Multi-instrument campaigns to observe the off-limb corona

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General remarks about campaigns

- A single instrument/satellite provides only a piece of the puzzle
- Interpretations based on single instruments can turn out to be wrong
- Fundamental for science to combine different datasets
- Have you ever found the dataset which contains all the information you need to solve a problem? (No)
- Why bother observing the ‘same’ feature? (the Sun changes and often does not cooperate)
- Why is still so time consuming and complicated to coordinate campaigns?

- A big THANK YOU to all the instrument’s teams
  TRACE, Hinode, SOHO/CDS, SUMER, UVCS
In May 2007 Ulysses was in quadrature with SOHO
Measure T,N, abundances in active regions as function of height from 1 to 1.7 \( R_{\odot} \)
Link them with in-situ measurements by Ulysses.

We needed
1- an active region at the right time (planning constraints!) and place (around 45-60° s)
2- Co-spatial and co-temporal measurements from

Hinode, SOHO (UVCS,CDS), TRACE, STEREO/EUVI

Long shot!

(see talk from A. Bemporad on the filament eruption)
EIS + CDS + UVCS

The plan

One month before

One week before

10953

The 'Del Zanna' AR!

The actual pointings

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The EIS sparse raster

• 2” slit - 60s exposure
• designed a sparse raster (8” step) to cover a large FOV in 1h (bottom CCD)
• problems with Eclipses - Good signal in most lines

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The bottom of the CCD is the best (in terms of line widths)!
7 9 10 May 2007

EIS Fe XII

Doppler shift
(+/-20 km/s)

Non-thermal width
(20-80 km/s)

Density (cm⁻³)
(7.5-9.5 log)
He II - yet another complex blend

Blend  Bl - Si X  Bl - Si X - Fe XIII  Bl - Si X - Fe XIII - Fe XII

Si X BR  Fe XIII dd  Fe XII dd  Bl - Si X - Fe XIII - Fe XII - Fe X

(Del Zanna & Mason 2005)

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Objectives:
1) **On-disc**: relate changes of the photospheric magnetic fields to corona study quasi-periodic oscillations at base of plumes with EIS (**Not possible**)

2) **Off-limb**: measure T,N, flows, abundances
   1) Direct T: **need to combine** forbidden [Fe XII] 1242 A and [Fe XI] 1467 A (SUMER/UVCS) with allowed Fe XI,XII (EIS/CDS), and Mg IX. 
   2) Ne: CDS, SUMER, EIS 
   3) Chemical abundances: **need to combine** CDS, SUMER, UVCS with EIS

**Hinode HOP 44**: Oct 30 - Nov 3 2007 SOHO/CDS,SUMER, UVCS, TRACE, STEREO

‘Unfortunately’, our campaign was mistaken for the SUMER campaign
Off-limb

Hinode/EIS: GDZ_PLUME1_2_300_50s 50s exp., 2" slit step size 4"
FOV=298"x512" in 1h 8m; 23 spectral windows.
Run 4 times on 31/10, 1/11 and 34 times on 2-3/11 during SUMER campaign.

The Sun did not cooperate.
Where were the plumes?

SOHO/UVCS: Lya, O VI from 1.7 to 5.5 $R_\odot$

TRACE: 171 A

SOHO/EIT
Aug 96
(Del Zanna et al. 1999)
SUMER and CDS radiances

SOHO/SUMER:
large (280"x300")
raster in 30h
4" slit step 12.5"

SOHO/CDS 4h
4" slit 120s exp.
O V, Mg IX

Composite of 9 NIS slit rasters

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Isothermal $T$ from EIS Fe XII/Fe X

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Direct measurement of T from Mg IX

First R-matrix calculation for Be-like Mg (Del Zanna Rozum Badnell 2008). Significant differences with the previous interpolated values (Keenan et al 1986).

An inter-plume measurement at 1.3 Ro of 850 000 K by Wilhelm et al. (1998) revised to 1 160 000 K.
Despite the various limitations (e.g. telemetry), there is a potential for very good science in combining Hinode observations with those from other satellites.

Hinode EIS off-limb observations are promising, in particular for QS,AR

Thank you