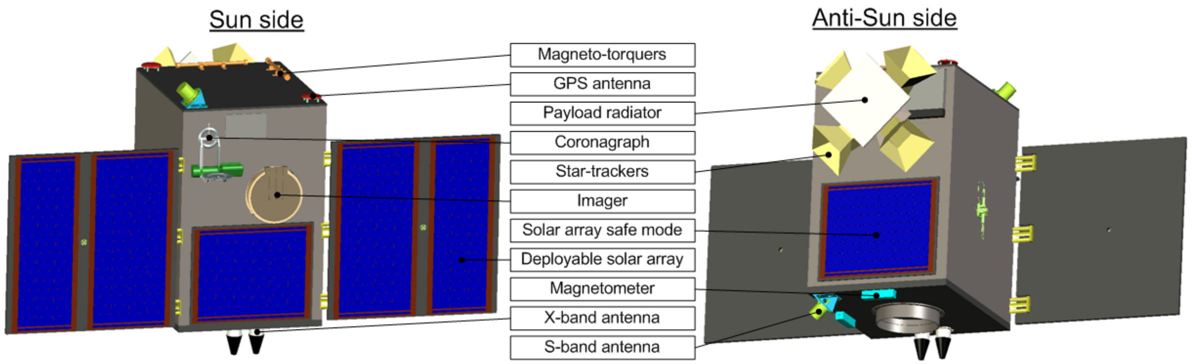
Strong heritage: SOHO/EIT, EUVI/STEREO, LYOT/SMESE, etc.

TRL 6 to 9

The MASC mission

- Continuous view of the Sun (SSO, geo-synchronous, Lx if enough ressources)
- Launch in 2021, three year nominal mission

- Several studies have shown that the concept is mature and fits a small mission
  - SMESE Franco / Chinese project phase A study (2006-2008)
  - SIGMA shortlisted for ESA's small missions (2012): exemple of implementation



- 6-18 h dawn/dusk Sun Synchronous Orbit
- Based on the PROBA series of platforms (TRL ≥ 8)
- Total S/C mass: ~200 kg (including payload)

Conclusions

- A mission dedicated to the coronal magnetic activity is bound to emerge
  - The proposed measurements are clearly identified by the community as key elements that can lead to major breakthroughs in heliophysics and space weather
  - A stream of prpoposals
    - SMESE (France/China microsat, 2006-2008), COMPASS (ESA M-class, 2007), SolMeX (ESA M-class 2010), SIGMA (ESA S-class 2012), …
- MASC
  - ESA & CAS can be the first to make these pioneering measurements !
- Payload is mature, has a strong heritage & fits on a small mission platform
- Let's do it !